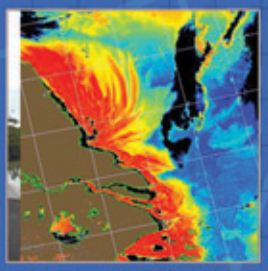
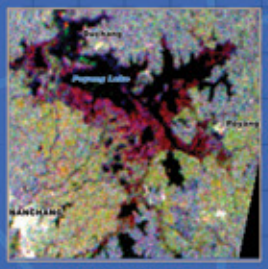
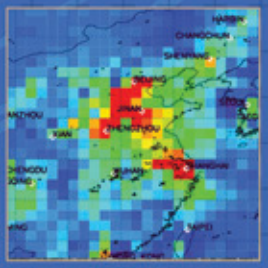
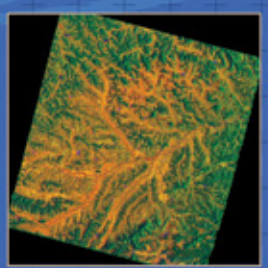
DRAGON PROGRAMME

BROCHURE 2006









DRAGON 2006

THE DRAGON PROGRAMME IN 2006

WELCOME

The 2006 Dragon Programme brochure presents the activities undertaken since the Santorini Symposium at the end of June 2005. A new Dragon project on "EO and sport events" has been formally initiated and there are now 16 projects investigating land, ocean and atmospheric applications in P.R. China. ESA and NRSCC have organised two progress meetings in Beijing, one in October 2005 and the other in February 2006. At these meetings, Chinese scientists provided details about their project progress and further defined their EO data requirements. In October 2005, a visit was also made to the agriculture project team at Fuzhou University in Fujian Province. Training is a key component of the programme, and an advanced training course in land remote sensing was successfully held at Capital Normal University in Beijing, during 6 days in October 2005. The training course was attended by 103 scientists from over 50 institutions from all over China. Since the formal start of the programme, a large quantity of ENVISAT/ERS EO data have been made available to all of the projects and detailed coordination of all requested acquisitions over China continues to be performed.

A joint ESA/NRSCC mid term publication (SP-611) has been published and is available as a printed volume as well as a CD-ROM.

The third Dragon annual symposium is to be held in Lijiang city, Yunnan Province, P.R. China from 10 to 14 July 2006 at which results will be presented for the 16 projects. In addition young scientists will report on their progress and joint field visits made to date.

The next step during 2006 is the preparation for an advanced training course in atmospheric remote sensing that will be held at the Peking University from 16 to 21 October 2006.

We thank all Dragon investigators from Europe and China for their joint contribution to the programme so far and look forward to the results of this continued cooperation.

Best regards,

THE DRAGON PROGRAMME CO-ORDINATORS
ESA - **Yves-Louis Desnos**, e-mail: yves-louis.desnos@esa.int
NRSCC - **Li Zengyuan**, e-mail: zengyuan.li@forestry.ac.cn

ABOUT THE DRAGON PROGRAMME

Background

ESA, together with the National Remote Sensing Center of China (NRSCC), an entity under the Ministry of Science and Technology of the P.R. China, have cooperated in the field of Earth Observation application development for the last ten years. The cooperation has taken on a new momentum with the creation of a dedicated three-year Earth Observation exploitation programme called Dragon (2004 to 2007). The programme formally kicked-off in April 2004, with a Symposium that was held in Xiamen city in P.R. China. The Dragon programme focuses on science and applications development in P.R. China exploiting mainly data from ESA ERS and Envisat missions.

Objectives

The Dragon Programme is targeted to land, ocean and atmospheric investigations in the P.R. China that are outlined by NRSCC in the ESA-MOST Dragon proposal, available at http://earth.esa.int/dragon:

- To promote the use of ESA data from the ERS and Envisat satellites
- To stimulate scientific exchange in EO science and technology by the formation of joint Sino-European teams
- To publish co-authored results of the research and applications development
- To provide training in processing, algorithm and product development from ESA EO data in land, ocean and atmospheric applications

Project Themes

The thematic areas under investigation are as follows:

- EO and sport events
- Agricultural Monitoring
- Flood Monitoring
- Forest Mapping
- Rice Monitoring
- Forest Fire Monitoring
- Oceanography
- Terrain Measurement
- Seismic Activity
- Landslide Monitoring
- Air Quality Monitoring and Forecasting
- Chemistry/Climate Change in the Atmosphere
- Forest Information from POLInSAR
- Drought Monitoring
- Water Resources Assessment
- Climate and Ocean Systems

The Dragon programme web site

http://earth.esa.int/dragon

INDEX

PROGRAMME

PROJECTS

PARTNERS

Symposium participants at the Marine Garden Hotel Conference Centre on Gu Lang Yu Island, Xiamen

2004 XIAMEN SYMPOSIUM, P.R. CHINA

- **Date:** April 27th - 30th 2004
- Gu Lang Yu Island - Xiamen, Fujian Province, P.R. of China
- **Hosts:** ESA/NRSCC and local authorities
- 130 participants (from 60 institutes in Europe and China)
- 50 presentations available on-line at:

http://earth.esa.int/dragon/Dragon_symposium.htm

The 2004 Dragon Symposium was the formal kick off for all the 15 projects at which time the joint teams started their work, refined their Earth Observation and other data requests and produced their detailed work plans.

At the Xiamen Symposium, the joint Sino-European teams made presentations on their projects over 3 days. The programme included presentations on the monitoring of land natural resources, on supporting natural disasters management, on studying the atmosphere and oceanography in China.

:: Xiamen Symposium organising committee

:: Chinese and European participants to the Dragon Symposium Xiamen April 27-30 2004

2005 SANTORINI SYMPOSIUM, GREECE

- **Date:** 27 June to 1 July 2005
- Santorini Island, Greece
- **Hosts:** ESA, NRSCC and GSRT
- 120 participants from 50 institutes in Europe and China
- 69 presentations available on line at:

http://earth.esa.int/dragon/programme.html

DRAGON 2005 Symposium poster

:: Chinese and European participants to the Santorini Symposium

:: Group meetings during the Santorini Symposium 2005

NRSCC and ESA in cooperation with the Greek Ministry of Development, General Secretariat for Research and Technology (GSRT) organised the 2nd annual Dragon Symposium in Santorini, Greece, from 27th June to 1st July 2005.

The Symposium brought together the joint Sino-European teams after one year's activity. On a project-by-project basis, the teams provided the following:

- Reports on project progress including early results
- Up-dates on the project teaming particularly the inclusion of Greek scientists into the programme and their contribution
- Details on the EO data acquired and investigated after one year's activity
- Details on the in-situ data measurements and requirements
- Information on planning for the next 2 years
- Reports from the young scientists training programme
- Outlines on the progress and status of cooperation within the projects

MERIS Reduced Resolution image (1.2 km) 15th February 2004 of China East coast

ADVANCED TRAINING COURSE IN OCEAN REMOTE SENSING

- **Date:** October 25th - 30th 2004
- **Hosts:** ESA, NRSCC and Ocean University of China
- **Lecturers:**

Dr. Roland Doerffer GKSS Research Centre, **Germany**
Prof. David Llewellyn-Jones Univ. of Leicester, **UK**
Dr. Pierre-Yves Le Traon CLS, **France**
Prof. Johnny Johannessen NERSC, **Norway**
Prof. Werner Alpers Univ. of Hamburg, **Germany**
Prof. He Mingxia Ocean University of China, **China**

Ph.D. students, postdoctoral and research scientists interested in ocean remote sensing from China and other Asian countries were invited to a one-week training course organised jointly by ESA and MOST in the framework of the Dragon Programme. The advanced training course was hosted by the Ocean University of China (OUC) in Qingdao.

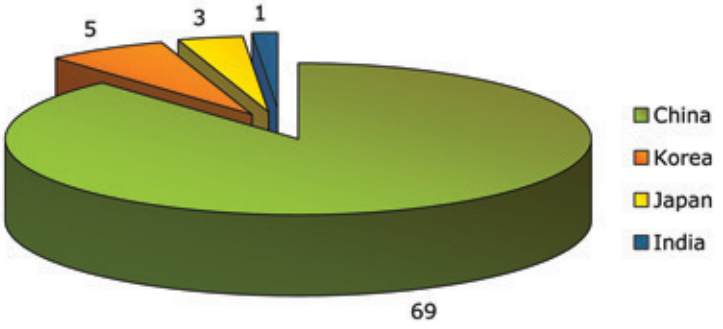
LECTURES ON:

- Current and future European and Chinese EO satellite missions
- Principles of SAR, MERIS, (A)ATSR, and RA measurements
- Products and applications in operational oceanography
- Practical exercises with BEAM and Bilko software tools

78 PARTICIPANTS

(selected from 125 applications)
- Associate or Assistant Professors
- Senior scientists
- Engineers
- Ph.D. students

:: The lecturers



:: Participants and lecturers of the Ocean training course at OUC, Qingdaog

ADVANCED TRAINING COURSE IN LAND REMOTE SENSING

- **Date:** 10-15 October 2005
- **Host:** Capital Normal University (CNU), Beijing, P.R.China
- **Co-sponsors:** ESA, NRSCC, CNU
- **Lecturers:** Prof. José-Luis Casanova, University of Valladolid, Spain - Dr Thuy Le Toan, CESBIO, France - Prof. Eric Pottier, University of Rennes, France - Prof. Fabio Rocca, Politecnico di Milano, Italy - Prof. Christiane Schmullius, Friedrich-Schiller-University of Jena, Germany - Prof. Bob Su, ITC, The Netherlands - Dr Wout Verhoef, NLR, The Netherlands

Advanced training course in land remote sensing poster

:: European lecturers receiving guest professorships from Capital Normal University at the closing session

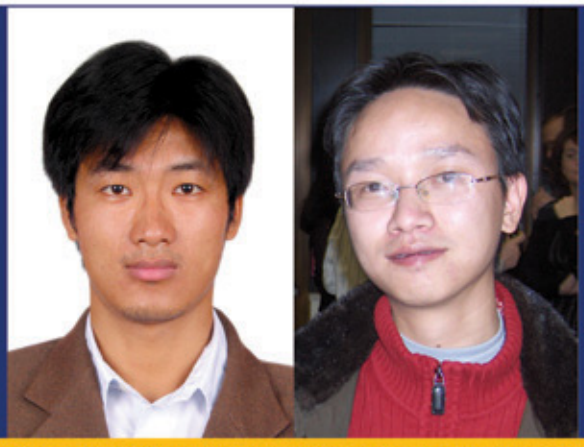
:: Prof. Eric Pottier explaining principles of polarimetric SAR theory during a land training course lecture at Capital Normal University, Beijing

:: Participants and organisers of the land training course at CNU, Beijing

PhD students , postdoctoral and research scientists interested in Land Remote Sensing were invited to a one-week advanced training course organized jointly by ESA and MOST as an initiative from the DRAGON programme. The training course was hosted by Capital Normal University (CNU) in Beijing.
A total of 103 participants (selected from 167 applications) attended the course, representing more than 50 different institutions from all over China.

LECTURES:

- Land Applications Using SAR data
  - Theory and principles of SAR and SAR interferometry over land
  - SAR Polarimetry
  - Applications for soil moisture, agriculture (including rice), forestry, floods, terrain motion
- Land applications using optical and thermal data
  - Theory of optical and thermal remote sensing over land
  - MERIS, (A)ATSR instrument series
  - Applications for forest monitoring, land use and land cover mapping, droughts, fire detection, agriculture



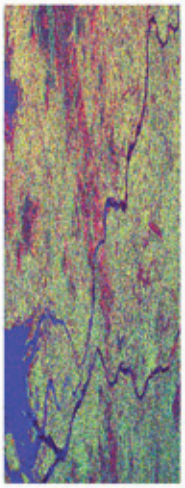
Feilong Ling (left) from Fuzhou University was hosted as a trainee by ESA during autumn 2005. Xin Tian (right) from the Chinese Academy of Forestry was hosted by ESA from November 2005 to February 2006.

DRAGON TRAINING IN EUROPE

- Pre-processing of MERIS, ASAR AP and ERS SAR data into the same geometry
- Pre-processing of ASAR and ERS SAR SLC data to investigate 35 day plus ILU for land use mapping
- Use of optical and SAR coherence and backscatter parcel statistics for land use classification and mapping
- Assessment of forest classification result for NE China from AP ASAR data
- Assessment of forest type discrimination using ASAP AP and L-band JERS-1 data
- Assessment of forest map up-dates using ERS SAR tandem ILU forest maps from the 1990s.

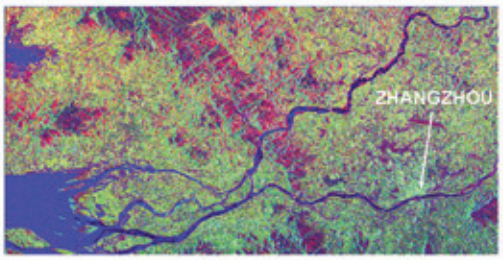
Feilong Ling investigated the synergistic use of SAR and optical data for agriculture monitoring in Fujian province, China. ERS-1/2 and ASAR data were used for the research, MERIS and TM data as well. To combine SAR and optical data, they were first processed into the same geometry. The SRTM _90m DEM was investigated for geocoding SAR imagery. Single look complex (SLC) ERS and ASAR SLC data were used for generating ILU products using ESA BEST freeware. Interferometric correlation or coherence contains thematic information which can be used for land-cover classification. To overcome the well-known speckle noise phenomenon in SAR imagery, a parcel based approach to information extraction was investigated for classification.

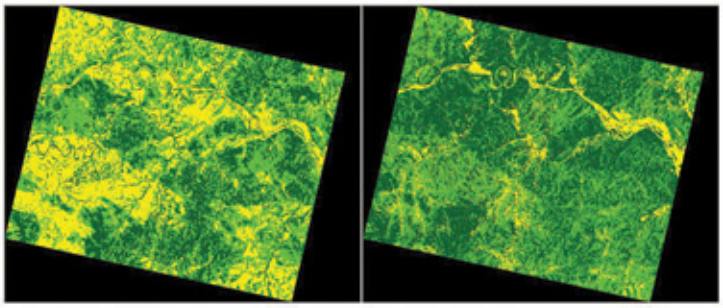
Xin Tian made an assessment of forest classification and forest type discrimination using multi-parameter satellite SAR data for NE China. The objectives of this training were to classify ASAR AP into forest/non-forest, to assess the classification performance as well as to improve the classification performance and forest type discrimination, to compare the forest/non-forest maps derived from ERS SAR ILU composites with the view to providing forest map up-dates and change statistics, for the Dragon Forest Project's test sites. The results will be validated using optical imagery acquired in similar time frames to the SAR imagery.



ILU image in slant range (left) and ground range (below) of Zhangzhou and surrounding area derived from ERS SAR tandem data ERS-1 02-JAN-1996;,ERS-2 03-JAN-1996

The channels are:
Interferometric correlation
Intensity average from the two acquisitions
Intensity difference from the two acquisitions





:: Comparison between the forest/non-forest maps from ERS SAR ILU Dec. 1995 (left) and multi-temporal ASAR APP 2004 and 2005 data (right), Tuqiang test site (yellow = non-forest areas, green = regeneration areas, dark green = forest)

DRAGON PROGRAMME MANAGEMENT

- 12 October 2005 Progress Meeting No. 8 at Chinese Academy of Forestry, Beijing
- 17 and 18 October 2005 Dragon Project Meeting at University of Fuzhou and Quanzhou Office of Science and Technology, Fujian Province
- 17 and 18 February 2006 Visit to 2006 Symposium venue, Lijiang city, Yunnan Province, P.R. China
- 20 February 2006 Progress Meeting No.9 at Chinese Academy of Forestry, Beijing

Progress meeting on 17 October 2005 at the Spatial Information Research Centre, Fuzhou, Fujian Province

:: ESA and NRSCC officials with Chinese investigators and visiting European young scientists, 12 October 2005, Chinese Academy of Forestry, Beijing

On 12 October 2005, ESA and NRSCC had a joint progress meeting with Chinese Dragon investigators in Beijing. Visiting European young scientists also attended. The progress and status of EO data delivery to the projects was reviewed. Extensions to several project quotas were requested and further planning for EO data acquisitions was made. The background to the new project EO and sport events was presented by the Greek co-ordinators.

From 16 to 22 February 06, visits were made to the Lijiang Symposium venue in Lijiang city, Yunnan Province. ESA/NRSCC also jointly prepared the programme for the Lijiang Symposium, P.R. China. The organisation for the advanced training course in atmospheric remote sensing was initiated following a visit to Peking University. On 21 February 2006, ESA and NRSCC had a joint progress meeting with Chinese Dragon investigators.

:: ESA and NRSCC officials meeting with Chinese investigators, 21 February 2006, Chinese Academy of Forestry, Beijing

:: Lijiang old city

ENVISAT is the largest Earth Observation spacecraft ever built. It was launched from French Guiana by Ariane 5 the 1st March 2002

DRAGON DATA DELIVERY

- As of April 2006, a total of 5400 ASAR and SAR scenes delivered to PIs
- As of April 2006, a total of 2000 MERIS FR scenes delivered to PIs
- Low Rate data accessed though the Internet
- Some 3300 orbits of Atmospheric Chemistry data delivered on DVD to Chinese Partners
- 8 different ESA Third Party Missions data to be delivered to PIs

ASAR/SAR

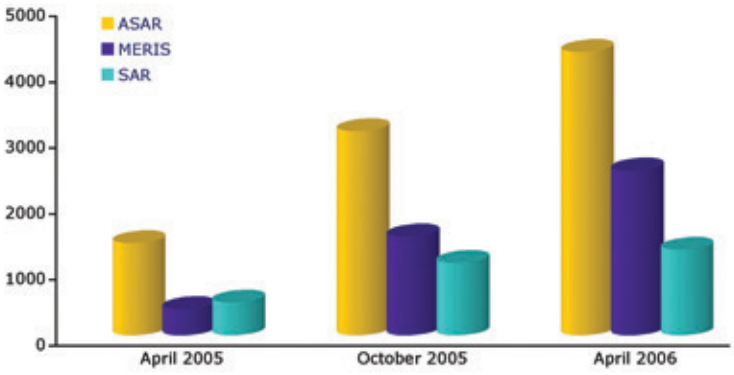
- ASAR and SAR data newly planned and from the archive are available on CD/DVD
- ASAR planning requests are analyzed up-front in order to minimize the cancellations due to mode conflicts
- ASAR data in Near Real Time are available to the Flood Monitoring project in case of flooding, via Internet through the Rolling Archive

MERIS/AATSR

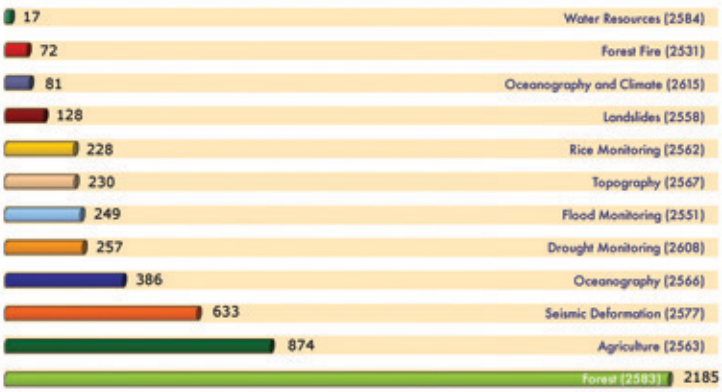
- MERIS FR data newly planned and from the archive are available on CD/DVD
- MERIS FR planning requests are analyzed up-front in order to minimize the cancellations due to on-board recorder conflicts
- MERIS RR and AATSR data are systematically available to 5 projects in Near Real Time, via Internet through the Rolling Archive and the Envisat Web File Server

ATMOSPHERIC CHEMISTRY

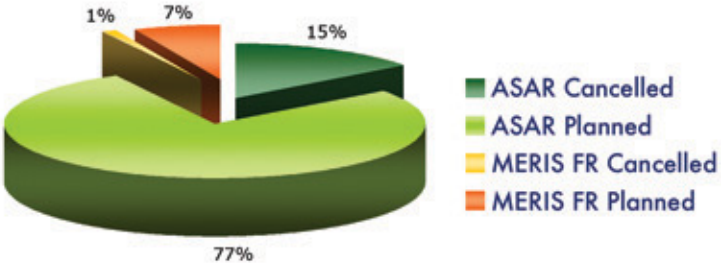
- GOMOS, MIPAS, SCIAMACHY and GOME data (already available to European Partners through FTP) were provided to Chinese Teams on DVD



:: ASAR, SAR and MERIS data delivery increase since April 2005



:: Amount of ASAR and SAR data distributed so far



:: Percentage of planned data vs cancellations

DRAGON STUDY AREAS

- Instrument's planning conflicts are checked up-front following the "Dragon conflict free" scheme
- Out of the 7700 ASAR and MERIS FR planning requests, 85% were successfully planned
- The 15% unplanned were mainly due to conflicts with the increasing Commercial requests over China
- Few requests over the Eastern part of China were cancelled because not in Artemis visibility (i.e. no simultaneous ASAR HR/MERIS FR acquisitions are available)

ERS-2: European Remote Sensing satellite was launched from French Guiana by Ariane 4 the 21st April 1995.

The Atmospheric Chemistry instruments coverage is global; the PolInSAR project is currently not requesting ESA data

Prof. Schmullius (right) and Oliver Cartus (left) discuss Forest DRAGON field work in NE. China during October 2005

DRAGON YOUNG SCIENTISTS

- Supported post graduate training for young Europeans in land, ocean and atmospheric applications
- Master of Science, doctoral degrees and research supervised by leading EO scientists in Europe and China
- Study periods, field work, and data collection in P.R. China
- Annual reporting in dedicated sessions at Dragon Symposia

ESA has allocated resources to Dragon projects for training of young scientists. The applicable period is Sept. 2004 to May 2007. ESA has now placed contracts with 13 European Institutions participating in Dragon projects.
The types of training supported include:
• Doctor of Philosophy (Ph.D.), 3 years duration
• Post graduate Master of Science (M.Sc.), 1 year duration x3 for each year of the applicable period
• Post Doctoral Research (Post Doc.) 24 months with evidence of publication in leading scientific journal or conference proceedings.

ESA has requested the following deliverables to set up the contracts and monitor student progress:
1. Proposal to ESA for training support using a proposal template
2. Training Report to ESA (every 6 months)
3. Presentation of progress and results at dedicated trainee sessions at Dragon Symposia (N.B. see special Session 5 at http://earth.esa.int/dragon/programme.html)
4. Any software developed as a result of the training support.

During 2005, several of the young scientists have undertaken extended study periods and field data collection campaigns in P.R. China. They have been working with their Chinese counterparts.
The Lijiang Symposium in July 2006 will report on the field work and data collection and further progress to date.

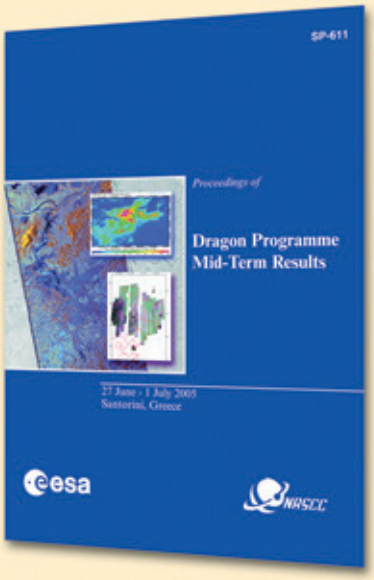
:: Rogier Van der Velde presenting results at the session dedicated to young scientists on 29 June 05 at the Santorini Symposium

:: Young Chinese and European scientists with rice project PIs planning field work together at the beginning of October 2005, Nanjing, P.R. China

:: Remi Andreoli presenting results at the session dedicated to young scientists on 29 June 05 at the Santorini Symposium

2005 DRAGON PROGRAMME MID TERM RESULTS

ESA and NRSCC have published the results of the joint Sino-European teams' research at the half way stage of the Dragon Programme as a Special Publication (SP-611). These are available as proceedings (printed volume) and on CD-ROM. The publication is available from:



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ADVANCED TRAINING COURSE IN ATMOSPHERE REMOTE SENSING

Venue
The course will be hosted by Peking University, Beijing, P.R. China

Dates
From 16 to 21 October 2006

Registration
Registration is free of charge. The course is open to Chinese scientists

Sponsors
The course is being sponsored by MOST/NRSCC, Peking University and ESA

Course Content
The lectures and practical sessions shall cover theory and processing of EO data from ESA ERS-1/2 and Envisat satellites as well as Chinese satellites for atmospheric science and application development

The training course programme and registration forms are available from the Dragon website:

http://earth.esa.int/dragon/atmostraining2006.html

Peking University science building, Beijing, P.R. China

Oblique aerial view of Faliron coastal zone development for Athens Olympic games

:: DRAGON PROJECT ID 3362

Use of Earth Observation in Support of the Needs of Major Athletic Events: Case Study for the Olympic Games (Athens-Beijing-London)

Prof. Costas Cartalis, e-mail: ckartali@phys.uoa.gr
Dr. Chen Guihong, e-mail: chengh@beijingit.gov.cn
Dr. Li Jun, e-mail: lij@beijingit.gov.cn

Dr. Iphigenia Keramitsoglou, Dr. Nektarios Chrysoulakis, Dr. Michael Petrakis, Dr. Iarla Kilbane-Dawe, Dr. Roger Saunders, Dr. Stuart Barr , Dr. Roger Proctor, Prof. Martin Wooster, Mr Steve Groom, Dr. Jack Lee, Dr. Yu Tao, Dr. Zhang Yong, Dr. Li XiaoJuan, Dr. Wang Yanbing, Dr. Li Xiaojing, Dr. Kan Zeng, Dr. Zhuo Chen, Prof. Dr. Yong Xue, Prof. Huadong Guo

OBJECTIVES

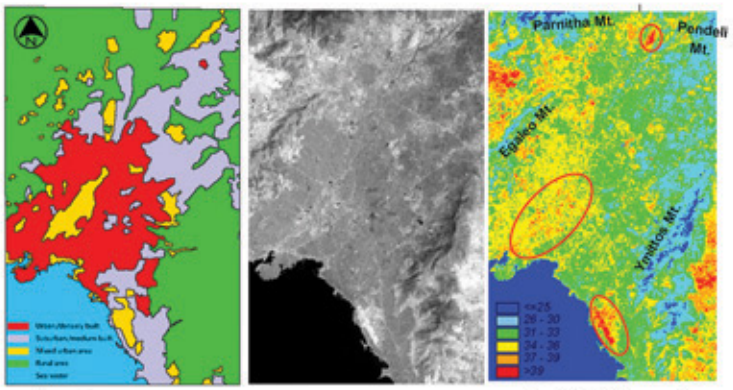
Use of Earth Observation for the:

- Planning and organisation of major sport events,
- Planning and development of the host city,
- Assessment of prevailing environmental conditions,
- Assessment of the impact of the sport event to the host city.

The project aims at five specific thematic areas:

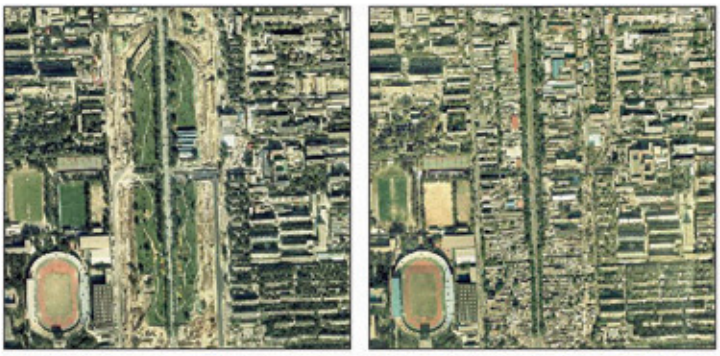
- Land use/Land cover
- Urban density and spatial planning
- Thermal environment within cities (including thermal comfort)
- Meteorology (including marine meteorology) and monitoring of extreme weather events
- Air pollution and quality of life indicators

The methodology includes the definition of the temporal and spatial needs of the sport event and of the respective host city, the examination of the potential of satellite (ESA and third party) data (in terms of the temporal, spatial and spectral resolutions) to support the needs of the sport event and the development of the products on the thematic areas listed above, with the case studies being the Athens, Beijing and London Olympic events.



Land cover map | Raw thermal image | Spatial SUHI mapping

:: Product examples of the land cover map and the urban heat island spatial distribution for Athens using satellite data (courtesy of National Kapodistrian University of Athens)



:: Land cover change from aerial photography in Beijing between 2003 (on the left) and 2001 (on the right). (courtesy of Beijing Information Resources Management Center).

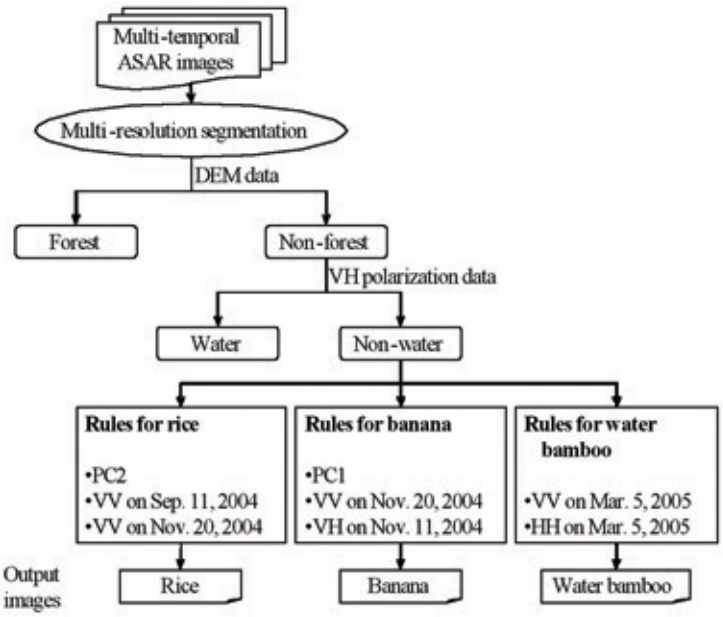
:: DRAGON PROJECT ID 2563

Agriculture and Land Use: ENVISAT Applications in Fujian Province

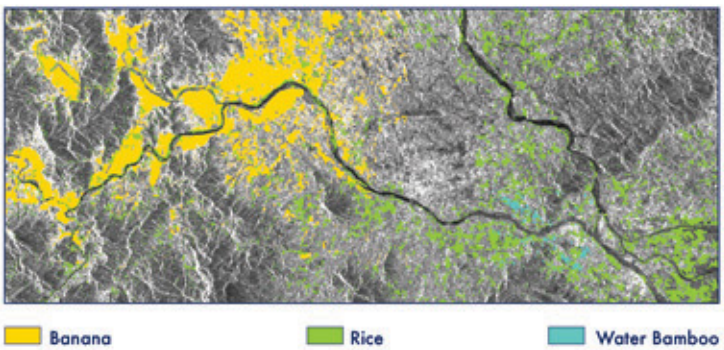
Prof. Shaun Quegan, e-mail: S.Quegan@shef.ac.uk
Prof. Wang Qinmin, e-mail: Qmwang@fzu.edu.cn

Dr. Guojin He, Dr. Thuy Le Toan, Dr. Mike Wooding, Prof. Li Zengyuan, Dr. Wang Xiaoqin, Mr. Ling Feilong, Prof. Lan Zhangren, Dr. Chen Chongcheng, Mrs. Zhu Qingdong

Agricultural production in the Zhangzhou study area of Fujian Province includes tropical fruit, rice and water bamboo



:: Land use classification from multi-temporal ASAR AP imagery using an object oriented classification scheme



:: Crop map from object orientated classification of multi-temporal ASAR AP imagery in the Zhangzhou study area of Fujian Province

BACKGROUND

The project focuses on land use classification and change detection using temporal series of ESA ERS SAR, ASAR and MERIS data. The results presented show the potential of multi-temporal ASAR AP data for crop mapping in the Zhangzhou study area.

ASAR AP ACQUISITIONS

Seven pairs of ENVISAT ASAR AP products (VV-VH and VV-HH) were acquired on May 29, August 7, September 11, October 16, November 20, December 25 2004 and March 5, 2005. According to the crop calendar, the September to November 2004 acquisitions were used for autumn rice mapping; all of the 2004 acquisitions were used for banana classification; the December 25, 2004 and March 5, 2005 acquisitions were used to classify water bamboo.

CLASSIFICATION METHODOLOGY

The classifications have been performed with the object-oriented multi-scale image analysis method embedded in the software eCognition. It consists of two main steps, multi-resolution segmentation and objects based classification. The first step is a segmentation of the image based on three parameters: scale, colour (spectral information), and shape (smoothness and compactness). Then image objects are assigned to classes using a fuzzy rule base.

ACCURACY ASSESSMENT

The overall accuracy of the crop classification is more than 80% when compared with field survey data obtained in November, 2004 and April, 2005 and comparison with ASTER imagery acquired on April 5, 2004.

Chinese investigators mapping field boundaries using in situ DGPS, 2005 ground campaign in P.R. China

:: DRAGON PROJECT ID 2562

Rice Monitoring in China

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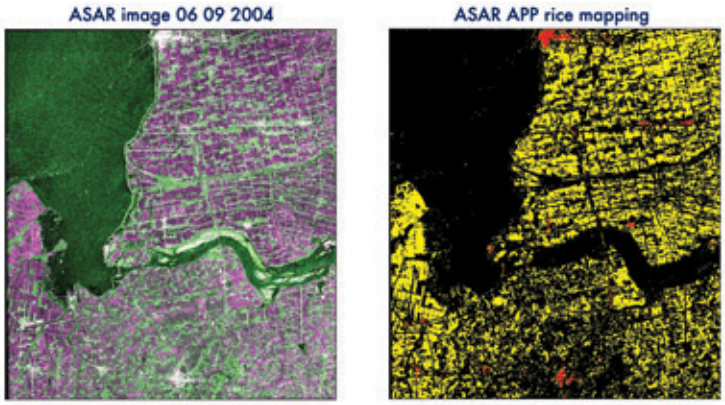
The objective of the project is to develop methodology to use ENVISAT data for rice mapping and retrieving information characterising rice fields (biomass, photosynthetic activities, water management status) relevant to the modelling of rice growth. The overall goal is the estimation of rice production and the estimation of the Carbon fluxes (CO_2, CH_4) at local and regional scale.

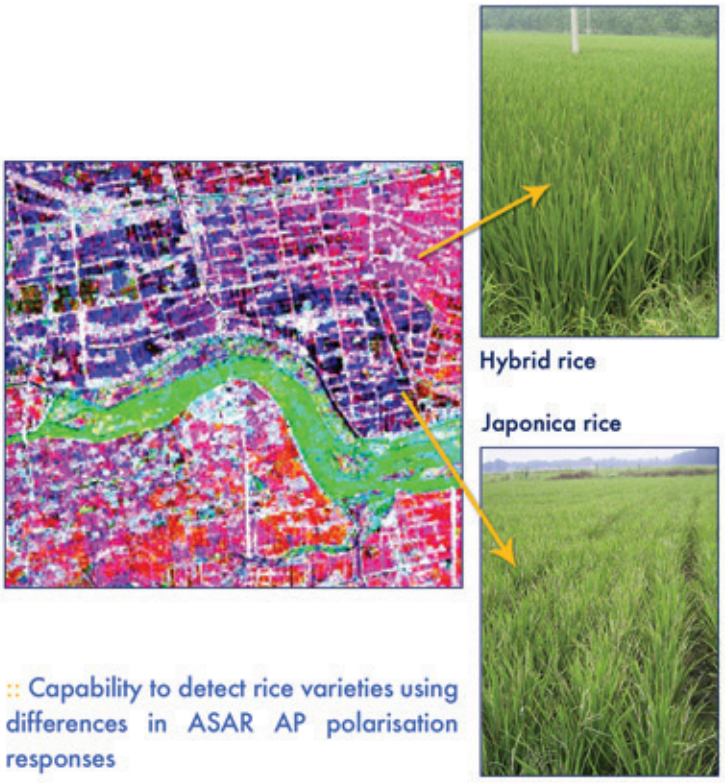
Remote sensing methodology has been developed at selected test areas for rice mapping and retrieving of rice biomass. The activities include ground data collection and analysis of remote sensing data. The results obtained using ENVISAT data in 2004 and 2005 at the test areas in Jiangsu province indicate that it is possible:

1. to map rice fields at a single date using two polarisations of ASAR APP (figure top)
2. to retrieve rice biomass using the polarisation ratio
3. to map the main rice varieties (figure bottom)
4. to achieve regional rice mapping using multi-temporal ASAR WideSwath data (reported last year)

These findings show great potential for providing statistics of rice growth areas, and for providing the essential information for the modelling of rice growth. Future works consist in interpreting the results using radar backscatter models, and in validating the mapping results in a double-rice-crop test site (Xinhua) in 2006. Meantime, the ENVISAT retrieved information will be integrated in rice growth models, and in methane emission models.



:: The potential of ASAR APP Single-date imagery for rice mapping, (Hongze area, Jiangsu Province, P.R. China)



:: Capability to detect rice varieties using differences in ASAR AP polarisation responses

:: DRAGON PROJECT ID 2583

The Forest DRAGON - Forest Related Development of Radar Applications for Geomatic Operational Networks

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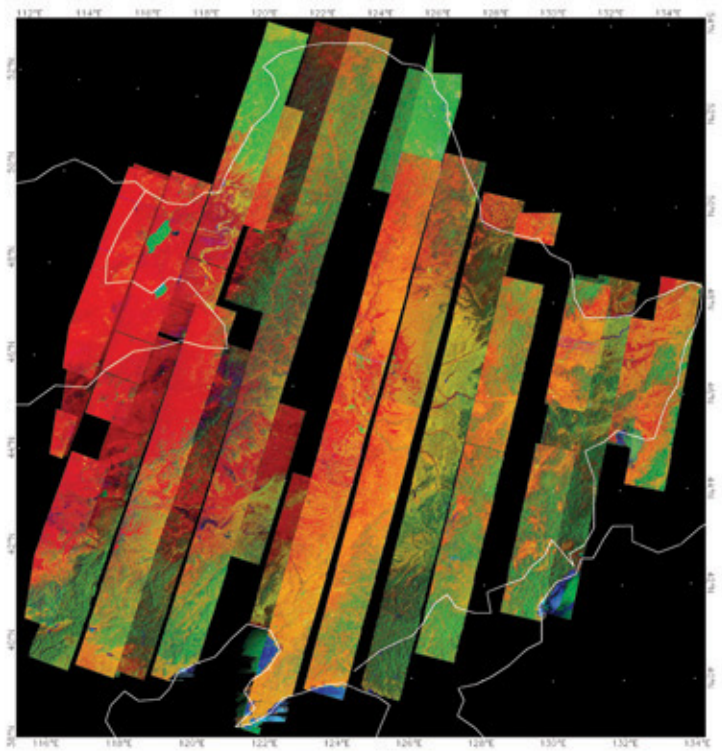
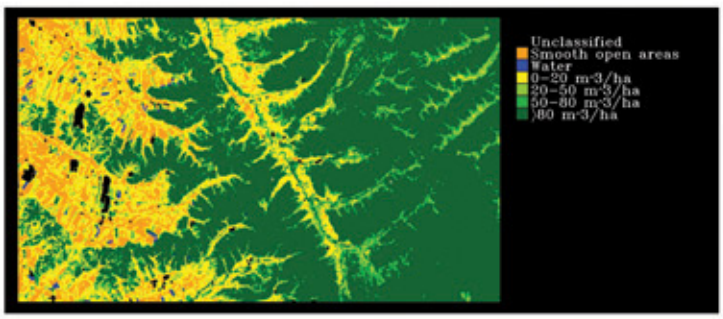
Dr Chen Erxue, Dr Stefan Erasmi, Dr Thuy Le Toan, Dr Jens Nieschulze, Dr Pang Yong, Dr Achim Roth, Dr Maurizio Santoro, Dr Urs Wegmüller, Dr Andreas Wiesmann, Mr Oliver Cartus, Mr Tian Xin, Ms Zhu Haizhen, Dr Li Xiaosong, Mr Julien L'Hermitte

European and Chinese Forest DRAGON investigators discussing field data collection during a test site visit to NE China during October 2005



:: Caption: ERS-1/2 SAR tandem mosaic of NE China acquired 1995 to 1998.
(ERS-1/2 tandem coherence, ERS-1 backscatter, ERS-1/2 backscatter difference)



:: Example of forest biomass map of Small Xing'an Mountains, P.R. China, derived using SIBERIA algorithm on ERS SAR and JERS SAR data

The objective of the Forest DRAGON Project is the development of algorithms for classification of Synthetic Aperture Radar, (SAR), data and Interferometric SAR (InSAR) data, and the generation of forest and biomass maps at regional level for the main forested regions of China.

During the first two years, mapping activities have focused on forests in Northeast China covering the areas of Daxinganling, Xiaoxinganling and the Changbai Mountains. For these areas, databases with in situ measurements have been established. In October 2005 several project partners from Europe and China visited these sites for field work.

The generation of a wall-to-wall forest biomass map of Northeast China is based on multi-temporal ERS-1/2 tandem coherence. For this purpose more than 250 interferometric pairs acquired between 1995 and 1998 have been processed to coherence and backscatter. For forest biomass estimation, ERS SAR coherence and JERS-1 backscatter are considered using the SIBERIA Project classification algorithm.

Map update since the 1990's is based on multi-temporal ENVISAT ASAR AP images in HH/HV mode acquired between fall 2004 and spring 2005. This allows for good discrimination between forests and other land cover types. This suggests the use of such data type for mapping forest disturbance and recovery that occurred after the ERS acquisitions.

In the P.R. China, the main fire regions are in Inner Mongolia, the montane-boreal forest in Northeast and tropical South of the country

:: DRAGON PROJECT ID 2531

Forest Fire Monitoring Demonstration by Satellite Remote Sensing in China

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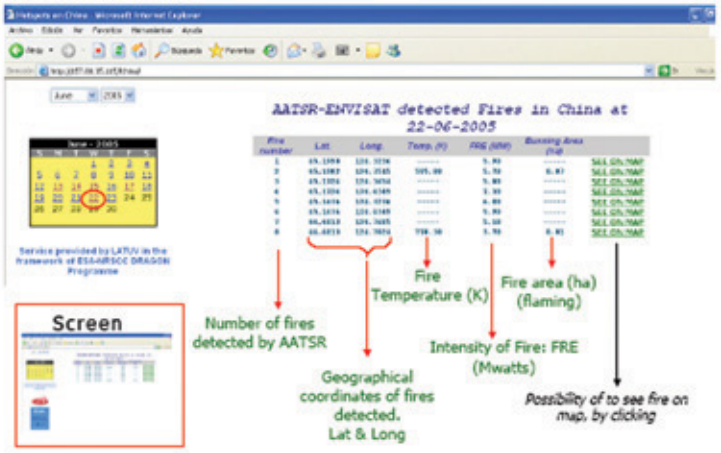
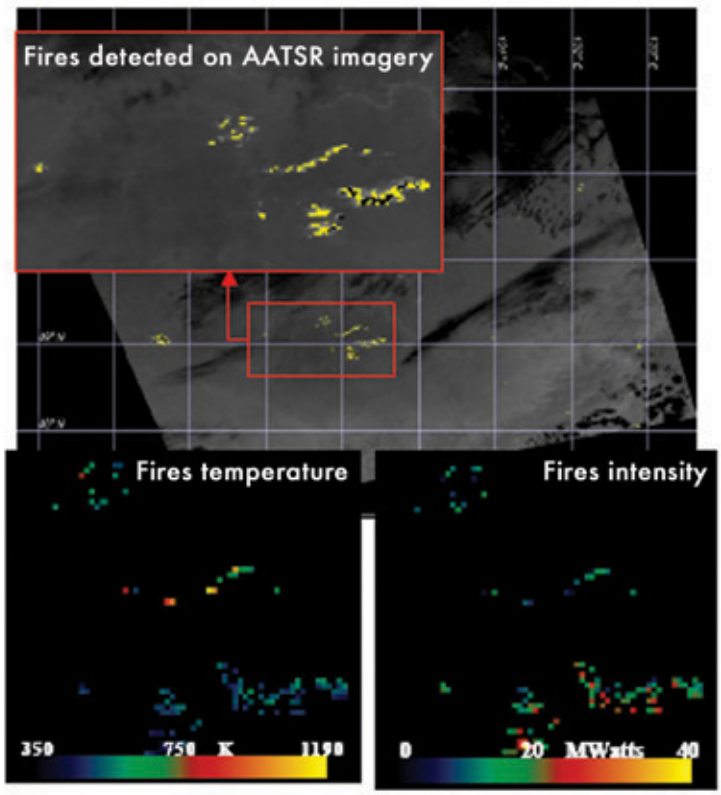
OBJECTIVES

1. To select a forested pilot area in China, which was historically affected by forest fires. This area will be selected by the Chinese partners.
2. To develop a suitable technique to obtain a risk forest fire index by means of AATSR and MERIS images. This risk index will merge several indicators: an indicator of vegetation evolution, an indicator of vegetation humidity, and indicator of meteorological conditions, mainly wind speed, and others. The parameters of this risk index will be adapted to the pilot area taking into account the historical fires and if necessary other factors such as fuel land cover, topographical conditions and so on.
3. To adapt a hot spot detection technique to the fires on the pilot area by means of AATSR images. This technique will include fire temperature detection, burning area, fire thermal power and reaction intensity. The Dozier method, including atmospheric effects will be applied to determine fire temperature and burning area. From these two values, the thermal power of the fire will be obtained. This thermal power is directly related to the destructive effects of fire and other characteristics such as high flame.
4. To set up a suitable methodology for burnt area cartography by means of MERIS and ASAR images.

The deliverables will be operational techniques for risk mapping, hot spot detection and analysis and burnt area cartography, by means of MERIS, AATSR and ASAR images, all of them tailored to the Chinese pilot area.



:: Front end of proto-type web tool for displaying NRT information about forest fires in NE China based on AATSR data, products shown below, Courtesy of Prof. José-Luis Casanova LATUV.



:: DRAGON PROJECT ID 2556

Techniques for Deriving Forest Information from Polarimetric Sar Interferometry

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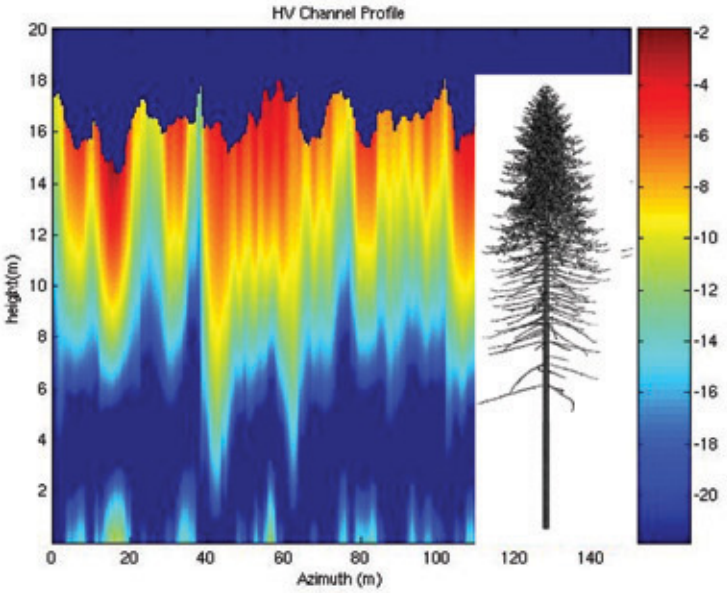
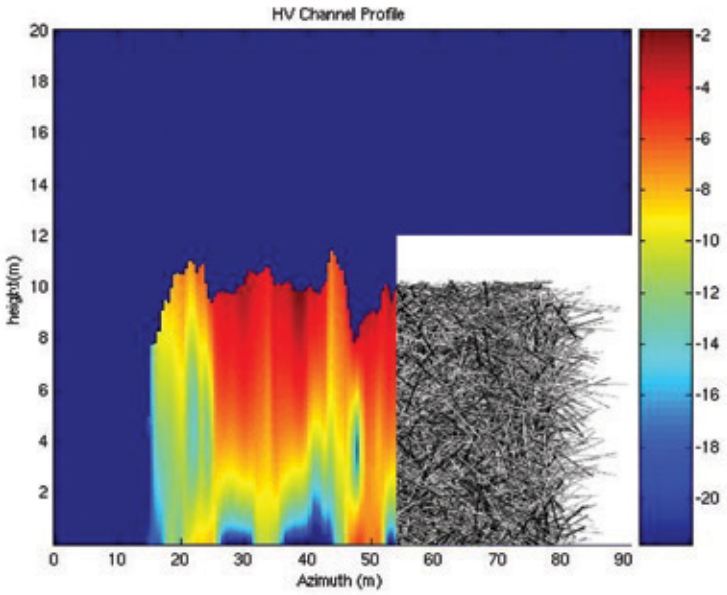
Ground photo of German test site used to retrieve forest height derived from POLInSAR data. This pine forest is heterogeneous in nature due to damage by acid rain.





:: Polarisation Coherence Tomography or PCT which can be used to provide 3-D images of forested terrain from interferometric radar data. Computer simulations are shown for a 10m high uniform canopy and 17m high Scots Pine superimposed on L-band tomograms so detecting changes in vertical structure.

This project aims to bring together, for the first time, experts in POLarimetric Interferometric Synthetic Aperture Radar (POLInSAR) and quantitative forest sciences from Europe and China.

OBJECTIVES

1. To study the potential impact of this new radar technology on forestry applications in China.
2. To review the current status of POLInSAR research in China and Europe and enable technology transfer where required.
3. To establish possibilities for future collaborative research aimed at development and validation of quantitative forestry remote sensing applications using POLInSAR techniques.

Prof. Fabio Rocca with members of the Topographic Measurement project team at Wuhan University, P.R. China November 2005

:: DRAGON PROJECT ID 2567

Topographic Measurement

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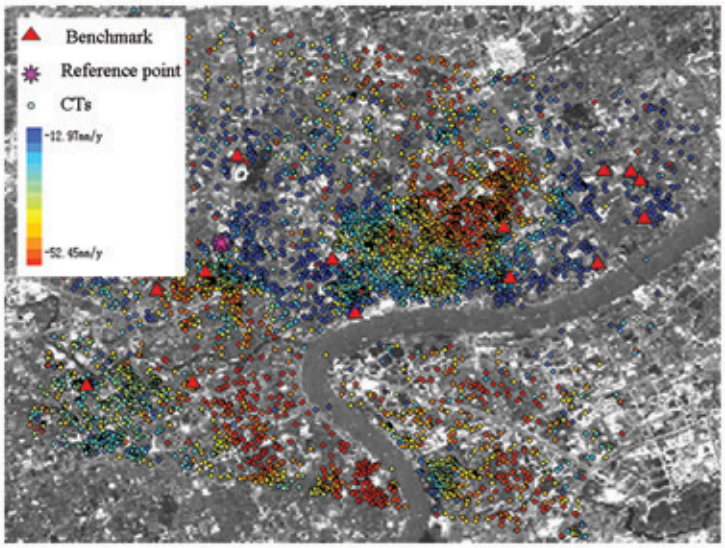
OBJECTIVES

- Urban subsidence
- Landslide analysis & monitoring
- Three Gorges Dam site stability
- Identification of flooded plain based on coherence

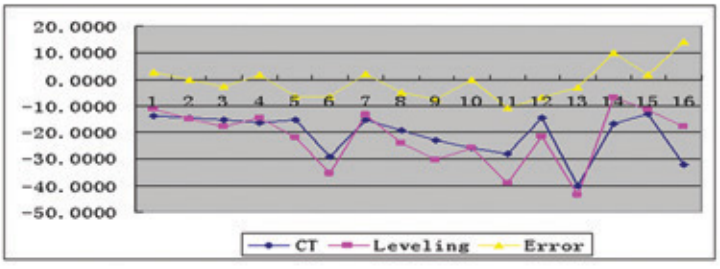
The scientific investigations will focus on the application on topographic mapping and earth deformation monitoring by Envisat/ASAR data. ASAR data offer an evident potential in this field because there are large zones covered with cloud and mist through the year in many areas of China. Interferometry using Synthetic Aperture Radar (SAR) data gives researchers a new set of tools to measure topography, tiny shifts and deformations in the Earth's surface, valuable in the study of landslides, urban subsidence, earthquakes, floods and other natural cataclysms in China.

This project responds to the ESA mission objectives on the following aspects:

- Evaluation of potential applications of ASAR data in generating DEM and monitoring the earth deformation;
- Investigation of the method for synthetical application of ERS-1/2 data and ASAR data;
- Development of relevant algorithms and data processing procedures;
- Cost-benefit analysis for Technology Transfer from European partner to Chinese partner to speed up the technical diffusing in China and explore the applications of ESA data in topographic measurement, such as the permanent scatterer in long-term deformation monitoring.



:: Preliminary results for Shanghai, average displacement rate of coherent targets (CTs) from a time series of ERS SAR images (1992 – 2000) with the distribution of ground benchmarks for levelling surveys



:: Comparison of subsidence velocities between CTs and benchmarks (nearest neighbour with benchmarks) shows that the distribution tendency of subsidence from CTA method is consistent with the levelling data in the benchmarks and that there are few coherent targets with large bias which is the subject of further investigation

:: DRAGON PROJECT ID 2577

Seismic and Inter-seismic Deformation Across Two Main Strike-slip Faults of Tibet (The Kunlun and the Haiyuan Faults) from conventional and Permanent Scatterers INSAR

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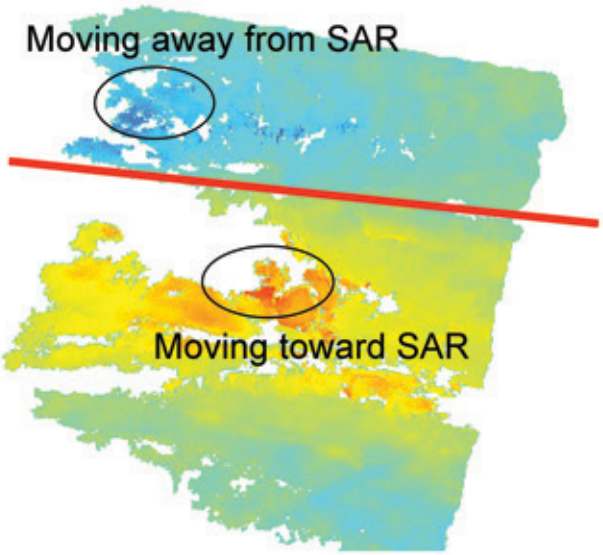
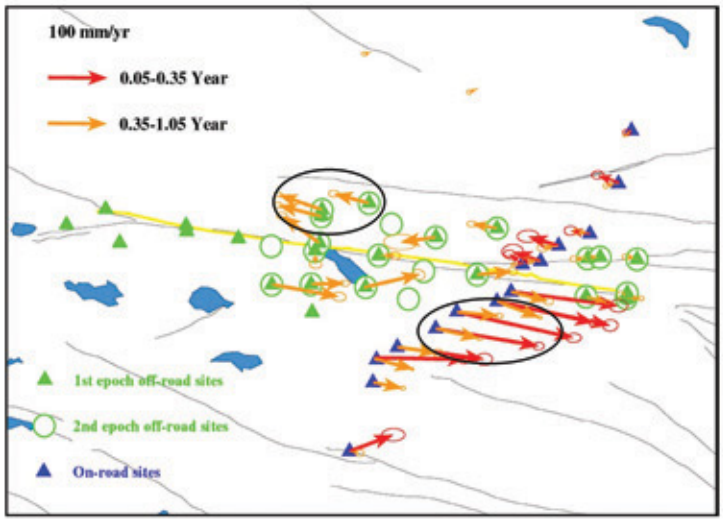
Prof. Xu Xiwei, Prof. Evangelos Lagios,Prof. Shen Zheng-kang, Ms. Liang Fang

Surface rupture zone of Kokoxili earthquake crossing Gelmod-Lhasa Road in N80W direction at the 2894 km road-marker. (Photo towards the west), Courtesy of Prof. Xu Xiwei



:: INSAR post-seismic deformation measurements of the Kokoxili Mw7.8 earthquake (11/14/2001) (ERS2 data: 12/15/2001~01/19/2002)



:: GPS post-seismic deformation measurements along the Lhasa-Golmd Road and the east rupture of the Kunlun fault (18~128~383 day after the Kokoxili Earthquake)

Seismic and Interseismic deformation along the Kunlun fault (PI: Sun Jianbao)
Long time series ERS and Envisat ASAR InSAR and PS InSAR will be used to investigate potential slip rate along the Dongdatan-Xidatan segment, the possible triggering effects of the Manyi earthquake on the Kokoxili earthquake, as well as the effects of the Kokoxili earthquake on the seismic hazard potential of other segments of the Kunlun fault.

Interseismic deformation across the Haiyuan fault (PI: C. Lasserre)
The interseismic strain across the Haiyuan fault system using the Permanent Scatterers technique will be mapped. Standard DInSAR processing methods revealed poor phase coherence on test interferograms, due to the loess cover. GPS data across the fault will provide control points on the InSAR measurements.

Northwest end of Xianshuihe Fault (PIs: E. Lagios and Shen Zhengkang)
The fault is seismically active at present with around 9-10 mm/yr left-slip across the Xianshuihe fault. A rate measurable by INSAR with a 4-5 year time scale if the coherence is high enough between SAR acquisitions. The InSAR results will be compared with GPS data collected from the Crustal Motion Observation Network of China between 1998 and 2001.

Yadong-Gulu Rift (PIs: E. Lagios and Shen Zhengkang)
This rift system is the most important in southern Tibet. It has a high West –East extention rate (about 5-7mm/yr) according to the recent GPS studies.

Qianjiangping landslide happened just a month after the Three Gorges Dam was closed to store water in 2003. Courtesy of Dr. Jian Guo Liu.

:: DRAGON PROJECT ID 2558

Monitoring the Landslides in Three Gorges Area by Using Corner Reflector Differential SAR Interferometry

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Dr. Xiaoguang Hao, Dr. Zhenhong Li, Dr. Jian Guo Liu, Dr. Ye Xia, Prof. Jingfa Zhang, Prof. Zhuxi Ouyang

OBJECTIVES

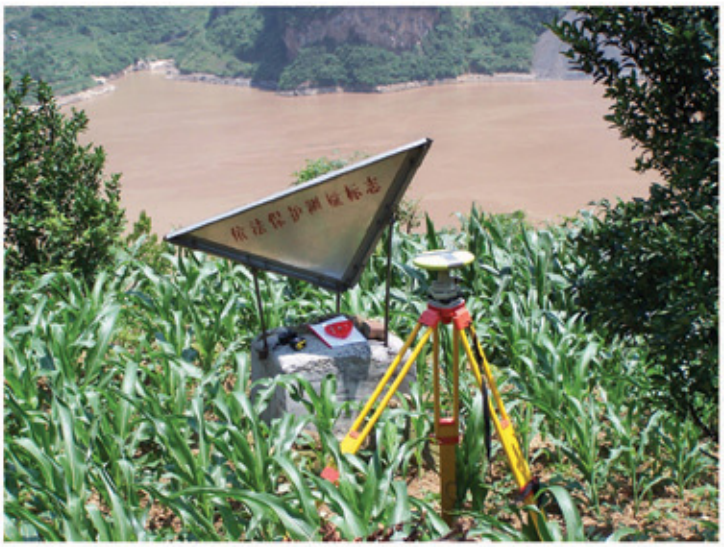
1. Measuring and monitoring landslides
2. Investigating Corner Reflector and Persistent Scatterer Interferometry (PS) techniques and their application in China
3. Studying atmospheric correction techniques for InSAR
4. Investigating the relationship between the rising water levels and landslide frequency

METHODS

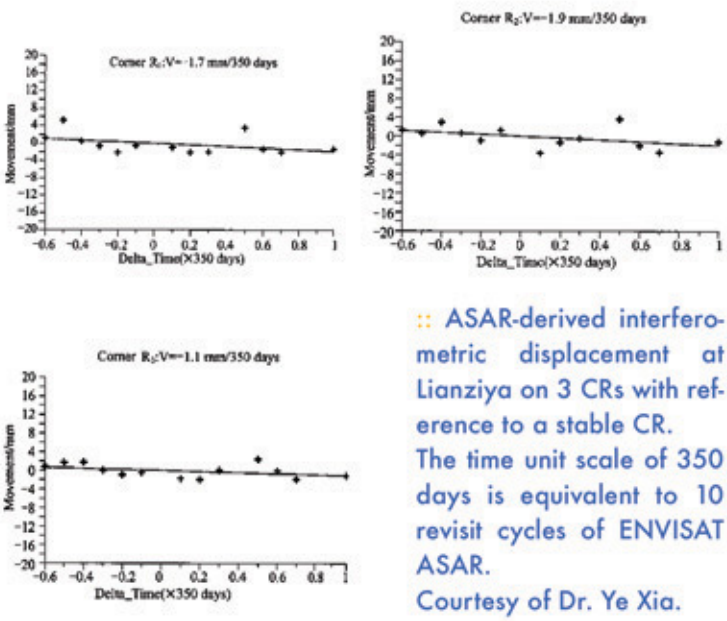
1. Identification of corner reflectors from co-registered SAR-SLC data
2. Identification of natural PS targets
3. Interferogram generation and removal of topographic and differential signatures
4. Correction of atmospheric phase corruption using GPS and MERIS WV
5. Association of differential phase with stable corner reflector targets
6. Validation of InSAR results with GPS benchmarks
7. Interpretation of results in the context of rising water levels

MILESTONES

1. Install 40 corner reflectors around the areas affected
2. Acquire ERS and programme ASAR datasets
3. Produce the best possible topography
4. Perform repetitive GPS site inspections
5. Process narrow swath interferograms
6. Develop wide-swath interferometry system for wide area monitoring
7. Assess the potential of using GPS and MERIS for atmospheric correction
8. Assess flood monitoring potential
9. Assess erosion of upstream areas and their contribution to sediment load
10. Validation, analysis and interpretation



:: Example of repetitive GPS measurement at a corner reflector (CR) site



:: ASAR-derived interferometric displacement at Lianziya on 3 CRs with reference to a stable CR.
The time unit scale of 350 days is equivalent to 10 revisit cycles of ENVISAT ASAR.
Courtesy of Dr. Ye Xia.

:: DRAGON PROJECT ID 2551

Assessment of the Synergistic Exploitation of Envisat ASAR and MERIS Data for Plain Flood Rapid Mapping and for Flood Support Risk Management

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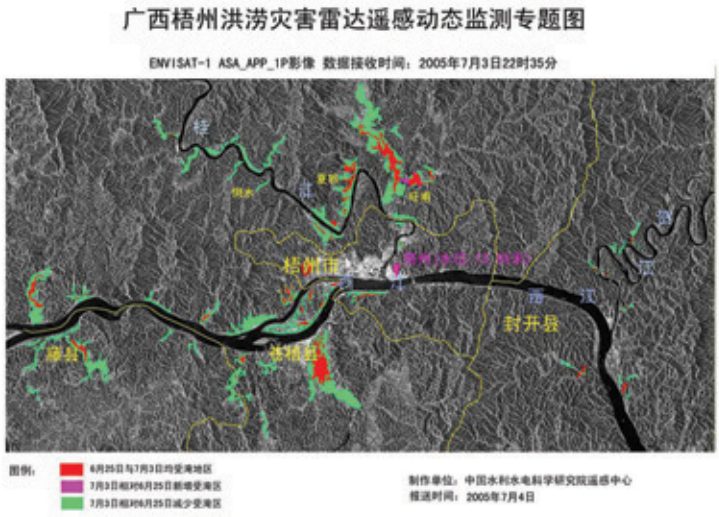
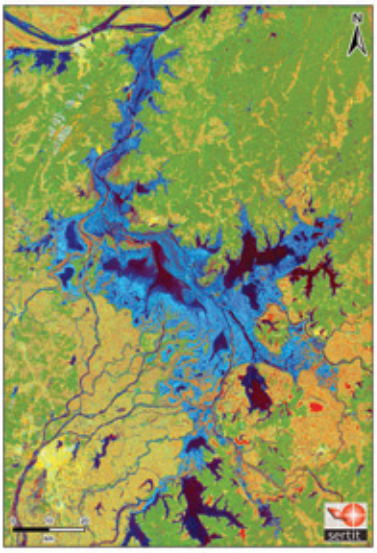
The flooded Xijiang River overflowing the embankment of Hedong district, Wuzhou city on 22 June 2005, Courtesy of Prof. Li Jiren, Institute of Water and Hydropower Research, Beijing.



:: An example of NRT results : Multitemporal analysis of the Wuzhou floods of summer 2005 exploiting ASAR IMP and APP data acquired within a week, respectively the 25-06-2005 and the 03-07-2005; Green = water extend on the 25-06, Red = area still under water on the 03-07 (Courtesy of Pr LI Jiren, IWHR, Beijing).



:: Poyang lake water bodies' modification between January to August 2005 based on the exploitation of ASAR WSM time series. Cyan = infilling of lake, Dark blue: semipermanent water bodies, Red = water draw-off and /or vegetation growth over water bodies (Courtesy of R. ANDREOLI, SERTIT, Strasbourg)

An assessment of the Envisat data is carried out to define the optimum ASAR configuration and synergistic exploitation with MERIS data for flood mapping and monitoring. Project goals are to insure thematic accuracy and maximize coverage and revisit over the tests sites well representative of Asian major flood plains and Mediterranean fast flood, CEVENOL phenomenon.

Over these wide areas yearly affected by flooding, it is also essential to elaborate and to test an assimilation procedure taking in account all the major acquisition parameters influencing/disturbing the SAR signal. The project has already delivered major steps in term of ASAR and MERIS data processing, and information merging for mapping and monitoring.

Robust and semi automatic flood procedures, within a time series exploitation context, have been defined and are actually tested in order to provide an ASAR fast processing tool for Near Real Time (NRT) flood mapping actions. Furthermore, eleven successful NRT mapping actions exploiting ENVISAT emergency programming have been carried out during the 2005 flood season, plus the Songhua benzene pollution.

Studies will link meteorological and hydrological simulation models and damage assessment on off line mode (to generate RISK MAPS associated to impacts of flood corresponding to various return periods).

Chinese and European scientists during a field visit to Huaihe in 2005

:: DRAGON PROJECT ID 2584

Satellite Tools for Water Resources Assessment and Management at River Basin Scales

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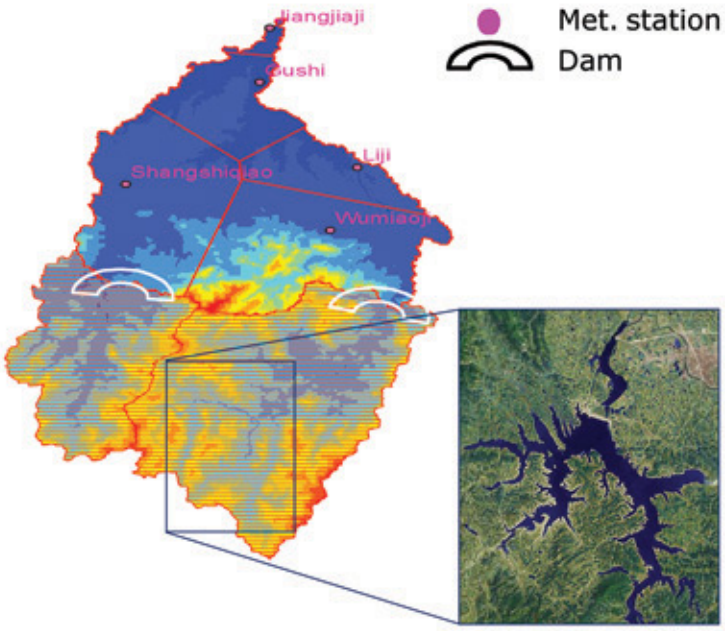
Prof. Li Jiren, e-mail: Lijiren@iwhr.com

Mr. Charles Baubion, Prof. Benoit Deffontaines, Prof. Paolo Gamba, Prof. Gong Huili, Prof. Emmanuel Ledoux, Prof. Li Jing, Dr. Marianthi Stefouli, Dr. Xin Jingfeng

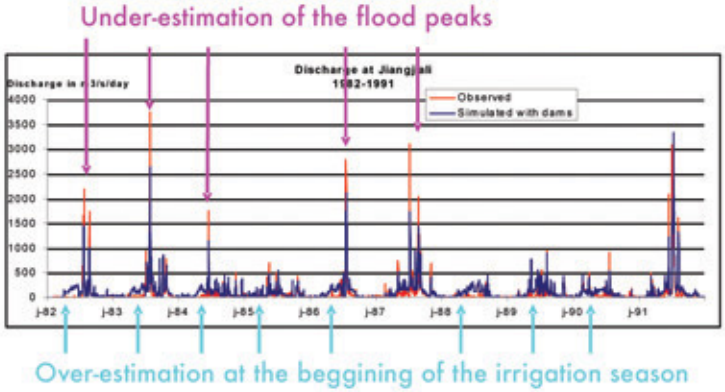
For this project, the Huai River basin in China (270,000 km²) was selected, facing severe water management problems (flooding, irrigation). The Shiguanhe sub-catchment was used as a test area (see figure top). The distributed flow model MODCOU was applied using satellite images for the morphology (DEM, river network) and land use. Ground data for soil maps, rainfall, temperature, potential evapo-transpiration and stream discharge from 1982 to 1991 were also used.

The results (see figure bottom) show the observed and calculated discharge at the Jiangjiali outlet. The fitting is relatively good, indicating that the major hydrological processes are well represented; the flood peaks are however underestimated and the flow is overestimated during the irrigation season. The inferred reasons are : (I) early in the irrigation season, all the small dams are filled, withdrawing water; (II) the water released by the two large reservoirs is used for irrigation; (III) during large floods, water from other sections of the Huai river may be transferred to the Shiguanhe basin; (IV) rainfall estimates for large floods may be biased, for a lack of rain gauges in the upper part of the basin.

Future work will first improve the representation of the irrigation system, using remote-sensing data to better characterize the land-use (extent of the free-water areas along the year), to determine the position of transfer and irrigation channels, and to understand the operation rules of the system. Once the model is calibrated, different management options will be tested, under present or future climate scenarios.



:: Sub basin division and the distribution of met. stations and dams in the study catchment area. The hydrology of southern sections (stripped) is controlled by large reservoirs (the image shows the Nian yu Shan reservoir in the Shiguanhe watershed)



:: Results of simulated and observed discharge at Jiangjiali gauging station

:: DRAGON PROJECT ID 2608

Drought Monitoring and Prediction over China

Prof. Youqi Chen, e-mail: Chenyqi@mail.caas.net.cn
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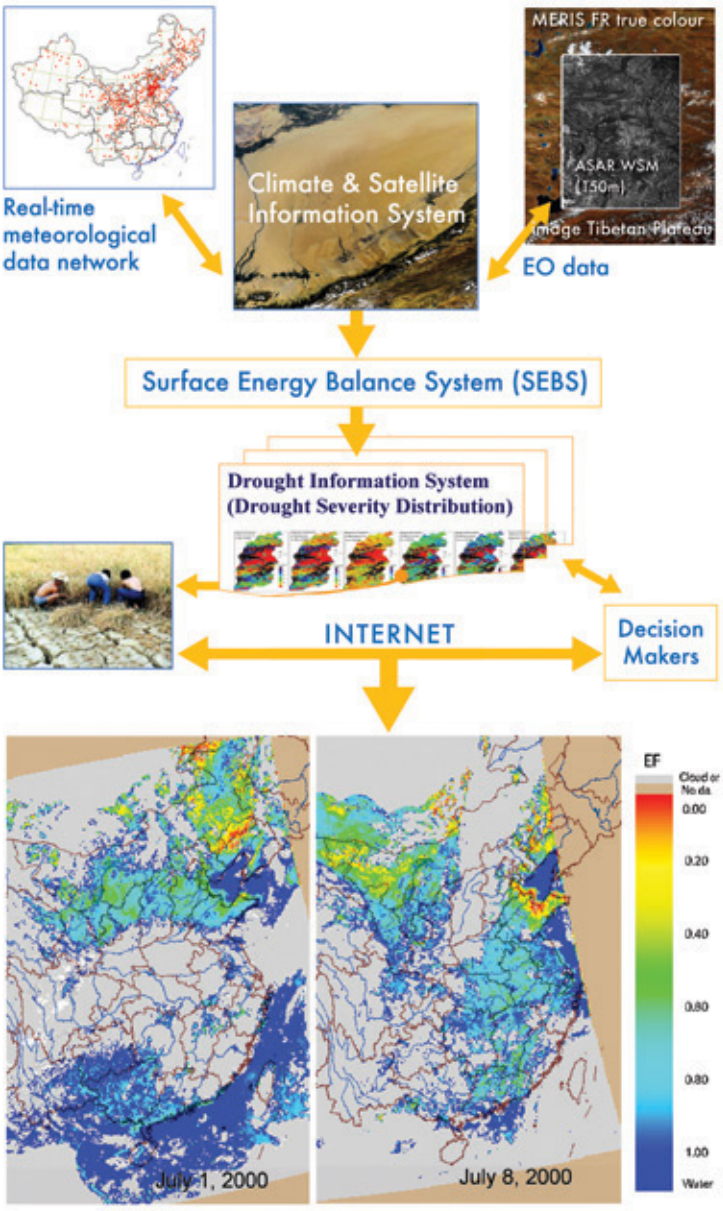
Dr. Cristos Gainnakopoulos, Dr. Yanbo He, Mrs. Caixing Li, Prof. Li Jiren, Prof. Li Wan, Prof. Zhao-Liang Li, Prof. Qinhuo Liu, Prof. Yaoming Ma, Prof. Massimo Menenti, Dr. Michael Petrakis, Dr. Tom Rientjes, Prof. Jose Sobrino, Prof. Peter Troch, Mr. Rogier Van de Velde, ir. Kees van Diepen, Dr. Wout Verhoef, Dr. Liming Wang, Prof. Jun Wen

Heterogeneous cropping and ground conditions during the 2005 Loess plateau LOPEX05 experiment, P.R China



:: SEBS will combine meteorological, ground and satellite data to provide an on-line drought monitoring system. ASAR WSM imagery (top right) will help fill in the gaps in areas with persistent cloud cover (After B. Su et al. 2003)

The drought project combines satellite observations acquired by Envisat and "state of the art" land surface modeling in order to improve simulations of drought related state variables, such as root zone soil moisture and surface temperature. This data will be used to feed an operational on-line drought monitoring system for nation wide application. The thermal and optical observations acquired by the Advanced Along Track Scanning Radiometer (AATSR) will be employed to determine an energy balance based Drought Severity Index (DSI, Su et al. 2003). Further, medium resolution (~150 metres) Advanced Synthetic Aperture Radar (ASAR) observations will be used to detect moisture changes in the top 5 cm soil layer independently of cloud and daylight conditions, factors which are limiting for optical sensors.

The algorithms used to retrieve the DSI and surface soil moisture from satellite observations and land surface modeling results will be validated using ground observations collected in four major study areas: 1) Tibetan Plateau, 2) Heihe river basin, 3) Loess Plateau, 4) Beijing area and Hebei province. In collaboration with the Chinese Academy of Sciences (CAS) a field experiment was conducted on the Loess Plateau (LOPEX05) to improve the satellite retrieval of soil moisture and latent heat flux in an agricultural heterogeneous environment. In the past year, an extensive data set of ESA optical and ASAR scenes have been collected over the Tibetan Plateau and Loess Plateau.

Waves caused by typhoon Khanun striking Cheguan Dock, Wenling City, Zhejiang Province, P.R. China on 11 Sept. 2005.

:: DRAGON PROJECT ID 2615

Coupling and Variability of the Southeast Asian Monsoon and Ocean Systems (SAMOS)

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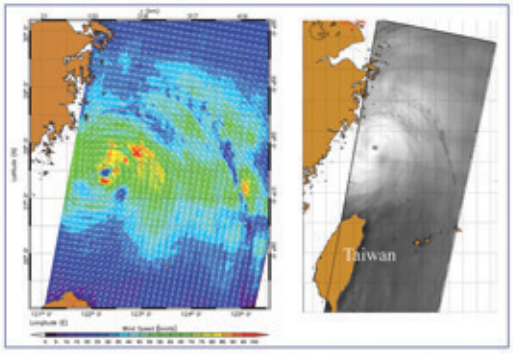
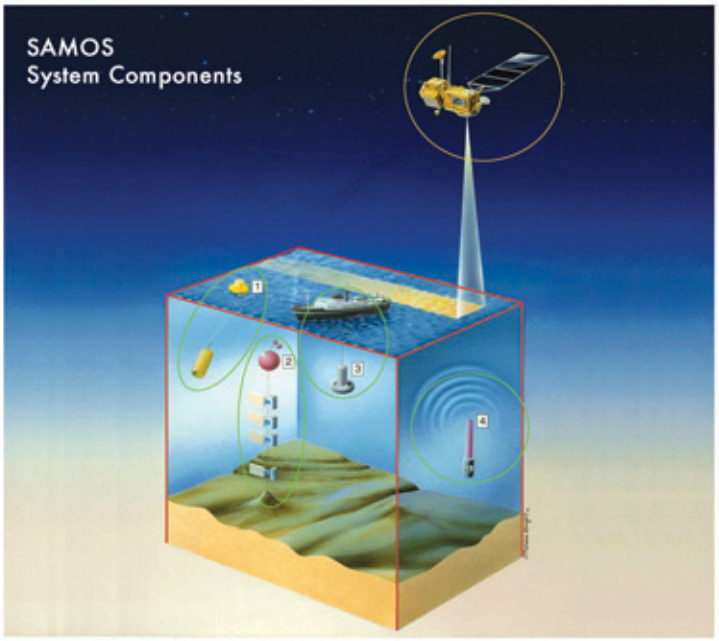
Prof. Helge Drange, Prof. Ming-Xia He, Dr. Bertrand Chapron, Prof. Zifa Wang, Dr. Laurent Bertino, Dr. Knut-Frode Dagestad, Lasse Pettersson, Prof. Pucai Wang, Prof. Liu Yi

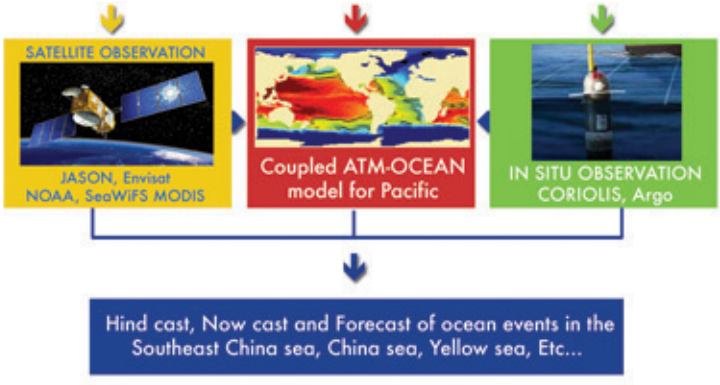
The coupled Southeast Asian Monsoon and ocean system is a regular seasonal climate feature of the region that has profound and coupled connection with and impact on the atmospheric and ocean circulations in the region. This in turn leads to changes both in the near surface wind field, sea surface temperature, evaporation and precipitation signals. By the systematic use of coupled atmosphere-ocean models and inter-comparison and validation with satellite observations, the aim of the project is to advance the ability to understand and predict the dominant interactive coupling processes. The key study quantities are ocean currents, fronts, eddies, waves, near surface wind, SST, precipitation water quality and atmospheric and ocean pollution. To this aim, primarily data from ASAR and MERIS onboard Envisat is used, in synergy with numerical models and remotely sensed data from other satellites.

More than 200 Envisat ASAR Wide Swath scenes have been examined, and several interesting oceanic and atmospheric features have been identified and analysed. The ASAR image shows one the typhoon "Khanun", which struck Shanghai on 11 Sept 2005 and killed at least 14 people. The imprint of the strong wind on the short surface waves can be seen on the ASAR image. The coloured image shows the wind speed calculated solely from the ASAR image using the CMOD-algorithm with the specialised software "SARTool" developed by BOOST.



:: ASAR image (left, near) of the typhoon Khanun and corresponding wind speed (left, far) calculated solely from the ASAR image using the SARTool software package (courtesy BOOST)





:: DRAGON PROJECT ID 2579

Dragon-Star - Exploitation of GOMOS and MIPAS Measurements for Studying the Change in the Middle Atmosphere

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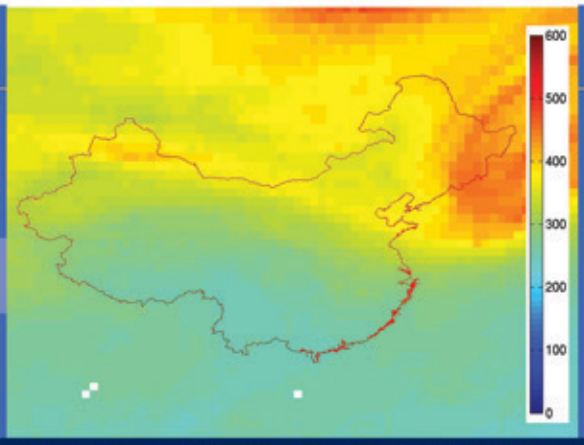
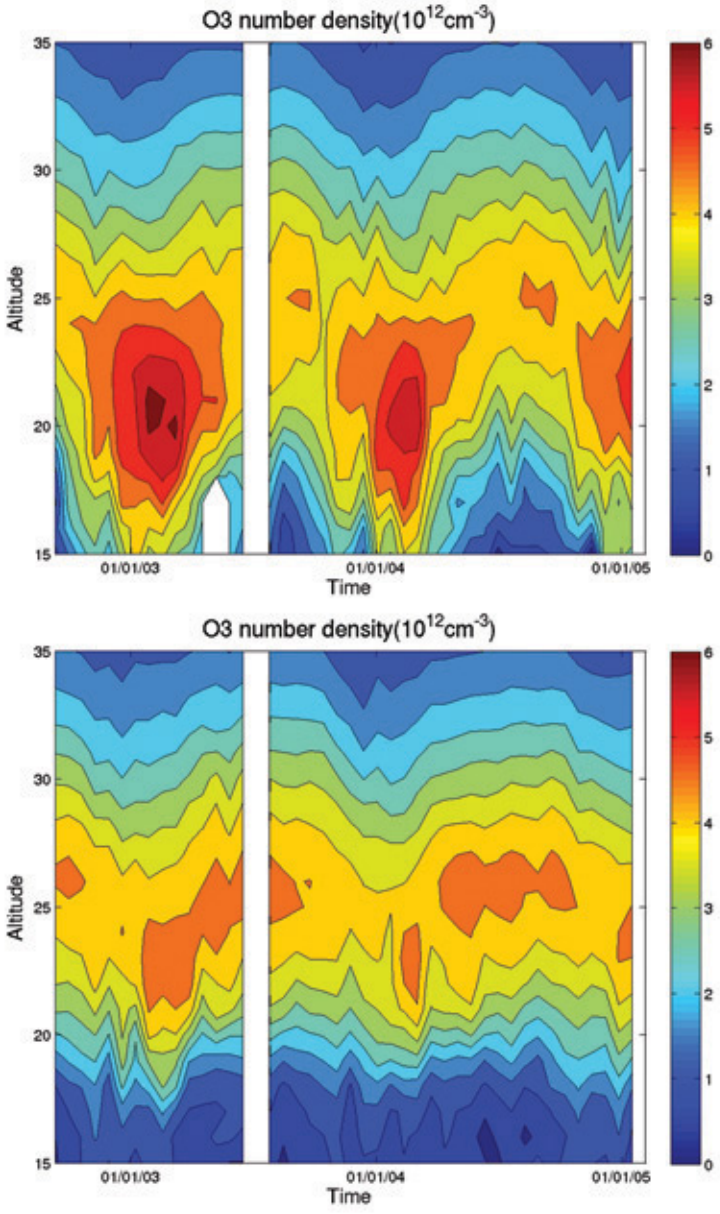
Dr. Dimitrios Balis, Prof. Bruno Carli, Dr. Seppo Hassinen, Dr. Hu Liqin, Dr. Kostas Kourtidis, Dr. Esko Kyro, Ms. Li Xiaojing, Dr. Johanna Tamminen, Prof. Christos Zerefos



A typical total ozone field in winter time over China (16.1. 2005) measured by OMI on EOS-Aura. The northern parts of China are covered with an ozone rich air mass (shown in orange and yellow).



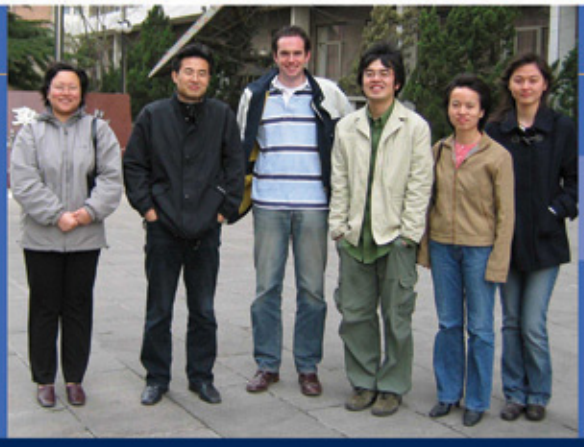
:: The variation of the vertical distribution of ozone situation in the northern part of China (latitude more than 30°N), top, and the the southern part of China (latitude smaller than 30°N), bottom.

In this project we will seek opportunities to enhance the exploitation of Envisat data (from GOMOS and MIPAS) and OMI data for atmospheric research. OMI is a joint effort of KNMI, NASA, and FMI, and is managed by NIVR/Netherlands.

A joint project between the GOMOS Expert Support Laboratory FMI and the MIPAS laboratory IFAC and the Chinese Team at National Satellite Meteorological Center (NSMC) provides experience on how expert instrument teams and a normal data user team can work together in using rather complicated data from GOMOS and MIPAS. The data access for GOMOS will first be provided by FMI but eventually it should be possible to access data by the public domain tools developed by ESA and FMI and by the cooperative tool development effort by the teams.

GOMOS and MIPAS data will be used for middle atmosphere studies on local and global scale problems. For example, the two figures on the left show the development of ozone vertical profiles as measured by GOMOS between 1.9. 2002 and 25.1. 2005. Notice that the ozone layer in the north shows a large variability with largest ozone values during winter and spring. In the south the ozone layer is more stable but also weaker. An important part is validation comparisons between GOMOS, MIPAS and the Chinese ground stations. Over time, larger data sets and assimilation tools will be used to study the middle atmosphere processes and change.

Common research projects for Chinese and ESA earth observation satellites will be investigated.



Dragon Air Quality Monitoring and Forecasting team members at the National Satellite Meteorological Center, Beijing.

:: DRAGON PROJECT ID 2580

Air Quality Monitoring and Forecasting in China

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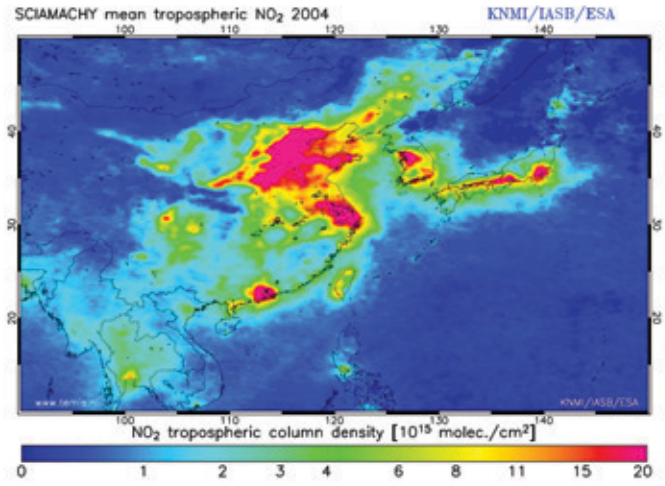
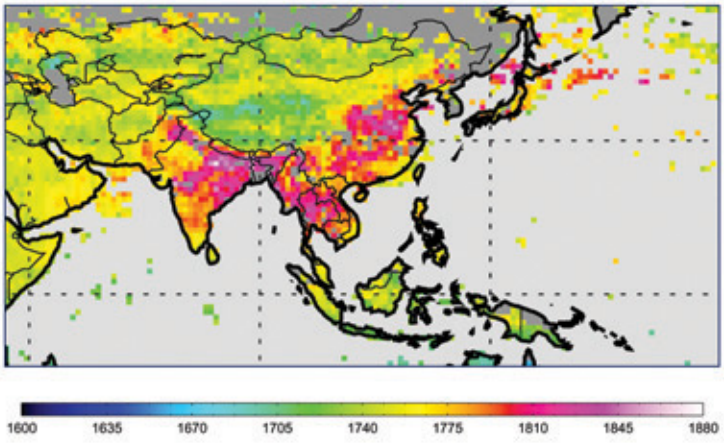
This project focuses on the monitoring and forecasting of air quality of China and its environment. The trace gases ozone, nitrogen dioxide, sulphur dioxide, carbon monoxide, methane and aerosols are being retrieved from satellite observations of ERS-2, ENVISAT and AURA. In China air pollution and green house gas emissions have become an increasingly important problem due to large-scale fossil fuel combustion related to an increasing energy demand and inherent fuel consumption. Other important emission sources are biomass burning, wind-blown dust and volcanic eruptions. The largest contributors of anthropogenic methane production are fossil fuel production, ruminants, rice cultivation and waste management. The quantification of the concentrations near the sources and the subsequent transport of pollutants is essential to monitor air pollution conventions. Forecasting of air pollution is important to warn and inform the general public.

For monitoring these trace gases existing retrieval methods will be combined with data assimilation techniques to determine the tropospheric component of the quantified trace gas concentrations.

Using data assimilation in combination with meteorological forecast fields from ECMWF allows us to make forecasts of the air pollution levels. The retrieval methods will be validated by intercomparison of different retrieval algorithms and by comparison to ground based measurements in China. The combination of model results and satellite retrievals will improve our understanding of the air quality over China.



:: Temporal series of satellite observations can be used to monitor the distribution and concentration of atmopsheric pollutants, in this case NO_2. Notice high concentration in densely populated regions East of China and Hong Kong.



:: SCIAMACHY measurements of column averaged methane VMR in ppb units. Notice high concentrations of methane production over China and SE Asia as a result of rice cultivation. Averaged measurements in the period August to November 2003, from Frankenberg (et al.) Science, Vol. 308, 13 May 2005.

:: DRAGON PROJECT ID 2566a

Oceanography from Space - Internal Wave, Ocean Wave, Shallow Water Topography, Ocean Color, Kuroshio Current

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Dragon Oceanography from Space European and Chinese team members in Xiamen 2004

Chinese PIs	European PIs
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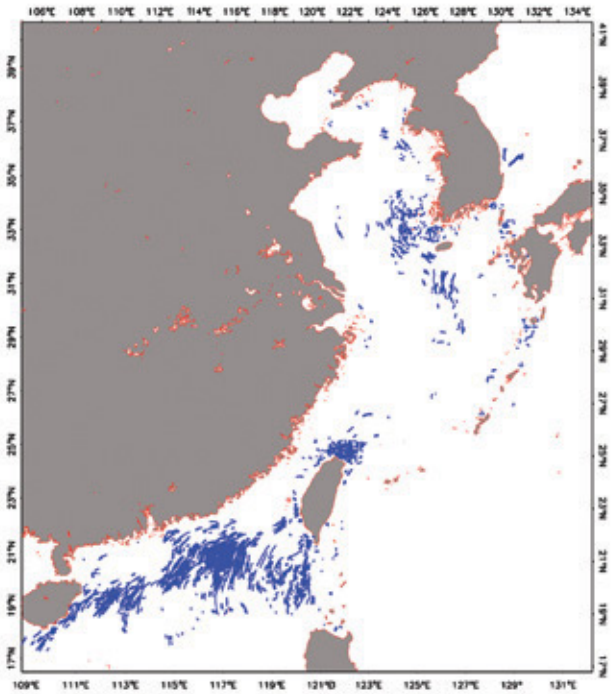
Prof. Zhi-shen Liu	Dr. Roland Doerffer
Dr. Lei Guan	Prof. Andre Morel
Dr. Kan Zeng	Prof. Johnny Johannessen
Prof. Tinglu Zhang	Prof. Jürgen Fischer
Dr.Mingqiang Fang	Dr. Pierre-Yves Le Traon
Dr. Jun-Min Meng	Prof. David Llewellyn-Jones
Dr. Yi Ma	Dr. Bertrand Chapron
Prof. Chao-Fang Zhao	Dr. Susanne Lehner
Prof. Hong-Ping Li	
Prof. Tao Du	
Dr. Xue-En Chen	
Dr. Ke-Ping Du	
Prof. Ming-Hui Zhu	
Prof. Jun-Wu Tang	



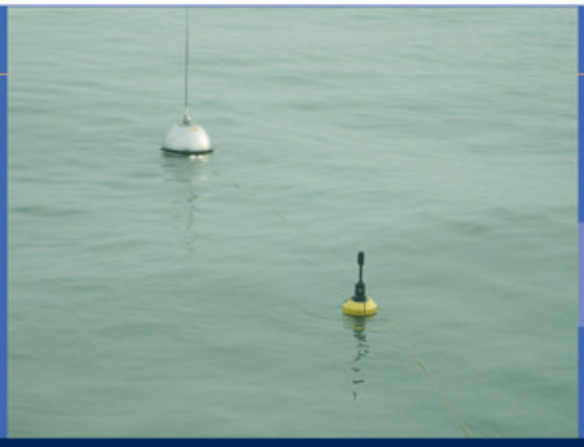
:: The distribution of internal wave signatures in the China Seas obtained from analyzing the available satellite images

The objectives of the proposal are to study the following topics using ENVISAT multi-sensor data:

- Distribution and characteristics of internal waves in the China Seas;
- Spatial and temporal characteristics of ocean wave directional spectrum in the China Seas;
- Detecting method for shallow underwater bottom topography;
- Retrieval methods for ocean colour in the China Seas;
- Impact of the variation of the Kuroshio on oceanic processes in the China Seas and Global climate change.

INTERNAL WAVE

In this study, about 800 images with internal wave signatures are found out from approximately 15.000 satellite images acquired between 1994 and 2004, which SAR and optical images occupy half and half respectively. The large number of internal wave images ensures the rationality of the statistics. The distribution of internal waves in the China seas based on the decadal timescale internal wave images is shown in the left figure. The China seas are roughly divided into 5 areas, i.e., Yellow Sea, East Sea, Taiwan waters, DongSha Island waters and Hainan Island waters. There are no internal waves observed in the areas of Yellow Sea, East Sea and Hainan Island in winter. However, internal waves can be observed in the areas of Dongsha Island and Taiwan for the whole year. In all the areas, summer has the highest occurrence of internal waves (see histograms on page 32).



Hyper-TSRB collecting Rrs(λ) data during sea truth campaign April 2006

:: DRAGON PROJECT ID 2566b

Oceanography from Space - Internal Wave, Ocean Wave, Shallow Water Topography, Ocean Color, Kuroshio Current

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Prof. Ming-Xia He, e-mail: mxhe@orsi.ouc.edu.cn

OCEAN WAVE

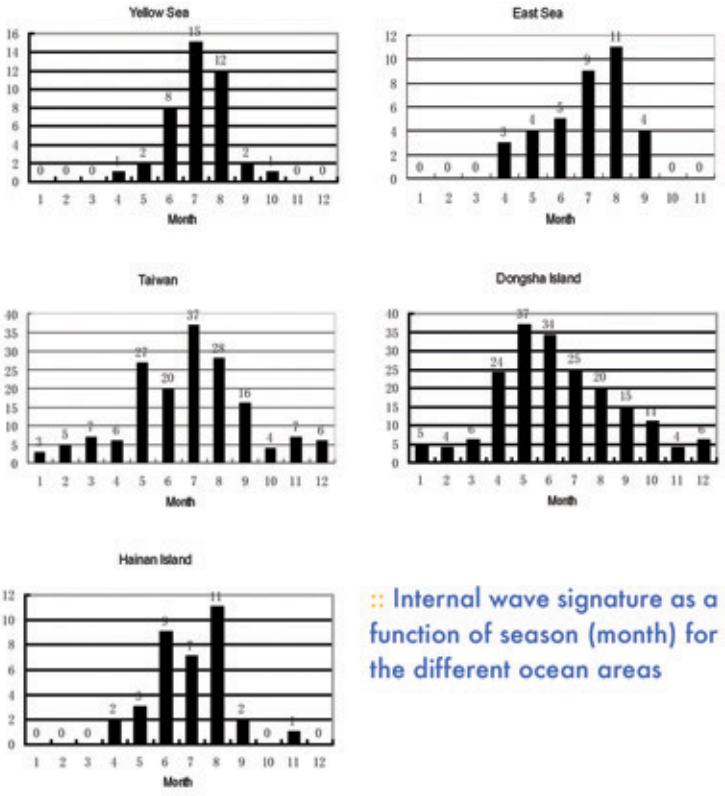
Comparison of several methods for retrieving ocean wave directional spectrum in the China Seas. Software running in the Windows system for ocean wave directional spectrum retrieval by SAR data using Hasselmann's method has been developed.

SHALLOW WATER TOPOGRAPHY

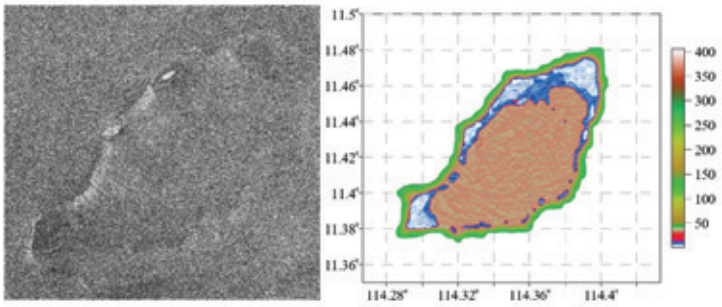
Developing shallow water topography detection technology using SAR data. Analytical and numerical models will be developed to extract information about underwater bottom topography from ASAR data based on SAR imaging mechanisms and a dynamical model (example shown bottom figure).

RED TIDES

Red tides develop mainly in coastal areas and they affect directly fishing and shell fish industries. Red tides can even be toxic to humans and are caused by the dense growths of bacteria and algae. They are increasingly common due to heavy pollution from sewage and industries along the densely populated east coast of China and the Yangtze River. An objective is to develop techniques and data sets using optical satellite sensors to map the duration and extents of such tides. Results from spectrometer measurements show that Red tides have quite characteristic spectral response (results reported in 2005).



:: Internal wave signature as a function of season (month) for the different ocean areas



:: Envisat ASAR sub-image acquired over Shuangzi Reefs in the South China Sea on August 18, 2004 (left) and retrieved bottom topography from the corresponding images (right).

:: DRAGON PROJECT ID 2566

Oceanography from Space - Internal Wave, Ocean Wave, Shallow Water Topography, Ocean Color, Kuroshio Current

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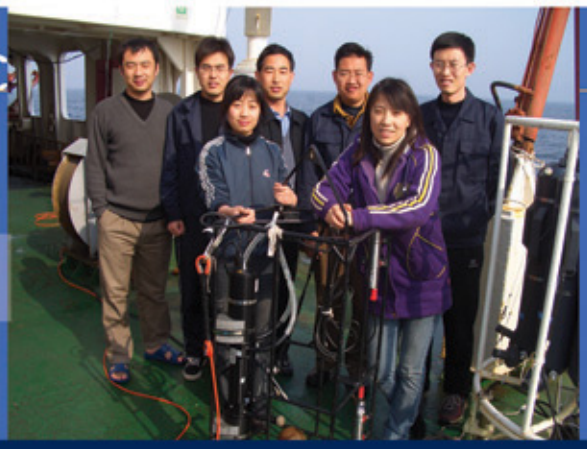
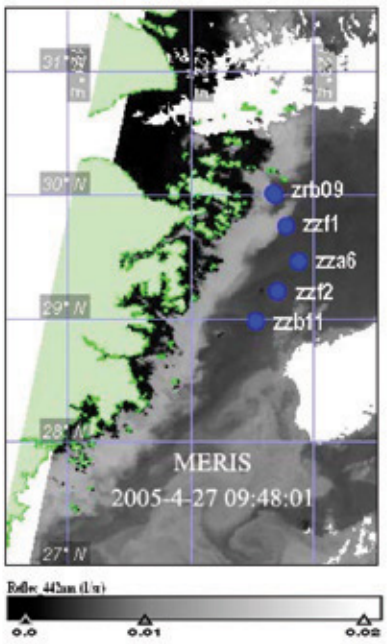


Ocean optics in-situ experiments group Apri.18-29, 2006



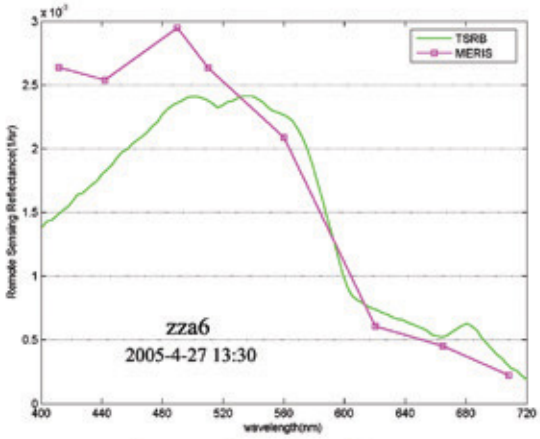
:: MERIS reflectance image and sea truth sampling points shown in blue on the MERIS image in the East China seas

OCEAN COLOUR

The study will investigate retrieval, validation and application of MERIS data in the China seas. A database of the IOPs of oceanic and atmospheric constituents in the China Seas will be developed.
An ANN-based bio-optical algorithm for MERIS data in the China Seas will be developed and compared with the semi-analytical algorithm. A methodology for monitoring red tide events in China coastal seas using MERIS and other satellite data will also be developed.

KUROSHIO CURRENT

In this study, decadal-scale satellite SST, SSH and SSW will be assimilated in a numerical model that has already been developed.



:: Comparison of in-situ (TSRB) and MERIS remote sensing reflectance (Rrs) in East China Sea (N.B. notice that from 400 to 540 nm MERIS reflectance is higher than TSRB)

OUC Ocean research vessel "Dong Fang Hong 2" used to collect sea truth data

List of Institutions Cooperating in the Dragon Programme

* Aristotle University of Thessaloniki, Greece
Capitol Normal University, China
o Beijing Information Research Management Center, China
BIRA, Belgisch Instituut voor Ruimte-Aëronomie, Belgium
BRGM, Bureau de Recherches Géologiques et Minières, France
o Bureau for International Cooperation, China
Cemagref, Institut de Recherche pour l'Ingénierie de l'Agriculture et de l'Environnement, France
o CERC, Cambridge Environmental Research Consultants, United Kingdom
CESBIO, Centre d'Etudes Spatiales de la Biosphère, France
China Seismological Bureau, China
Chinese Academy of Forestry, China
Chinese Academy of Meteorological Sciences, China
Chinese Academy of Sciences, China
Chinese Academy of Survey and Mapping, China
Chinese National Center for Disaster Reduction, China
* CLS Space Oceanography Division, France
CNES, Centre National d'Etudes Spatiales, France
CNR, Consiglio Nazionale delle Ricerche, Italy
* Cold and Arid Regions Environmental and Engineering Research Institute, Chinese Academy of Sciences, China
* Demokritus University of Thrace, Greece
DLR, Deutschen Zentrum für Luft- und Raumfahrt, Germany
o Earth Sciences and Engineering, Imperial College London, United Kingdom
Ecole des Mines de Paris, France
Ecole Pratique des Hautes Etudes, France
ENS, Ecole Normale Supérieure, France
First Institute of Oceanography, China
FMI, Finnish Meteorological Institute, Finland
Freie Universität Berlin, Germany
Friedrich-Schiller-Universität Jena, Germany
Fundación General Universidad de Valladolid, Spain
Fuzhou University, China
Gamma Remote Sensing Research and Consulting AG, Switzerland
o Geomatic Engineering, University College London, United Kingdom
Georg-August-Universität Göttingen, Germany
GFZ, GeoForschungsZentrum, Germany
GKSS Forschungszentrum, Institute for Coastal Research, Germany
* ICL, Imperial College London, United Kingdom
IFREMER, Institut français de recherche pour l'exploitation de la mer, France
INIA, Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria, Spain
INPT/ENSEEIHT, Institut National Polytechnique de Toulouse/Ecole Nationale Supérieure d'Electrotechnique, d'Electronique, d'Informatique, d'Hydraulique et des Télécommunications, France
o Institute of Applied and Computational Mathematics, Regional Analysis Division, Vassilika Vouton, Crete, Greece
* Institute of Atmospheric Physics, Chinese Academy of Sciences, China
o Institute of Crustal Dynamics, China Seismological Bureau, Beijing
* Institute for Geology and Mineral Exploration, Greece
o Institute of Geophysics and Geodesy, Academy Science of China, Wuhan, China
Institute of Meteorological Sciences, China
Institute of Natural Resources and Regional Planning, Chinese Academy of Agricultural Sciences, China
o Institute of Remote Sensing Application, Chinese Academy of Sciences, China
o Institute of Remote Sensing and GIS, Peking University

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Jiangsu Academy of Agriculture Sciences, China
o Kings College London, United Kingdom
KNMI, Koninklijk Nederlands Meteorologisch Instituut, The Netherlands
* LIAMA, Sino-French Laboratory for Computer Sciences, Automation and Applied Mathematics, China
METEO France, France
Ministry of Water Resources, China
* NAGREF, National Agricultural Research Foundation, Greece
* National and Kapodistrian University of Athens, Greece
* National Observatory of Athens, Greece
NERSC, Nansen Environmental and Remote Sensing Centre, Norway
NRSCC, National Remote Sensing Center of China, China
NSMC, National Satellite Meteorological Center, China
Ocean University of China, China
* PIK, Potsdam Institute for Climate Research, Germany
o Plymouth Marine Laboratory, United Kingdom
POLIMI, Politecnico di Milano, Italy
o Proudman Oceanographic Laboratory, United Kingdom
Remote Sensing Technology Application Center, Ministry of Water Resources, China
Research Institute of Forest Resources Information Techniques, Chinese Academy of Forestry, China
SERTIT, Service Régional de Traitement d'Image et de Télédétection, France
* Shanghai Institute of Geological Survey, China
SOGREAH, Société Grenobloise d'Etudes et d'Applications Hydrauliques, France
State Key Lab. for Information Engineering in Surveying, Mapping and Remote Sensing, China
State Oceanic Administration, China
T.R.E. s.r.l., Tele Rilevamento Europa, Italy
TNO/FEL, Toegepast Natuurwetenschappelijk Onderzoek/Fysisch en Electronisch Laboratorium, The Netherlands
UN/ISDR, International Strategy for Disaster Reduction,Germany
o United Kingdom Meteorological Office, United Kingdom
Università degli Studi di Pavia, Italy
Universität Bremen, Germany
Universität Hamburg, Germany
* Université de Marne-la-Vallée, France
Université de Rennes 1, France
Université du Littoral Côte d'Opale, France
Université Pierre et Marie Curie, Paris VI, France
University College London, United Kingdom
* University of Adelaide, Australia
* University of Leicester, United Kingdom
o University of Newcastle, United Kingdom
* University of Patras, Greece
University of Sheffield, United Kingdom
Wageningen Universiteit, The Netherlands

* Partner institution joining the Dragon Programme since April 2004
o New partner institution joining the Dragon Programme in October 2005

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