

2007 DRAGON Symposium

“龙计划” 2007年学术研讨会

Aix-en-Provence France, 18 to 22 June 2007

埃克斯-普罗旺斯, 法国, 2007年6月18-22日



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▲ *The MEdium Resolution Imaging Spectrometer (MERIS) image is centred over the Provence region in Southern France*

ABSTRACT BOOK

Abstract Book

***2007 Dragon
Symposium***

18 – 22 June 2007

Aix-en-Provence, France

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FOREWORD

前言

THE 2007 DRAGON AIX-EN-PROVENCE SYMPOSIUM

BACKGROUND

The Dragon Programme concerns the exploitation of ESA and Chinese EO data particularly from the ERS and Envisat satellites for monitoring and mapping applications in 16 thematic application areas in the P.R. China. The abstracts presented herein detail the results achieved since the Lijiang Symposium that was held in July 2006 in P.R. China. Since then, ESA and NRSCC have organised two progress meetings in Beijing, one in October 2006 and the other in March 2007. At these meetings, Chinese scientists provided details about their project progress and further defined their EO data requirements. Since the formal start of the programme in April 2004, a large quantity of ESA EO data have been made available to all of the projects and detailed coordination of all requested acquisitions over China continues to be performed.

Post graduate training is a key component of the programme, and an advanced training course in atmospheric remote sensing was successfully held at Peking University in Beijing, during 6 days in October 2006. The training course was attended by 55 scientists from 30 institutions from all over China. Five European experts gave lectures and practical sessions on data processing, product development, validation and assimilation of EO and other data from atmospheric instruments on board ESA satellites. ESA and NRSCC are also sponsoring post graduate training in Europe and in China. At the Aix Symposium there will be three sessions dedicated to presentations by young scientists. The young Europeans have been undertaking field work and data collection with their Chinese counterparts.

OBJECTIVES

The 2007 Dragon Symposium will bring together the joint Sino-European teams after more than three years of activity. On a project-by-project basis, the 16 project teams will undertake the following:

- Report on the progress of each project to date including the latest results
- Detail the ESA EO and third party mission data acquired and investigated after three years of activity
- Detail the in-situ data measurements and requirements particularly joint field visits made in P.R. China during 2006 and 2007
- Report from the young scientists training programme
- Outline the progress and status of cooperation within the project
- Provide an up-date on the on-going bilateral Sino-European research projects

DAY TO DAY ORGANISATION

Following Symposium registration on the morning of the Monday 18 June 2007, there will be team meetings between Chinese and European partners for all of the projects. The formal opening session will take place on the afternoon of Monday 18 June. The project presentations will start on the morning of Tuesday 19 June and will last for 3.5 days. There will be three sessions dedicated to presentations by young scientists.

“龙计划”2007 年埃克斯 - 普罗旺斯研讨会

背景

“龙计划”的主要目标是利用欧洲空间局 (ESA) 和中国的地球观测数据，特别是 ESA 提供的 ERS1/2 和 ENVISAT 卫星数据，在中国开展 16 个专题领域的监测和制图应用研究。本摘要详细阐述了自 2006 年 7 月丽江研讨会以来“龙计划”取得的成果。自此，ESA 和中国国家遥感中心 (NRSCC) 分别在 2006 年 10 月和 2007 年 3 月在北京举行了两次项目进展会议，会上中方专家详细汇报了各项目取得的进展，并陈述了下一步的数据需求。自 2004 年 4 月项目正式启动以来，ESA 已向“龙计划”提供了大量的遥感数据，各项目进一步获得数据的协调工作正在继续进行。

“龙计划”项目的另一个主题是培训，2006 年在北京大学成功举办了一次大气遥感高级培训，该培训班为期六天，来自中国 30 个研究院 (所) 和大学的 55 位科研人员参加了此次培训。五位欧洲专家就欧空局卫星的大气传感器数据和其它相关数据的处理、产品开发、验证和同化等做了专题讲座并指导实习。ESA 和 NRSCC 也正在中国和欧洲资助研究生的培训。在埃克斯普罗旺斯研讨会上将举行三场青年学者的专场研讨。欧方青年学者正与中方合作伙伴进行野外工作和数据收集工作。

目标

2007 年“龙计划”学术研讨会将使中欧双方的联合研究队伍在三年多的合作中再次欢聚一堂，进行技术交流与信息沟通。会上，16 个研究项目将就下列内容进行交流和讨论：

- 到目前为止每个项目的进展，包括最新成果；
- 三年来，ESA 地球观测和第三方任务数据的获取情况；
- 2006—2007 年间试验区数据调查和需求，特别是双方在中国进行的联合野外调查情况；
- 青年科学家培训计划；
- 项目合作的现状和进展；
- 正在进行的最新中欧双边合作研究计划。

日程安排

2007 年 6 月 18 日早晨安排注册，随后中欧双方将进行项目小组会议。6 月 18 日 (星期一) 下午将举行正式的大会开幕式。大会报告将于 6 月 19 日 (星期二) 早晨开始，星期五中午结束，历时三天半，其中，将安排三场青年科学家专场报告。

SESSION 1: OPENING SESSION

专题 1: 开幕式

Official Welcome and Presentations

官方致辞和报告

French Activities over China in Radar Altimetry

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Abstract

Space Hydrology : Water Level for Huang He and Yangtze Kiang Derived from Topex/Poseidon Altimeter

We have developed a worldwide database accessible via internet concerning water level time series for major rivers, continental lakes and floodplains. These time series are mainly based on altimetry data from Topex/Poseidon for rivers. Over lakes, we use also ERS1/2, ENVISAT, GFO and JASON 1 data, when available. The water level time series cover the period 1993 up to 2006 for 150 lakes and reservoirs and 160 virtual stations over major rivers. The data concerning Huang He river and Yangtze river basin are presented. These data are water level fluctuations and would have to be compared to in situ data for validation.

中法在雷达高度计方面的合作

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摘要

空间遥感：自 Topex/Poseidon 高度计提取的黄河与扬子江水位

我们已经建立了一个可通过互联网连接的世界范围主要河流、大陆湖泊和冲积平原的水位时间序列数据库。这些时间序列数据中的河流信息主要来源于 Topex/Poseidon 高度计数据，对于湖泊，若数据存在的话，我们也利用 ERS 1/2，ENVISAT，GFO 和 JASON 1 的数据。水位时间序列数据包括自 1993 年到 2006 年的 150 个湖泊和水库、160 个主要河流上的虚拟站。将展示有关黄河及扬子江流域的数据。这些数据是水位的波动数据，必须和实测数据进行比较验证。

NOTES

SESSION 2: ATMOSPHERIC MONITORING

专题 2 : 大气监测

Session 2.1: Air Quality Monitoring and Forecasting (id. 2580)

专题 2.1: 大气质量监测与预报

Observation of Air Pollutants over Northern China

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Abstract

Air pollution over Beijing area becomes now more attention-getting with the approaching of Beijing Olympic Games 2008. Beijing is a very fast-growing mega-city, currently having about 15 millions of population and approximately 2 million of cars. The air quality assurance and transport situation are two important factors for the Olympic games, of which the former is a challenge problem, as transport situation can be resolved from several metro lines to be operated before the Olympic games. However it is very difficult to cut down the amount of cars on the road and reduce the factories of pollution. Moreover, even Beijing local government can control the emission of pollutants of their own factories such as power plants, it is still difficult to control the transport of air pollution from the neighbor regions. Therefore, Beijing local government set up the project “the transport and transformation of air pollutants of Beijing and its surrounding regions, and Beijing air quality assurance measures”. For this project, a subproject of air pollutants’ measurement using optical remote sensing techniques has been conducting in the Institute of Atmospheric Physics, Chinese Academy of Sciences. This subproject, together with air quality scenario simulation and pollution source inventories will greatly support the air quality control for Olympic Games. Air pollution is not harmful to human ecological environment, but also affects the climate system. The Asian Brown Clouds over metropolitan circles will affect much the circulation pattern and Asian monsoon through scattering and absorbing the solar radiation. The composition change in the lower atmosphere will also lead to climate change. Menon’s paper in Science (2002) demonstrates the climate pattern of waterlogging in South and drought in North due to Asian brown clouds. Aerosols due to air pollution have direct and indirect effects on climate. The mechanism of direct effect is the aerosol loading will directly reduce the solar radiation incoming to the earth surface. The indirect effect is when the aerosol loading becomes larger, the number concentration of aerosol as cloud condensation nuclei will be larger, leading to smaller cloud particles due to competition to the limited liquid water, increasing cloud life and finally decreasing the precipitation. For well characterizing aerosols, it had better to measure the aerosol optical depth (AOD), size distribution, number concentration, extinction coefficient profile. The AOD can be well measured with CE-318 sun photometer. The aerosol single scattering albedo can also be derived from the scanning measurement of the sun photometer. The lidar can be used to determine the extinction coefficient profile continuously. The tethered balloon was used to detect the number concentration as function of altitude. Satellite observation can provide a regional distribution of air pollutants. The Differential Optical Absorption Spectroscopy (DOAS) were used to monitor main air pollutants such as O₃, NO₂, SO₂ since August, 2006, in Beijing and Xianghe, respectively. DOAS technique has many advantages compared to the chemical gas analyzers. Firstly, DOAS can simultaneously measure up to 30 species, including the main air pollutants such as O₃, NO₂, SO₂. Secondly, DOAS is a kind of remotely detection technique, it can detect the species in the dangerous areas or where it is difficult to access. Thirdly, it is good for detecting the active gas species, avoiding the fast transformation or lost in the transporting tubes for the active gases. Fourthly, what the DOAS measured is the average of gas concentration of open path, better standing for the gas concentration of an area. Fifthly, It can continuously monitor the air pollutants in very high time resolution. Finally, DOAS is a kind of instrument of low cost and easy to maintain. Therefore, it is a very potential technology for atmospheric environmental detection. The DOAS measurement were conducted since the beginning of August 2006, in Beijing as well as in Xianghe, 60 km at the east of Beijing. From the measurement of DOAS, it is found that Ozone concentration has pronounced diurnal variation, high value in daytime and low value in nighttime, which is consistent with the photochemical reaction. NO₂ concentration has the diurnal variation in opposite phase to O₃ diurnal variation, namely low value in daytime and high value in nighttime. It can also be found that the O₃ concentrations in suburban regions are higher than those in urban regions, this may be due to less NO₂ in suburban than in urban regions. The measurement with DOAS instrument in Beijing were compared with those by gas analyzers, and very good

agreement can be found for the two different measurements. The EZ Lidar ALS-300 made in Leosphere, France, was used to measure the aerosol extinction profile, and obtain the atmospheric boundary layer structure by considering aerosol particles as tracer. This lidar works at 355 nm ultraviolet wavelength. It has been worked since August 2006, obtaining a profile every 6 minutes usually, and one profile every 2 minutes during intensive observation period. It can do unattended measurement in all weather, automatically stop measurement when raining as the signal is saturated, and resume measurement when rain disappeared. Some typical Lidar measurements for aerosol vertical distribution in August 4, September 4 and 20, 2006 are given in Figure 1. The figure can clearly characterize the variation of aerosol vertical distribution. In the daytime, the aerosols from the surface or transformed from the car exhaustion can get high altitude due to strong convection, leading to maximum boundary layer of 1200 m, while in nighttime, the aerosols can be limited to several hundred meters. The residual layer of aerosols can be clearly identified sometimes during the morning of daytime due to the relative slow deposition.

It is hard to deduce the regional distribution of air pollutants such as NO₂. For well understanding the NO₂ regional distribution, the OMI/AURA NO₂ products during the 2006 summer campaign were collected. OMI instrument born in Aura satellite rotates around the Earth in polar orbit, giving NO₂ regional distribution per day. It can be seen that the OMI NO₂ products is good for characterizing the regional distribution of tropospheric NO₂ over north China. It is shown from the distribution of August 11, the high NO₂ density (30 in 10¹⁵/cm², same below) transports southward. On August 12, many pollutants source areas such as Shijiazhuang, Xingtai, Beijing, Tangshan, Tianjin, can be identified when weather is stable. The Shijiazhuang and Xingtai areas were polluted on August 13, and Tangshan area was seriously polluted during August 15 to 18. On August 19, High NO₂ concentration (50) occurs in Shijiazhuang region, there was a strip of NO₂ pollutant in Beijing and Tangshan, it can be deduced from the strips of pollutant from Tianjin and Tangshan that this pattern is caused by east-southern wind. High NO₂ occurred in Shijiazhuang on Sep. 1, west-northern wind can be identified from the NO₂ distribution pattern, leading to a strip of pollutants transporting from Tianjin to Bohai bay. The high NO₂ value in Beijing on September 6 can be identified as the outcome of east-northern wind. On September 7, the high NO₂ value in Shijiazhuang transported along the direction of Jing-Shi freeway to Baoding, Beijing, while the high NO₂ value (40) in Shijiazhuang transported east-southward under favorable winds.

Key words: Air Pollutant, O₃, NO₂, SO₂, Lidar, DOAS, OMI, Aerosol

华北地区大气污染物的观测研究

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摘要

随着北京 2008 奥运会的临近, 北京市的大气污染受到越来越多的关注。北京市已经是一个超级都市, 拥有 1500 万人口和将近 300 万辆汽车。对于奥运会来说, 空气质量保障和交通运输能力是关系到奥运会顺利举行的两个重要因素, 其中空气质量保障更具有挑战性, 而交通状况到时能期望得到有效改善, 因为奥运会举行前, 将有多条地铁线开通, 能够大大减轻地面汽车交通的压力。要减少路面上的汽车或者污染工厂是一件非常艰巨的任务。因为即使北京地方政府能够控制自己管辖范围内诸如发电厂的污染物的排放, 也很难控制从周边地区输送过来的污染物。为此, 北京市政府设立一个科技计划项目“北京与周边地区的大气污染物的输送、转化及北京市空气质量保障研究”。在这个项目里, 中国科学院大气物理研究所负责了一个“大气污染物的光学遥感技术研究”的子课题。这个子课题, 与空气质量模拟和大气污染源清单等课题一起, 形成对 2008 奥运会期间的空气质量的有理支持。大气污染不仅对人类生存的生态环境很有害, 对气候系统也有重要影响。都市圈上空的灰霾通过散射和吸收太阳辐射对大气环流形态和亚洲季风产生重要影响。Menon 2002 年在美国《科学》期刊上发表论文, 称南涝北旱的气候形态分布与亚洲灰霾有很大的相关。形成空气污染的物质之一气溶胶具有直接的和间接的气候效应。直接气候效应的机制是当气溶胶层会直接削弱到达地球表面的太阳辐射。间接气候效应是, 当气溶胶层变厚时, 作为云凝结核的气溶胶颗粒数浓度变大, 导致由于大量云滴对有限液态水的过度竞争使云滴变小, 最终导致云的降水减少。为了有效描述气溶胶, 基本的测量要包括气溶胶光学厚度、粒子尺度谱、数浓度、消光系数廓线。气溶胶光学厚度可以用 CE-318 太阳光度计来进行测量。气溶胶单次散射反照率可以通过太阳光度计的扫描测量来反演得到。激光雷达能够连续地获得气溶胶消光系数廓线。系留气艇可以测量气溶胶数浓度廓线, 高度可以达到最高 1200 米。卫星遥感则可以提供气溶胶的区域分布情况。差分吸收光谱仪(DOAS) 主要用来监测 O₃, NO₂, SO₂ 等大气污染物, 观测开始于 2006 年 8 月, 分别在北京和香河两地进行。与化学气体分析仪比较, 差分吸收光谱仪探测技术具有很多优点: 首先, 差分吸收光谱仪能够同时测量 30 余种大气成分, 包括大气污染成分, 如 O₃, NO₂, SO₂。第二, 差分吸收光谱仪属于远距离非接触式探测技术, 它可以测量一些不容易到达的可能污染或者危险物质。第三, 适合活性气体的测量, 可以防止活性气体的转化或丢失。第四, 差分吸收光谱仪的测量结果更有代表性。第五, 可以以高时间分辨率进行大气污染物质的连续监测。最后, 差分吸收光谱仪是一种相对廉价和容易维护的仪器。所以, 差分吸收光谱仪在环境探测领域具有广泛的应用前景。从 2006 年 8 月开始, 我们在北京和香河两地利用差分吸收光谱仪进行了大气污染物的测量。香河站

位于北京东边，相距 60 千米。从差分吸收光谱仪的测量结果来分析，可以发现近地面臭氧浓度具有明显的日变化，白天高，晚上低，与光化反应程度强烈相关。NO₂ 浓度具有与 O₃ 相反的日变化特征，即白天低，夜晚高。还可以发现，都市郊区 O₃ 浓度比市区的浓度要高，这可以用在郊区 NO₂ 浓度比较小因而对 O₃ 分解比较少来解释。用差分吸收光谱仪和化学气体分析仪在北京进行的同时测量的比较给出了比较一致的探测结果，说明了两种探测手段都是可靠的观测手段。从法国引进的 ALS-300 气溶胶激光雷达用于测量大气气溶胶消光廓线，以获得大气边界层结构信息。该激光雷达工作在 355nm 紫外波长上。自从 2006 年 8 月初开始观测以来，每 6 分钟获取一次观测数据，而在加强观测期间，每 2 分钟观测一次数据。该雷达可以进行全天候自动观测，下雨的时候，由于信号饱和自动暂停观测，待降水停止时，又自动恢复观测。图 1 给出了 2006 年 8 月 4 日、9 月 4 日和 20 日激光雷达在香河站观测到的气溶胶廓线的结果。可以看出，激光雷达观测能够很好地描述气溶胶垂直分布的变化。白天，从地表扬起来的气溶胶或者汽车尾气排放形成的气溶胶在强对流的作用下可以带到高处，达到约 1200 米的大气边界层高度，而在晚上，气溶胶则集中在只有几百米厚度的边界层内。在部分早上，还可以看到缓慢沉降尚未到达大气低层的气溶胶残留层与前一天进入混合层的新鲜气溶胶同时出现的情况。要从地面测量来获得 NO₂ 等大气污染物质的区域分布是相当困难的。为了更好了解 NO₂ 的区域分布特征，我们收集了 OMI/AURA NO₂ 产品数据。OMI 仪器装载在 AURA 卫星上，以极轨方式观测，每天给出一个区域分布的观测数据。可以看出，OMI NO₂ 产品数据可以很好地表达华北地区对流层 NO₂ 的区域分布状况。从 2006 年 8 月 11 日的区域分布图可以看出，天气稳定，NO₂ 浓度很高(30 in 10¹⁵/cm²，下同)，向南部输送。在 8 月 12 日的分布图可以看出多个污染物源区，如石家庄、邢台、北京、唐山、天津。8 月 13 日，石家庄和邢台地区污染严重，而 8 月 15-18 日唐山地区污染十分严重。8 月 19 日，石家庄地区 NO₂ 浓度达到 50，在北京和唐山之间有一个污染带，因此可以推断东南风导致了污染物的这个分布形态。从 9 月 1 日出现在石家庄的 NO₂ 高浓度，从污染物的分布形态可以推断西北风造成了天津到渤海湾的带状污染物的分布。9 月 6 日出现在北京的 NO₂ 高浓度可以判定是东北风的结果。9 月 7 日，石家庄上空的高浓度 NO₂ 沿京石高速方向向保定、北京方向输送，同时石家庄上空的高浓度 NO₂ (40) 在弱风力的作用下，向东南方向输送。

关键词：空气污染, O₃, NO₂, SO₂, 激光雷达, DOAS, OMI, 气溶胶

The Recent Activities of Atmospheric Chemistry Remote Sensing in NSMC

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Abstract

National Satellite Meteorological Center (NSMC) has participated in the ESA-MOST Dragon Programme since Oct. 2003. Under the international cooperation framework, NSMC involves two Dragon projects 2579/2580, which focus on atmospheric compositions remote sensing by using of the data from ENVISAT. In this presentation, the progress of these two projects after the Lijing Conference will be summarized in details.

For the data access, following data are used: 1) four months SCIAMACHY data in 2004 (Apr., July, Oct., and Dec.), 2) GOMOS Level 2 products downloaded from ESA website, 3) MERIS and AATSR data since Jul., 2006 by FTP service, 4) 10 years' GOME and SCIAMACHY products, typically NO₂ and SO₂ downloaded from KNMI website, 5) OMI ozone global mapped data downloaded from website.

The progress on research work include: 1) Sensitivity study for NO₂ retrieval algorithm with the forward model SCIATRAN, especially the effects of the surface albedo and aerosol loading on NO₂ retrieval, 2) NO₂ retrieval algorithm development and results comparison with SCIAMACHY product, 3) Aerosol retrieval over ocean and land with MERIS and MODIS data, 4) Results analysis for the distribution of NO₂ and CO with TM5 model, 5) Application of SCIAMACHY product to evaluate the regional NO₂ pattern and spatial/temporal characteristics, 6) Groundbased FTIR observation since Dec., 2006 (Breuker IFM120).

New Chinese partners have been added into these two projects. The new partners come from Chinese Academy of Meteorological Sciences/CMA and Anhui Institute of Optical and Fine Machine (AIOFM/CAS) respectively.

In the very near future, following main tasks have been planned: 1) Results analysis of ozone total amount and profile over China from OMI and GOMOS product, 2) Algorithm development to retrieve trace gases and aerosols from groundbased FTIR observation, 3) SCIAMACHY Retrieved NO₂ product validation with the in situ measurement.

国家卫星气象中心大气化学遥感进展

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摘要

自 2003 年 10 月, 国家卫星气象中心开始参加中欧合作 (ESA-MOST) 龙计划项目。在国际合作框架下, 国家卫星气象中心参加了两个子项 2579 和 2580 的研究, 主要在利用 ENVISAT 遥感大气组分研究方面开展工作。本报告将主要回顾自 2006 年丽江会议之后, 上述两个子项目的研究进展。

在数据获取和处理方面, 使用的数据主要有: 1) SCIAMACHY 2004 年 4 个月的 1 级原始观测数据 (4 月、7 月、10 月和 12 月); 2) 从 ESA 网站下载的 GOMOS 二级产品; 3) 自 2006 年 6 月以后通过 FTP 方式获取的 MERIS 和 AATSR 数据; 4) 从 KNMI 网站下载的、由 GOME 和 SCIAMACHY 反演的 NO₂ 和 SO₂ 长达 10 年的产品; 5) 从网站下载的 OMI 臭氧全球观测资料。

主要的研究进展包括: 1) 利用正演高光谱大气辐射传输模型 SCIATRAN 模拟分析了二氧化氮卫星遥感敏感性试验; 2) 基于 DOAS 原理, 独立发展了一套 NO₂ 的反演算法, 并同欧洲反演的产品进行了比较; 3) 利用 MERIS 和 MODIS 进行了海上和陆上气溶胶反演的试验; 4) 利用 TM5 模型模拟分析了 NO₂ 和 CO 的空间和垂直分布特征; 5) 利用 GOME/SCIAMACHY 的产品分析了中国区域 NO₂ 空间分布特征和时间变化趋势; 6) 自 2006 年 12 月开展了地基 FTIR 观测试验 (Breuker IFM120)。

此外, 还有新的中方科学家加入了这两个子项目的研究, 分别来自中国气象局气象科学研究所和中国科学院安徽光学精密机械研究所。

近期计划开展的工作有: 1) 从 OMI 和 GOMOS 的产品分析和验证中国区域臭氧总量和廓线的变化趋势; 2) 开展由地基 FTIR 观测反演痕量气体和气溶胶的反演方法; 3) 利用地面观测资料验证 SCIAMACHY 反演的中国区域 NO₂ 产品。

Air Quality Monitoring and Forecasting in China

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Abstract

The Air Quality Monitoring and Forecasting in China (AMFIC) project addresses atmospheric environmental monitoring over China. The aim is to develop an integrated information system for monitoring and forecasting tropospheric pollutants over China. The system uses satellite and in situ air quality measurements and modelling to generate consistent air quality information over China. The data will cover the recent years and the actual situation including an air quality forecast for several days ahead. Air pollutants covered are ozone, nitrogen dioxide, sulphur dioxide, formaldehyde, carbon monoxide, methane and aerosol/particulate matter. These gases are retrieved from satellite observations of GOME (ERS-2), SCIAMACHY (ENVISAT) and OMI aboard EOS-AURA. AMFIC will supplement and broaden the existing ground-level monitoring and air quality assessment activities in China. Satellite data will cover regions where no ground-based stations are available; air quality models fill-in the sparse temporal and spatial sampling of the measurements and connect them in a physically consistent manner. Recently, a new multi-year dataset of formaldehyde has been processed from GOME data. The existing long-term dataset of NO₂ has been analysed for trends in emissions and source identification. Strong trends in emissions have been detected for several cities in China.

中国空气质量监测与预报

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摘要

中国空气质量监测与预报项目 (AMFIC) 主要是从事中国地区的大气环境监测。项目研究的目的是发展一套完善的信息系统去监测和预报中国对流层污染物。系统集成卫星监测、空气质量监测和模式模拟为一体, 得到完善的中国空气质量信息。数据覆盖最近这些年以及目前大气污染物的真实状况, 还包括后几天的空气质量预报情况。监测和预报涵盖的空气污染物包括: 臭氧、二氧化氮、二氧化硫、甲醛、一氧化碳、甲烷以及气溶胶颗粒物。这些痕量气体是从卫星 (GOME /ERS-2, SCIAMACHY/ENVISAT , OMI/Arua) 反演得到。AMFIC 项目将对中国污染物的地面监测系统和空气质量评估做有益的补充, 卫星数据可以覆盖到地面没有监测的区域, 模式模拟可以填补和连接稀疏的时空地面监测。最近, 已经从 GOME 反演得到多年的甲醛数据集, 长时间序列的二氧化氮数据已经用来做排放趋势变化和来源解释, 在中国的几个城市地区监测到了强烈的增长趋势。

NOTES

Session 2.2: Chemistry and Climate Change in the Atmosphere (id. 2579)

专题 2.2: 大气化学和气候变化

Dragon-Star: Time Development of the Middle Atmosphere Above China as Seen by Satellites

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Abstract

The aim of the Dragon-Star project is to study the middle atmosphere composition, especially ozone content, on local and global scale using satellites and ground based instruments. In this paper we report on our studies of the temporal behaviour of the middle atmosphere constituents.

Dragon-Star:卫星观测中国上空中层大气成分时间序列分析

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摘要

Dragon-Star 项目的研究目标是利用星载及地基仪器观测数据研究区域及全球范围中层大气成分，特别是臭氧成分的变化。本文主要报告了中层大气成分随时间变化的特征。

Applications of MIPAS, GOMOS and SCIAMACHY L2 Products in the Atmosphere Researches of China.

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Abstract

1.Objectives of the project: The objective of this project is to study the features and characteristics of ozone vertical distributions and variations of China, and to validation GOMOS, MIPAS, and SCIAMACHY Ozone Products with ozone sounding data, and ground-based Dobson data. Another objective of this project is apply Envisat atmospheric products in the Studies of troposphere atmospheric pollutants and the middle atmosphere processes, such as the troposphere-stratosphere exchange process, and the Stratospheric Sudden Warming phenomenon and corresponding changes of ozone vertical distribution.

2.Envisat Data collected and ground data collection campaigns: We haven't downloaded new date of GOMOS, MIPAS, and SCIAMACHY L2 data during the pass year. We have launched ozone sounde continuously up to date. Therefore the six years of IAP Ozone Sounding Data from 2002 to 2007 will be applied to validate Envisat products.

3.Research results: (1) Validataion of MIPAS and GOMOS Ozone profile with Beijing Ozonesonde MIPAS ozone profiles are compared with ozonesonde profiles of Beijing. To select a dataset of matching pairs of MIPAS and O3 sondes profiles, satisfying the following coincidence criteria: max. distance between MIPAS and O3 sonde within 300 km and max. time difference between MIPAS and O3 sonde within 3 hours. Cooperated with U. Cortesi from Italy team, and many other scientists, the comparison result will be published in Journal of Atmospheric Chemistry and Physics, titled as "Geophysical validation of MIPAS ozone data v4.61 and v4.62 by intercomparison with ground-based, airborne and satellite measurements. A clear indication of the validity of MIPAS O3 vertical profiles is obtained for most 65 of the stratosphere, where the mean relative difference with the individual correlative data sets is always lower than $\pm 10\%$. GOMOS ozone profiles are compared with ozonesonde profiles of Beijing. The coincident GOMOS-Sonde pairs were collected for the years 2003-2004, and coincidence criteria were ± 8 hours, ± 4 latitude and ± 10 of longitude. The comparison results show that the agreement is generally within 15% or better between 20 and 30Km, and it remains acceptable up to 33 Km, especially when the two profile locations are close.

(2) Stratospheric Atmosphere Research from Envisat Products We apply the MIPAS and GOMOS L2 products to study the SSW happened during Dec. of 2003 and Jan. of 2004. First, we use MIPAS temperature profile data combined with NCEP data to examine the evolution of SSW, it is found the MIPAS temperature profile data has the advantage to describe the evolution of SSW in the Middle atmosphere than NCEP data (limited below 10 mb). The temperature increasing is first observed in the upper level of stratosphere, then it is downward transported to the lower level stratosphere, therefore the observation onset of SSW will provide useful information for long term weather forecasting. Besides, temperature, the O₃, NO₂, water vapor, CH₄ from GOMOS and MIPAS products are also studied during the SSW process. O₃, water vapor and CH₄ increased during and after the SSW, the mixing ratio of water vapor spread upward during the warming and downward when the SSW event was over, the similar character happened to CH₄, but not obvious as H₂O, while the mixing ratio of NO₂, N₂O, and HNO₃ changed little during the event, NO₂ and N₂O increase during warming and decreased when the warming was over.

(3) Application of SCIAMACHY and OMI products to the research of boundary layer atmospheric pollutions in China. The O₃, NO₂, SO₂ observation data at 8m, 120m and 280m heights in Beijing 325m meteorological tower and surface DOAS measurements are used to validate SCIAMACHY and OMI

boundary layer SO₂ and NO₂ products, in which the LIDORT model are used to calculate AMF. The concentrations of boundary layer NO₂ and SO₂ over North China Plain are studied by use of satellite observations.

4. The plan for the next period: The comparable ozone profiles of GOMOS and ozone sounding will be sought and compared with each other, in order to analyses and validate the data, and use them for further studies. Updated level 2 data of GOMOS will be needed. Based on ENVISAT instrument data, ozone sounding data, and ground-based Dobson data, we will study the features and characteristics of ozone vertical distributions and variations of China, and propose a reference model of ozone profiles over China. The vertical and geographical distributions change of Ozone, NO₂, water vapor, CH₄ in Middle atmosphere when the dynamic change will be fully studied by use of more Envisat atmospheric products.

应用 MIPAS、GOMOS、SCIAMACHY 二级产品开展中国地区大气化学成分变化过程的研究

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摘要

1. 研究目标

本研究项目充分利用 Envisat 观测的大气臭氧及其相关大气化学成分资料开展中国地区臭氧的变化规律的研究, 重点研究臭氧的垂直分布同大气变化过程之间的关系。首先通过北京地区长期观测的臭氧探空和地面 Dobson 臭氧资料对 GOMOS, MIPAS, 及 SCIAMACHY 臭氧结果进行比较和验证。在获取可靠的卫星观测大气化学成分资料的基础上, 本项目针对平流层-对流层交换过程和平流层结构突变过程中大气化学成分的变化及其与大气动力和热力过程的相互影响进行诊断分析和数值模拟研究; 结合地面综合观测资料, 对以北京为中心的对流层中主要污染物的时空分布进行卫星遥感观测研究。

2. 卫星资料和地面验证资料

卫星资料和地面验证资料获取: 在龙计划合作项目中本课题已通过互联网下载获取 2003-2004 年的 GOMOS, MIPAS, 和 SCIAMACHY L2 的主要大气产品。同时在其它项目的共同支持下课题组从 2002 年开始还进行了近 3 年的臭氧探空观测, 为卫星产品的验证积累了丰富的资料。

3. 研究成果

(1) 利用北京臭氧探空资料验证 GOMOS 臭氧垂直分布结果。在 2003-2004 年期间获取北京臭氧探空匹配的 GOMOS 臭氧观测资料, 匹配条件为: 臭氧探空释放地点 ± 4 经度及 ± 10 经度范围内, 臭氧探空释放前后 8 小时的卫星资料。验证结果标明在 20-30 公里高度范围内 GOMOS 反演臭氧浓度同臭氧探空观测结果偏差小于 15%, 其中靠近北京测站的 GOMOS 结果更接近臭氧探空观测值。低于 20 公里两者偏差明显增大, 表明 GOMOS 反演臭氧浓度的可信度有所降低。比较结果得出 GOMOS 在 20-30 公里高度上提供了可靠的臭氧垂直分布。(2) 利用 ENVISAT 的大气产品开展了中层大气变化过程中大气臭氧及相关成分的变化过程研究。传统的观点认为平流层爆发性增温过程是典型的平流层过程, 同对流层的天气与气候关系不大, 近来的综合研究表明 SSW 通过平流层结构的变化对中高纬地区对流层的天气和大气环流有着重要影响。本项目利用 MIPAS 反演的温度廓线资料结合 NCEP 温度场资料研究了 2003 年 12 月至 2004 年 1 月发生的一次平流层爆发性增温过程 (SSW)。研究结果显示 2003 年 12 月初发生的 SSW 过程首先发生在平流

层中上层的 50-60 公里高度，随后逐步向平流层中下层传播，在 40 至 50 公里高度上升温最为显著，伴随温度的增加北半球高纬平流层臭氧浓度上升，整个过程持续到 2004 年 1 月上旬。同已有仅利用 NCEP 资料研究 SSW 的结果的明显区别在于：运用卫星观测温度场资料能够在平流层上层首先观测到 SSW 形成的初始阶段（NCEP 资料限制在 10mb 以下），因此能为中长期天气预报和气候变化研究提供信息。最后，利用 ENVISAT 资料研究了 SSW 及平流层动力、热力场变化过程中 O₃、NO₂、水汽、CH₄ 等的变化过程。增温使得 O₃、水汽、CH₄ 的体积浓度比明显增加，而 NO₂、N₂O and HNO₃ 的变化不太明显。NO₂ 和 HNO₃ 在增温过程中浓度略有增大，增温结束后浓度减小。

4. 工作计划：

(1) 利用已有臭氧探空资料进一步开展 GOMOS、MIPAS 及 SCHIAMACHY 反演臭氧的验证工作。(2) 为了改善 2008 年北京奥林匹克期间北京的空气质量，利用 SCHIAMACHY 提供的对流层 NO₂、SO₂ 等资料结合北京地面 DOAS、激光雷达、系留气球等综合观测资料，研究北京接周边地区主要大气污染物的时空分布。(3) 利用 ENVISAT 卫星资料分析平对流层动力、热力等变化引起的大气化学成分的变化。

The Trend, Seasonal Cycle, and Sources of Tropospheric NO₂ over China During 1996~2006 Based on Satellite Measurement

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Abstract

The characteristics of spatial and temporal distribution of tropospheric NO₂ column density concentration over China are presented, on the basis of measurements from the satellite instruments GOME and SCIAMACHY. From these observations, monthly averaged tropospheric NO₂ variations are determined for the period 1996 to 2006. The trend and seasonal cycle are also investigated. The possible source of tropospheric NO₂ over megacity area is discussed in this text. The results show a large growth of tropospheric NO₂ over eastern China, especially above the industrial areas with a fast economical growth, such as, Yangtze delta region and Pearl River Delta region because of the prominent anthropogenic activity. There is a rapid increase of tropospheric NO₂ over megacities in China. For instance, Shanghai had a linear significant increase in NO₂ columns of ~19% per year (reference year 1996) in the period 1996–2005, which is more than Beijing. The seasonal pattern of the NO₂ concentration shows a difference between east and west China. In the eastern part of China, an expected winter maximum in seasonal cycle is found because the prominent anthropogenic activity and meteorological conditions. In the western part this cycle shows a NO₂ maximum in summer time, which is attributed to natural emissions, especially soil emissions and lightning. A Quickly increasing vehicle population may contribute to the increase of tropospheric NO₂ over megacity in China for the remarkable correlation for vehicle population with tropospheric NO₂.

近十年中国对流层NO₂的变化趋势、时空分布特征及其来源解析

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摘要

本文利用卫星遥感资料, 分析了近十年中国对流层 NO₂ 的变化趋势和时空分布特征以及来源解析。研究发现我国近十年来对流层 NO₂ 浓度具有明显的增长趋势, 其中东部地区近 10 年的均值 (8.6×10^{15} molec/cm²) 是西部地区 (0.83×10^{15} molec/cm²) 的 10 倍, 而东部 NO₂ 污染最严重的地区主要集中在京津冀、长江三角洲、珠江三角洲以及四川盆地等人口聚居和工业发达的地区, 其分布与人口的分布有密切的关系。在对流层 NO₂ 浓度季节变化方面, 由于气象因素、人居和自然环境等因素的差异, 东部和西部地区具有明显不同的特征, 东部地区在冬季浓度最高, 而西部地区在夏季达到极大值。本文还针对性对几个典型的超大城市上空对流层 NO₂ 浓度进行了分析, 表明增长率最高的是上海, 以大约每年~19%的增长速率呈线性上升趋势, 增长率超过了北京。卫星遥感同地面实测资料的比较和验证表明, 大城市对流层与近地面的 NO₂ 浓度呈现一致的变化趋势, 且与机动车保有量的变化有显著的相关性, 表明剧烈的人为工业和经济活动对对流层 NO₂ 的来源有重要的贡献。

NOTES

SESSION 3: OCEANOGRAPHY FROM SPACE

专题 3 : 海洋学

Session 3.1: Oceanography from Space (id. 2566) I

专题 3.1: 海洋学

Studies of Red Tides Monitoring in the East Sea of China Using MERIS Data

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Abstract

Harmful Algal Blooms (HABs) have expanded rapidly in China seas since 1998, which cover an area of more than 1000 km² and may last one month. In addition, toxic and harmful red tide causative species are increasing. Red tides occur frequently in the East Sea of China where the Chinese biggest fishery farm located. The formation mechanism of red tides not only relate to the biological characteristics but also with the ocean dynamic and geochemistry process, so satellite remote sensing data have a big potential in red tide monitoring. Especially, MERIS and MODIS are designed with fluorescence bands and provided with corresponding products which can be applied to red tides studies. Typical cases of 2004, 2005 and 2006 of massive spring red tides of *Prorocentrum donghaiense* are chosen to study using multi-sensors in this paper. MERIS operational products of Chl-a concentration, Fluorescence Line Height (FLH), Maximum Chlorophyll Index (MCI) and Remote Sensing Reflectance (Rrs), MODIS/AQUA operational products of Chl-a concentration, FLH and Rrs, SeaWiFS operational products of Chl-a concentration and Rrs are used to study the initiating, developing, proliferating and dispersing four periods of the red tides development process. Differences between the performance for the MERIS and MODIS/Aqua and SeaWiFS sensors are also discussed. MERIS has advantages in description of the red tide spectrum characteristics, MODIS can provide better spatial and temporal coverage. In 2005, massive spring red tides of *Prorocentrum donghaiense* occurred nearly one month later than several years before, the reason of delay is studied primarily in the paper.

MERIS 数据用于中国东海赤潮的监测研究

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摘要

1998 年以来, 中国海赤潮发生规模急剧扩大, 面积超过 1000km², 持续时间达 1 个月。而且, 有毒、有害赤潮原因种不断增加。东海是中国赤潮频发区; 它是中国最大的渔场。赤潮形成机理不仅与赤潮生物种群特征有关, 而且与海洋动力过程、地球化学过程有关; 因此, 卫星遥感数据在监测赤潮方面具有很大潜力。尤其, MERIS, MODIS 海色传感器专门设置了用于赤潮监测的荧光光谱通道和遥感产品。本文选择 2004、2005 和 2006 年春季东海大规模甲藻赤潮典型案例, 利用多传感器卫星数据进行东海赤潮的监测研究。将 MERIS 的业务化 Chl-a, FLH, MCI 和 Rrs 产品, MODIS/AUQA 的业务化 Chl-a, FLH 和 Rrs 产品以及 SeaWiFS 的 Chl-a 和 Rrs 产品用于研究赤潮的起始, 增殖, 爆发和消散四个阶段的生消过程。对三个海色传感器的赤潮监测性能做了初步比较。MERIS 在赤潮荧光光谱特征描述上具有明显优势; MODIS 提供了较高的重复观测频率和高空间分辨率数据。2005 年春季东海大规模甲藻赤潮的爆发时间比往年推迟近一个月, 本文对推迟的原因作了初步研究。

Ocean Color Inversion Using MERIS in Bohai Sea

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Abstract

Bohai Sea is the inland water of China and surrounded by the land from 3 sides. Several rivers such as the Yellow River, the Haihe River and the Liao River run into the Bohai Sea, carrying a large amount of inorganic and organic suspended matter. Optical properties of the Bohai Sea are complex and the major area of the Bohai Sea belongs to typical Case II water, and ocean color remote sensing is difficult. MERIS images are obtained through Dragon project. Phytoplankton, total suspended matter and yellow matter absorption coefficients are obtained by optical experiment cruises in Bohai Sea, and seawater backscattering coefficients, ocean color constitute concentration and sea water spectral data are obtained by the cruises too. The experiment cruises are supported by China 863 program. Bohai ocean color statistical models, semi-analytic model and FLH model are developed: (1) Statistical models: [Chl-a] inversion algorithm developed for the Bohai Sea in spring (June) has mean relative error better than 30%. We develop regional [TSM] inversion algorithms, which is tested by measured data to prove to have good performance with mean relative error of 28% and 12% in Bohai Bay and Laizhou Bay. (2) Semi-analytic model: The forward model which simulates remote sensing reflectance with ocean color constitute (chlorophyll-a and suspended matter) concentration is put forward based on the analysis of optical properties in Bohai Sea. Based on the seawater remote sensing reflectance model used in Bohai Sea, we present a color constitute concentration inversion model through function optimization. (3) FLH model: An algorithm expression which is suitable for Bohai Sea was obtained by regressing the simulating data, where FLH is the fluorescence baseline height, C is chlorophyll concentration. The algorithm was verified by 18 groups data of ocean color, and mean relative error between inversion and real value is 34%. The precision satisfies the requirement of the Case II water ocean color remote sensing basically. The verifying cases show that the above inversion models are feasible, and its practicability need further validation with more MERIS image data.

基于 MERIS 数据的渤海水色反演

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摘要

渤海是近封闭型的浅海, 其北、西、南三面被陆地所包围。黄河、海河和滦河等入海径流为渤海带来大量无机和有机悬浮物质。渤海光学性质复杂, 是典型的二类水体, 其组分浓度的定量反演是水色遥感的难点。在的支持下, 获取了多格式的 MERIS 图像数据。在 863 计划课题的支持下, 获取了渤海浮游植物、总悬浮物和黄色物质吸收系数、海水后向散射系数、水色要素浓度和海表面光谱数据。发展了统计模型、半经验模型和 FLH 模型: (1) 统计模型: 开发的渤海春季叶绿素 a 浓度反演算法(6 月), 经实测数据检验, 相对误差优于 30%; 所开发的总悬浮物浓度区域性反演算法, 经实测数据检验, 在渤海湾和莱州湾的反演精度较高, 相对误差分别优于 28%和 12%。(2) 半分析模型: 在渤海水体光学性质分析的基础上, 提出了应用水色要素浓度模拟遥感反射率的正向模型。引入模拟和实测光谱之间的偏差函数, 应用非线性优化方法, 提出了水色要素浓度反演模型。(3) FLH 模型: 回归得到适合于渤海环境条件的算法表达式, 其中 FLH 为荧光基线高度、C 为叶绿素浓度, 并应用 18 组水色数据作算法检验, 得到反演值与真值的平均相对误差为 34%, 这基本满足二类水体水色要素反演的要求。验证个例表明上述反演模型是可行, 但其是否可业务应用, 还需要应用更多的 MERIS 数据进行实验。

Pacific Extreme Wind and Wave Conditions Observed by Synthetic Aperture Radar

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Abstract

It is well known that synthetic aperture radar (SAR) provides information on ocean winds and surface waves. SAR data are of particularly high value in extreme weather conditions, as radar is able to penetrate the clouds providing information on different ocean surface processes.

In this paper some recent results on SAR observation of extreme wind and ocean wave conditions are summarised. Particular emphasize is put on the investigation of typhoons occurring in the North Pacific. The study is based on the use of ENVISAT ASAR wide swath images. These images that cover 400 x 400 km allow synoptic measurement of the complete mesoscale system.

Wind speed for typhoon cases is determined by using the algorithm CMOD5, which was originally derived by ESA for the scatterometer. Further structures observed in the image like streaks indicating wind direction and ring of maximum wind speed are taken additionally into account to reconstruct the wind typhoon field. The CMOD5 algorithm yields measurement accuracy for wind speed in moderate to strong conditions of about 2m/sec. For conditions of a tropical cyclone saturation of the backscatter and dampening due to heavy rain occurs. The influence of rain on the radar cross section is analyzed. A possible damping of the cross section due to heavy rain is estimated from existing models and compared to the SAR measurements. Furthermore a possible impact of the ocean waves on the radar cross section is discussed.

It is well known that SAR instruments are capable of imaging ocean waves. Usually waves longer than 100 m are imaged depending on travel direction. To determine wavelength and direction a 2-dimensional spectral analysis is performed.

A new Holland type model is used together with an interpolation technique to derive the wind field of a typhoon from a SAR image jointly taking the radar backscatter, rain damping and image structures into account. Limits in the retrieval of wind speed in typhoon conditions are shown.

Several examples like, e.g., typhoon Talim are presented, demonstrating that these data provide valuable information on the two dimensional structure of the both the wind and the ocean wave field. The work aims at the improvement of prediction of the typhoon intensity and sea state at these high wind speed conditions.

合成孔径雷达太平洋强风速和海浪观测

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摘要

众所周知, 合成孔径雷达可以全天候的工作以提供海洋表面的海浪和风场信息, 因为雷达波可以穿透云层, 因此在极端天气条件下, 它对海洋的研究具有更高的价值。这篇文章总结了进来合成孔径雷达对极端海面风场和海浪的观测的研究。特别研究合成孔径雷达对发生在北太平洋的台风。对台风的观测基于 ENVISAT ASAR 的宽刈幅工作模式数据。这些数据可以覆盖 400km*400km 的面积, 因此可以通过这些数据来分析测量中尺度天气现象。本文用 CMOD5 地球模式方程来计算台风的风速, CMOD5 最初是 ESA 研究用于散射计反演风速, 后来扩展到从 SAR 数据反演风场。通过获得的台风 SAR 图像中的风条纹确定风向, 同时考虑台风中的最大风速环来重建台风产生的风场。在中等和强风速条件下, 通过 CMOD5 方程计算得到的风速误差大概是 2 米/秒。对于热带气旋的合成孔径雷达图像来讲, 后向散射系数趋于饱和 (强风速条件下), 强降雨则引起衰减。本文分析了降雨对于雷达后向散射截面的影响。通过现有模型估计降雨引起的后向散射截面的衰减, 然后与雷达图像的实际测量结果进行比较分析。此外还讨论海浪对后向散射截面的影响。合成孔径雷达图像可以观测到波长大于 100 米的海浪, 当然这依赖于海浪的传播方向。在热带气旋观测中, 通过二维谱来决定海浪的波长和方向。

本文还将介绍一个新的 Holland 类型的模型, 通过插值方法得到从 SAR 图像中反演得到台风的风场, 在该模型中还将考虑后向散射系数, 降雨引起的衰减和图像本身的特征等因素。

通过几个台风实例, 例如台风泰利(Talim), 阐明合成孔径雷达提供非常丰富的二维风场和海浪信息。本研究的主要目的是提高对台风强度和强风速条件下的海况预报。

NOTES

Session 3.2: Oceanography from Space (id. 2566) II

专题 3.2: 海洋学

Estimating Internal Solitary Waves Propagation Velocity in South China Sea by Using Multi-sensor Images

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Abstract

Internal waves occur frequently in northern of South China Sea. Satellite SAR images show that wave crest lines may reach as long as 250 km. The largest amplitude of internal wave retrieved from field observation is about 170m. The research of internal waves in SCS is very important. Internal wave traveling speed is an important parameter in propagation forecasting, which is dominated by water stratified structure. The traditional method to estimate the velocity is under the hypothesis of two close internal wave packets in same image are generated by tide interaction with bottom topography and separated one tidal cycle. In SCS this hypothesis is not true in many cases. With the development of remote sensing, more and more remote sensing images can get. Many optical images also can observe internal waves, especially MODIS. It is possible that combine quasi-simultaneous remote sensing image to research internal wave propagation feature. In this paper, 10 pairs of images are collected, covering sea area from around 19° to 22° N latitude and from 111° to 119° E longitude. The internal wave propagation velocity distribution is obtained. The speed is in proportion to water depth. The largest 7 kn is in deep ocean near Luzon Strait, and the small one-1 kn in continental shelf. The results are also compared with field data. The upper mixing layer depth is estimated by the propagation speed.

利用多遥感器数据估计南海北部内孤立波的传播速度

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摘要

南海北部是中国近海内波的多发海域。雷达卫星影像显示, 内波的波峰线可达 250 公里。而现场观测的内波最大振幅可达 170m。南海内波的研究是非常重要的。内孤立波的传播速度主要由海水的分层结构所决定, 是对内波传播预测的一个重要参数。传统上, 估计内波传播的方法是假定内波的产生是由于潮流与变化的地形相互作用, 而在同一景图像中的相邻两个内波波包的生成时间相隔一个潮周期。在南海这种假设很多情况下是不正确的。随着遥感技术发展更多的遥感图像可以获取。而且很多光学图像也可以观测内波, 特别是 MODIS 数据。因此, 结合同一海区的准同步遥感图像研究内波的传播特征成为可能。本文收集了 10 对准同步的遥感图像, 覆盖北纬 19 度至 22 度东经 111 度至 119 度的海域。由此, 得到了该海域的内波传播速度分布。传播速度与水深成正比, 最大为接近吕宋海峡深海处的 7 节, 最小为大陆架处的 1 节。结果与现场数据进行了比对, 并由此给出了上混合层深度的估计。

Vessel Detection Using ENVISAT ASAR APS Data

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Abstract

Vessel detection using spaceborne Synthetic Aperture Radar (SAR) has already been a hot research topic of satellite oceanography, especially in ocean fishery or coastal sea-route traffic, where it is playing a significant role. Since 2002, the successful launch of Envisat/ASAR entitled people commercial accesses to the spaceborne multiple polarimetric SAR data, which is absolutely helpful for enhancing the vessel detection efficiency. ASAR's Alternating Polarization (AP) mode can provide two geo-registered images simultaneously in different polarization combinations, namely VV/HH, HH/HV, and VV/VH, with Precision and Single-Look Complex data type respectively. Since high resolution ability is important for vessel analysis, we mainly utilized Single-Look data, which is not only with relative higher resolution than Precision data, but also polarimetric phase reserved. This dual polarization function can probably help to enhance the vessel detection efficiency by spaceborne SAR. Until recently, the utilization of Envisat/ASAR APS data for vessel detection is seldom reported. In this paper, based on a dual polarization fusion, we aimed to design a vessel detection CFAR method, which was tested later in this paper by several experiments. In our experiments, several APS sub-datasets of China Sea were used for purpose, and preliminary results reveal that the proposed method was valid and effective.

ENVISAT ASAR 交替模式单视复数据舰船检测

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摘要

利用星载合成孔径雷达数据对舰船目标进行检测, 已经成为了卫星海洋学的一个热门研究领域, 特别是在海防、远洋渔业、近岸航道交通等等领域, 它都扮演着十分重要的角色。2002 年 Envisat ASAR 的成功运行, 使人们能够商业获取到多极化的星载 SAR 数据。多极化信息的获取和应用, 无疑能够极大提高人们进行舰船检测的效率。ASAR 的交替极化 (AP) 成像模式能够同时提供相同范围内的两种不同极化方式的数据产品, 具体包括 VV/HH、HH/HV 和 VV/VH 这三种, 以供研究和工程人员使用, 数据产品包括单视复数据, 精细模式等。由于舰船检测对目标成像分辨率要求较高, 研究中我们主要选用单视数据源。另外, 单视复数据保留了极化相位信息, 这对舰船检测是十分有利的。目前, 关于 Envisat/ASAR 双极化 APS 数据在舰船目标检测方面的研究几乎未见报道。基于双极化融合算法, 本文提出了一种利用 APS 双极化数据的舰船目标检测方法, 并随后进行了多组实验进行验证。实验中针对中国海域内多组 Envisat/ASAR 单视双极化数据进行处理, 结果表明, 文中提出的方法是切实有效的。

Statistical Analysis of Ocean Wave and Wind Parameters Retrieved with an Empirical SAR Algorithm

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Abstract

Significant wave height (Hs) and wind speed (U10) are derived using a new empirical algorithm (Cwave 1.0 and Cwind 1.0) developed at DLR from global Spaceborne Synthetic Aperture radar (SAR) images. The results are validated by spatially and temporally collocated in situ data of NOAA buoys and observations undertaken on the German research vessel Polarstern. The results are also compared to spatially and temporally collocated ERA-40, scatterometer, HOAPS and altimeter data.

The wave mode SAR images applied in this study are acquired by the ERS-2 satellite every 200 km along the satellite track. Between 1300 and 1500 images were collected each day by the ERS satellites. About 1 million images from September, 1998 to December, 2000 were processed at DLR and used for this study.

The results are globally compared to other satellite measurements; wind speed is compared to ERS scatterometer and HOAPS passive microwave SSM/I data and Hs to ERS altimeter measurements. The HOAPS-II (Hamburg Ocean Atmosphere Parameters and Fluxes from Satellite Data set) contains global fields of different oceanic and atmospheric parameters (e.g. precipitation, turbulent heat fluxes, evaporation minus precipitation, wind) derived from SSM/I data over the ice free ocean. In addition, the scatterometer data used in this study were provided by CERSAT and have 50km x 50km resolution. The ERS-2 altimeter provides Hs measurements each second along the orbit.

The validation between SAR results and in situ data shows rms order of less than 0.5 m in Hs and less than 2 m/s in U10. It is shown that SAR measurements of Hs are comparable in accuracy to altimeter measurements.

A statistical analysis of SAR derived measurements in comparison to ECMWF ERA 40 data is given. ERA-40 datasets contain reanalyzed values Hs and U10 interpolated to a 2.5° x 2.5° regular latitude/longitude grid at the four synoptical hours 00:00, 06:00, 12:00 and 18:00 UTC each day. Cases of difference between SAR measurements and model are discussed.

Using SAR results and ERA-40 data the inter-annual and seasonal variability of Hs and U10 is investigated. Case of high wind speed and high Hs in China Sea are analyzed.

利用新的经验模式函数和 SAR 图像反演海浪和风速的统计分析

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摘要

本文利用新的经验模式函数 (CWAVE 1.0 和 CWIND 1.0) 和星载 SAR 图像反演得到了全球分布的有效波高和 10 米风速。利用同步的 NOAA 浮标数据和德国科研考察船 - Polarstern 号的观测资料对模式反演结果进行了验证, 同时, 也利用了同步的 ERA - 40、 散射计、 HOAPS 和高度计资料对反演结果进行了比较。

ERS - 2 卫星沿轨道方向每隔 200 公里就获得一幅波模式的 SAR 图像, 每天大约可以获得大约 1300 - 1500 幅这样的 SAR 图像, 从 1998 年 9 月到 2000 年 12 月一共收集了大约一百万幅波模式的 SAR 图像, 这些 SAR 图像在 DLR 经过再处理之后应用于新的经验函数来反演海洋参数。

由 SAR 反演得到的全球分布的海洋参数与其他卫星观测结果进行了统计比较。得到的风速与 ERS 散射计资料和 HOAPS 被动微波 SSM/I 资料进行了对比, 而反演得到的有效波高参数与同步的 ERS 高度计资料进行了对比。Hamburg Ocean Atmosphere Parameters and Fluxes from Satellite Data set (HOAPS) 资料包含了许多由 SSM/I 得来得大气海洋的参数场: 降水、湍流热量通量、风场、蒸发降水差等。另外, 本文用到的散射计风速资料是由 CERSAT 提供得 50km \times 50km 分辨率的, 而 ERS - 2 的高度计资料沿轨道方向每隔 1 秒就会有一个有效波高的测量值。

由 SAR 反演得到的结果与实测资料的验证表明: 有效波高的均方根误差的量级为 0.5 米, 风速的均方根误差量级为 2 米/秒。并且, 由 SAR 得到的有效波高具有与高度计资料相当的精度。

由 SAR 反演得到的风浪参数与 ECMWF 的 ERA - 40 资料进行了统计分析和比较。ERA - 40 资料包括有效波高和 10 米风场的再分析数值, 这些数值的格点是 2.5 $^{\circ}$ \times 2.5 $^{\circ}$ 的, 一天会有 4 个时刻: 00:00, 06:00, 12:00 和 18:00 的数值。本文也提供了这两种数据差异比较大的个例分析。

利用 SAR 结果和 ERA - 40 资料进行了有效波高和 10 米风速的年际变化和季节变化的分析。同时, 对中国海域的巨浪和飓风进行了个例分析。

NOTES

Session 3.3: Coupling Climate and Ocean Systems (id. 2615)

专题 3.3: 海洋与气候

Marine Monitoring of the Southeast Asian Monsoon

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Abstract

The Southeast Asian monsoon is closely coupled with the ocean circulation, and feedback mechanisms makes this system challenging to understand and predict. Synthetic Aperture Radar (SAR) images over sea are particularly useful for monitoring this system since they can be used to study currents, fronts, eddies and waves in the ocean and near surface wind. In this study, more than 300 Envisat ASAR Wide Swath scenes from the South and East China Seas from 2005-2007 have been collected, and made available in a browsable web-database. Wind speed has routinely been generated in near real time from the ASAR images. Based on this, maps of mean wind speed have been created. MERIS imagery has also been used to study aerosol loaded outbreaks of air. This is compared with a numerical model which includes aerosol transport. Some selected scenes with identified interesting features will be presented, and some scenes will also be compared with output from an oceanographic model.

东南亚季风海洋监测研究

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摘要

东南亚季风与海洋环流密切耦合，反馈机制使得了解和预测该系统非常困难。海上合成孔径雷达图像对于监测该系统特别有用，因为这些图像可以用来研究海流、锋面、涡漩、海浪、近海面风。在本研究中，收集了 2005 至 2007 年 300 多幅位于东南中国海的 ENVISAT / ASAR 宽刈幅影像，并建立了可以浏览的网络式数据库。从 ASAR 图像生成准实时风速，在此基础上产生平均风速图。应用 MERIS 图像研究大气中气溶胶爆发，并与包含气溶胶输送的数值模式相比较。将给出一些含有感兴趣特征的影像，同时也将一些影像与海洋数值模式输出结果进行比较。

Coastally Trapped Atmospheric Gravity Waves on SAR, AVHRR and MODIS Images

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Abstract

Alternative dark-bright patterns on two ENVISAT Advanced Synthetic Aperture Radar (ASAR) images of the east coast of the Korean Peninsula acquired on May 18 and 19, 2004 are interpreted as atmospheric gravity waves (AGWs) on the basis of simultaneous multi-satellite observations and atmospheric gravity wave theory. The AGWs appeared in the form of a wave packet containing several waves located between 50-200 km offshore. The wavelengths were ranging from 13 to 20 km. The lengths of AGWs crest were from 20 to 150 km. A NOAA-17 satellite pass was received about 30 minutes after the ASAR pass. Its channel 4 infrared (IR) image clearly shows moisture wave patterns. However, the sea surface temperature (SST) image derived after applying nonlinear calibration and split-window atmospheric correction shows no wave patterns. A daytime true-color MODIS image taken about 13 hours later still shows a cloud band of same AGWs, indicating the lifespan of the standing AGWs can be over half a day. Although oceanic internal waves (IWs) may also cause similar wave patterns imaged by spaceborne SAR as they modulate the ocean surface roughness, we provide evidence to eliminate this possibility in this case. The characteristics of satellite observed AGWs are in good agreement with these simulated by a linear coastal AGW model.

在 SAR, AVHRR 和 MODIS 图像上的沿岸大气重力波

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摘要

在利用多源遥感卫星数据观测与大气重力波理论的分析基础上, 2004 年 5 月 18 -19 日朝鲜半岛的两幅 ENVISAT ASAR 图像上的明暗相间的条纹被解译为大气重力波。这些大气重力波在离岸 50-200km 范围内以波群的形式出现, 每个波群含有几个波列。波长范围为 13-20km。波群的横向跨度为 20-150km。收集到的一景 NOAA-17 图像滞后于 ASAR 图像 30 分钟。它的 4 通道图像上显示了该区域存在湿气的波动。但通过非线性定标和分裂窗法大气校正后的 SST 图像上没有任何波动条纹。一景滞后于 ASAR 图像 13 个小时的白天的 MODIS 图像上显示了该区域存在大气重力波造成的云扰动。这表明该重力波的生命史超过半天。虽然海洋内波也能引起海面粗糙度的改变, 进而在 SAR 图像上也会形成类似的波条纹, 我们提供的证据证明这个个例不是海洋内波。

NOTES

SESSION 4: AGRICULTURE

专题 4 : 农业

Session 4.1: Agriculture Monitoring in Fujian Province (id. 2563)

专题 4.1: 福建省农业监测

Agriculture and Land Use Monitoring: Envisat Applications in Fujian Province

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Abstract

The main objective of project 2563 is to develop, validate and apply methodology, using new features of Envisat data, for: a) Land use, land cover and agricultural classification, b) Agricultural monitoring by retrieving crop and soil biophysical parameters, c) Land use and land cover changes using historical and/or archived ERS data. The main activities in the third year will be presented in this symposium. They are: 1) Data acquisition. ENVISAT and ERS data received and data acquisition plan for the next stage will be discussed. 2) Agriculture crop mapping by multi-temporal ASAR data. In the first two years of Dragon, we developed effective ASAR data processing procedure and information retrieval methods for agriculture purposes. Several researches were carried out in Zhangzhou and Fuzhou test areas. We applied these data processing and information retrieval methods to other places in Fujian. 3) Land cover/ land use change monitoring by SAR data. ENVISAT ASAR and archived ERS-1/2 SAR data were combined to monitor land cover/land use changes. 4) Field survey. For rice mapping validation in Fuzhou area, we visited 5 places near the city of Fuzhou at the end of September, 2006. The same places were visited in April, 2007 and more parameters of rice were collected.

农业和土地利用：ENVISAT 在福建的应用

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摘要

龙计划 2563 项目研究目的是在以下三个方面开发、验证和应用 ENVISAT 卫星数据的新特性：1) 土地覆盖/利用分类和农业分类；2) 通过提取作物和土壤生物物理参数进行作物监测；3) 结合历史的 ERS-1/2 数据进行土地覆盖/利用动态变化监测。本次大会上我们将就第三年的一些情况向大家汇报，主要是：1) 数据接受。将报告数据接受的情况和下阶段数据预定的大致计划；2) 利用多时相数据进行农作物制图。在前两年的研究中，我们已经开发了一些切实可行的数据处理方法和信息提取方法。我们将展示把这些方法扩展到漳州、福州试验区以外的其他一些地区的结果；3) 土地覆盖/利用动态变化监测。利用 ENVISAT ASAR 和存档的 ERS 数据进行土地覆盖/利用动态变化监测；4) 野外考察。在去年 9 月和今年 4 月我们在福州周边进行了两次野外考察，收集了大量地面数据，为精度验证和数据分析提供了依据。

Land cover and Rice Mapping with ASAR in Fujian Province

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Abstract

Fujian province in S-E China is characterised by a complex landscape of crops, forest, urban areas and infrastructure elements. It is also very dynamic, with complex crop rotation and crop calendar, urban expansion and changes in land use. There is therefore a clear need for regular monitoring, but under the constraint that clouds limit the availability of optical data. This paper will review the areas where Envisat can add to the knowledge obtainable from high resolution optical data, which are typically available once a year. The ASAR brings particular capabilities that can be exploited. Amongst these are: (a) Polarisation diversity, which is most valuable for discriminating cereal and grass type crops with strong vertical structure. Here the HH/VV ratio at certain times of the year is a simple and effective classifier. (b) Strong effects from double bounce scattering from crops over standing water, important for rice and water bamboo (although with confusion between these two cover types. (c) InSAR, which can exploit the stability of man-made structures to map urban areas, since they exhibit temporal coherence over the repeat cycle. (d) Temporal stability of the backscatter from forest areas. In addition, some types of cover show distinct radiometric signatures, e.g., banana. An important issue in using ASAR is data availability. If data are not systematically available (in time, polarization or incidence angle), then supervised classification is the preferred method for land cover mapping, and possible methods will be compared. If there is systematic data acquisition, hierarchical, knowledge-based classification is possible, using physically-based properties of the signal based on polarisation, backscatter and backscatter change through time. The structure of such a scheme will be presented. This paper will also illustrate use of medium resolution optical data (MODIS, MERIS and VGT) for vegetation monitoring.

ASAR 数据在福建省土地覆盖和水稻提取中的应用研究

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摘要

福建省位于中国的东南部，地形复杂，主要的土地覆盖包括农田，森林，城市区域和一些基础设施。由于农作物的轮作，城市土地利用的扩张变化等，土地利用总是处于动态的变化中，非常有必要对其进行长期有规律地监测。但是光学数据受云的影响制约了其可用性，Envisat 卫星数据能很好的弥补大部分高分辨率光学数据一年只能有效获取一次的不足。ASAR 传感器能提供更多优良的功能，包括：（a）多极化特性，非常有利于识别谷类作物和饲料作物等有明显纵向结构特征的地物，这类地物在每年某一特定时候 HH 与 VV 极化的比值是一个简单有效的分类器。（b）从农作物到平静水面经过两次反射后形成强烈的散射效果，特别对于水稻和茭白这两类农作物散射效果更明显（虽然这两类地物容易混淆）。（c）干涉雷达，通过重复周期表现地物的时间相干性，可以通过检测城市区域内人造建筑的稳定性来进行城市区域的识别。（d）森林的后向散射随时间保持相对稳定。除此以外，有些典型地物表现出明显的回波散射信号，比如香蕉。对于 ASAR 研究的一个重要问题是数据的可用性。如果无法系统地获得数据（在时相、极化或入射角方面），那么对于土地覆盖制图，监督分类是首选的方法，其他可能使用的方法可以和它相比较。如果能够系统地获取数据，可以根据信号的物理属性，分析极化、后向散射和后向散射变化随时间变化的特性，应用等级分类法和基于知识的分类法。文中将阐述该设计方案的结构。本文也将介绍 MODIS，MERIS 和 VGT 等中分辨率光学遥感数据在植被监测中的应用。

Urban Dynamics with Multitemporal ENVISAT/ERS SAR and INSAR Data in Fujian Province

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Abstract

This work is part of “Agriculture and land use: ENVISAT application in Fujian Province” project (Dragon ID: 2563). The validation of land use/ land cover classification by the synergistic use of SAR and optical data in Zhangzhou area, which was presented in last Dragon symposium, will be presented first. In the second part of this presentation, urban dynamics analysis will be presented. Different behaviors of urban dynamics phenomenon (urban growth, urban decrease and urban constance) in Fujian test site have been detected by using multitemporal ENVISAT and ERS SAR and INSAR coherence. Three main SAR/INSAR parameters are used for the urban dynamics analysis, which are SAR temporal change, ERS tandem interferometric coherence and ERS (or ENVISAT) long-term coherence.

基于多时相 ENVISAT ASAR 和 ERS SAR/INSAR 的城市动态变化分析

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摘要

这项工作是龙计划项目 2563 的一部分。在去年丽江会议我的报告中, 介绍了联合 SAR 和高分辨率光学影像进行土地覆盖分类的方法, 当时未完成的精度验证将在本次报告的一部分讨论。报告的第二部分将讨论利用多时相 ENVISAT ASAR 和存档的 ERS-1/2 数据进行城市动态变化分析。主要用 SAR 数据的时相变化性质和城市区域的高干涉相干性来监测城市增长和减少等变化现象。

NOTES

Session 4.2: Rice Monitoring (id. 2562)

专题 4.2: 水稻监测

Rice Monitoring in China (the Dragon Project)

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Abstract

The objective of the project is to develop methodology to use remote sensing data for rice mapping, and retrieving information characterising rice fields (biomass, photosynthetic activities, water management status) relevant to rice growth and biochemical models. The overall goal is the estimation of rice acreage and rice production at local and regional scale and the estimation of the Carbon fluxes (CO₂, CH₄) at regional scale. The project relies on ENVISAT data, mainly on ASAR data for rice mapping and retrieval of rice biomass and information on water management practices. SPOT-VGT data were planned to derive indicator of rice photosynthetic activities, and SCIAMACHY data were planned to derive information on the seasonal variation over China of atmospheric methane.

The activities include ground data collection and analysis of remote sensing data. The relevant parameters retrieved from remote sensing are subsequently used in carbon fluxes models. Measurement campaigns have been performed in Hongze, Rongchang, and Xinhua county in Jiangsu for detailed measurements of rice fields during the growing season, and observations have been done in Xinjian, in the province of Jiangxi.

Remote sensing methodology using ENVISAT ASAR has been refined and validated for rice mapping and retrieving of rice parameters. The results indicate that it is possible 1) to map rice fields at a single date, 2) to retrieve rice biomass, 3) to map the main rice varieties, 4) to achieve regional rice mapping and 5) to detect mid season drainage in rice fields. Monitoring of vegetation photosynthetic activities has been done with SPOT VGT, instead of MERIS data which did not have consistent coverage over our test regions. These findings show great potential in providing statistics of rice growth areas, and the essential information for the modelling of rice production and the biochemical modelling.

Works have been carried out to adapt the LPJ Dynamic Vegetation Model to cropping systems in China. The LPJ Model has been run and tested at the Jiangsu test fields and the results show that rice fields are a source of atmospheric CO₂. A crop model (Agri-C) and a model to estimate methane emission from ricefields (MODCH4) developed by the Institute of Atmospheric Physics are applied to rice in China. The use of the remote sensing retrieved information in the models are currently undertaken. The information can be used as inputs to the models, or for comparison with the model outputs (for example the seasonal variation of the methane column measurements from SCIAMACHY).

中国水稻监测专题

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摘要

“中国水稻监测”专题 (ID: 2562)

本专题的研究目的在于研制遥感数据用于水稻制图和提取稻田特征参数 (如生物量、光合效应、水管理状态等) 的方法, 同时建立水稻生长模型和水稻生物化学模型。专题的目标是在局部和区域尺度上对水稻面积和水稻产量进行估测, 以及在区域尺度上对碳通量 (如 CO₂, CH₄) 进行估测。本专题利用 ENVISAT 数据, 主要是其 ASAR 数据进行水稻制图、水稻生物量和稻田水管理措施信息的提取。SPOT_VGT 数据用于监测水稻的生长趋势, SCIAMACHY 数据用于提取整个中国大气甲烷含量的季节变化信息。本专题的主要任务是地面数据的收集和遥感数据的分析。从遥感数据中提取的有关参数用于碳通量模型中。本项目分别于 2005、2005、2006 年在江苏洪泽县、金湖县和兴化县进行了水稻生长期间的多种参数调查和测量, 于 2006 年在江西新建县进行了地面调查。利用 ENVISAT ASAR 数据进行水稻制图和水稻参数提取的遥感方法在实践中不断完善和改进, 验证结果表明: (1) 用单时相的 ASAR 数据可以识别区分水稻与非水稻; (2) 提取水稻生物量是可行的; (3) 利用多时相 ASAR 数据可以区分不同水稻品种; (4) 区域范围的水稻制图可行; (5) 用遥感手段可以监测稻田的排水状况。另外, 由于本专题未能够获取试验区连续的 MERIS 数据, 因而采用了 SPOT VGT 数据对植被光合效应进行了监测。根据我们的研究结果, 认为利用遥感手段获取水稻面积以及用于估测水稻产量和水稻生化参数模型的基本信息有很大的潜力。本专题对 LPJ 动态植被模型进行了修改, 以便在中国使用该模型进行作物监测。在江苏试验区对 LPJ 模型进行了检验和运行, 结果表明稻田是大气 CO₂ 的来源之一。本专题还利用中国科学院大气物理研究所开发的 CH₄MOD 模型和 Agro-C 模型对中国水稻田甲烷释放及农田碳收支进行了估计。遥感反演信息在这些模型中的应用也正在进行, 这些信息可以是模型的输入, 也可以用来与模型输出结果进行比较, 如, SCIAMACHY 估测的大气柱甲烷的季节变化。

Simulating Changes of Methane Emission from Rice Fields of China from 1955 to 2000

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Abstract

CH4MOD, a model for simulating CH₄ emission from rice paddies with a minimal number of inputs and parameters that are commonly available, was utilized to simulate annual methane emissions from rice fields of China from 1955 to 2000. In order to drive the model, spatial databases were built up by GIS (Geographic Information System) techniques for the model inputs including daily air temperature, annual rice cultivation acreage and rice yields, decadal straw amendment and manure application as well as soil sand percentage and rice calendar etc. Results showed that on the nation scale the temporal change of methane emission from rice fields experienced slight decrease, rapid increase and then leveled off to about 6 Tg a⁻¹ from 1955 to 2000. In the early stage from 1955 to 1961, the amount of methane emission decreased from 2.56Tg a⁻¹ to 2.29Tg a⁻¹ due to the fall down of the rice cultivation acreage, and after that, both the rice cultivation acreage and the methane emission per unit area increased significantly until 1976 which made a rapid increase of the emission amount from 2.29Tg a⁻¹ to 5.28 Tg a⁻¹. From then on, in spite that the methane emission per unit area kept increasing, notable decrease of rice cultivation acreage negated the effect, and the emission amount showed therefore no obvious trend but undulated between 5.07 Tg a⁻¹~6.22 Tg a⁻¹.

1955-2000 年中国稻田甲烷排放变化模拟

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摘要

甲烷 (CH₄) 是大气中重要的温室气体之一。研究我国稻田的甲烷排放年际变化, 对于客观评估我国稻田 CH₄ 排放量对于区域乃至全球大气 CH₄ 浓度的贡献具有积极意义。本文将一个比较成熟的稻田甲烷排放模型 CH₄MOD 和 GIS 空间化数据库结合, 模拟估计了中国大陆 1955~2000 年水稻生长季稻田甲烷排放的年际变化。从 1955 年到 2000 年, 我国稻田甲烷的年总排放量变化可分为三个阶段 (图 1), 第一阶段从 1955 年到 60 年代初呈现出下降趋势, 从 2.56Tg/a 下降到 2.29Tg/a; 其后至 1980 年呈明显上升趋势, 从期初的 2.29Tg/a 上升到 5.88Tg/a; 1980—2000 年甲烷排放总量以年际波动为主, 范围在 5.07—6.22 Tg/a 之间。这期间我国稻田的播种面积也同样呈现出三个阶段的变化。1980 年之前, 水稻播种面积的年际变化与稻田甲烷排放量的变化基本一致, 但是 1980 年之后, 我国水稻播种面积表现为下降趋势, 而同期的稻田甲烷排放则没有明显变化趋势, 其原因在于由于水稻产量 (同时也有稻田总生物量) 的逐年增加, 单位播种面积的稻田甲烷排放在过去 45 年中一直表现为缓慢上升。

Carbon Fluxes and Yield Estimates in China Using Vegetation Modelling and Remote Sensing

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Abstract

Being the world's most populated country, China has an important land area devoted to agriculture. Since many centuries, the farming system has been efficient in feeding many people, with an extensive use of multiple annual crops. After the 1950s, the agricultural productivity even increased due to the introduction of artificial fertilizers. This transformation has had significant impacts on the carbon cycle and on greenhouse gas emissions. Particularly, the flooding of rice fields leads to the emission of the radiatively powerful methane. In a context of rapid global change, it is important to distinguish the human and natural processes that drive the rice production and its impact on the climate. To do so, we combine a biogeochemical model with satellite derived products obtained through the Dragon project.

The LPJmL model (Bondeau et al. 2007), driven by climate, soil, and management data, simulates the coupled carbon and water fluxes of both natural vegetation and agriculture. It estimates the yields of the major crops. We use LPJmL to determine the role of the rice agricultural system in the CO₂ & CH₄ fluxes in China. Field data from the Nanjing site (Jiangsu) were provided by the Dragon rice team. Some important input of the model, like the determination of the crop calendars and the periods of flooding are retrieved from satellite data using ENVISAT SAR data or SPOT VGT data.

The results highlight the seasonal CH₄ emissions related to the rice cropping cycles. There is a great interest to compare our simulations with the CH₄Mod model estimates from Huang et al. (2004), and with the ENVISAT SCIAMCHY estimates.

基于植被模型和遥感的中国碳通量和产量估测研究

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摘要

中国是世界上人口最多的国家，对农业非常的重视。几个世纪以来，由于广泛采用一年多季作物耕种系统，满足了许多人的吃饭问题。自上个世纪 50 年之后，由于人工合成化肥的使用，农业产量在持续增长。这种改变给碳循环和温室气体释放带来了重要的影响，尤其是水稻田的灌溉导致了甲烷气体的释放。从全球快速变化看，区分水稻产品是人类活动还是自然过程带来的非常重要，因为水稻产品影响全球气候。因而，我们将生物地球化学模型和“龙计划”中卫星遥感提取的信息结合在一起开展相应的研究。LPJmL 模型 (Bondeau et al. 2007) 以气候、土壤和管理措施数据为输入因子模拟自然植被和农田释放的碳和水通量。该模型还可以估测主要农作物的产量。我们利用 LPJmL 模型估测中国稻田释放的 CO₂ 和 CH₄ 通量。江苏南京试验区的地面数据来自专题合作伙伴，模型需要的其它输入数据如作物的生长期和灌水期等从 ENVISAT SAR 和 SPOT VGT 图像上提取。结果表明 CH₄ 的释放与水稻的生长周期有密切关系。结果有待与 CH₄Mod 模型和 ENVISAT SCIAMCHY 数据的估测结果进行比较。

Rice Mapping and Monitoring Using ENVISAT ASAR Data

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Abstract

Radar remote sensing technology has become an important method for stable and long-time rice growth monitoring for its capability to operate in all weather conditions. In this paper, ENVISAT Advanced Synthetic Aperture Radar (ASAR) alternative polarization HH/VV data was used for rice monitoring in Xinghua rice experiment site (approximately 32°51' N-32°58' N and 120°00' E-120°06' E) in the middle of Jiangsu Province. In this region, land surface is rather flat, and height above sea level is about 1 m. Rice season begins in early June and harvested in late October. During an extensive field survey in 2006, seven rice growth monitoring areas about 8-15 mu (1 ha = 15 mu) each were selected within the rice experiment site, and each of them has five small fixed observation sites about distributed within the monitoring area. Rice growth parameters including plant height, plant fresh/dry biomass, leaf area index (LAI), plant water content and so on were measured from June 20th to October 20th every ten days. Under the framework of "Dragon Project", 8 ASAR APMODE images were received from ESA in 2006, which cover the experiment site. Image preprocessing including calibration, geo-correction, speckle reduction and backscattering image generation was carried out in BEST software. Firstly, a threshold classification method was developed for mapping rice growth area, according to the different characteristic of backscattering coefficient between rice paddies and other land surface objects. The validation results showed that Rice identification accuracy is 84.36%. Then, relational models were built for rice growth parameters retrieval based on the field experiments and ancillary data collected during the research. VV polarization was most highly correlated with the NDVI, and with most rice growth parameters, while it was poorly correlated with the plant water content. The HH polarization was less well correlated with most rice growth parameters than VV polarization, but high positive correlation coefficient was found between HH polarization and the plant water content ($r^2=0.849$). HH-VV containing information from both HH polarization and VV polarization showed good correlation with NDVI and LAI. Close correlations between NDVI and LAI, and also between LAI and the plant biomass coincided with the facts. On the whole, our results suggest that HH polarization is more sensitive to the plant water content, and VV polarization is more sensitive to the plant structure and other parameters such as LAI, the plant biomass and NDVI. Linear regression models to extract the LAI, the plant biomass from ASAR image were also developed. For inversion of LAI, NDVI was first calculated from equation (1) and then substituted into equation (2), together with VV polarization as input. Since LAI has a strong correlation with the plant biomass, we further transformed the plant biomass and LAI using a linear regression model (see equation (3)) to examine the plant biomass variation in the experiment areas.

$$NDVI = 0.353 + 0.014\sigma_{HH-VV} - 0.027\sigma_{VV} \quad r^2 = 0.864 \quad (1)$$

$$LAI = -6.486 - 0.392\sigma_{VV} + 8.368 NDVI \quad r^2 = 0.829 \quad (2)$$

$$Bio = 0.013 + 0.608LAI \quad r^2 = 0.832 \quad (3)$$

As expected, the retrieved rice growth parameters are consistent with those of field measurements. Maps of retrieved rice growth parameters covering the rice experiment site were generated, which were compared with our field survey records. The map of derived NDVI from ASAR image showed good agreement with the map of NDVI from CBERS-02 data, but with higher values.

Other maps also showed that the variation of derived rice parameters was highly consistent with the actual rice growing conditions.

基于 ENVISAT ASAR 数据的水稻遥感监测

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摘要

利用雷达遥感监测水稻能够克服云、雨等不利天气条件的影响, 成为长期、稳定的水稻遥感监测的主要技术手段。本文以江苏省兴化市水稻试验区为例, 利用 ENVISAT ASAR 数据对试验区水稻生长进行监测。试验区位于江苏省中部的兴化市昌隆镇, 地处北纬 32°51'—32°58' 东经 120°00'—120°04', 海拔高度在 0—1m, 地势平坦。该地区种植单季水稻, 播种约在 6 月上旬完成, 10 月 20 日左右成熟收割。在试验区内设定了 7 个水稻生长观测点。观测时间从 6 月 22 日起到 10 月 20 日结束, 每隔 10 天观测。主要的观测内容包括: 水稻生育期、水稻叶面积指数、株高、地上部生物量及植株含水量等。

在中国科技部—欧洲空间局“龙计划”合作项目框架内, 从欧方获取了 2006 年 8 月 4 日覆盖试验区的 ENVISAT ASAR 交叉极化模式 (APMode) 数据。首先通过分析水稻田 HH 极化和 VV 极化的后向散射特征, 利用阈值分类算法对试验区进行水稻制图, 其水稻识别精度为 84.36%。然后结合地面实测水稻参数、中巴地球资源卫星 02 星 CCD 数据和 ASAR 数据, 建立了反演水稻归一化植被指数和水稻叶面积指数的关系模型。利用 CCD 数据计算生成了试验区内归一化植被指数 (NDVI) 图, 并求算了水稻观测点区域的 NDVI 平均值, 然后将地面试验中记录的水稻叶面积指数 (LAI)、植株含水量与 NDVI、HH 极化后向散射系数、VV 极化后向散射系数和 HH-VV 极化差值进行相关性分析。建立水稻归一化植被指数 NDVI 与水稻 VV 极化后向散射系数、HH-VV 极化差值的关系模型, 其拟合回归方程如下式:

$$NDVI = 0.353 + 0.014\sigma_{HH-VV} - 0.027\sigma_{VV} \quad r^2 = 0.864 \quad (1)$$

使用式 (1) 对试验区内水稻 NDVI 进行反演, 其标准差为 0.059。因 LAI 与 NDVI 和 VV 极化后向散射系数的相关性达到显著。

故利用 NDVI 和 VV 极化来预测试验区内水稻叶面积指数, 拟合回归方程如下:

$$LAI = -6.486 - 0.392\sigma_{VV} + 8.368 NDVI \quad r^2 = 0.829 \quad (2)$$

$$Bio = 0.013 + 0.608LAI \quad r^2 = 0.832 \quad (3)$$

拟合相关系数为 0.83。因此可以由 (1) 式反演试验区水稻 NDVI。把反演的 NDVI 代入式 (2), 结合水稻的 VV 极化后向散射系数, 对试验区样点水稻 LAI 进行反演。最后, 利用建立的模型从 ASAR 数据中提取了试验区水稻叶面积指数、生物量等, 其结果与地面调查和测量结果相一致。

Use of Envisat Data for Rice Monitoring in China

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Abstract

The goal of the project is the estimation of rice acreage and rice production and the estimation of Carbon fluxes (CO₂, CH₄) using rice growth and biochemical models. The project relies on ENVISAT data, mainly on ASAR data for rice mapping and retrieval of rice biomass and information on water management practices.

In this paper, remote sensing activity and achievements will be presented.

During the last year, remote sensing methodology has been refined and validated for rice mapping and retrieving of rice parameters. The activities include ground data collection and analysis of remote sensing data. The results obtained using ENVISAT data from 2004 to 2006 at different test areas in Jiangsu and Jiangxi province indicate that it is possible 1) to map rice fields at a single date using two polarisations of ASAR APP, 2) to retrieve rice biomass using the polarisation ratio, 3) to map the main rice varieties, 4) to achieve regional rice mapping using multidate ASAR WideSwath data, and 5) to detect intermittent drainage using WSM data. Monitoring of vegetation photosynthetic activities has been done with SPOT VGT, instead of MERIS data which did not have consistent coverage over our test regions. The presentation will also discuss the operational conditions to use remote sensing data to derive for statistics of rice growth areas, and to provide the essential information for the modelling of rice production and the biochemical modelling.

基于 ENVISAT 数据的中国水稻监测

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摘要

本研究的目标是估测水稻面积和水稻产量以及利用水稻生长和生物化学模型估测碳通量(CO₂, CH₄)。本专题利用 ENVISAT 数据, 主要是其 ASAR 数据进行水稻制图、水稻生物量和稻田水管理措施信息的提取。

在本文中主要阐述了遥感水稻监测的技术和结果。

自研究工作开展以来, 遥感水稻制图和水稻参数提取的方法不断改进和完善, 并进行了验证。开展的主要工作是地面数据收集和遥感数据分析。利用 2004 年到 2006 年的 ENVISAT 数据在江苏省不同的试验区 and 江西试验区进行的研究结果表明: (1) 利用单时相双极化的 ASAR APP 数据识别区分水稻田是可行的; (2) 利用不同极化图像的比值可以估测水稻生物量; (3) 利用多时相图像可以识别不同的水稻品种; (4) 利用宽模式的 ASAR WSM 数据可以进行区域范围的水稻制图; (5) 利用 ASAR WSM 数据能够监测稻田的排水状况。

另外, 由于本研究未能够获取试验区连续的 MERIS 数据, 因而采用了 SPOT VGT 数据对植被光合效应进行了监测。本文还将对遥感提取水稻生长面积、遥感反演信息用于水稻产量估测和水稻生化模型的可操作性进行讨论。

Agro-c: a Bio-physical Model for Simulating Carbon Budget in Agroecosystem

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Abstract

Human activities have released increasing quantities of CO₂ into the atmosphere over the past 150 years. Agroecosystem is recently considered to sequester atmospheric CO₂. Various models have been developed to assess carbon budgets in forest and grassland ecosystems, while few models were dedicated to agroecosystem. Agro-C, a bio-physical model, was developed to assess carbon budget in agroecosystem. The model consists of two sub-models of Crop-C and Soil-C. Driven by solar radiation, temperature, soil moisture, crop tissue nitrogen and atmospheric CO₂ concentration, Crop-C simulates crop photosynthesis and autotrophic respiration for rice, wheat, maize, cotton, rapeseed and soybean. Soil-C simulates soil heterotrophic respiration via the decomposition of input organic carbon and soil native carbon with a first-order kinetics reaction driven by soil temperature, moisture, texture and pH. Changes in soil organic carbon was determined by a balance between the loss of soil carbon and the sequestration of the input organic carbon. Agro-C also simulates the net CO₂ exchange between cropland and atmosphere as a balance between crop gross primary production and ecosystem respiration, the sum of crop autotrophic respiration and soil heterotrophic respiration. Model validation against independent field observations indicated that crop NPP, changes in soil organic carbon and net CO₂ exchange in agroecosystem can be well simulated by Agro-C from parameters of climate, soil properties and agricultural management in various regions of China.

Agro-C: 一个模拟农田生态系统碳收支的生物物理模型

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摘要

过去 150 余年来, 人类活动向大气释放的 CO₂ 不断增加。有研究表明, 农田生态系统在固持大气 CO₂ 中起着重要作用。不同的模型已开发并用于评价森林和草地生态系统的碳收支, 但针对农田生态系统的模型尚不多。近几年来, 我们开发了一个用于模拟农田生态系统碳收支的生物物理模型 (Agro-C), 该模型由两个子模型 Crop-C 和 Soil-C 组成。Crop-C 由大气 CO₂ 浓度、太阳辐射、温度、土壤水分和作物氮含量等因子驱动, 用于模拟 6 种主要作物 (水稻、小麦、玉米、大豆、棉花、油菜) 的光合作用、自养呼吸和干物质积累。Soil-C 模拟由有机碳输入量和土壤异养呼吸决定的土壤有机碳动态, 主要驱动因子为土壤质地、温度、水分和 pH 等。Agro-C 也具有模拟由作物总初级生产力和生态系统呼吸所决定的农田—大气 CO₂ 净交换的功能。对大量田间观测数据和文献资料的模型验证结果表明, 根据当地的气候、土壤和农业管理措施, Agro-C 可有效地模拟中国不同区域的作物净初级生产力、农田土壤有机碳变化和地气 CO₂ 净交换。

NOTES

SESSION 5: PRESENTATIONS BY YOUNG SCIENTISTS

专题 5 : 青年科学家报告

Session 5.1: Presentations by Young Scientists I

专题 5.1: 青年科学家报告

Measurement of Interseismic Strain Accumulation Across the Haiyuan Fault by Radar Interferometry

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Abstract

SAR interferometry has shown a great potential in detecting small ground motion. In this study, we measure the interseismic deformation across the Haiyuan fault. This fault is one of the major left-lateral faults at the north-eastern edge of the Tibetan plateau. Our aim is to better constrain the present mechanical behavior of this fault system, at the origin of two M~8 earthquakes in 1920 and 1927, and along which a seismic gap with high potential seismic hazard has been identified. We focus on this 'Tianzhu seismic gap'. We analyze ERS SAR data from two tracks along descending orbits between longitudes 102.6° and 105.3° and latitudes 36°N and 38°N. Along the eastern track (61), we compute 22 interferograms based on 12 ERS images acquired between July 1993 and August 1998. Along the western track (333), we compute 27 interferograms based on 15 ERS images acquired between 1995 and 1998. Baselines are limited to 200 m to maintain phase coherence across the fault and most parts of the scene. The interferometric phase contains informations about the deformation occurring between two satellite passes, as well as satellite orbital errors, and atmospheric delays. Atmospheric delays, in our interferograms, are mainly due to the variation of water vapor vertical stratification in the troposphere between two passes. They result in a clear, mostly linear, correlation between phase and elevation (tropostatic delays). We jointly correct for orbital errors and tropostatic delays, removing a best fitting twisted phase plane and a slope between phase and elevation, respectively. However, other residual atmospheric delays remain important after those corrections. We thus select interferograms showing the best signal to noise ratio (based on the analysis of 2D noise spectra), before stacking them to obtain velocity maps. 5 and 4 interferograms are selected for tracks 333 and 61, respectively, corresponding to a cumulated time of up to 11 years for each track. The results obtained for both independent tracks are remarkably consistent. In the overlapping part of tracks 333 and 61, the 9 selected interferograms can finally be stacked, increasing the cumulated time to 22 years. Obtained fault-parallel velocities, assuming a purely horizontal motion, are best fitted by a fault slipping at 7 ± 2 mm/yr, below a shallow locking depth of 2 km. This last value may be indicative of shallow creep.

应用干涉雷达技术测量海原断裂震间应变积累状况

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摘要

干涉雷达技术监测地面微量形变方面显示了巨大潜力。本研究中, 我们测量了海原断裂的震间形变场。该断裂是青藏高原北 - 东边界的一条主要左旋走滑断裂, 我们的目的是更好地约束它的力学行为。该断裂于 1920 年和 1927 年发生了两次 8 级大震, 而且沿该断裂还发现了一个具有高地震潜势的地震空区。我们主要关注“天祝空区”的形变, 分析了东经 102.6°到 105.3°, 北纬 36°到 38°N 两条下降轨道的 ERS 雷达数据。东侧的 61 轨道, 我们用 12 景 1993 年 7 月到 1998 年 8 月获取的 ERS 数据, 处理得到了 22 个干涉图。西侧的 333 轨道, 我们用 15 景 1995 年到 1998 年获取的 ERS 数据, 处理得到了 27 个干涉图。所采用的干涉基线限制在 200m 以内, 以保持跨断层和图像大部分区域的相干性。干涉相位包含了两次成像期间的断层形变, 以及卫星轨道误差和大气延迟影响。干涉图上的大气延迟主要是两次成像时对流层中水蒸气垂直分层变化引起的。它导致了清晰的, 干涉相位和高程之间的线性相关性 (电离层延迟)。我们联合校正轨道误差和电离层延迟, 消除一个最佳拟合的相位曲面和与高程相关的相位坡面。然而, 剩余的大气延迟仍然较大。我们基于两维噪声谱选择信噪比较好的干涉图, 将其叠加获得形变速度图。从 333 和 61 轨道分布选择 5 个和 4 个干涉图, 相当于每条轨道形变聚集 11 年。从两条独立轨道获得的结果非常一致。在 333 轨道和 61 轨道重叠的部分, 9 个干涉图叠加, 聚集时间达到 22 年。假设纯水平断层运动, 获得断层平行的速率可以用 7 ± 2 mm/yr 的滑动速率和较浅的锁定深度 2km 进行最佳拟合。后者可能反映了断层浅部的蠕滑运动。

InSAR Adaptive Range Filtering with Terrain Slope (id 2567)

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Abstract

One of the limitations of SAR interferometry (InSAR) is geometric decorrelation (baseline decorrelation). It is caused by the different incidence angles between two acquisitions. In frequency domain, it can be described by wavenumber shift theory, which indicates that the range spectrums shift of SAR images reduces the coherence of interferogram. Because wavenumber shift is a function of normal baseline and local terrain slope, the prior knowledge of the terrain slope is very important in mountainous areas. In the conventional procedures of InSAR, the range filtering is performed on the assumption that filtering windows with constant slope, which is hardly accepted in mountainous areas. Another problem is that, the estimation of local fringe frequency may be affected by the orbital errors in the interferogram. Depending on the above analysis, a novel range filtering procedure is developed. In this algorithm, a map of filtering windows with constant local terrain slope is firstly produced from Shuttle Radar Topographic Mission (SRTM) DEM. The size of these filtering windows is not constant but changing with the terrain slope change. This strategy can ensure the accuracy of the wavenumber shift estimation. Also, in order to fit the need of Fast Fourier Transform (FFT), the filtering windows are overlapped to keep that the size of them is power of 2. Finally, this proposed approach is applied on filtering the InSAR data sets in mountainous areas. The preliminary result shows its capability in coherence enhancement.

InSAR 地形坡度自适应滤波算法研究 (id. 2567)

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摘要

在合成孔径雷达干涉测量 (InSAR) 中, 干涉图的质量不仅决定了相位解缠的难易程度, 还直接影响地形量测的精度。而由主从影像在入射角上的差异造成的几何 (基线) 去相干是限制干涉图质量的一个重要原因。解决这一问题的一个重要手段是对主从影像进行距离向谱滤波。由于滤波中对波谱偏移的估计取决于垂直基线和地形坡度, 所以地形的先验知识就显得十分重要。在传统 InSAR 数据处理流程中, 距离向滤波是在滤波窗口内坡度不变的假设下进行的。而这一假设在地形复杂区域是很难得到满足的。传统方法的另一个问题是, 通过对干涉图的局部最大频率来估计波数偏移时会受到干涉图中轨道误差的影像。基于上述分析, 我们提出了一种新的距离向滤波算法, 在这一算法中, 首先利用 SRTM DEM 产生与 SAR 影像对应的拥有不变地形坡度值的滤波窗口图。通过滤波窗口间的重叠使其大小为 2 的倍数, 从而满足快速傅立叶变换的要求。然后, 通过该算法生成的滤波窗口图对山区的 InSAR 影像进行距离向滤波, 最终的实验结果验证了该方法在地形变化剧烈地区增强干涉图相干性的能力。

A Regional Investigation of Urban Land Use Change in the Three Gorges Reservoir Area, People's Republic of China: Zigui to Wanzhou

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Abstract

The near-completion of the Three Gorges Dam has led to the creation of a narrow reservoir that when completed in 2009, will stretch over 660 kilometres upstream and result in the displacement of approximately 1.9 million people (Dai, 1998). The reservoir will drown more than 100 towns, some of which have already been lost due to the rising waters, and result in a significant change in land use. New urban areas have been constructed at higher elevations to avoid the rising water but it is feared that some of these settlements may now be exposed to a greater risk of slope failure.

Geographic Information Systems and Remote Sensing provide a cost effective means to monitor changes in urban areas and landslide susceptibility. This project has used Landsat TM and ETM+ data obtained prior to the Dam's construction along with recent ASTER data to map urban areas between the Dam's location at Sandouping and Wanzhou. However, for this project and for many other applications, information provided by an individual sensor can be incomplete, inconsistent or imprecise. SAR data provides a direct method to obtain a more consistent interpretation of a given scene and to make use of different information available.

To detect urban change in the Three Gorges Reservoir Area, radar data from prior to the Dam's construction with present day data would be required. The European Space Agency's (ESA's) ERS-1/2-SAR and Envisat-ASAR instruments are ideal sources of radar data. ERS-SAR and Envisat-ASAR data are currently being analysed for their potential in detecting changes in urban areas using the high SAR backscatter caused by the dominance of single and double-bounce backscattering (Dong et al., 1997).

Fieldwork was carried out along the Yangtze River towards the end of April. The urban area boundaries detected from satellite were field-checked by on-site visits in late April/early May to each of the main urban areas studied in this project. Digital photos were also taken in order to record the results of the observations. Initial comparisons are good, and it is hoped that further analysis with the recently acquired SAR data will enable the changes in urban areas to be accurately detected.

In order to perform this analysis, a high resolution DEM was required to correct for terrain relief distortions (orthorectify). ASTER and SRTM DEM data have been fused together to produce an accurate DEM with the improved vertical accuracy of the SRTM DEM and 30m spatial resolution of the ASTER DEM. This DEM has also been used to derive a slope map used as an indicator of landslide susceptibility.

The results show that a majority of the new urban areas are in fact located on shallow slopes, but are positioned below steep slopes which could pose a threat of landslides to the inhabitants of the new towns.

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中华人民共和国三峡库区城镇土地利用区域调查：从秭归到万州

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摘要

三峡大坝将在 2009 年彻底竣工，目前已形成了一个狭长的绵延 660 公里的水库，并且使得 190 万人迁移 (Dai, 1998)。水库将淹没 100 多个城镇，其中一些由于水位上升已经被淹没，这将导致土地利用发生显著变化。为了回避不断上升的水位，新城镇都建设在较高海拔的地方，但是这样有可能面临巨大的边坡失稳风险。GIS 和遥感为监测城镇面积和滑坡风险提供了经济有效的手段。本研究采用了大坝修建前获取的 Landsat TM 和 ETM+ 数据和最新的 ASTER 数据对万州到坝址三斗坪之间的城镇区域进行制图。可是，对本研究和许多其他研究来说，单个遥感器的数据所提供的信息有不完备、不一致和不精确的问题。SAR 数据对一个给定区域可以直接提供更一致的解译，使得利用不同信息成为可能。要研究三峡库区的城镇变化，从建坝前到目前的雷达数据都是必要的。欧空局 (ESA) 的 ERS 1 / 2 SAR 数据和 Envisat-ASAR 是理想的雷达数据源。由于城镇区域以单散射和二次散射为主，表现出高亮度 (Dong et al., 1997)，我们将利用这个特征来识别城镇区域的变化。从四月底到五月初我们沿着长江进行了野外工作。对本研究涉及的每个主要城镇实地验证了从卫星图像上识别的城镇边界，同时拍摄了数码照片记录观测结果。初步比较结果良好，希望进一步深入分析最近获得的 SAR 数据以得出城镇变化的准确情况。为了进行这种分析，需要利用高精度 DEM 进行地形起伏校正 (正射校正)。我们将 ASTER 和 SRTM 产生的 DEM 进行融合改进了 SRTM DEM 和 30 米分辨率的 ASTER DEM 的垂直精度，得到了精确的 DEM，然后用这个 DEM 导出坡度图作为滑坡风险评价指标。结果表明大多数新城镇事实上都修建在缓坡上，但是却位于陡坡下，这有可能使得新城镇居民处于滑坡的威胁下。参考文献： Dai, Q., 1998, *The River Dragon Has Come! The Three Gorges Dam and the Fate of China's Yangtze River and Its People*. Translated by Ming Yi; edited by J.G. Thibodeau and P. B. Williams. Armonk, NY: M. E. Sharpe, pp. 240. Dong, Y., Forster, B., and Ticehurst, C., 1997, Radar backscatter analysis for urban environments, *International Journal of Remote Sensing*, 18(6), 1351– 1364. 致谢：我们首先要感谢伦敦帝国工学院地球科学工程系的刘建国博士自始至终对本研究的支持。我们还要感谢北京大学的曾琪明教授、中国地震局的张景发教授和三峡大学的涂国保先生，他们组织安排了我在中国的野外考察工作。特别要感谢重庆大学的周金国先生作为向导，陪伴我沿长江进行了 6 天考察。最后我要对你们说谢谢对我野外工作的支持和帮助，还有我的朋友 Andrew Polley 先生，没有你的帮助，这次野外工作将一事无成。

Identification of Stable Pointwise Point Targets in Urban Areas (id. 2567)

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Abstract

Identification of stable pointwise target is a key procedure in SAR image interpretation and InSAR applications. In long-term D-InSAR data analysis for monitoring surface deformation, stable pointwise target is characterized by stable scattering mechanism and unaffected by either geometrical or temporal decorrelation in time series.

So far there are mainly two kinds of methods to identify the stable pointwise target. One is to identify the point targets based on their temporal stability in long time series, such as PS(permanent Scatter)and CTM (Coherent Target Monitoring)approach. Another is to extract stability parameters based on the characteristics of single image itself, i.e. CSs(Coherent Scatters) approach which could be used in the limited number of observations (Rafael Zandoná Schneider,2006, IEEE/TGRS). In this method, the SAR image is split as sublooks and calculated their correlation.

The purpose of this research aims at investigating the advantages and restrictions of the above methods. The different SAR data, such as ERS and ASAR data set, are chosen as the experiment data. The two kinds of methods above-mentioned are firstly carried out on the different SAR data set. The result of the stable pointwise target identified are validated by field investigation in shanghai urban, the physical and geometrical characteristics are further analyzed and generalized. Finally, the identification methods of the stable pointwise target are evaluated in precision, reliability, and efficiency.

时间序列 InSAR 数据中城区稳定点目标的识别 (id. 2567)

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摘要

在基于时间序列的 InSAR 地表形变监测应用中, 在稳定点目标上提取形变等关键参数为有效地检测出高精度形变量提供了一个有效的解决途径。稳定点目标的主要特点是具有稳定的散射机制, 同时在时间序列上不受几何和时间去相关的影响。因此对于它的准确识别在 SAR 影像解译和地表形变监测处理流程中是一个非常关键的步骤。

到目前为止, 在 SAR 影像解译和地表形变监测应用中主要有两类识别稳定点目标的方法。一类方法是以多时相影像上点目标的稳定性为基础, 在长时间序列上推导稳定点目标的提取指数, 比如 PS 和 CTM 方法。另一类方法是从单幅影像本身的信息出发, 在有限的观测中提取稳定性参数来进行稳定目标点的识别, 比如 CSs 方法。本文的研究目的在于探讨上述两类方法的各自优势和适用范围。

本研究主要针对城区点目标的识别问题。首先在两组不同的 SAR 影像数据——ERS 和 ASAR 数据上实现两类稳定点目标识别方法。然后在实地的地面调查和验证的基础上, 进一步分析和归纳稳定点目标的物理和几何特征。最后从准确性、可靠性、有效性和适用性多个方面对稳定点目标识别方法进行比较和分析, 为今后的应用研究提供理论依据。

Creation of Large Area Forest Biomass Maps for NE China Using Synergy of Spaceborne Radar Data

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Abstract

In the period since the last DRAGON Symposium, the forest map of Northeast China has been produced. Contrary to the original plan, the JERS mosaic, provided by the GBFM project, could not be used for the classification. This was the consequence of an insufficient co-registration of the ERS and JERS mosaic as well as the existence of large gaps in the common coverage. The ERS-1/2 tandem data was therefore the only data source used for the classification.

The classification utilized a fully-automated procedure, based on the MODIS Vegetation Continuous Field 'VCF' product, which provides global estimates of percent tree cover at 500 m pixel size. The VCF product was used for the training of the semi-empirical Interferometric Water Cloud Model, which describes the relationship between forest stem volume and ERS-1/2 tandem coherence. Model training was done for each of the 223 ERS-1/2 tandem coherence images in order to account for the variability of coherence with respect to meteorological and environmental acquisition conditions. Simple thresholds were then used to distinguish four stem volume classes: 0-20, 20-50, 50-80 and >80 m³/ha. An accuracy assessment, using the forest inventory data available for the Central Siberian test sites at Chunsky and Bolshe-Murtinsky, indicated overall accuracies of up to 80 % and kappa values up to 0.7.

Uncompensated spatial decorrelation was found to be a considerable problem in the mountainous areas, especially when the perpendicular baseline was long. Therefore all slopes above 10° had to be masked out before doing model training. For images with a short baseline below ~150 m masking of steep slopes tilted towards the sensor was sufficient. In order to account for the spatial estimation of coherence (up to 9x9 pixels), which causes a propagation of spatial decorrelation into flat areas, the topographic masks were widened for half of the maximum coherence estimation window size. A new processing procedure based on slope-adaptive range common-band filtering has been recently tested for some scenes of the ERS dataset of Northeast China. For details see the abstract by Santoro et al.

The new classification approach represents a fast and easy to apply method to map forests. Weak points of the forest map produced are related to uncompensated spatial decorrelation in mountainous areas and the large fraction of coherence images acquired under unstable weather conditions. Therefore a quality flag map will be produced, indicating areas of higher uncertainty in the classification.

利用合成星载雷达数据进行中国东北地区大面积森林生物量制图

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摘要

自上次“龙计划”年会以来，中国东北地区的森林制图结果已经处理结束。与起初项目计划不同的是，从 GBFM 项目获取的 JERS 镶嵌图并未能应用到该研究中。这主要是因为 ERS 和 JERS 镶嵌图之间的配准存在着不足，并且两者数据覆盖范围间存在着很大的间隙。因此，ERS-1/2 串行数据是此研究的唯一数据源。

基于 MODIS 植被连续覆盖 (VCF) 产品 (全球植被覆盖率, 500 米分辨率), 本研究利用了全自动化分类处理。VCF 产品用于训练半经验干涉水云模型, 该模型描述的是森林蓄积量与 ERS-1/2 相干影像间的关系。考虑到获取时影像相干性变化与气象及环境之间的关系, 针对 223 对 ERS-1/2 相干影像进行了模型训练。利用域值对森林蓄积量进行了分类, 共 4 类: 0-20, 20-50, 50-80 和 >80 m³/ha. 利用西伯利亚试验区 Chunksky 和 Bolshe-Murtinsky 的森林清查数据进行了精度评价得出, 总体精度达到 80%, Kappa 系数达到 0.7。

在山区, 特别是当垂直基线长时, 未能得到补偿的空间去相干性是一个相当麻烦的问题。因此, 在模型训练前, 不得不将所有斜面角大于 10 度的地区掩模, 对于基线短于 150 米的相干数据来说, 掩模陡峭且正对传感器的地区非常有效。考虑到能引起平坦地区传播空间去相干性的空间估算 (最大 9x9 窗口), 地形掩模的空间尺度将予以最大相干估算窗口大小的一半的放宽。近期, 一种基于坡面自适应范围的普通-波谱滤波器已用于测试一些东北地区的 ERS 数据, 具体细节见 Santoro 的摘要。

本研究中所用的新分类方法表现出了在森林制图中迅速且容易地应用该算法的特性。分类结果图中产生的不足与山区地形的未能得到补偿的空间去相干性, 不稳定天气情况下获取的数据产生的大片不连续的相干图有关。因此, 将要生产的产品质量标识图将指出那些在分类处理中未予以确定的区域。

On Multibaseline Polarimetric Interferometric Techniques for Natural Media

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Abstract

Within the framework of the DRAGON project, a study of polarimetric SAR interferometry (POLInSAR) techniques for forests, and natural media in general, has been conducted. In order to perform a qualitative and quantitative analysis of polarization diversity in polarimetric SAR interferometry (POLInSAR), a general polarimetric coherence model is examined. This model is motivated by interferometric coherence models, polarimetric system models, and POLInSAR coherence models for vegetation. Starting from single particle scattering, a randomly distributed natural medium with a possibly vertical volume structure is examined. The effects of propagation through the atmosphere and the natural medium are considered, as well as possible distortions in the acquisition system. The major constituents of the interferometric coherence are identified and analyzed in reference to polarization diversity.

The use of more than one baseline provides the possibility to observe and to quantify temporal changes in the scene (due to temporal baseline), as well as the volume structure (due to spatial baseline). It is of importance to identify the most correlated scattering mechanisms along all data sets, since for these scattering mechanisms the phase error is minimal. In this work, the optimization problem is analyzed and two methods for multibaseline coherence optimization are presented. These optimization methods provide the most coherent (dominant) scattering mechanisms and corresponding interferometric phases, maximizing simultaneously the coherence in all baselines. Obtaining the optimal polarizations enhances interferometric and polarimetric applications, e.g. in differential interferometry (DInSAR), in permanent scatterer (PS) determination, or in polarimetric calibration. These methods can also be used for Faraday rotation detection and correction, as well as change monitoring. The performance improvement is examined.

自然媒体的多基线极化干涉技术

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摘要

在“龙计划”框架下, 本文开展了对森林和一般自然媒体的极化干涉 SAR 技术(POLInSAR)的研究。为了对极化干涉 SAR(POLInSAR)中的极化多样性进行定性和定量的分析, 开展了通用极化相干模型的研究。该模型由干涉相干模型、极化系统模型和植被的极化干涉相干模型引导。从单一粒子散射开始, 研究了带一个可能的垂直体结构的随机分布自然媒体。研究考虑了大气和自然媒体传播的影响, 同时考虑了接收系统可能带来的失真, 并对关于极化多样性的干涉相干的主要成分进行了识别和分析。

多于一条基线的使用使得观测和定量测量场景的时相变化(根据时间基线)和体结构(根据空间基线)成为可能。由于相关散射机制的相位误差是最小的, 因此确定对于所有数据集的最相关的散射机制十分重要。本文分析了最优化问题, 并提出了多基线相干最优的两种方法。这些最优化方法能给出最相干(占优势地位的)的散射机制和其相应的干涉相位, 同时使各条基线的相干性达到最大。最优极化的获得使干涉和极化的应用得到了增强, 如差分干涉(DInSAR)、永久散射体(PS)确定和极化定标等领域。这些方法也可用于法拉弟旋转检测和校正, 或用于变化监测。另外, 本文对性能的提高也进行了研究。

NOTES

Session 5.2: Presentations by Young Scientists II

专题 5.2: 青年科学家报告

Combining Remote Sensed Soil Moisture and Land Surface Modeling for Drought Monitoring and Forecasting Over China

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Abstract

Droughts cause reduced soil water availability to vegetation and affects crop growth reduction. The project on drought monitoring and prediction has a focus on utilizing remote sensing for modeling of land surface processes such as transpiration and soil moisture movement that control real world soil moisture distributions and availability. Within this project, Advanced Synthetic Aperture Radar (ASAR) observations are analyzed to provide soil moisture information and Advanced Along Track Scanning Radiometer (AATSR) observations are used for evapotranspiration estimations.

In this study, over 80 ASAR WSM acquisitions have been collected over the Naqu river basin on the Tibetan Plateau for the period 2005-2006 from which soil moisture has been extracted from the backscatter observation. For this a time series based retrieval procedure has been utilized. Comparison of the retrievals with soil moisture measured in 2005 showed that the retrievals correspond well with the measurements. For further validation of the retrieval methodology, an intensive soil moisture field campaign has been conducted in the period July 16-27, 2006. This data set is currently investigated and preliminary results will be presented during the symposium.

In addition, the ASAR based soil moisture retrievals from 2005 have been used within a data assimilation procedure through application of Direct Insertion and Ensemble Kalman Filtering techniques. However, due to uncertainties in the model parameterizations and model forcing terms as well as an observed incompleteness of the applied model structure (i.e. NOAH 2.6), relevant data assimilations is precluded and results of the soil moisture assimilation are not yet fully evaluated but is still in progress. Various methodologies are being researched to ameliorate the model simulations of the water and energy balances.

基于遥感土壤湿度和陆面模型的中国干旱监测与预报研究

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摘要

干旱气候导致植被可利用水份的减少并可直接影响到作物的生长。干旱监测和预报研究旨在通过结合遥感数据进行陆面过程模拟，例如进行控制现实土壤湿度分布状况和水份利用的蒸散发和土壤水份运移的模拟。在该研究中，我们利用先进合成孔径雷达(ASAR)资料计算土壤湿度，利用高级跟踪扫描辐射计(AATSR)资料计算蒸散量。

在本研究中，收集了 2005-2006 年间 80 余幅青藏高原那曲地区的 ASAR WSM 后向散射数据，利用建立在时间序列基础上的反演程序计算得到土壤湿度。通过反演结果和 2005 年的实测数据对比发现二者能够很好的吻合。为了进一步验证反演方法的可靠性，我们于 2006 年 7 月 16 日至 27 日在那曲地区进行了一次加强观测试验。观测数据现已进入分析阶段，初步研究结果会在会议期间予以介绍。

此外，通过应用直接插值法和集合卡尔曼滤波方法，利用 ASAR 数据反演的土壤湿度已经被用于数据同化。但是，由于模型参数化和模型驱动项的不确定性，以及所运用模型结构（例如：NOAH 2.6）的不完整性，相关的数据同化被剔除。虽然现在还不能对土壤湿度同化进行全面评价，但其正处在不断发展完善过程中。我们正在对各种不同方法进行研究以期改进模型对水份和能量平衡的模拟。

Hydrological Assessment in China : Remote Sensing in a Watershed Strongly Modified by Man

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Abstract

In our first attempt to build a hydrological model of the Shiguanhe river basin, we used several remote-sensing products such as the SRTM 3 DEM, a Landsat ETM land-use map, and Google Earth maps. Meteorological data, and the integration of the man-induced discharge from the two major dams into the hydrological model allow us to obtain a good representation of the discharge at the JiangJiali outlet over a ten-year period.

But there was two major phenomena which were not explained by the MODCOU model: a significant amount of water released from the dams did not appear in the observed discharge at the outlet during the irrigation season, and we could also observe several flood peaks which were not reproduced by the model, or underestimated.

Those differences can in fact be explained by the irrigation water management practices. Indeed, through an analysis of the discharge from the Mei Shan dam, we discovered that a significant amount of water was extracted from the river to supply an irrigation network outside of the basin. So we subtracted an amount of 100 m³/s from the Mei Shan discharge during the irrigation period, and the correlation between calculated and observed discharge at the outlet greatly improved.

We made then the hypothesis that, during the irrigation season, the amount of water which does not flow at the outlet of the basin is used for rice-irrigation within the Shiguanhe basin, and we assigned this water to the rice-fields through an artificial modification of the rainfall over those fields. Lastly the adaptation of the rice-fields production function allows us to represent the traditional methods chinese farmers are using for rice cultivation, in particular the emptying of their fields and small dams when rainfall events are occurring.

Finally we can say that remote sensing, except for classical purposes such as DEM and land-use, is not the tool which helped us the most in modelling correctly this basin. Indeed, in such a strongly human-modified system, the most needed data are the management rules of the equipments used in the basin. Dams, canals and irrigation management rules used by the farmers are the essential data to improve the modelling, and it is only through the hypothesis we made on these water management rules that we could finally represent correctly the specific features of the discharge in the Shiguanhe basin.

中国水资源评价：遥感应用与人类活动影响

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摘要

在最初所建立的史灌河子流域的水文模型中，我们用到一些遥感产品，如 SRTM 3 DEM、Landsat ETM 土地利用图以及 Google Earth 图等。气象数据和两个主要水库的流量与水文模型的结合，对近 10 年蒋家集流量的模拟获得了较好的结果。

但是，有两种现象 MODCOU 模型没有说明：在灌溉季节，由水库排放的相当数量的水并没有出现在流域出口水文站观测的流量中；我们可以观察到几次没有模拟出或低估的洪峰。

这些差异实际上是由于农田灌溉管理造成。通过分析梅山水库的流量，发现相当数量的水经过灌渠、河网输往子流域外的灌溉系统。因此，在灌溉季节将梅山水库流量按 100 m³/s 进行修正，模型模拟效果得到极大提高。

因此，我们提出如下假说，在灌溉季节，未流经流域出口的水量用于史灌河子流域水稻灌溉，这些稻田灌溉用水通过该区的降雨量来修正。稻田产出函数的修改可以表现中国农户水稻耕作的传统方法，特别是当降雨发生时，雨水首先填满稻田与池塘。

最后，在本研究中遥感除了具有 DEM、土地利用等传统的用途外，其他遥感反演产品尚未在流域水文模拟中发挥作用。实际上，在人类活动影响的体系内，我们最需要的数据来源于流域经营管理。农户利用的水库、沟渠、灌溉技术等资料是改善模型、提高模拟效果的主要数据。通过采用上述水量修正假说，我们可能最终正确地描述史灌河子流域出口流量的特征。

Remote Sensing Methods for Rice Mapping and Crop Parameters Retrieval in China.

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Abstract

The research study carried out in the frame of the “Rice Monitoring in China” project (Dragon 2562) aims at developing and validating methodology using ENVISAT data, to provide information relevant to rice ecosystem monitoring. In a next step, studies will be undertaken on the use of remote sensing retrieved information in rice production and biochemical models.

In the first two years of the project (2004 and 2005), a rice mapping method using a single-date ASAR APP image (incidence IS2, polarisations HH&VV) based on the polarisation ratio HH/VV had been developed and validated in the Hongze county, Jiangsu province. Overall accuracy of these rice maps was assessed to 85%. In addition, using data from these 2 years on 2 test sites (Hongze county and Gaoyou county), a correlation of 80% between wet biomass and polarisation ratio HH/VV had been found from planting to flowering stage. In the past year (2006), the single-date rice mapping method has been tested in the Xinhua county, Jiangsu province, with similar results. Analysis of other APP images under incidence IS7 in the Hongze county indicates that the single-date method based on the polarisation ratio can also be used at this incidence. Data available in 2006 in the Xinhua county do not match the relationship that was found in 2004 and 2005 between wet biomass and the polarisation ratio. This can be explained by differences in the agricultural practices (direct sowing in Xinhua, transplanting in Hongze and Gaoyou) resulting in differences in the bunch density. This tends to indicate that rice biomass can be retrieved locally in areas where agricultural practices are the same, when a few biomass measurements are available to derive a relationship between wet biomass and polarisation ratio HH/VV.

Mid-season drainage in the rice fields is a widely used agricultural practice in China, and has a major impact on the methane emission factors. Knowledge of the drainage status is therefore a key input in the methane emission models. Our preliminary studies on ASAR WSM data in 2006 in the Jiangsu province tend to demonstrate the feasibility of drainage detection based on SAR data.

For large scale rice mapping and retrieval of number of crops per year, SPOT-VGT 10-day synthesis data covering eastern China from 1999 to 2006 have been investigated instead of MERIS which did not provide consistent coverage. Methods based on the Fourier decomposition of NDVI and NDWI time series are developed and need validation.

Next steps to complete the project are: - modelling of radar backscatter to interpret ASAR response from rice fields, under flooded and drained conditions; - reinforced cooperation with other partners from the Rice Monitoring project for crop modelling and methane emission modelling.

中国水稻制图和农作物参数提取的遥感方法研究

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摘要

本研究是“龙计划”中“中国水稻监测”专题 (Id2562) 的一部分, 目的在于开发和验证 ENVISAT 数据用于水稻生态系统信息提取的方法。下一步的研究工作是水稻产量遥感估测和生物化学模型的应用。

在 2004 年与 2005 年间, 用单时相双极化 ASAR APP 图像的极化比值 (HH/VV) 数据进行了水稻制图方法的研究, 试验区位于江苏省的洪泽县。经验证, 水稻制图的总精度为 85%。另外, 利用两年的地面调查数据 (洪泽县和高邮县), 建立了水稻鲜重与极化比值 (HH/VV) 之间的相关关系, 精度达 80%。在 2006 年, 将开发的单时相水稻制图方法用于江苏省兴化县试验区, 获得了相似的结果。

对覆盖洪泽试验区的 IS7 模式的 APP 数据的分析发现, 基于单时相的极化比值数据的水稻制图方法也能够用于该模式的图像。用 2006 年覆盖兴化试验区的数据无法得到 2004 年和 2005 年建立的水稻鲜重与极化比值之间的相关关系。原因可能是种植方式的不同, 兴化试验区是直播的方式, 而洪泽和高邮试验区是插秧的方式, 从而导致水稻分蘖株数的不同。与此同时, 可以认为在局域范围内, 对相同种植方式下的水稻生物量的估测可以采用相似的方法, 可以利用较少的实地测量数据建立鲜重与极化比值 HH/VV 之间的相关关系。

水稻生长季节稻田排水现象在中国比较普遍, 这对稻田甲烷的释放影响很大。因此, 排水状况是甲烷释放模型的一个重要输入因子。我们利用 2006 年覆盖江苏省的 ASAR WSM 数据对稻田排水状况进行了初步研究。

我们利用 1996 到 2006 年的 SPOT-VGT 10 天合成数据对中国东部地区进行大范围的水稻制图和每年作物的轮植数监测研究。开发了基于 NDVI 和 NDVII 时间序列数据傅立叶分解的方法, 并对该方法进行了验证。

整个专题的下一步的任务是: 稻田有水和排水状况下雷达后向散射的模拟, 以解释 ASAR 的响应; 加强专题成员之间的合作以更好地进行作物模拟和甲烷释放估测。

Burnt Scar Cartography in China by Means of ASAR Images

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Abstract

The objective of this work is the cartography of large burnt areas by means of ENVISAT ASAR (Advanced Synthetic Aperture Radar) data. This cartography provides a map-perimeter of burnt areas and total affected area. Multi-temporal ASAR Alternating Polarisation (AP) data are used. The VV/HV polarization is selected.

A new procedure has been developed in order to obtain the burnt areas after a forest fire. By means of ASAR compositions, the burnt areas are easily detected. The main advantage of the proposed procedure is that all the images used are post-fire images.

基于 ASAR 影像的中国过火区制图方法

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摘要

开展这项工作的目的是获得利用 ENVISAT ASAR(Advanced Synthetic Aperture Radar)数据对大面积的过火区制图方法。这种制图法可获得过火区的周长和所有受害面积。利用多时间的 ASAR 极化数据(AP), 并选择了 VV/HV 极化方式数据。为了获得林火后的过火区, 设计了一个新的处理流程。利用合成后的 ASAR 数据, 很容易地检测出过火区。这个处理流程的主要优点是所有处理后的影像都是过火后的影像。

Poyang Lake Flood Monitoring Based on Large Scale Change Detection Method Using ENVISAT Wide Swath Mode Data

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Abstract

Poyang Lake, one of the most regularly flooded areas in China, can be considered as a key natural flood control and reduction element within the Changjiang middle basin. Within the Flood DRAGON Project, part of the MOST-ESA DRAGON Programme, Poyang Lake's area was monitored since January 2004. Being particularly adapted to plain flood monitoring and mapping, semi-automatic flood extraction procedures based on change detection techniques was explored in order to highlight changes in Poyang Lake's region. The change detector was specifically elaborated to analyse ENVISAT ASAR Wide Swath Mode data pairs, which appear very well adapted to flood monitoring over wide areas. The algorithm is based on two analysis levels: an enhanced ratio for strong changes over large homogeneous and flat areas combined with a ratio calculated from the two raw images which aims to keep the raw data's thematic precision. Slope and aspect effects are also eliminated by the use of a Digital Elevation Model during the processing. This change detection analysis was performed on 32 data pairs acquired within the framework of the flood DRAGON Project. The first set of results is very promising and robust using HH polarization. Change detection between data with VV polarization or with different polarization (HH vs VV) has to be fully validated but results are promising.

基于 ENVISAT 宽幅 WSM 数据采用大尺度变化检测方法进行鄱阳湖洪水监测

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摘要

鄱阳湖是中国遭受洪水最频繁的地区之一，也是长江中游防洪重点。在中欧龙计划洪水监测项目支持下，我们自 2004 年开始监测鄱阳湖地区。为了便于洪泛区洪水监测与制图，我们开发了洪水范围半自动提取程序用于识别鄱阳湖边界的变化。利用的数据是 ENVISAT ASAR 宽幅模式数据，该数据对于大范围洪水监测是非常好的。洪水范围提取算法基于两个层次：对于大范围平坦地区，我们采用增强比率法；对于其他地区，为了更好的保持原始数据的专题信息，采用直接影像比的方法。在处理过程中，利用数字高程模型去除了坡度和坡向的影响。在龙计划框架下，我们获取了 32 景影像，并利用相邻遥感影像进行了变化检测。结果表明，利用 HH 极化影像对进行变化检测效果很好，而且很稳定，利用 VV 极化影像对或者 HH/VV 极化影像对进行变化检测还有待于进一步验证，但效果也还可以。

NOTES

Session 5.3: Presentations by Young Scientists III

专题 5.3: 青年科学家报告

Investigating the Global Impact of Growing Anthropogenic NO_x Emissions in China

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Abstract

The growing Chinese anthropogenic emission of NO_x has its consequences for the local air quality, but it also influences atmospheric chemistry on a global scale. To study intercontinental transport (ICT) from China to the downwind North American west coast, satellite observations are used together with chemical transport model simulations. Data products and techniques are derived from the ESA project TEMIS (Tropospheric Emission Monitoring Internet Service).

Despite the relatively short lifetime of NO₂ in the lower troposphere, ICT can be made possible by the NO₂-induced production of (longer lived) ozone, and the chemical bonding of NO₂ in peroxyacetyl nitrate (PAN). At sufficient low temperatures (as found in the upper troposphere), PAN is stable up to several months before it decomposes and regenerates NO_x. Other important factors for successful ICT across the Pacific are the meteorological conditions (rapid uplift of the pollutants towards the higher troposphere, followed by fast horizontal displacement) and the amount of daylight.

To detect an ICT event, we monitor the tropospheric NO₂ concentrations, derived from satellite observations by the OMI instrument (aboard EOS-AURA). In order to quantify the impact of ICT on local air quality in North America, simulations are done with the chemical transport model TM5, putting its zoom mode of 1x1 degree over China.

Part of the study consists of updating the Chinese anthropogenic emission estimates, which are subject to rapid change. In our top-down approach, NO_x emissions are adjusted in such a way that the simulated NO₂ concentrations correspond best with the NO₂ observations from 1997 to 2005, made by GOME (ERS-2) and SCIAMACHY (ENVISAT).

These new emission estimates can be used to simulate the long range impact and behavior of individual events. On a longer timescale, simulations are averaged to study the global effects of increasing Chinese emissions on tropospheric ozone. So far, our model simulations show that –comparing Chinese emissions of 2005 with those of 1997– there is a 2% increase in global tropospheric PAN, and a 0.4% increase in global tropospheric ozone.

中国日益增长的 NO_x 排放对全球影响研究

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摘要

中国日益增长的 NO_x 的人为排放不仅使区域的空气质量恶化，而且在对于全球大气化学过程产生影响。本文利用卫星观测结合化学输送模式计算结果，研究了从中国向下风方向北美西海岸之间洲际输送过程。数据产品及处理技术均来自 ESA 的 TEMIS 项目(Tropospheric Emission Monitoring Internet Service)。尽管在对流层中 NO₂ 的寿命相对较短，但是通过 NO₂ 诱发的较长寿命的臭氧以及硝酸过氧化乙酰 (PAN) 可以导致洲际传输，在持续低温的条件下 (对流层顶) PAN 在降解重新产生 NO_x 之前可以保持稳定状态几个月之久。其他有利于跨越太平洋洲际传输的重要影响因子包括气象条件 (由于迅速的水平位移，污染物可以被迅速地抬升到更高的对流层位子) 和白天的数量。为了监测洲际传输事件，本文利用卫星遥感仪器 (OMI/Arua) 来监测 NO₂ 的浓度。为了量化北美局地空气质量的影响，利用化学传输模式 TM5，在中国区域采用 1x1 的格点。部分研究包含了最新的中国人污染物的估算。在我们组织管理严密的方案下，NO_x 的排放按照模式模拟的结果与 GOME/ERS-2 和 SCIAMACHY/ENVISAT 卫星长时间序列观测 (1997-2005) 最一致的基础上进行估算。这个新的排放估算可以用来模拟长距离传输的影响和表征单个传输事件的特征。在长时间尺度范围内,模式模拟可以研究迅速增长的中国对流层臭氧排放对全球的影响。到目前为止，我们的模拟结果显示：相对 1997 年，中国在 2005 年的对流层 PAN 增长了 2%，对流层臭氧增长了 0.4%。

Carbon Sequestration of Cropland Soils from 1980 to 2000 in Eastern China

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Abstract

Cropland may play a significant role in mitigating climate change via sequestering the atmospheric CO₂. To evaluate the carbon sequestration, an examination of changes in soil organic carbon (SOC) becomes essential. We compiled data from 50 published papers that report changes of SOC in eastern China. These data covered 76% of the total croplands in this area with more than 8500 measurements of soil samples. A meta-analysis of these data indicated that SOC in topsoil of 17.9 Mha area increased by 75.4–134.1 Tg with an average of 103.5 Tg from 1980 to 2000. Paddy soils account for approximately 70% of the total increase. SOC increase in the cultivated layer accounts for approximately 88% (upland soils) and 71% (paddy soils) of that in the topsoil, respectively. The increase of SOC may be attributed to an augment of crop net primary production and hence of residue retainment.

Key Words: Carbon sequestration, cropland soil, eastern China, meta-analysis

1980~2000年中国华东区农田土壤有机碳的变化

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摘要

大气 CO₂ 等温室气体浓度升高引起的气候变化是目前国际社会普遍关注的重大全球性环境问题。土壤碳库的稳定、增长或者衰减都与大气 CO₂ 浓度变化密切相关。农田土壤有机碳库是陆地生态系统最为活跃的碳库, 不仅在减缓气候变化中具有重要的地位, 同时又是土壤肥力和基础地力最重要的物质基础。本研究通过文献调研和数据整合 (meta-分析) 的方法, 分析了中国华东区农田土壤有机碳近 20 年的变化趋势。数据来源于 50 篇相关文献的约 8500 个土壤样本, 涵盖了华东区 76% 的农田面积。研究表明: 1980~2000 年华东区 1790 万 ha 农田的表土 (耕层 + 亚耕层) 有机碳增加 103.5 Tg, 变化范围为 75.4~134.1Tg。其中, 水稻土 SOC 增加显著, 约占总增加量的 70%。农田土壤 SOC 的增加主要集中在耕层, 旱地土壤 SOC 耕层增加量占其表土总增加量的 88%, 水稻土占 71%。1980~2000 年华东区农田 SOC 增加可主要归因于作物净初级生产力的提高, 及由此带来的土壤有机质输入的增加。

Ocean Wave and Wind Parameters Retrieved from SAR Images Using an Empirical Algorithm

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Abstract

Significant wave height (Hs) and wind speed (U10) are derived using a new empirical algorithm (Cwave 1.0 and Cwind 1.0) developed at the German Aerospace Center (DLR) from global Spaceborne Synthetic Aperture radar (SAR) images. The results are validated by spatially and temporally collocated in situ data of NOAA buoys and observations undertaken on the German research vessel Polarstern. The results are also compared to spatially and temporally collocated ERA-40, scatterometer, HOAPS and altimeter data.

The wave mode SAR images applied in this study are acquired by the ERS-2 satellite every 200 km along the satellite track. Between 1300 and 1500 images were collected each day by the ERS satellites. About 1 million images from September, 1998 to December, 2000 were processed at DLR and used for this study.

The validation between SAR results and in situ data shows rms order of less than 0.5 m in Hs and less than 2 m/s in U10. It is shown that SAR measurements of Hs are comparable in accuracy to altimeter measurements.

A statistical analysis of SAR derived measurements in comparison to ECMWF ERA-40 data is given. ERA-40 datasets contain reanalyzed values Hs and U10 interpolated to a 2.5° x 2.5° regular latitude/longitude grid at the four synoptical hours 00:00, 06:00, 12:00 and 18:00 UTC each day. Cases of difference between SAR measurements and model are discussed.

Using SAR results and ERA-40 data the inter-annual and seasonal variability of Hs and U10 is investigated. Statistical analysis of the storm path over the north Pacific is investigated.

A case of high wind speed and high Hs in the north Pacific are analyzed. A storm crossing the North Pacific from December 29th 1998 to January 2nd 1999 is analyzed using SAR results and ERA 40 data.

利用经验函数由 SAR 图像反演海面风、浪信息

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摘要

本文利用新的经验模式函数 (CWAVE 1.0 和 CWIND 1.0) 和星载 SAR 图像反演得到了全球分布的有效波高和 10 米风速。利用同步的 NOAA 浮标数据和德国科研考察船 - Polarstern 号的观测资料对模式反演结果进行了验证, 同时, 也利用了同步的 ERA - 40、散射计、HOAPS 和高度计资料对反演结果进行了比较。

ERS - 2 卫星沿轨道方向每隔 200 公里就获得一幅波模式的 SAR 图像, 每天大约可以获得大约 1300 - 1500 幅这样的 SAR 图像, 从 1998 年 9 月到 2000 年 12 月一共收集了大约一百万幅波模式的 SAR 图像, 这些 SAR 图像在 DLR 经过再处理之后应用于新的经验函数来反演海洋参数。

由 SAR 反演得到的全球分布的海洋参数与其他卫星观测结果进行了统计比较。得到的风速与 ERS 散射计资料和 HOAPS 被动微波 SSM/I 资料进行了对比, 而反演得到的有效波高参数与同步的 ERS 高度计资料进行了对比。Hamburg Ocean Atmosphere Parameters and Fluxes from Satellite Data set (HOAPS) 资料包含了许多由 SSM/I 得来得大气海洋的参数场: 降水、湍流热量通量、风场、蒸发降水差等。另外, 本文用到的散射计风速资料是由 CERSAT 提供得 50km×50km 分辨率的, 而 ERS - 2 的高度计资料沿轨道方向每隔 1 秒就会有一个有效波高的测量值。

由 SAR 反演得到的结果与实测资料的验证表明: 有效波高的均方根误差的量级为 0.5 米, 风速的均方根误差量级为 2 米/秒。并且, 由 SAR 得到的有效波高具有与高度计资料相当的精度。

由 SAR 反演得到的风浪参数与 ECMWF 的 ERA - 40 资料进行了统计分析和比较。ERA - 40 资料包括有效波高和 10 米风场的再分析数值, 这些数值的格点是 $2.5^{\circ} \times 2.5^{\circ}$ 的, 一天会有 4 个时刻: 00:00, 06:00, 12:00 和 18:00 的数值。本文也提供了这两种数据差异比较大的个例分析。

利用 SAR 结果和 ERA - 40 资料进行了有效波高和 10 米风速的年际变化和季节变化的分析。同时, 对北太平洋的风暴路径进行了分析。

对中国海域的巨浪和飓风进行了个例分析。利用 SAR 结果和 ERA-40 数据对发生于 1998 年 12 月 29 日到 1999 年 1 月 2 日的穿越北太平洋的风暴过程进行了分析。

Joint SAR Surface Wind Field and MERIS Cloud Parameters Investigation

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Abstract

The aim is to use Synthetic Aperture Radar (SAR) in synergy with optical data to analyse severe weather systems, e.g., Tropical Cyclones, Storms over the Pacific Ocean or Yellow Sea.

Radar reflectivity over the ocean depends on the roughness of the sea surface and thus mainly on the wind field. Additionally the backscatter of the radar signal is influenced by the size of hydrometeors, e.g. rain drops or snow in the atmosphere and their precipitation rate. The Medium Resolution Imaging Spectrometer (MERIS) instrument that is flying on board the ENVISAT satellite or the Moderate Resolution Imaging Spectroradiometer (MODIS) that is flying on the AUQA/TERRA satellites provide an image over a specific region every three respectively every two days. These measurements are useful to estimate cloud parameters. Synthetic Aperture Radars (SARs) are capable of imaging synoptic wind fields near the sea surface with coverage of up to 500 km x 500 km and a resolution on a subkilometer scale. For retrieving wind speeds from SAR data a model function (CMOD 4 and 5) relating the Normalized Radar Cross Section (NRCS) of the ocean surface to the local nearsurface wind speed, wind direction versus antenna look direction and incidence angle is used. As examples severe storm system are investigated. By synergetic use of ENVISAT ASAR, MERIS and MODIS data the relationship between cloud patterns with different cloud parameters e.g. cloud top pressure, cloud optical thickness and NRCS is investigated. A high correlation between convective clouds and NRCS was detected. Downburst produced by a convective downdraft over a region of less than 1 to 10 km horizontal extension and their interactions with the sea surface are observed in SAR images. The variation of the backscattering coefficient due to rain is considered, too

合成孔径雷达表面风场和 MERIS 云参数联合探测

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摘要

本研究的主要目的是利用合成孔径雷达和同步光学图像分析强天气系统分析，例如热带气旋，太平洋风暴和黄海风暴潮。雷达在海表面的后向散射主要依靠风致海表面粗糙度的改变。另外一些大气中的水汽现象，比如降雨和降雪也会引起雷达后向散射系数的改变。

ENVISAT 搭载的中分辨率成像光谱仪(MERIS)或者 AUQA/TERRA 系列卫星搭载的中分辨率图像辐射仪(MODIS)可以每两天提供某一区域的三次图像。这些设备对估计云参数是很有作用的。合成孔径雷达可以提供至多 500 公里刈幅宽度的高分辨率海表面风场图像。利用 CMOD 模式函数可以从合成孔径雷达反演海表风场，利用几个强热带风暴作为研究实例。利用同步 ASAR、MERIS、MODIS 图像数据，探讨云参数，例如云顶压力，云层光学厚度，和后向散射系数的关系。结果表明对流云和后向散射系数之间有很高的相关性。通过 SAR 图像可以观测到由对流云下压在一个小于 1-10 公里的区域上产生的下沉风和海表面相互作用的现象。

本文也研究了由于降雨引起的合成孔径雷达后向散射系数的改变。

Retrieval Experiment and Result Analysis of Aerosol and Ocean Color Products Around China Coast from MERIS

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Abstract

In this paper, an atmospheric correction algorithm using 2 near infrared (NIR) bands is presented for ENVISAT/MERIS based on radiative transfer simulations, and are applied to MERIS data processing, obtaining several product parameters, such as aerosol optical thickness, aerosol Angstrom coefficient and water-leaving reflectance. Furthermore, the concentration distributions around China coast of chlorophyll a, total suspended matter and yellow substance are acquired using the empirical retrieval algorithms of ocean color components. The MERIS retrieved results are analyzed by comparison with the MODIS standard ocean color products. The aerosol results are primarily validated using the AERONET data, and the water-leaving reflectance and ocean color component concentrations are analyzed in the distribution pattern validity. The atmospheric correction algorithm for MERIS does not consider the influence of NIR water-leaving signals over turbid waters on the retrieving process, thus the algorithm performance in the very turbid coastal waters around China is relatively poor. According to the much stronger absorption of water toward long wave, a corresponding atmospheric correction algorithm is developed using several short-wave infrared (SWIR) bands for MODIS. The simulated data analysis and satellite data processing results show that it can partly avoid the influence of NIR none-zero water-leaving radiance over turbid waters.

中国近海 MERIS 气溶胶与水色产品反演试验与结果分析

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摘要

针对 ENVISAT/MERIS 的波段设置, 基于辐射传输模拟建立了采用 2 个近红外波段的大气修正算法, 并用于中国区域的 MERIS 数据处理, 得到了气溶胶光学厚度和 Angstrom 指数、离水反射率等产品参数。再利用针对 FY-3/MERSI 开发的水色因子浓度统计反演算法, 处理得到了叶绿素 a 浓度、总悬浮物浓度和黄色物质浓度的中国区域分布。我们将 MERIS 的反演结果与 MODIS 的水色标准产品进行了比较分析, 还利用 AERONET 数据对反演的气溶胶结果进行了初步的真实性检验, 并对离水辐射和水色因子浓度结果进行了分布趋势的有效性分析。针对 MERIS 的大气修正算法没有单独考虑混浊水体的近红外离水信号对反演结果的影响, 因此, 在部分非常浑浊的中国沿岸区域的反演效果较差。鉴于水体在长波方向的吸收作用显著增强, 利用 MODIS 提供的多个短波红外 (SWIR) 波段, 开发了对应的大气修正算法。模拟分析和卫星数据处理结果表明, 这可以在一定程度上避免水体信号对气溶胶模型和 TOA 贡献估计的干扰。

Bistatic SAR Ocean Imaging Mechanism and Simulation

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Abstract

With the development of bistatic SAR technology, the bistatic SAR application research get more and more interest. Some spaceborne bistatic SAR system are proposed, such as TechSAT 21, BISSAT, Cartwheel; some bistatic SAR methods which get the scatter signal of communication or navigation satellite are also given in some papers. Ocean observation is one of the most important bistatic SAR applications. Bistatic SAR can give extra information of ocean than conventional monostatic SAR, which can converse more accurate ocean state, wave spectrum or current and so on. This paper will first focus on the bistatic SAR ocean imaging mechanism. The linear modulation mechanism such as tilt, hydrodynamic and bunch modulation models are given. And the nonlinear modulation is also studied, in which the second order of tilt, hydrodynamic, bunch modulation are taken into account. The proportions of these modulations account for in the total modulation are analyzed, and the relations between the ocean wave spectrum and the proportions are studied. The bistatic coherent time of ocean is also studied and the relationship between the coherent time and the ocean wave spectrum is given. In the second part of this paper, a bistatic SAR simulation model is proposed. This model is divided into bistatic scatter simulation model and bistatic SAR raw data simulation model. In the bistatic scatter simulation model, the idea of stochastic multi-scale composed surface model and nonlinear modulation model in the previous backscatter simulation research are referenced. In the raw data simulation model, the speckle effect of radar signal is simulated by Rayleigh distribute model; and the decorrelation effect of the ocean echo signal due to the ocean stochastic movement is taken into account. At last, some typical simulation results are given and compared. The compared results are explained by the bistatic SAR ocean imaging mechanism.

Key words: Bistatic, SAR, Ocean, Imaging mechanism, simulation

双站 SAR 海洋成像机理及其仿真

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摘要

随着双站 SAR 技术水平的发展, 双站 SAR 应用研究得到了越来越多的关注。国际上的研究人员陆续提出了一些星载双站 SAR 的方案, 例如 TechSAT 21、BISSAT、CartWheel 等, 在一些文献中也提出了利用通信或导航卫星信号进行双站 SAR 成像的方法。海洋应用是双站 SAR 的一个重要应用领域, 双站 SAR 可以获取比单站 SAR 更多的信息, 从而可以更精确的反演海况、波浪谱、海流等信息。本文首先研究了双站 SAR 海面成像机理。给出了倾斜、流体动力、聚束调制等线性调制模型, 并对包含倾斜、流体动力、聚束二阶调制效应的非线性调制进行了研究。分析了这些调制效应在总调制中所占的比重, 给出了这些比例关系与波浪谱的关系。对双站 SAR 海面回波相干时间进行了研究, 给出了相干时间与波浪谱的关系。本文的第二部分给出了双站 SAR 海面仿真模型。该模型分为双站散射仿真和双站 SAR 回波仿真两部分。在双站散射仿真中, 借鉴了海面后向散射仿真中的随机多尺度复合表面模型和非线性调制模型。在双站 SAR 回波仿真中, 海面的斑点噪声用瑞利模型实现, 并考虑了海面随机运动导致的时间去相干特性。最后给出了一些典型条件下的仿真结果, 对结果进行了比较并用海面成像机理进行了一些分析和解释。

关键词: 双站, SAR, 海洋, 成像机理, 仿真

Extreme Sea State Analysis by ERS-2 SAR and Envisat ASAR

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Abstract

Several storms are observed from space using as well radar and optical data. new algorithms developed at the German Aerospace Center (DLR) are used to determine SAR derived individual and spectral sea state parameters together with the wind speed u_{10} from the radar images.

For the coastal area investigation, the scan SAR data from the 100kmx100km ASAR and MERIS optical data are used for ocean wave and wind field analysis. Since the launch of Envisat in 2003, the operational ERS-2 SAR and Envisat ASAR work at the Tandem mission. China's strongest storm tide since 1969 occurred in Bohai Sea and Yellow Sea is observed by the Tandem mission on March 5 2007. By analyzing the SAR and ASAR image mode data together with the synergy optical data—MERIS RR data, the wind field in the storm is retrieved. Ocean wave parameters is retrieved as well from the Tandem mission data and compared with the high resolution WAM (0.25 by 0.25) forced by Quikscat data and in-situ measurements.

For investigation in the open sea, scatterometer and SAR wave mode data are used for sea state analysis. The SAR onboard the European Satellite ERS-2 is operated in wave mode over the global oceans whenever no image-mode data acquisition is requested. In the scope of Wave Atlas Project, ESA-provided a two year wave mode dataset of ERS-2 SAR raw data, mainly collected during 1999 and 2000, which was reprocessed into single-look-complex imaggettes at DLR using BSAR processor. The processed dataset contains daily between 1300 and 1500 images of 10 km by 5km size acquired over the global ocean. Several severe North Pacific storms that are difficult to predict in a model are observed by ERS-2 SAR are analyzed in more detail and compared to the ocean wave model WAM.

Further an example of a crossing sea occurring in the South Pacific is analysed.

利用 ERS-2 SAR 和 Envisat ASAR 对强海况的观测和分析

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摘要

本研究的主要目的是利用雷达图像和光学图像观测海洋风暴。利用德国空间中心海洋遥感研究实验室开发的从合成孔径雷达图像反演单个波和海浪谱的算法研究海洋风暴中的海浪和风场参数。

对海岸带研究来讲, ASAR 提供的扫描模式图像可以提供刈副宽度 100 公里的图像, 与同步的 MERIS 光学图像一起, 可以研究海岸带的风场结构。在 2007 年 3 月 4 日 - 5 日, 中国渤海和黄海区域发生了自 1969 年以来的最严重的风暴潮。在该区域, 获得了同步的 ASAR 和 MERIS 数据, 并且利用 ERS-2 SAR 和 ASAR 一前一后的观测特性, 对该海域的风暴潮进行全面的观测和分析。对海浪参数和风场结构进行了具体的分析。

对开阔海域研究来讲, 主要利用 ERS-2 环境遥感卫星搭载的合成孔径雷达提供的波模式数据和散射记数据来分析研究极端气候条件下的海况。在 Wave Atlas 的项目框架下, 欧洲空间局 (ESA) 向德国空间中心(DLR)提供了从 1999 年到 2000 的全球范围内的原始波模式数据。德国空间中心用 BSAR 处理器将这些数据处理成单视复数据。这些数据每天提供大概 1300-1500 个覆盖面积为 5 公里*10 公里的小块图像 (被称为 imagette)。利用这些波模式数据和散射记数据观测发生在北太平洋的强烈风暴, 并与模式结果进行了比较分析。

本文还分析了一个交叉海的个例。波模式数据在 2000 年 8 月 10 日 17:31 在东南太平洋观测到了清除的交叉海。利用数值预报模式的二维谱、2 维 SAR 图像谱和从 SAR 图像反演得到的海浪方向谱来分析交叉海的产生和发展。利用简单的涌浪传播模型, 估计单个涌浪系统的产生海域。

NOTES

SESSION 6: ELEVATION MODELS AND TERRAIN MOTION

专题 6 : 高程模型和地形移动

Session 6.1: Monitoring Seismic Activity (id. 2577)

专题 6.1: 地震活动监测

Co-seismic Deformation and Source Parameter Inversion of the 1998 Mijiagou Mw5.7 Earthquake, North China from SAR Interferometry

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Abstract

The 1998 Mijiagou Mw5.7 earthquake, which happened near the Great Wall of North China, 180 km away from Beijing City, is one of the significant earthquakes in 1998. It leads to 49 people death and bulk of economic losing. This earthquake is the largest one hitting the capital region of China since last tens of years after the Tangshan Great earthquake in 1976. But until today the mechanism of the earthquake is still subject to debate, because there is no devastating earthquakes recorded in the region and there are not any signs of the seismogenic fault (wholly blind). In order to infer the fault of the earthquake, we use INSAR method to produce the deformation field of the earthquake. 2-track ERS SAR data captured the earthquake; both of them have satisfactory coherence. We find that only one fault was involved in the earthquake, other than 2 faults as previous studies. Because the location of the deformation field concentrated near the small town, called 'Mijiagou', we name this earthquake as Mijiagou earthquake, so that better indicate its geographic location, other than 'Zhangbei-Shangyi' earthquake as other literatures. From deformation field inversion, we find that this earthquake is mostly thrust faulting, which strike NE-SW. The magnitude from deformation field inversion is only Mw5.7, remarkably consistent with seismic wave inversion of Harvard earthquake catalog, clearly less than previous result, Mw6.0.

1998 年华北米家沟 Mw5.7 级地震的干涉雷达同震形变场和源参数反演

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摘要

1998 年米家沟 Mw5.7 级地震发生在华北的长城附近, 距离北京城约 180km, 是 1998 年全球发生的一次重要地震事件。地震导致 49 人死亡和大量的经济损失。这次地震是自 1976 年唐山大地震以来过去几十年影响首都地区最大的地震。但是此次地震的震源机制仍然存在争论, 因为该地区历史上没有破坏性地震记录, 也没有关于发震断层的任何信息(隐伏断层)。为了推测该地震断层, 我们使用 INSAR 方法产生同震形变场。两条轨道的 ERS 数据都获取了该地震的形变场; 两者都具有很好的相干性。我们发现只有一条断层参与在本次地震事件中, 而不是其他研究中认为的两条断层。因为形变区集中在“米家沟”这个小镇, 我们称此次地震为“米家沟地震”, 以便更好地指示它的地理位置, 而不是用其他文献采用的“张北 - 尚义地震”。通过形变场反演, 我们发现此次地震主要为 NE-SW 走向的逆冲断层作用。地震震级只有 Mw5.7 级, 与哈佛地震目录给出的结果非常一致, 显著小于以前给出的 Mw6.0 级。

Monitoring Seismic Activity in China from InSAR : Progress Summary

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Abstract

The aim of our project is to use InSAR, combined with GPS and tectonic studies, to characterize the seismic behavior of several major faults slicing the Tibetan plateau in China. So far we have mainly focused our work on faults in north and northeastern Tibet (Haiyuan, Kunlun and Altyn Tagh) and central Tibet, documenting large and medium-size earthquakes, postseismic and interseismic deformation. Regular exchanges and scientific visits between Chinese and French teams collaborating in this project have been organized, as well as a GPS campaign in the Haiyuan fault area, to validate InSAR data. We will summarize the main results obtained since the last Dragon meeting in Lijiang, China, and the objectives for the future. In particular, in the case of the Haiyuan fault, we have characterized the average interseismic behavior of the fault, stacking ERS and Envisat SAR data on descending orbits, in areas where phase coherence is good. We plan to improve our results in areas of lower coherence, based on the Hooper et al.'s approach (2004). Finally, since mid-2006, we have requested systematic ASAR acquisitions on both descending and ascending orbits along selected segments of the Kunlun and Haiyuan faults, which will allow, when the built-up archive becomes sufficient, a refined time series analysis of both horizontal and vertical motion across these faults.

INSAR 监测中国的地震活动：进展和总结

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摘要

本项目的目的是应用 INSAR，并合并 GPS 和构造研究，探究中国青藏高原地区几条大断层系统的地震行为。截至目前，我们已经着力研究了青藏高原北部和东北部（海原、昆仑和阿尔金）以及中部的几条断层。这些断层经历了大、中级别的地震，以及震后和震间形变。项目组织了定期的交流和互访，同时进行了海原断裂的 GPS 观测以验证 INSAR 结果。我们将总结自中国丽江会议以来的主要研究结果，并确定下一步的目标。特别是对于海原断裂，我们已经通过叠加 ERS 和 Envisat ASAR 降轨数据的高相干性区域研究了它的平均震间行为。我们计划基于 Hooper et al.(2004)的方法改善低相干性区域的观测结果。自 2006 年年中以来，我们已经要求了昆仑断裂和海原断裂系统的升降轨道 ASAR 获取任务。当数据积累充足后，这将允许我们更好地对这些断层的水平和垂直滑动进行时间序列分析。

Measurement of Interseismic Strain Accumulation Across the Kunlun Fault by Radar Interferometry

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Abstract

SAR interferometry has shown a great potential in detecting small ground motion. In this study, we measure the interseismic deformation across the Kunlun fault. This fault is one of the major left-lateral strike-slip faults in the north of the Tibetan plateau. Two large earthquakes (Mw7.5 and Mw7.8) happened on its western end and middle part (Mani segment and Ku Saihu segment) in 1997 and 2001 respectively. In order to better constrain the present mechanical behavior of this fault system and investigate its stress field evolution, we use SAR interferometry to detect interseismic signals of these segments.

Along the Mani segment, we processed mainly track 305 ERS data before Nov. 1997, when the Mani earthquake happened. The data show good coherence across the fault, so that we can easily connect phase between the 2 sides of the fault. Because there is a large lake in the middle of the fault, which shows some kind of subsidence signals which have no relationship with active fault, we also merge some data in the east track in the processing. Preliminary results give ~ 10mm/yr slip rate of the segment with 18 km locking depth, which is consistent with our co-seismic inversion.

Along the Dongdatan-Xidatan segment, we processed all of the ERS data along track 090, which show better correlation than the other 2 neighbor tracks. If we use the locking depth 18km as in Lasserre,2006, the inverted slip rate along this seismic gap would be 7~8 mm/yr. We are also deploying some CGPS stations, so that we can better constraint its present-day dynamic behavior.

应用干涉雷达技术测量东昆仑断裂震间应变积累状况

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摘要

干涉雷达技术监测地面微量形变方面显示了巨大潜力。本研究中, 我们测量了东昆仑断裂的震间形变场。该断裂是青藏高原北部的一条主要左旋走滑断裂。它的西端和中部(玛尼段和库赛湖段)在1997年和2001年分别发生了两次大地震(Mw7.5级和Mw7.8级)。为了更好地约束该断层系统的力学行为, 调查它的应力场演化状况, 我们使用干涉雷达方法监测这些段的震间形变信号。在玛尼段, 我们主要处理了305轨道1997年11月玛尼地震发生之前的雷达数据。该数据显示跨断层部分具有较好的相干性, 所以我们能够容易地连接断层两侧的形变相位。由于在断层中部有一个较大的湖泊, 它显示了与活动断层无关的沉降信号, 我们加入了一些东侧轨道的数据进行处理。处理和反演的初步结果显示, 该断层滑动率在10mm/yr的水平滑动速率, 断层闭锁深度18km左右, 与我们的同震反演结果非常一致。在东大滩-西大滩段, 我们处理了090轨道的所有ERS数据, 该轨道数据比其他两条相邻轨道的数据具有更高的相干性。如果使用Lasserre,2006给出的断层闭锁深度, 该地震空区的断层水平滑动率约为7~8 mm/yr。我们在该段也布设了一些连续GPS站, 以便更好的约束它的现今动力学行为。

NOTES

Session 6.2: Terrain Measurement (id. 2567)

专题 6.2: 地形测量

Topographic Measurement with ERS and ENVISAT Data

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Abstract

(1) Background & Objectives Spaceborne SAR remote sensing is essential in many geo-related projects such as monitoring environment, controlling flood, land subsidence, slope stability landslide, seismic movement, preventing pollution and has become a very important technology for the sustainable development strategy of China. Especially the SAR data possesses the evident potential because there is large area with cloud and mist through the year in many areas of China. In this project the science investigations will be mainly centered at the application on topographic mapping and earth deformation monitoring by ERS-1/2 and Envisat/ASAR data.

(2) Monitoring Long-term Subsidence with PS-InSAR Technique In this project, time series InSAR analysis has been applied in several application cases. Coherent Target Analysis is one of the approaches for detection and processing of coherent information from stacks of SAR data. It directly uses phase stability to identify the Permanent Points — Coherent Targets in the long time series InSAR data set. This method may simplify the flowchart as it keeps the accuracy. Our early research concentrated on the coherent point target analysis of long-term ERS-1/2 data set in Shanghai city, which has been affected by subsidence for more than eighty years. For ASAR data, we have collected few images in the test site. The approach for identifying stable point targets with small data stack is investigating. The subsidence velocity obtained from few ASAR data has been compared with the ground subsidence map of 2003 year provided by Shanghai authority. Nearest Neighboring interpolation method is used to validate the accuracy of the subsidence velocity derived from ASAR data.

(3) Deriving Accurate DEM in mountainous areas Through this project, we focus the data processing procedures for generating DEM with InSAR and validate the potential for topographic mapping in hilly area, such as the southwestern of China. The limitations of SAR interferometry (InSAR) include geometric and temporal decorrelation. It is necessary to introduce the filtering method to remove the noise and improve the quality of interferogram. Several approaches have been considered in this project. The experiment results will be shown in this presentation.

利用 ERS 和 ENVISAT 数据进行地形量测的研究

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摘要

1. 研究目标 本主题主要围绕欧空局 ENVISAT 卫星搭载的先进合成孔径雷达 (ASAR) 的数据应用, 重点针对我国在环境监测、地质灾害、地形测绘等方面的需求, 跟踪和解决雷达干涉测量 (InSAR) 领域的关键科学问题, 掌握和发展相关的实用化技术。本年度研究工作主要集中在 InSAR 技术应用于我国东部城市的地表沉降监测和我国困难地区 DEM 获取这两个方面。

2. 时间序列 InSAR 技术在城市地表沉降中的应用。随着地下水的开采、大型地下工程和高层建筑的大量兴起, 我国大中城市地表沉降的问题日益严重。在常规的差分 InSAR 研究基础上, 利用时间序列 InSAR 技术进行地表沉降监测的典型示范应用, 重点解决消除大气影响和时间去相关等技术难点, 与实地考察数据和历年的水准测量数据进行对比分析和验证。本项目对上海市长时间序列 ERS-1/2 影像进行相干点目标分析, 获取了超过八年的地表沉降场的 ERS - 1/2 影像数据。与同期的高精度水准测量数据比较, 实验结果达到了毫米级。对于近期获取的少量 ENVISAT/ASAR 数据, 进一步研究了识别稳定点目标的方法, 取得了初步的实验结果, 并进行了实地调查和验证。

3. 在困难地区提取 1:5 万 DEM 提取 DEM 是 InSAR 技术的基本应用, 但是计算结果的稳定性一直困扰实际的应用推广, 尤其是在高差大或者有植被覆盖的地区, 去相关的现象严重影响 InSAR 数据的相干特性。本项目以我国西部无图区为实验区, 研究解决 1:5 万地形图测绘中 DEM 量测的关键问题。在深入分析 InSAR 技术获取的 DEM 之误差来源, 研究了消除或抑制误差的优化处理方案。本年度重点研究有植被覆盖的山区如何有效滤除各种噪声, 提高干涉图的质量的问题。采用了多种滤波器进行实验并提出改进的方案。

Multi-track PS Analysis in Shanghai

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Abstract

It is known that several areas in Shanghai town are affected by strong subsidence and many studies are being carried on for monitoring its ground motion. Moreover, the city is growing more and more both in extension and height, and this fact can be connected to the subsidence phenomena. In this work, all the available data acquired by ESA satellites ERS and Envisat over Shanghai are jointly exploited in order to get the full story of the ground motion and of the city growth. The interferometric phase of the acquired data as a function of the acquisition geometry and time is used for estimating the 3D location of the targets and for recovering their displacement time series. The amplitude of the radar images is analyzed for understanding the targets physical nature (dimensions, orientation, resonating properties) and for estimating their life-time. The results obtained by analyzing the whole ESA ERS and Envisat archive on an area of about 400 km² around Shanghai city-center will be shown and the feasibility of combining data acquired from different orbits will be discussed. Finally, the results will be shown being in good agreement with leveling data collected in in-situ surveys.

上海地区多轨道永久散射体分析

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摘要

上海市部分区域地面沉降严重, 为此相关部门展开了许多对地表进行监测的研究。与此同时, 上海市在面积和建筑高度上都在不断扩展, 这与沉降现象有着很大的关系。在这一实验中, 我们选取了由 ESA 获取的上海地区所有可利用的 ERS 和 Envisat 影像, 用来反演地表运动和城市发展的整个过程。影像的干涉相位作为其几何和时间的函数, 用来估算目标的三维位置和获得目标在时间序列上的沉降量。雷达影像的振幅用来解译目标的物理特性 (尺寸, 方向, 共振性) 及估计目标的寿命 (life-time)。在本实验中, 选取了上海市中心城区约 400 平方公里为实验区, 对实验结果进行分析并探讨了结合不同轨道获取的数据的可能性。最后, 通过比较, 显示实验结果与现场获取的水准测量数据具有高度的一致性。

NOTES

Session 6.3: Landslides (id. 2558)

专题 6.3: 滑坡监测

Monitoring Landslide Susceptibility in the Three Gorges Area Using Corner Reflector Differential Interferometry, DRAGON (2558):year 3 Report

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Abstract

Since the kick off ceremony of the Dragon program in Xiamen, China, in April 2004, the Chinese groups in collaboration with the European groups have conducted the following research activities: 1. Have installed 26 Corner Reflectors (CR) in the Three Gorges area and researched the methods to accurately locate the position of these CRs in SAR datasets. The method could effectively find out CRs in the Xintan area where is rather flat, but should be refined to work in steeper areas such as Wanzou. 2. Acquired 140 scenes of ERS SAR data, 160 scenes of Envisat ASAR data, 41 scenes of MERIS data. The most of these data covered in the Three Gorges Area (TGA), a few of them are for Daxiong, Tibet. For TGA, more than 30 interferometric pairs have been processed, among them, there are only 5 pairs with perpendicular baseline less than 100 meters and time span less than one year, on which a few meaningful fringes could be found, there is no meaningful fringes on other results. The situation for Tibet is much better than TGA. 3. Explored Corner reflector Interferometric modelling to retrieve the movement of corner reflectors. The results from 3 CRs showed the total movement in 2004 is only 1~2 mm, which demonstrated these slopes were rather stable during that time. 4. Designed and implemented a Permanent Scatter (PS) Interferometric algorithm including how to select common master image for a series of SAR images, how to screen the PS candidates, how to reduce the atmosphere effect by APS, based on the result published by Ferreti etc. The method has been tested in Wanzou. 5. Studied the Li et al (2005) method to remove atmosphere effects by using simultaneously acquired MERIS data with the ASAR data. The result from test in middle lower reach of Yangtze River showed that the residue deformation due to the atmosphere effect has been reduced from 1.36mm to 0.62mm. 6. Conducted CTM (using the software by Atlantis Sci.) analysis for Dangxiong Tibet Area to survey the tectonic activities, the further seismology analysis has been undergoing. 7. Created a 30m DEM of the area by fusing SRTM 90m and ASTER 30m stereo DEMs. Performed validation in collaboration between CEB and UCL. This DEM is being employed for SAR interferometric processing. 8. Studied the sources of large quantities of sediments in the Jinsha river upstream of Chongqing and determined that land cover changes caused by fires had resulted in significant large-scale erosion. 9. Assessed the land stability of new urban developments using the 30m DEM where over a million people had moved to as a result of the water level rise and found that it appears that these new settlements are in more stable areas. 10. Begun studying changes in agricultural land use as a result of the rise in water levels from Wanzhou to Yichang.

Since May 2003, when the dam started to operate, several landslides occurred in the area, but the places where we have set up CRs appear to be rather stable without remarkable movements. This is believed to be because the Chinese government has invested about 6 billion RMB to take engineering measures to fasten all known risk spots. However, on 25 April, 2007, it was reported that one place with a CR is active. Processing the data is currently in progress to check if we could find any evidence for this with SAR interferometry.

龙计划项目 (2558) “应用角反射器差分干涉监测三峡地区滑坡危险区”第 3 年年度报告

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摘要

自从 2004 年 4 月龙计划在厦门会议正式启动后, 本项目中欧双方合作开展了以下研究: 1. 在三峡地区安装了 26 个角反射器, 研究了在 SAR 图像中自动精确识别角反射器的算法。该算法在新滩坡度较缓地区比较有效, 但在万州山区还需要改进。2. 获取了 140 景 ERS SAR 数据, 160 景 Envisat ASAR 数据和 41 景 MERIS 数据, 这些数据大部分覆盖三峡地区, 少数是西藏当雄地区的。处理了 30 多对三峡地区的 InSAR 结果, 干涉垂直基线小于 100 米且时间间隔小于 1 年的只有 5 对, 结果中局部可见干涉条纹, 其他都没有干涉条纹。西藏当雄地区的情况要好得多。3. 研究了角反射器干涉处理模型和技术, 得到角反射器点的形变位相。结果表明 2004 年差分干涉得到的三个角反射器的形变速率在 1~2 毫米, 基本上稳定的。4. 根据 Ferreti 等人发表的结果设计并实现了永久散射体干涉算法, 具体有: 对序列 SAR 图像分析如何选择公共主图像, 如何筛选永久散射体候选点, 如何估算大气窗 (APS), 并利用 APS 减少大气干涉效应。在万州地区得到初步结果。5. 研究并实现了李正红等(2005)发表的利用与 ASAR 同步获取的 MERIS 数据进行大气校正, 经在长江中下游地区试验, 大气效应对应的残留形变从 1.36 毫米减小到 0.62 毫米。6. 对西藏当雄地区的活动断层利用 Atlantis 公司的 CT 软件进行了分析, 得到的结果正在进行进一步的地震学分析。7. 通过将 90 米分辨率的 SRTM DEM 和 ASTER 立体测量得到的 30 米分辨率的 DEM 融合生成了研究区 30 米分辨率的完整 DEM。经和中国方面合作进行了验证, 将该 DEM 用于干涉处理。8. 研究了重庆上游金沙江的大量泥沙沉积的来源, 结果表明由于山火导致的土地覆盖变化是这种大范围侵蚀的主要原因。9. 应用生成的 30 米 DEM 评估了新建城镇的地表稳定性, 这些新建城镇都是由于兴建三峡大坝水位上升带来的百万移民的新居住地, 评估结果证明这些新建城镇大多建设在比较稳定的地基上。10. 开始研究万州到宜昌之间由于水位上升带来的农业土地利用变化。

自从 2003 年 5 月大坝开始蓄水运作以来, 在三峡库区已经发生了几次重大滑坡灾害, 但是我们安装角反射器监测的地区基本上处于稳定状态, 没有发现有明显的移动。这归功于中国政府投入了 60 多亿元人民币对库区已知的滑坡采取了工程措施进行治理。但是, 2007 年 4 月 25 有报道在宜昌地区的野猫面滑坡有蠕动的迹象, 在该滑坡上我们安装有角反射器, 目前正在处理该区域的数据, 以核查 InSAR 是否可以对此有所反映。

NOTES

SESSION 7: FLOODING, DROUGHT AND HYDROLOGY

专题 7 : 干旱、洪涝和水文学

Session 7.1: Drought Monitoring in China (id. 2608)

专题 7.1: 中国旱情监测

Drought Monitoring and Prediction over China

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Abstract

• The progress and the latest results Drought disasters have often caused great hunger, social instability, large scale migration of the population and extinction of civilizations in the history. The conflict between supply and demand of water resources constitutes the biggest problem for food security of a huge population in China and drought has become a key factor constraining China's economic development. The objective of this project is to develop an operational system for nation wide drought monitoring and drought impact assessment for application in agriculture and hydrology in China using ESA and other relevant satellite data as major data source in combination with other data source (e.g. meteorological and drought statistics, etc.). In detail the project will generate: (1) scientifically based drought mitigation and drought relief decision alternatives, (2) real time drought monitoring and prediction maps, (3) improved understanding of land surface processes over heterogeneous terrain, (4) algorithms for estimation of land surface parameters and heat fluxes over China, (5) assessment of economic loss caused by drought and finally providing suggestions for drought relief decisions. An Internet based system will be developed to provide information concerning the drought evolution situation and to support drought relief decision-making. The system will be implemented at the Remote Sensing Application Center of the Ministry of Agriculture and can be accessed in real time by decision-making agencies at different levels (national, provincial, local authorities) via Internet. The field experiments and data analysis have been conducted according to project planning. Objectives 1, 3, 4 have been achieved as joint effort. Objective 2 is currently operationalized by the Chinese PI. Objective 5 is still under development by the Chinese PI.

• ESA EO and third party mission data acquired and investigated after three years of activity MERIS, AATSR and ASAR data were acquired over different sites in Europe and China and some data processing will be reported in the presentation of R. van der Velde.

• Detail the in-situ data measurements and requirements particularly joint field visits made in China during 2006 and 2007

Various field campaigns have been organized since the kick-off the project, including campaigns for algorithms development and validation (SPARC2004, SEN2FELX2005, CAMP/Tibet, LOPEX2005) and other dedicated comprehensive field experiments were conducted in the summer 2006 (EAGLE2006, Tibetan soil moisture experiment 2006, field expedition to the Heihe river basin in 2006).

• Outline the progress and status of cooperation within the project 1. A new campaign data set has been collected during EAGLE2006 where multi-sensor satellite data (MERIS, AATSR, ASAR, ASTER, MODIS, CHRIS/PROBA, SEVIRI) have been collected. 2. Data over several test sites in China have been continuously acquired and analyzed. 3. Preliminary data assimilation using a mesoscale atmospheric data has started and is ongoing. 4. A case study was conducted to estimate evapotranspiration for the entire Heihe River basin using MODIS data was completed. 5. Several visits have taken place to China by ITC

scientists. ITC has accepted two Chinese Dragon participants as sandwich PhD candidates (Xin Tian & Lei Zhong).

- Outline plans for continuity and / or further work under Dragon II. The progress and achievements in this project has been very substantial and should be continued in Dragon II. In particular, the scientific results should be further utilized and deployed in operational processing chain, training of technical personnel, reporting. A web based information drought monitoring system, Operational data processing, validation of data products, consultation with end users could now be established and should be used in operation. Future collaboration should be extended to other major Chinese players in the field of Earth Observation and Water Cycle research and applications.

中国干旱监测和预报

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摘要

• 最新的研究结果表明, 在历史上严重的干旱灾害经常引起饥荒、社会动乱、大范围的居民迁移和文明社会的倒退。在中国, 水资源的供需矛盾导致粮食安全出现巨大问题, 干旱因此而成为制约中国经济发展的一个关键因子。本项目的目标是利用欧洲空间局和相关卫星遥感数据结合其它资料 (如气象和统计等), 发展一个全国范围内干旱监测业务系统, 以此评估干旱灾害在中国农业和水文应用中的影响。更具体一些, 该项目将提出: (1) 有科学依据的干旱缓解和减轻对策, (2) 干旱监测和预报的实况分布图, (3) 增加对非均匀地区陆面过程的认识, (4) 估算中国大陆尺度地表参数和热通量的方法, (5) 评估由干旱导致的经济损失并最终提供干旱减轻对策的建议。发展以互联网为基础的干旱监测系统, 提供干旱相关信息的演变状态并以此支持干旱减轻决策制定。该系统将在中国农业部遥感应用中心运行, 不同级别的决策部门 (国家级、省级和地市级) 通过互联网可以实时进入该系统。野外试验和资料分析根据项目计划进行, 目标 1、3 和 4 通过联合攻关实现, 目标 2 目前由中方负责人执行, 目标 5 目前由中方负责人发展。

• 在 MERIS, AATSR and ASAR 资料收集研究 3 年之后, 欧空局执行办公室和第三方结构已经在欧洲和中国的一些站点获得了这些资料, 一些资料的处理方法将在 R. van der Velde 的报告里给出。

• 细化了实时资料的观测和获取, 特别是在 2006 和 2007 年间参观在中国开展的野外观测场。

• 自从该项目启动会议以来, 组织了各种各样的野外观测试验, 包括野外试验的方法发展和验证 (SPARC2004, SEN2FELX2005, CAMP/Tibet, LOPEX2005), 在 2006 年夏季还开展了其它一些特殊的野外试验 (EAGLE2006, 高原土壤湿度试验 2006, 黑河流域野外考察 2006)。

- 概括了该项目内合作的进展和状态，（1）在 EAGLE2006 期间，收集了一套新的野外观测试验资料，包括多传感器卫星遥感资料（MERIS, AATSR, ASAR, ASTER, MODIS, CHRIS/PROBA, SEVIRI）。（2）持续收集并分析了中国几个站点的观测资料。（3）利用中尺度大气资料开始并正在进行初步的资料同化研究。（4）利用 MODIS 资料完成了黑河流域蒸散发量的估算个例研究。（5）ITC 科研人员几次访问中国，ITC 接受两位“龙”项目参加人攻读三明治博士学位（田欣和仲雷）

- 概括了继续进行“龙”项目 II 或进一步研究工作的计划。该项目取得了较大的进展和成果，“龙”项目 II 应该持续这方面的研究。特别是有科学理论的研究成果应该在业务系统运行、人员培训和报告中获得进一步的采用。目前，可以建立一个以互联网为平台进行干旱监测、业务资料处理、资料产品验证和终端用户咨询系统并且应用于业务。将来的合作应该扩展到与其他对地观测和水循环研究与应用的中国科研工作者。

NOTES

Session 7.2: Satellite Tools for Water Resources Assessment (id. 2584)

专题 7.2: 水资源评价卫星工具

Water Resources Assessment in the Huai River Basin : Hydrological Modelling and Remote-sensing

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Abstract

OBJECTIVE OF THE PROJECT

Water resources are becoming more and more exploited and vulnerable throughout the world, it is expected that, by 2050, the amount of fresh water withdrawal that will be actively exploited worldwide will be on the order of 10,000 km³/y, whereas it is presently on the order of 5,200 km³/y, and the maximum possible withdrawal is estimated at 13,500 km³/y, excluding rainfed systems. Both surface water and groundwater will be intensely exploited, and the management of the resources (optimal allocation, optimal design of new equipment, taking into account all aspects such as floods, contamination, and climate changes, etc.) will necessarily require detailed distributed modelling of the water cycle at the basin scale. Given the lack of dense hydrologic data at that scale, it is clear that remote sensing data will be more and more used to assess the water cycle and its spatial and temporal variability. This project aims at combining basin-scale hydrologic models with remote sensing data to improve the model reliability as decision-support tools.

RESULTS SINCE THE 2006 LIJIANG SYMPOSIUM

The hydrological modelling of the Shiguanhe basin has been greatly improved. The MODCOU model now takes into account artificial water-transfer between adjacent basins through canals. This important withdrawal from the main channel of the river has been evaluated through a dam-discharge analysis. Secondly, the rice field irrigation is now more accurately represented. We initially proposed to model the rice irrigation networks and to use remote-sensing to determine the networks position, but finally, a simpler way has been explored: introducing the water used for irrigation as “artificial rainfall” over the rice-fields in the model, estimated from the potential evapotranspiration needs. Lastly, the traditional water management techniques used by farmers in this basin, and in particular the release of water stored in the rice-fields and small dams during rainfall events, has also been represented in the model. Thanks to these improvements, the correlation between measured and calculated discharge is now very satisfactory over the calibration period (1982-1991).

EO DATA AND GROUND DATA COLLECTION

The Huai River basin in China (270,000 km²) was selected as a test case for developing the project. Exposed to a strong human pressure, it is geographically, meteorologically, and therefore hydrologically, very heterogeneous, and faces severe water management problems concerning flooding and irrigation in particular. A sub-catchment, the Shiguanhe watershed (5,400 km²), which is well representative of the heterogeneity of the whole Huai river basin, was used, with a complex hydraulic system, including many dams and irrigation channels. The MODCOU model (developed by the Paris School of Mines) was used, as it can represent both surface water and groundwater at the basin scale; it is a distributed hydrological model using a conceptual reservoir-based approach. The data collected were first a EO- DEM of the area, to delineate the rivers and hydrographic boundaries; then a soil map and an EO land-use map (from ETM images); then climatic data for 1982-1991 (rainfall and potential evapotranspiration) and measured flow rates at the river gauging stations from 1982 to 1991. Additional ESA-EO data were also collected for hydrologic purposes by the Remote Sensing Technology Application Centre, Institute of Water Resources and Hydropower Research, see the parent PI abstract.

PROGRESS AND STATUS OF COOPERATION

New data-sets covering the 1995-2005 period have been obtained by IWHR, and we are in the process of validating them and improving their accuracy. The Xinanjinag model developed at IWHR has also been run on the Shiguanhe basin for the 1981-1992 period, and the Aix Symposium will allow us to make the final comparison between the results of these two models. A cooperation has also been developed with CESBIO to obtain an up-dated map of the rice-fields in the Shiguanhe catchment using ENVISAT images.

淮河流域水资源评价：遥感与水文模型

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摘要

项目目标：

全球水资源开发程度越来越高。据估计,到 2050 年不包括雨水资源全世界每年开发利用淡水资源 100,000 亿方,而目前是 52,000 亿方,可能最大将达到 135,000 亿方。地表水和地下水将会强烈地开发,水资源管理(优化配置,新设备使用,以及洪水、水污染和气候变化等等)需要流域尺度的分布式水文模型。在这个尺度,如果缺少水文数据,遥感将会被越来越多地用于获取水文循环的时空参数。本项目的目标就是将遥感技术与流域尺度水文模型耦合,以提高模型用于决策支持的可靠性。

2006 年丽江会议后研究成果：

首先,改进了史灌河流域水文模型。目前 MODCOU 模型考虑了人工运河的影响。通过大坝流量分析,评估从主河道引走的水量;第二,水田灌溉得到更准确的表达。我们最初计划利用遥感技术来得到灌溉网络,但是最后,我们采用了一个更简单的办法:在模型用水田区的“人工降雨”来模拟灌溉的水,并计算潜在的蒸散发。最后,在史灌河流域一些小的坑塘在降雨过程中放水也在模型中得到考虑。由于这些改进,模型计算的流量与实际观测的流量在模拟期(1982 - 1991)已十分吻合。

对地观测数据与地面数据的收集：

中国淮河流域(270,000 平方公里)被项目选为试验区。由于人类获得强烈影响,淮河流域面临着严重的水问题,尤其是洪水以及灌溉。作为淮河流域子流域,史灌河流域(5400 平方公里)具有复杂的水力系统,包括众多的大坝以及灌溉网络,在淮河流域具有代表性。项目采用巴黎矿业学院开发的 MODCOU 模型,该模型是一个可以在流域尺度进行地表水、地下水模拟的分布式模型。数据收集首先是 DEM 数据,该数据主要用于水系以及水文边界的提取,其次是土壤图和土地利用图(由 ETM 影像提取)、1982 - 1991 年气象数据(降雨和潜在蒸发)、1982 - 1991 年水文观测数据等。另外,中方中国水科院也收集了欧空局对地观测数据用于水文模型的率定。

合作进展与目前状况：

中国水科院已获得 1995 - 2005 年期间的数据，我们目前正在确认和提高这些数据的精度。中国水科院也已开发史灌河流域 (1981 - 1992) 新安江模型，在 Aix 会议期间，双方将对 2 两个模型进行对比。另外，我们与 CESBIO 合作利用 ENVISAT 影像更新史灌河流域水田分布图。

NOTES

Session 7.3: Flood Plain Disaster Rapid Mapping and Monitoring (id. 2551)

专题 7.3: 洪涝灾害制图与监测

Application of Envisat Data to Flood Monitoring and Assessment System in China

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Abstract

Abstract : Due to complicated natural condition, China is suffered from flood for a long history. Since 1980, satellite remote sensing started to become one of major tools for flood monitoring and disaster assessment. By means of space technology, the operational system of flood monitoring and assessment was set up in 1998 in China, which is an professional system in charge of flood monitoring and assessment for whole China during flood season. The system and its practical operation is introduces briefly in this paper. Due to bad weather conditions in flood season, space borne and airborne SAR are the major measures for flood monitoring in China. Optical remote sensing is mainly used for extraction of background data. ENVISAT and ERS data are excellent data source for flood monitoring. NRT ERS data played important rule during the heavy flood in 1998, especially for the flood occurred in the Nenjiang River Basin. It is quite suitable for flood monitoring along the river in north-south direction. ENVISAT is equipped with powerful SAR. Data, especially ASAR and MERIS data instead of Radarsat, becomes now the main data source for flood monitoring and assessment operational system mentioned above. During the operation in previous three years, the application potential by ENVISAT ASAR and MERIS for flood mapping in China is analyzed, quick extraction of current water body information from ASAR and MERIS image data is studied, polarization mode and incidence angle for thematic accuracy is compared, detailed procedure of NRT action is specified and realized. Some examples would be shown in the paper, especially for the flood occurred in the year of 2006. Flood disaster assessment is performed before, during and after the occurrence of flood. The preparedness is the most important thing for flood control and disaster mitigation. On the basis of spatial social-economic database, a quantitative assessment model is proposed on the basis of spatial information grid. The flood monitoring and assessment system have been installed in several flood control headquarters in different levels, namely, watershed level and provincial level. Besides, the flood risk mapping based on space technology, including remote sensing, is being widely carried out in China. It is strongly believed that The Envisat data will play more important rule to flood control and disaster mitigation in China.

ENVISAT 数据在中国洪涝灾害监测与评估中的应用

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摘要

由于复杂的自然条件, 中国长期遭受洪涝灾害的困扰。从 1980 年以来, 卫星遥感成为洪涝灾害监测与评估的重要手段之一。在 1998 年, 利用空间技术, 中国建立了洪涝灾害监测与评估业务运行系统, 负责全国汛期洪涝灾害监测与评估。本文主要介绍该系统及其实际有用。由于在汛期恶劣的天气条件, 机载和星载 SAR 是中国洪水监测的主要手段。光学遥感主要用于提取背景数据, ENVISAT 和 ERS 数据是洪水监测很好的数据源。近实时 ERS 数据在 1998 年大洪水中发挥了重要作用, 尤其是在嫩江大洪水监测中。ERS 数据对于沿南北向河流的洪水监测十分合适。ENVISAT 卫星装载了高性能的合成孔径雷达。ENVISAT 卫星影像, 尤其是 ASAR 和 MERIS 代替 Radarsat, 成为上述洪涝灾害监测与评估业务运行系统的主要数据源。在系统运行的前三年, 项目分析了 ENVISAT ASAR 和 MERIS 数据在中国洪水制图中应用潜力, 研究了基于 ASAR 和 MERIS 影像快速提取洪水淹没范围的方法, 对比了不同极化、不同入射角用于洪水监测的精度, 实现了近实时数据获取与洪水监测评估。本文将介绍一些应用实例, 主要是 2006 年洪水监测。洪水灾害评估包括灾前评估、灾中评估和灾后评估。灾前准备对于防洪减灾来说最为重要。在空间展布式社会经济数据库的支持下, 项目提出了一种基于空间信息格网的定量评估模型。该洪水监测评估系统已经在多个不同级别的防汛指挥部, 也就是流域级和省级安装。另外, 在中国, 基于空间技术包括遥感技术的洪水风险制图也被广泛实施。可以相信, ENVISAT 数据将在中国防洪减灾中发挥越来越重要的作用。

Low and Medium Resolution Envisat ASAR Data: An Adequate Tool for Land Cover Map Generation. Application to Poyang Lake Area (Jiangxi, P.R. China)

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Abstract

The Dragon programme gives opportunities to access large amounts of different types of ENVISAT products, from low to high ASAR, from low to medium optical data for MERIS with in addition high optical CRIS PROBA images. DRAGON programme through its training support gives also opportunities to develop and to test new approaches for data exploitation and application. Part of the flood DRAGON project was focussed on synergistically use of ENVISAT ASAR low and Medium resolution time series, for flood monitoring but also scale land cover mapping within this context of flood monitoring and flood impact forecasting.. Indeed, monitoring and forecasting floods as well as monitoring the dynamic of large water bodies require a strong knowledge of the landscape and land cover. Over such a wide area composed of very different hydrodynamical, geomorphological and biophysical environments, this information is not easily accessible. Earth Observation data, more precisely low and medium resolution one, can a very useful resource. Within the framework of the flood Dragon, an impressive amount, more than one hundred since 2004, of low to medium resolution ENVISAT data has been acquired over the Poyang Lake's, largest freshwater lake in China and a major hydrological subsystem of the middle Changjiang basin in Central China, and analysed.

Land cover mapping had been realized using synergistically: 1) a land cover map derived colour composition of seasonal sums from ENVISAT ASAR Global Monitoring Mode, and; 2) a multitemporal colour composite generated on ENVISAT ASAR Wide Swath Mode filtered images and on seasonally summed products.

In a first step, a preliminary land cover map of 22 classes has been extracted. If the overall quality of this map was acceptable, by comparison with optical HR data, some misclassification appeared. For example, sand dunes in Duchang area which were misclassified as areas of water level seasonal variation on WSM landscape analysis. In July 2006, a field survey was organized by Beijing' IWHR in order to retrieve field information to validate ENVISAT derived products. This survey was also a good opportunity to present Flood DRAGON results to the institutes involved in flood monitoring in the Jiangxi province from regional office to county ones. All met persons were amazed of the accuracy of these products and were very interested by the potential of EO data for helping them in their daily work.

Finally, based on field observations, plus by confrontation with hydrodynamic characterization derived from Landsat reference, a second refine land cover map was produced. This leads to a final land cover map of 13 classes over 20,000 square kilometers (170 km from North to South and 120 km from East to West). Been realized at the 1/200 000 scale, this map is in fact exploitable at scales ranging from 1:500 000 to 1/150 000. Exploiting this new reference map, the use of an ENVISAT ASAR database over Poyang Lake area should greatly complement and continue wetland restoration monitoring. It would be also exploited in a near future in an epidemiologi context associated with water submersion time probabily, a product alos generated from the flood DRAGON database (ANDREOLI et al. , 2007).

Based on a synergistically use of ENVISAT ASAR low and Medium resolution time series, the results obtained over this large area in China highlight the great potential of ASAR medium and low resolution products for large scale land cover map generation over wide area. It has to be ping pointed that large and rich archive of such ENVISAT data already exist allowing getting access to a sufficient amount of data required providing worldwide large scale land cover characterization of wide hydrodynamical complex.

中低分辨率 ENVISAT ASAR 数据在土地覆盖监测中的应用——以中国江西省鄱阳湖地区为例

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摘要

龙计划提供了一个获取大量不同类型的 ENVISAT 数据的机会, 包括从低分辨率到高分辨率的 ASAR 数据、中低分辨率的 MERIS 数据以及高分辨率的 CRIS PROBA 数据。通过培训, 龙计划也提供了开发和测试这种数据应用新方法的机会。龙计划洪水制图项目目标不仅是综合利用多时相 ENVISAT ASAR 中低分辨率的影像进行洪水制图, 而且也包括土地覆盖监测以及进行洪水影响预测。实际上, 洪水监测与预报, 也就是动态监测水体范围, 也强烈需要景观与土地覆盖的知识。对于有着复杂水文、地貌、生态特征的大面积区域来说, 这类信息并不容易得到。对地观测数据, 尤其是中低分辨率数据是非常有用的数据源。在龙计划洪水制图项目框架下, 我们申请并分析了自 2004 年以来超过 100 景的鄱阳湖地区中低分辨率的 ENVISAT 数据。鄱阳湖是中国最大的淡水湖泊, 也是长江中游主要水文子系统。土地覆盖制图主要是通过以下方法实现的: 1) 利用不同季节 ENVISAT ASAR 全球监测模式数据彩色合成影像综合得到土地覆盖图; 2) 利用多时相 ENVISAT ASAR 宽幅模式影像生成不同季节土地覆盖产品。

首先, 我们提取了 22 个分类的初步土地覆盖图。通过与可见光 HR 影像对比, 有一些错误分类, 但总体分类精度可以接受。例如, 在都昌县有一些沙丘被错误分类了。为此, 在 2006 年 7 月, 为了验证 ENVISAT 数据分类效果, 中国水科院组织了一次野外实地考察。在这次考察中, 我们也向江西省防洪相关部门展示龙计划洪水制图项目成果。他们对于产品的准确性感到吃惊, 并对对地观测数据在他们日常工作中的应用潜力非常感兴趣。最后, 基于野外观测的结果, 加上由陆地卫星 (Landsat) 得到的水利工程信息, 我们更正得到了最终的覆盖图, 其土地分类 13 类, 面积超过 20, 000 平方公里 (南北 170 公里, 东西 120 公里), 比例尺为 1:20 万地图 (实际上可制作 1:15 万到 1:50 万比例尺地图)。该图以及 ENVISAT ASAR 数据库也可以用于鄱阳湖地区湿地修复监测以及分析遭受洪水淹没的概率 (ANDREOLI et al., 2007)。

以上基于 ENVISAT ASAR 中低分辨率时间序列数据综合分析结果显示中低分辨率 ASAR 产品用于大范围土地覆盖制图具有很大潜力。需要指出的是, 目前已有大量且充足的全球范围内这种 ENVISAT 数据的存档, 他们也可用于全球范围土地覆盖监测与分析。

NOTES

SESSION 8: FORESTRY

专题 8 : 林业

Session 8.1: Deriving Forest Information from POLInSAR Data (id. 2566)

专题 8.1: 极化干涉 SAR 森林信息提取

Validation of Forest Area and Forest Gap Mapping Derived from PolSAR Data Analysis

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Abstract

In this paper is provided a review of the first activities carried out under the DRAGON Project “Deriving Forest Information from Polarimetric SAR Interferometry (ID2556)” in collaboration with the National Key Laboratory of Microwave Imaging Technology – IECAS, a new partner that was accepted to join the DRAGON Project during the 3rd annual Dragon Symposium which took place in Lijiang City, P.R. China, from 10 to 14 July 2006.

This paper is concentrated on the presentation of the following recent developments concerning forest classification/segmentation from Pol-SAR data sets. Forest mapping is performed using an identification of three basic types of scattering mechanism, corresponding to single bounce, double bounce and volume scattering, from a single PolSAR data set, based on unsupervised statistical segmentation and PolSAR data interpretation techniques. An improvement is provided for the Cloude-Pottier decomposition for the fully polarimetric SAR data analysis. In this new approach, the total power SPAN instead of the anisotropy A is used to describe the scattering mechanisms. Based on the complex Wishart clustering scheme, a new method is proposed to perform the unsu-pervised classification for fully polarimetric SAR data with an adaptive number of clusters instead of a fixed number of clusters. These different classification techniques are compared in term of clear-cuts, paths low and high density forest determination performances using only PolSAR data sets. At least, a new mapping algorithm is introduced to transform the H/α /SPAN space to the HSI color space, and the HSI family of color models is applied to get the final RGB results. The main advantages of this method are that it preserves the whole information within the H/α /SPAN feature space and it gives a direct representation of the decomposition results.

The efficiency of these new classification approaches is demonstrated on L-band PolSAR data sets acquired by DLR’s ESAR over a well-characterized European forest test site: Traunstein in Bavaria. Classification results are compared to a comprehensive set of ground truth measurements.

基于极化 SAR 数据分析的森林区域评估和森林间隙制图

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摘要

本文介绍了与中国科学院电子学研究所微波成像技术国家级重点实验室合作开展的第一轮研究工作。中国科学院电子学研究所微波成像技术国家级重点实验室于 2006 年 7 月 10 至 14 日在中国丽江召开的第三届“龙计划”年会上被接收为新的合作伙伴并加入到“龙计划”项目中。本研究工作依托于“龙计划”项目“基于极化干涉 SAR 的森林信息提取(ID2556)”。

本文着重介绍有关极化 SAR 数据森林分类和分割的近期研究成果。极化 SAR 数据的森林制图是通过三种基本散射机制的识别进行的。这三种散射机制包括：单次散射、偶次散射和体散射。该森林制图方法只采用极化 SAR 数据，并基于非监督的统计分割和极化 SAR 数据的解译技术。本文对全极化 SAR 数据的 Cloude-Pottier 分解算法进行了改进。这一新方法用极化总功率 SPAN 替代了各向异性度 A 对散射机制进行描述。基于复 Wishart 分割算法，本文提出了一种新的全极化 SAR 数据非监督分类算法，该算法采用可自动调节的类别数，而不是固定的类别数进行非监督分类。针对森林皆伐地、集材道和高密度森林的识别性能，本文开展了极化 SAR 数据不同分类技术的比较。另外，本文提出了一种新的映射算法将 H/α /SPAN 空间映射到 HSI 彩色空间，并且采用 HSI 彩色模型簇获得最终的 RGB 图像。该方法的主要优势是提供了一个与散射机制直接对应的颜色表，保留的 H/α /SPAN 特征空间的全部信息，并且给出了对分解结果直接表达。

本文采用 DLR ESAR 采集的巴伐利亚 Traunstein 地区 L 波段极化 SAR 数据开展分类算法的有效性验证。该地区为欧洲森林试验区，有完备地面实况数据记录。分类结果与详细的地面真实测量数据进行了对比。

Quantitative Validation of Forest Mean Height Inversion Methods with Polarimetric Interferometric SAR Data

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Abstract

Several forest mean tree height inversion methods with polarimetric interferometric SAR data using interferometric random volume over ground (RVoG) model have been developed in the past few years. However, these methods were published separately with different POLinSAR data from different test sites. In order to stimulate the application and education of these already established techniques, some POLinSAR forest mean height inversion methods have been coded in the POLinSAR tree height inversion module of the new PolSARPro®ESA software, and the corresponding user manual published the algorithms implemented in each tree height inversion program. The performance of these tree height inversion methods were successfully demonstrated with one simulated POLinSAR dataset generated from a coherent polarimetric interferometric SAR data simulation model. However, there is still very few comparative validation work carried out for all the established tree height inversion methods using the same real POLinSAR data. In this paper, several RVoG model based tree height inversion methods were quantitatively validated using one repeated passes L-band ESAR POLinSAR data and the corresponding ground measured mean tree height data in the scale of forest stand. The performances of each method are presented and one general forest mean height estimation frame is suggested for operational forest resource inventory with the integration of polarimetric interferometric SAR data and permanent plots data collected by National Forest Inventory.

极化干涉 SAR 森林平均高反演方法定量评价

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摘要

在过去几年内, 国际上已发展了几种基于随机散射-表面散射模型 (RVoG) 的极化干涉 SAR 森林平均高提取方法。然而这些分别发表的方法通常基于不同的试验区和数据。为了促进这些已经提出的极化干涉测量技术的应用和教育, 欧洲空间局资助开发的极化 SAR 处理软件 (PolsarPro)。其最新版提供了极化干涉 SAR 处理模块, 实现了几种森林平均高提取方法, 并在其用户手册中发表了所实现方法的算法。而且还以通过一个极化干涉相干散射模型模拟得到的数据成功演示了这些方法的有效性。但至今基于相同的实际极化干涉 SAR 数据比较评价各种方法有效性的研究工作还很少开展。本文基于一套 ESAR 极化干涉测量 SAR 数据和相应的林分尺度平均高实测数据, 比较评价了几种森林平均高提取方法, 并给出了一种基于极化干涉 SAR 数据和国家森林资源清查固定样地数据综合应用的森林平均高提取技术框架建议。

NOTES

Session 8.2: Forest Map of China (id. 2583)

专题 8.2: 中国森林制图

Update on the Forest DRAGON Project

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Abstract

The scope of the Forest DRAGON Project is the generation of forest maps on a regional basis using ERS-1/2 tandem and JERS-1 SAR data for the mid-1990s and ENVISAT ASAR to produce an updated version for 2004-2005. During the first two years activities focused on SAR data acquisition, collection, processing and archiving, and on the development of forest biomass retrieval algorithm for large areas. During the last project year the methods have reached their maturity. An automatic biomass retrieval procedure based on ERS-1/2 tandem coherence, the Interferometric Water Cloud Model and the Vegetation Continuous Fields tree canopy cover product has been established. The retrieval algorithm has been used to estimate four biomass classes, as in the SIBERIA Project, for a 1.5 Million km² large area of Northeast China. The forest biomass product consists of over 200 ERS image frames with 50 x 50 m² pixel size. An even larger dataset consisting of over 800 image frames has been used to generate a forest/non-forest map from ENVISAT ASAR Alternating Polarization data. Using a hierarchical classification approach, maps at 50x50 m² pixel size have been obtained. The ASAR forest map has been found to well agree with Landsat-based land cover products. Future activities will focus on the comparison between the ERS- and the ASAR-based maps to assess forest cover changes during the last 10 years in Northeast China. Also forest mapping of South China will be considered, depending on funding possibility available.

“龙计划”SAR 森林制图项目进展

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摘要

“龙计划”森林制图项目的研究范围是基于 ERS-1/2 串轨和 JERS-1 SAR 数据生成森林区域覆盖图 (90 年代中期), 并基于 ENVISATASAR 数据生产一个更新图 (2004-2005)。在项目最初两年, 研究活动集中于 SAR 数据的获取、收集、处理、存档及发展大区域森林生物量提取方法。在过于一个项目年度内, 方法已趋于成熟, 建立了一个基于 ERS-1/2 串轨相干数据、干涉水云模型和植被连续覆盖产品的生物量自动提取方法。像在 SIBERIA 项目中一样, 该方法已被用于估测 4 个等级的生物量类别, 对中国东北 1.5 百万平方公里进行了生物量制图。该生物量分布图由 200 景 ERS 影像生成, 像元大小为 50x50m² 的。一个更大的由 800 景 ENVISAT ASAR 双极化 SAR 影像组成的数据集已用于生产一个森林/非森林分布图。主要是采用分层分类的方法, 生产的森林/非森林分布图的像元大小为 50x50m²。发现该 ASAR 森林分布图和基于 Landsat 的土地覆盖图符合性很好。未来的工作主要是将 ERS 和 ASAR 的制图结果进行对比, 分析评价过去 10 年中国东北部的森林覆盖变化。而且, 下一步将考虑启动中国南部森林制图工作, 但取决于能否获取可能的经费支持。

Improvement of Coherence-based Forest Maps and new Possibilities for Forest Mapping in Dragon 2

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Abstract

The scope of this presentation is twofold: illustrate recent advances in interferometric processing to improve forest mapping using coherence data and introduce new possibilities based on SAR and interferometric SAR data for forest mapping.

One of the objectives of the Forest DRAGON Project is the generation of a forest biomass map from ERS-1/2 tandem coherence data for Northeast China. The processing sequence adopted for the generation of the coherence imagery and the coherence products have been presented at previous Dragon Symposia. During the third project year generation of the forest biomass maps and their validation has highlighted that strong spatial decorrelation can occur on sloped terrain for image pairs with long perpendicular component of the baseline. This leads to classification errors, in which unvegetated areas are identified as densely forested. To overcome this problem, we tested a new processing algorithm that takes into account slope information in the range common-band filtering step (Santoro et al., IGARSS'07). The new processing algorithm has been tested on some of the image pairs of Northeast China showing promising results.

A forest mapping project within DRAGON-II not only must be based on the experience gained during the first stage of the DRAGON Cooperation Programme but should also exploit the rapidly expanding data archive of a variety of spaceborne SAR data (ENVISAT ASAR, ALOS PALSAR, as well as, hopefully TerraSAR-X). Herewith we take the chance for illustrating the status-quo and some emerging applications based on ENVISAT ASAR and ALOS PALSAR data for forest mapping.

During Forest DRAGON ENVISAT ASAR high resolution data (Image Mode, IM, and Alternating Polarisation, AP) has been widely investigated showing that (i) AP data are a valid observable for forest/non-forest discrimination, (ii) interferometry in IM is not useful because of the very long baseline characterising most image pairs.

At an early stage of the project multi-temporal ENVISAT ASAR Wide Swath data has been investigated for large-area forest/non-forest mapping in Northeast China. The main limitation has been the patchy acquisition in WS mode. A recent look at the archives showed that extensive multi-temporal data in WS mode is available. Using a newly developed biomass mapping algorithm based on multi-temporal WS data and the MODIS Vegetation Continuous Fields tree cover product (Santoro et al., ENVISAT Symposium, 2007), it could be possible to map biomass at regional level for example for carbon accounting. At the Symposium an example for Siberian forests will be showed.

L-band data are known to be more sensitive than C-band to forest biophysical properties. ALOS PALSAR will acquire this summer in dual-pol mode and allow interferometry in winter 2008. Because of the similar geographical location of Central Siberian and Northeast Chinese forests, we plan to show some applications of PALSAR data using data collected over Siberia.

相干性森林制图干涉处理方法改进及可能应用于龙计划-2 的森林制图新技术

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摘要

本文的两个目的为：阐述基于相干性数据的森林制图干涉数据处理技术进展，并介绍基于 SAR 和干涉 SAR 数据的森林制图新技术。“龙计划”森林项目的目的之一是利用 ERS-1/2 串轨干涉相干性图像进行整个东北地区的森林生物量制图。整个相干影像数据的处理流程及产品已在前一次龙计划研讨会上汇报。在项目执行的第三年通过对整个东北地区森林生物量制图及其可靠性的验证，发现当像对具有较长的垂直基线分量时，陡峭地形区容易发生空间去相关，由此引起了分类错误，其中非森林地区被错分为稠密的森林。为解决此问题，试验了一种新的处理算法，在进行距离向重叠光谱滤波中考虑到了地形影响(Santoro et al., IGARSS'07)。在中国东北地区，基于这种新的方法进行了几个条带的处理试验，得到了很好的结果。龙计划第二阶段的森林制图项目不仅必须基于龙计划第一阶段取得的经验，而且还要探索使用大量各种不同的星载 SAR 存档数据（如 ENVISAT ASAR、ALOS PALSAR，希望也可以用 TerraSAR-X）的方法。这里我们将借此机会展示新出现的基于 ENVISAT ASAR 和 ALOS PALSAR 数据的森林制图技术。在龙计划森林制图中，广泛采用了 ENVISAT ASAR 高空间数据（成像模式 IM、双极化 AP），主要发现在于：（1）双极化（AP）数据对森林非森林识别比较有效；（2）由于干涉像对的基线通常都太长，成像模式（IM）干涉数据对森林识别用处不大。在龙计划的早期阶段，利用多时相宽模式 ENVISAT ASAR 数据进行了大覆盖区域森林/非森林制图技术研究，主要局限在于宽模式数据的获取在空间上具有不连续性。近期对存档的 WS 模式数据查询表明，已经有大量的宽模式数据获取。基于多时相宽模式数据及 MODIS 植被连续覆盖数据产品，采用一种新开发的生物量制图算法，可进行区域水平的生物量制图，可应用于，比如，碳储量的估测。这次研讨会上，将以西伯利亚地区森林制图为例来讲述。L 波段数据比 C 波段数据更容易探测森林生物物理特性。ALOS PALSAR 将在这个夏季获取双极化模式数据，在 2008 年冬天将可获取干涉测量数据。鉴于中西伯利亚地区和中国东北地区的森林具有相似的地理位置，我们将展示基于西伯利亚 PALSAR 数据的一些应用实例。

Forest Map Updating Using ENVISAT ASAR Data

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Abstract

A few months after 2006 Dragon Symposium, the commercial Gamma software was introduced into Dragon Forest Project for the geocoding process of Envisat ASAR data, especially for the geometry terrain correction. In this project, by Gamma software, the simulated SAR image, which is based on 100m SRTM data, was used to do the above process and at the mean time, a series of affiliated products have been generated, such as layover/shadow (L/S) map, radiometric normalization factor map, which are indeed helpful to the L/S masking and terrain radiant correcting for the geocoded ASAR data. As well, on basis of batch mode, a few tools were developed to keep the data format and other information, such as projection details, compatible between Gamma software and others.

The former results (before Lijiang Symposium) of North-East (NE) show it is very potential to use HH/HV ASAR AP data for forest map update. And this time, the unsupervised classifier was used to map them. By the same way as before, the land use map from 2001 ETM+ images will be the reference for accuracy assessment.

Totally, about 900 scenes, covering NE China, have been geocoded. Based on above processing method, the forest/non-forest map of whole North-East China have been generating. After primary assessment of several small regions assessment, the accuracy of the maps from multi-temporal ASAR AP data can meet the request of the mapping of boreal forests at large scale.

By the comparison, the combination of growth season and winter season ASAR data can map forest with high accuracy. Change detection from the combination of ERS-1/2 ILU composites and ENVISAT ASAR AP data is possible.

However, for the mosaic product of whole NE China, it seems to be hard to keep the color balance well among the images acquired in different circles, one possible reason is that their different backscattering coefficients changed so much in different seasons.

应用 Envisat ASAR 数据更新森林制图

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摘要

自“龙计划”2006 年会议结束几个月后, Envisat ASAR 森林制图项目引进了 Gamma 软件以为 Envisat ASAR 数据地理编码处理所用, 特别是为了对该类数据进行正射校正。在该研究中, Gamma 软件利用基于 100 米分辨率的 SRTM 数据的模拟 SAR 影像对 ASAR 数据进行地理编码, 同时产生一系列相关的辅助产品, 如叠掩区/阴影区影像, 标准化因子影像等。这两个产品确实对于叠掩区/阴影区的掩模及山区地形辐射校正起到了很好的帮助作用。另外, 研究中还开发了一些基于批处理的模块工具, 以用于保证数据格式和其他信息(如影像投影信息)在 Gamma 和其他遥感软件之间的兼容性。

2006 年丽江年会之前的结果表明了利用 Envisat ASAR AP HV/HH 数据对东北森林制图更新的潜力。在本研究中, 非监督分类器被用于该类数据分类处理, 同时采用了与前期结果相同的评价方法, 即利用 2001 年 ETM+的土地利用结果图进行分析评价。

迄今, 本研究对东北地区近 900 景 ASAR 数据进行了正射处理, 并且基于前期研究的处理方法, 对这些数据进行了分类处理。经过分析评价, 基于多时相 ASAR 数据的森林分类结果图可以满足大区域的北方森林制图的精度要求。

通过比较发现, 生长季节和冬季的时相组合的 ASAR 多时相数据可以获得较高分类精度的结果, 同时也表明了利用 Envisat ASAR 结果图与 ERS-1/2 ILU 反演结果进行对比更新的可行性。

然而对于整个东北 ASAR 镶嵌图来说, 要保持各获取周期期间的多时相数据的颜色均衡比较困难, 这是因为不同的获取周期时间导致了地物后向散射系数的变化。

NOTES

Session 8.3: Forest Fire Monitoring (id. 2531)

专题 8.3: 森林火灾监测

Method on Fuel Moisture Content Estimation Using AATSR Data

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Abstract

Abstract Forest Fuel moisture content (FFMC) is an important parameter in determining forest fire risk and forest fire behavior. It will cost many peoples, large money and much time if the FFMC is measured directly in field work. Many research papers show that the reflectance of Short Wave Infrared (SWIR) band has been found negatively related to leaf water content. Satellite data has the characters, such as covering broad area, and high temporal resolution, so satellite remote sensing has become very fast and effective method to retrieve FFMC at large scale. Here SWIR and NIR (Near Infrared), NIR and Red bands of ENVISAT-AATSR (Advanced Along Track Scanning Radiometer, AATSR) are used to retrieve FFMC in our experiment region. The results show that the value of FFMC by using the SWIR and NIR have the similar trend to the locate observation. This method can provide efficiently fuel moisture spatial distribution.

Key word Forest Fuel Moisture Content (FFMC), Moisture Index , AATSR

用 AATSR 数据预估可燃物湿度的方法研究

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摘要

森林可燃物湿度是影响森林火险发生等级和火行为的一个重要因子。通过野外直接测量大面积内森林可燃物的湿度需要花费大量的人力、物力和财力。已有研究文献表明：卫星传感器通常在短波红外波段的反射率与植被冠层水分含量呈负相关；卫星遥感因其具有覆盖范围大、时间分辨率高等特点而成为大尺度获取森林可燃物湿度的有效手段。利用卫星数据反演大范围内可燃物的湿度是一种快速有效的方法。本文利用 ENVISAT-AATSR (Advanced Along Track Scanning Radiometer, 简称 AATSR) 数据, 对东北实验林区的可燃物湿度的估测方法进行了探讨。分别利用 AATSR 数据的短波红外波段、近红外波段和红光波段对可燃物湿度估测方法进行对比研究。研究表明：利用 AATSR 数据的短波红外波段和近红外波段相组合来估算可燃物湿度, 与可燃物湿度的实际趋势空间分布具有一定的相似性, 从而可有效获得可燃物湿度在空间上的分布。

关键词：森林可燃物含水率, 湿度指数, AATSR

Determining the Forest Fire Risk in China by Means of MERIS Images

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Abstract

The amount of fuel is an essential issue of the forest fire risk, since it determines, among other factors, the disposable mass amount to burn. A fast way to calculate this variable by remote sensing is based on assuming that areas with low historical values of NDVI have, more likely, little amount of biomass, that is to say, little amount of alive load, due to the little level of photosynthetic activity shown by the NDVI. The use of data MERIS for obtaining an living fuel map sets out with a resolution of 300 m.

This fuel map will be characteristic for each homogenous zone and each type of fuel. This supposes to have characterized the forest masses on China and the knowledge of the type of fuel presents in each one.

MERIS 数据在中国森林火险中的应用方法

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摘要

可燃物的数量是导致森林火险的一个内在问题，和其他因子相比，因为它决定了可以燃烧的物质总量。利用遥感快速计算这个变量是基于以下假设：即历史上 NDVI 低的区域，其可燃物总量就愈少，也就是说，活可燃物载量也越少，因为 NDVI 可以反映可燃物短时间内的光合作用。利用 MERIS 数据来获得空间分辨率为 30 米的活可燃图。可燃物分布图将标示为每类可燃物分布区和每类可燃物类型的特点。这种假设是基于中国森林特点和每种可燃物类型的知识。

Summary of Working Progress on Forest Fire Research

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Abstract

Detection of forest fires is the main user requirement in order to know the fires distribution. Despite the restrictions shown by the Envisat-AATSR sensor, as low saturation level in the MIR spectrum and diurnal saturation by high surface temperatures, it can provide useful information complementing the results coming from other sensors. In this work, we have try to improve detection algorithm in order to be available in day-time scenarios. This part of work is focused on operability results.

Without MIR saturation, it's possible to retrieval the fire parameters, in order to analyze fire activity and ecological consequences. The main involved parameter is the Fire Radiative Power, showing a good correlation with severity of fire. In this work we have studied the main errors of FRP, fire temperature and flaming area estimations. These errors are due to different factors: sensor characteristics, atmospheric conditions, surface emissivity, etc. In addition we have estimated the errors caused by PSF due to the application of bi-spectral method. This part of the work is focused on academic and scientific results.

From an ecological point of view, atmospheric consequences of fire emissions are a very important factor in global change. We are evaluating different methodologies in order to estimate the atmospheric impact of emissions. One of them is an indirect method based on the cartography of burnt areas and estimation of biomass before fire (MERIS imagery is involved in the cartography methods). Other method is the analysis of trace gases from atmospheric ENVISAT sensors. Our results are preliminary yet. This part of the work is focused on the ecological implications.

森林火灾研究工作进展总结

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摘要

为了获得火点的分布，主要的用户需求是对林火的检测。尽管 ENVISAT-AATSR 传感器存在如中红外波段饱和点低、白天影像因地表高温造成像元饱和等局限性，但它可以其他传感器提供的有用信息来获得补充。在本研究中，为了对白天影像能有效检测，我们曾尝试改进检测算法。这部分研究工作被定位在结果的可操作性上。如果 AATSR 中红外波段的没有饱和，是可能提取出火点参数的。为了分析火行为和火对生态的影响，主要的有关参数是与火强度较好相关的火辐射能量。在本研究中，我们研究了影响火辐射、火的温度和燃烧面积估测的主要误差。这些误差取决于如传感器特性、大气环境、地表发射率等不同因子。而且我们还估测了因应用了双光谱法而由点扩散函数引起的误差。这部分研究工作被集中在结果的理论和科学性上。从生态学的观点来看，在全球变化中，火发射的能量对大气的影响是一个非常重要的因子。为了估测火发射的能量对大气造成的影响，我们正在研究不同的估测方法。其中的一种方法是一种基于过火区制图和火灾前的生物量估计的间接方法（MERIS 影像被选用来研究过火区制图方法）。另一种方法是利用 ENVISAT 所搭载的探测大气的传感器来监测分析气体的痕迹。目前我们只是获得了一些初步的结果。这部分研究工作主要集中在火对生态的影响上。

NOTES

SESSION 9: EO AND SPORTS EVENTS

专题 9 : 对地观测与体育事件

Session 9.1: EO and Sport Events: Case study Athens Olympic Games (id. 3362)

专题 9.1: 对地观测和体育事件 : 雅典奥运会案例研究

Assessing the Impact of the Olympic Games of 2004 to the Urban Environment of Athens with the Use of Earth Observation

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Abstract

Earth observation is a valuable tool for the study of the urban environment. In this study, the impact of a major sporting event, namely the Olympic Games of Athens 2004, on the urban environment of the host city is examined. Emphasis is given to detecting changes with respect to urban density, green areas and open spaces, air quality and the thermal environment. Special emphasis is given regarding the study of the above in the coastal zone of Athens, the latter constituting a highly valuable asset for the city. For the needs of the study, earth observation data of high spatial resolution as acquired prior and after the year 2004 are processed accordingly. A discussion on the prospects as well as on the limitations of the use of earth observation is also provided for further consideration.

利用地球观测技术评价 2004 年雅典奥运会对雅典城市环境的影响

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摘要

地球观测技术是城市环境研究的重要手段之一。本研究中调查分析了重要的运动事件——2004 年雅典奥运会对主办城市环境的影响。重点在于探测与城市密度、绿地面积和空地空气质量和热环境等的变化。特别关注了雅典海岸线区域内的上述指标，因为海岸线对城市有重要的价值。为满足研究需要，获取并处理了 2004 年前后的高空间分辨率的地球观测数据。最后，讨论了地球观测数据的应用前景、不足和以后应注意的问题。

Changes in the Quality of Life Indicator for the City of Athens Due to the Olympic Games 2004

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Abstract

Satellite data can effectively describe the physical environment of a city. Integration of physical variables from satellite data with socioeconomic variables from census data in a GIS, results in the development of an aggregate index for assessing the quality of life in cities. In this study, the quality of life indicator is estimated for the city of Athens for the periods prior and following to 2004 so as to define the impact of the Olympic Games of Athens. To this end, high-resolution summer Landsat ETM+ image data and 2001 Greek census data are used for such variables as surface temperature, urban vegetation, urban density, air pollution, population density, unemployment rate, education level, median home value, etc. Each variable is regarded as either positive (+) or negative (-); positive (negative) indicates a higher (lower) quality of life. Urban quality is expressed by means of a scale which parameterizes the contribution of each variable. Results reflect the overall Athens agglomeration and are discussed in terms of their potential to assess adequately the impact of the Olympic Games of 2004 to the quality of life of the host city.

2004 雅典奥运会引起的雅典市生活质量指标的变化

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摘要

卫星数据可以有效地描述城市的物理环境。在地理信息系统中集成卫星数据的物理变量与统计数据中的社会经济变量，可以开发出聚合指标以评价城市的生活质量。本研究中，用生活质量指标来评估 2004 年奥运会期间奥运会的影响。采用了夏季的 Landsat ETM+图像数据和 2001 年希腊的普查数据研究表面温度、城市植被、城市密度、空气污染状况、人口密度、失业率、教育水平、家庭收入均值等。每个变量值或为正 (+)，或为负 (-)。正、负值表示生活质量的高低。城市质量用每个变量的贡献参数尺度来表示。研究结果反映了整个雅典的聚合情况，讨论了 2004 年奥运会对主办城市生活质量的潜在影响。

NOTES

Session 9.2: EO and Sport Events: Case study Beijing Olympic Games (id. 3362)

专题 9.2: 对地观测和体育事件 : 北京奥运会案例研究

Use of Earth Observation in Support of the Needs of Major Sports Events: Case Study for Beijing 2008 Olympic Games

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Abstract

Use of Earth Observation in Support of the Needs of Major Athletic Events: Case study for Beijing 2008 Olympic Games Guihong Chen(1), and Jun Li(1) (1) Beijing information resources management center, No.9 Wenhuiyuanbei Road, Beijing, 100082, China

In the frame of DRAGON-16, as to Beijing 2008 Olympic Games, five focused topics such as land use/land cover, urban density and spatial planning, thermal environment within cities, meteorology (including marine meteorology) and monitoring of extreme events, air pollution and sunshine duration – UV radiation balance, are being carried out by six different Chinese partners. In order to realize the three concepts of 'Green Olympic Games, High-tech Olympic Games and People's Olympic Games' in Beijing 2008 Olympic Games, many modern technologies including earth observation have been adopted, as it does in the case of DRAGON-16. During the pre-event period of 2008 Olympic Games, the main objective is focusing on the use of earth observation in the fields of land use/land cover, urban and spatial planning, thermal urban environment, and comfort indices. At present, the project is just in the second and third phase (four phases in all: literature review and methodology, data acquisition and pre-processing, development of products, and assessment of products), Chinese partners are busy in dealing with data collecting (ASAS, MERIS, TM, SPOT, DMC, aerophotograph, DEM, etc) and pre-processing, and some products of land use/land cover, water quality and AOT detection, thermal environment within cities, etc, have been achieved.

对地观测技术在重大运动会上的应用

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摘要

对地观测技术在重大运动会上的应用 ——2008 年北京奥运会范例分析

在龙计划 16 专题的框架下, 针对北京 2008 年奥运会, 主要设立了 5 个研究主题: 土地利用/土地覆盖、城市密度和空间布局规划, 城市热岛效应、气象 (包括海洋气象) 和极端天气监测、空气污染和太阳辐照度——紫外线辐射。中方共有 6 个单位参与了该项工作。为了实现 2008 年北京奥运会“绿色奥运、科技奥运、人文奥运的”的三大理念, 包括对地观测技术 (EO) 在内的众多高新技术在涉及奥运的方方面面得到了广泛应用, 正在开展的龙计划 16 专题就是其中的一个实例。在 2008 年奥运会准备阶段, EO 技术将更多地在地利用/土地覆盖、城市密度和空间布局规划, 城市热岛效应、舒适度指数等领域。目前, 16 专题计划正处于第二、第三个阶段 (共四个阶段: 方法准备阶段、数据获取和处理、数据成果产品制作、成果评价), 中国参与单位正在进行数据获取 (ASAS、MERIS、TM、SPOT、DMC、航拍、DEM 等) 和处理, 并在土地利用、气溶胶监测、城市热岛效应监测等方面取得了阶段性成果。

Aerosol Monitoring from AATSR over Beijing Area

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Abstract

It is a very difficult task to decouple aerosol contribution from signals received by satellite sensors at the top of atmosphere due to the high reflectance and significant inhomogeneous of Earth land surface and high level variation of aerosol distribution. The aerosol optical thickness retrieval over land surface still remains as one of the toughest tasks in quantitative geophysical parameter determination from remotely-sensed data.

A model has been developed that can be used to retrieve the aerosol optical thickness and surface reflectance simultaneously based on the radiative transfer equation by taking account of the dual-angle characteristics of AATSR onboard ENVISAT launched by ESA in 2002. This model can be used to separate the contribution due to the aerosol from that due to the land surface. It returns aerosol optical thickness (AOT) values from AATSR data. Totally, 33 scenes of AATSR images covering Beijing area were chosen to calculate the AOT values using the model. There are good agreements between the in-situ measurements determined from AERONET site of Beijing and the AOT from the model. The average relative error is about 9.97%. It exhibits high robust in aerosol remote sensing over land and great potential in climate modeling.

基于 AATSR 的北京大气气溶胶监测

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摘要

由于陆地地表的高反射特性和强烈的时空不均一性, 大大增加了从卫星传感器上接收到的信号中成功分离出大气分子及大气气溶胶贡献的难度, 从而导致气溶胶遥感反演已然成为国际研究难点和热点问题之一。

本文在深入分析大气辐射传输方程基础之上, 通过考虑搭载在 ESA 发射的 ENVISAT 卫星上的 AATSR 传感器的双角度观测特性, 成功地推导出能够同时反演大气气溶胶光学厚度和地表真实反射率的模型, 利用该模型能够成功分离地表和大气贡献, 从而达到成功反演陆地地表上空大气气溶胶的目的。基于该模型, 我们选取 2004 年-2005 年北京地区的 33 景 AATSR 数据, 反演了该地区序列的大气气溶胶光学厚度, 并通过与 AERONET 站点地面数据比较, 反演结果的精度表现出与地面实测气溶胶光学厚度高度一致性, 从而证明了该模型在区域陆地地表上空气溶胶光学厚度遥感反演方面的强壮性, 以及它在全球气候变化中具有巨大的应用潜力。

Lidar Applications in the Pretest Campaign for the Olympic Sailing Games in Qingdao

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Abstract

The Laser remote sensing is a powerful tool to obtain the physical and chemical parameters of atmosphere and ocean with extremely high spatial resolution. The capability of three-dimensional wind field measuring makes it one of the most prospective remote sensing tools especially for the precise forecasting such as the weather service for the Olympic sailing games. Other information of aerosol, water vapor and temperature could also improve the precision of the numerical weather forecasting model and the radiation balance evaluation model to a great extent. This report introduces the development and application of lidars in the pretest campaign for the 2008 Olympic sailing games in Qingdao, including the meteorological Doppler lidar and the PBL aerosol lidar. Furthermore, we propose a project for the DRAGON II, in which OUC/ORSI and DLR/IPA are going to upgrade original atmospheric lidars and carry through a series of field campaign between lidars from each part and from different platforms. The field campaign and data analysis of the spaceborne Doppler lidar will also be included after the launch of the ADM-Aeolus by ESA, which will be the first Doppler lidar to obtain the global wind from the orbit. The proposal aims at improving the data analysis and application level, and contributes to the 2008 Olympic Games and Chinese space-borne lidar program in the future.

激光雷达在奥帆赛青岛测试赛中的应用

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摘要

激光遥感能够以高时空分辨率获得大气和海洋的多种重要的物理和化学参数。激光雷达获得的高分辨率三维大气风场信息将有效地提高精细天气预报水平, 为 2008 年北京奥运会青岛帆船赛提供气象保障。而气溶胶、水蒸气和温度数据对于提高数值天气预报水平和研究辐射平衡都有重要意义。本报告介绍了 OUC/ORSI 的多普勒测风激光雷达和边界层气溶胶激光雷达的研制及其在青岛奥帆赛测试赛中的应用。对于即将开始的第二期“龙计划”, 我们和德国空间中心大气物理研究所建议开展大气激光遥感方面的研究, 包括大气激光雷达开发以及双方多种平台搭载的激光雷达测试和应用。在第一台星载多普勒测风激光雷达 ADM-Aeolus 发射后, 双方还将就星载、机载和地基印证实验和数据分析工作展开研究。第二期“龙计划”将着眼于提高激光遥感的研究和应用水平, 并为 2008 年北京奥运会和中国未来的星载激光雷达技术作出贡献。

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On the Discrimination between Radar Signatures of Oceanic and Atmospheric Internal Waves on SAR Images of the Ocean Surface

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Abstract

On SAR images of the sea surface often wave-like features are visible, which are sea surface manifestations either of oceanic or atmospheric internal waves. We have analyzed a large number of ERS SAR and Envisat ASAR images acquired over the Chinese Seas and other parts of the World's ocean. In particular, we have compared radar signatures of atmospheric internal waves with MERIS and MODIS cloud images, and in one case even with in-situ measured near sea surface wind fluctuations. This comparison has yielded new insight into the structure of non-linear atmospheric internal waves in the marine boundary layer. In order to distinguish between these two types of internal waves one needs, in general, auxiliary information on the topography (above ground and under water), on the state of the ocean and the state of the atmosphere. But in many cases it is possible to infer from the shape and location of the wave pattern whether the pattern results from oceanic or atmospheric internal waves. Several criteria are presented that allow unambiguous discrimination between these two types of waves.

SAR图像上大气内波与海洋内波信息区分研究

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摘要

在海洋SAR图像上，经常能看到海洋内波和大气内波的雷达信息。然而，这两种雷达信息看起来非常相似，很难确定它们是来自海洋内波还是来自大气内波。在某些情况下可以从雷达信号的几何结构来判断内波的类型。但大部分情况下，必须辅助其他的海洋和大气同步观测数据。为了能够成功区分海洋内波和大气内波，本文将讨论需要什么样的辅助数据，这些数据从哪里获得等问题。本文列举了中国东海、南海、地中海和黑海的几个例子。我们还列举了两个同时被Envisat ASAR和MERIS传感器观测到的大气内波的例子。ASAR通过海面粗糙度观测大气内波，MERIS通过云分布观测大气内波。

Chasing Swell Systems Across the Ocean

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Abstract

After being generated by a storm, wind waves become swell systems that can propagate for great distances over the surface of the Earth, their travel being largely uninterrupted until they break and dissipate upon reaching a coast (almost no wave energy is reflected from the coast in the wind wave frequency range). In fact, for propagation over large distances, swell waves seem to obey the linear theory of wave propagation from a limited initial disturbance. The theory leads quite naturally through the method of stationary phase to the concept of group velocity as the signal velocity of the wave energy. In practice, such a property can help to predict the arrival time of waves at any given ocean location using the group velocity by knowing the position and time of the storm. Today, global satellite wind observations (i.e. active scatterometers and passive radiometers), directly, statistically or through assimilation procedures, contribute to improve knowledge on surface wind conditions. Such a wealth of ocean surface environmental condition information can now be complemented by very high resolution Synthetic Aperture Radar images. In particular, global ENVISAT Wave Mode products (10x10 km imaggettes every 100 km), can uniquely provide valuable directional surface wave properties to help tracing low frequency swells along their propagation paths. For any significant high wind events, an inverse ray tracking procedure can be used to locate the originating storm area and period. Once the generating storm area can be regarded as a point source, i.e. the propagation time and distance become very large compared to the source duration and extent, the propagation paths of swells can first be linearly predicted along great-circle routes. Idealized paths can then be used to identify possible island obstructions, and to anticipate some surface current refractive effects. The selected paths can further be used to look for time and space closely co-located satellite observations. Global satellite surface wind observations (i.e. active scatterometers and passive radiometers), altimeter and SAR measurements, can thus be ideally combined to refine the method, and to better characterize these great-circle storm swell events. First demonstrations will be presented and discussed. Present results will be focused on particular events to demonstrate the potential benefit to use ENVISAT Wave Mode measurements to advance and improve surface wave forecasts.

跨海洋涌浪系统跟踪

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摘要

风浪会被风暴激发演变成涌浪。涌浪可以不受阻挡地传播很长的距离，直到它们到达岸边破碎消散（在岸边在风浪频率范围内几乎没有波能量反射）。事实上，对于传播很长距离的涌浪，它似乎遵循从线性波理论。通过静态相位法，从这个理论很自然地得出群速度就是波动能量的传播速度。在应用中，这个属性可以帮助我们知道了风暴的发生时间和位置情况下，通过群速度预测海洋上任何位置的涌浪的到达时间。今天，全球卫星风观测（例如主动散射计和被动辐射计）无论是直接的、统计的还是同化得到的数据对海面风场的了解有很大的帮助。这样一种丰富的海洋环境信息现在可以通过高分辨率合成孔径雷达来获得。实际应用中，全球ENVISAT波模式产品（10x10公里图像）可以提供海浪传播方向信息，帮助我们跟踪低频涌浪的传播路径。对于任何重要的高风速事件，反射射线跟踪程序可以帮助我们定位风暴的发生位置和周期。一旦风暴产生区域被认为是点源，即传播时间和传播距离相对于源的持续时间和范围较长，涌浪的传播路径可以被线性地预测。理想的路径可以用来识别岛屿障碍和预测某些海流的反射作用。选择的路径可以用来计算卫星观测的位置和观测时间。全球卫星风观测（例如主动散射计和被动辐射计）、高度计和SAR观测，可以完美地结合起来提高测量的精度，从而更好地认识这些大风暴涌浪事件。论文给出了一些应用示范实例，目前的结果将集中在一些特殊的事件，证明利用ENVISAT波模式来提高和改进海浪预报的可行性

Inversion Model Research of Soil Surface Roughness by Using Microwave Remote Sensing

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Abstract

Soil surface roughness plays an important role in radar backscatter correspondence, but the measurement of surface roughness, RMS height and correlation length, faces some difficulties, such as time taking, high errors, poor representative of real surface conditions. So inversion model research of surface roughness is necessary by using radar backscatter data. This paper proposes a new inversion model of surface roughness parameter on the basis of simulation by using the theoretical backscatter model IEM and analysis on the relationship between backscatter coefficient difference and soil surface roughness. The new empirical model, giving by a quadrinomial equation, uses the difference between VV and HH polarization backscatter coefficient under the same incidence angle. Using ENVISAT-ASAR data and in situ experimental data, the inversion model was applied in south He Bei plain, China. The use of the new empirical model can avoid tedious ground measurements to a great extent, and can represent soil surface in pixel scale.

微波遥感中地表粗糙度参数反演模型研究

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摘要

土壤表面粗糙度是影响雷达后向散射特征的一个重要因子, 但是均方根高度、相关长度这些表面粗糙度参数的测量有很多的困难, 耗费大量的时间, 误差较大, 给实际应用带来较大困难。因此, 研究、探索新的用雷达后向散射系数反演地表真实粗糙度的算法很有必要。本研究通过利用IEM模型对不同雷达参数条件下的后向散射系数进行模拟, 然后分析不同极化后向散射系数组合与地表粗糙度参数之间的关系, 得到了一种利用VV和HH极化同角度后向散射系数差来反演地表粗糙度参数的经验模型, 并将得到的经验模型在河北省南部平原地区进行了应用。应用本研究建立的经验模型可以大大减轻地面实测数据的工作量, 并且使雷达后向散射系数与地表粗糙度之间建立起像元尺度的关系成为可能。

