This 2007 Dragon Programme brochure presents the activities undertaken since the Lijiang Symposium that was held in July 2006 in P.R. China. At the Symposium, the joint Sino-European teams and young scientists reported on their latest results for the 16 projects investigating land, ocean and atmospheric applications of ESA EO data 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.

Joint ESA / NRSCC publications such as the mid term publication (SP-611), the 2004, 2005 and 2006 brochures and articles are available via the Dragon web site at http://earth.esa.int/dragon/.

The fourth Dragon annual symposium is to be held in Aix-en-Provence in France from 18 to 22 June 2007 at which the latest project results will be presented for the 16 projects. In addition Dragon young scientists will report on their progress and joint field visits made during 2006 and early 2007.

The next step during 2007 is the preparation for the second advanced training course in ocean remote sensing that will be held at Satellite Ocean Environment Dynamics, Second Institute in Oceanography, Hangzhou P.R. China in October 2007.

We thank all Dragon investigators for their contribution to this 3 year programme. In 2008, the final Dragon Symposium will be held in Beijing. At the same time the proceedings of the final results of the programme will be published on CD-ROM and be made available on-line.

Best regards,

The Dragon programme co-ordinators
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NRSCC - Li Zengyuan, e-mail: zengyuan.li@caf.ac.cn
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

2004 Xiamen Symposium, P.R. China
2005 Santorini Symposium, Greece
2006 Lijiang Symposium, P.R. China
2007 Montreux Envisat Symposium
Advanced Training Course in Ocean Remote Sensing
Advanced Training Course in Land Remote Sensing
Advanced Training in Atmosphere Remote Sensing
Processing Tools – BEST, BEAM, BEAT, BRAT, POLSAR PRO
Academic Exchanges
Dragon Programme Management
Latest Figures
Dragon Study Areas
Dragon Young Scientists
Dragon upcoming events

ID 3362 EO and Sport Events
ID 2567 Topographic Measurement
ID 2577 Monitoring Seismic Activity
ID 2558 Landslides Displacement Monitoring
ID 2563 Agricultural Monitoring in Fujian Province
ID 2562 Rice Monitoring
ID 2583 Forest Map of China
ID 2531 Forest Fire Monitoring
ID 2556 Deriving Forest Information From POLInSAR
ID 2551 Flood Plain Disaster Rapid Mapping and Monitoring
ID 2584 Satellite Tools for Water Resources Assessment
ID 2508 China Drought Monitoring
ID 2580 Air Quality Monitoring and Forecasting
ID 2579 Chemistry/Climate Change in the Atmosphere
ID 2515 Coupling Climate and Ocean Systems
ID 2566 Oceanography from Space

List of institutions cooperating in the dragon programme
NRSC and ESA in cooperation with the Greek Ministry of Development, General Secretariat for Research and Technology (GSRT) organized 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
- Updates 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

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.
The opening of the Montreux Symposium Dragon session by chairmen, Prof. Zhang Jingfa (left) and Yves-Louis Desnos (right)

Session 4E1
An overview of the programme, its achievements, training and documentation and results was presented. There were 3 presentations on flood mapping using Envisat ASAR NRT data, terrain motion applications on the Tibetan plateau and rice modelling and monitoring. Methane is produced as a result of rice cultivation and models of methane production over China have been run for 45 years.

Session 4E2
There were 5 presentations by Dragon Young scientists. The first two were on forest applications in NE China and included the background and science to the generation of the forest biomass map as well as the use of ASAR AP data for forest mapping. The use of ASAR PSInSAR techniques and methods to increase temporal sampling were demonstrated for Shanghai. The fourth presentation was on the flood dynamics of Poyang Lake as derived from Envisat low and medium resolution products. The rice presentation provided an update on the use of ASAR medium and higher resolution AP data for mapping rice area, varieties, yield potential and management practices.

Session 4E3
The first presentation continued Dragon young scientists and covered land use / land cover mapping in the Zhanzhou region of Fujian province. There were two presentations on the exploitation of MERIS and ASAR data for ocean applications. The last presentation was on air quality monitoring in China. A consequence of rapid development and increased industrial output in China has been coupled with an increase in atmospheric pollutants with 4 major hotspots identified.

The papers will be available in the Symposium proceedings which will be released on CD-ROM SP-636.

Participants during the opening session

Chinese and European participants to the Lijiang Symposium

NRS CC and ESA in association with Yunnan Science and Technology (YNST) organised the 3rd annual Dragon Symposium in Lijiang city, P.R. China, from 10 to 14 July 2006.

The 2006 Dragon Symposium brought together the joint Sino-European teams after more than two year’s activity. On a project-by-project basis, the 16 project teams undertook the following:

- Reports on the progress of each project to date including the latest results
- Details on ESA EO and third party mission data acquired and investigated after two year’s of activity
- Details on the in-situ data measurements and requirements particularly joint field visits made in China during 2005 and 2006
- Information on planning for the next year
- Reports from the young scientists training programme (N.B. there were a total of 22 presentations by young scientists)
- Outline the progress and status of cooperation within the projects
Over the last year, significant progress has been made on a number of different fronts including:

- atmospheric correction of the ENVISAT-ASAR interferograms using MERIS (residue correction reduced from 1.36mm down to 0.62mm)
- assessment of CR types and location characteristics (e.g. slope) to maximise their detection using SAR amplitude data
- measurement of CR position of 1-2mm per annum shown
- creation of 30m DEM of the entire Yangtze river form Yichang (dam location) to Wanzou by fusing ASTER and SRTM
- processing of tens of interferometric pairs although only 5 with $B_p < 100m$ 
- studied the source regions for sediment (Jinsha river) and found that deforestation following forestfires most likely responsible
- mapped the development of new urban areas where relocation of over a million people had occurred

Since the beginning of the project, no significant landslides had occurred until 25 April 2007 where one CR is located. Results will be shown at the Symposium.

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

Dr. Sun Jianbao, e-mail: suninsar@yahoo.com
Dr. Cécile Lasserre, e-mail: Lasserre@geo.ens.fr
Prof. Xu Xueyi, Prof. Evangelos Lagios, Prof. Shen Zhengkang, Ms. Liang Fang

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

Prof. Jan-Peter Muller, e-mail: jmpuller@ge.ucl.ac.uk
Prof. Zeng Uiming, e-mail: gmzenglipku.edu.cn
Dr. Hao Xingxiang, Dr. Li Zhenhong, Dr. Liu Jianghao, Dr. Ye Xia, Prof. Zhang Jingfa, Prof. Ouyang Zhuxi

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**Atmosphere Correction Result refined in Yangtze River Region**

(a) MERIS water vapour image of 15th Mar 2007. (b) MERIS water vapour image of 19th Apr, the gray areas are acquired under cloudy conditions. (c) MERIS cloud type image of 19th Apr 2007, (d) a cloud mask colored by maroon is applied to the water vapour image of 19th Apr

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**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 Manzi 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 InSAR 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 extension rate (about 5-7mm/yr) according to the recent GPS studies.

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**Fault-parallel velocity map**

- Fault-parallel velocity map and profile across the Haiyuan fault (Gansu, China), derived from ERS SAR data stacking. 7 mm/yr of interseismic strain accumulation is observed [Cavalié et al., in prep., 2007]
The objectives of the project are to develop and validate methodology using Envisat data for three main issues:

- Land use, land cover classification, with emphasis on agriculture and forestry, in interaction with the related Dragon application projects.
- Agricultural monitoring by retrieving crop and soil biophysical parameters.
- 10 year land use, land cover changes using archived ERS SAR data from the 1990s and up-to-date Envisat ASAR data.

Results and achievements

In the past 3 years of the Dragon programme, both Chinese side and European side have developed several different methods for crop mapping, particularly for rice, water-bamboo and banana mapping. Experiments on rice mapping were made by using ASAR AP data for different rice cycles in 2004, 2005 and 2006 at Zhangzhou and Fuzhou test sites. Agricultural crops were mapped by mainly using their temporal changes in backscatter in SAR images. The derived processing chains and classification results were reported in 2006. Since then, the project team has been investigating the use of ERS SAR and ASAR Interferometric Land Use (ILU) composites for land use classification and crop mapping as well as 10 year land use change detection. A parcel based classification methodology has been used in which parcel boundaries are extracted from high resolution optical imagery. The parcel boundaries are then used to extract mean parcel statistics in the SAR coherence and intensity images. Classification is based on mean parcel signatures. An example of an ASAR coherence composite is provided (Figure top). Land cover/land use change in the Zhangzhou area between 1995 and 2005 has been derived using ERS-1/2 SAR from 1996 and ENVISAT ASAR data acquired in 2005 (Figure bottom).

Agriculture and Land Use: ENVISAT Applications in Fujian Province

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Dr. Wang Xiaojin, Mr. Ling Feilong, Dr. Thuy Le Toan, Prof. Li Zengyuan, Dr. He Guojin, Prof. Lan Zhangren, Dr. Chen Henglin, Ms. Zhu Qingdong

Rice monitoring in China

Dr. Thuy Le Toan  email: Thuy.LeToan@cnes.fr
Dr. Tan Bingxiang  email: Tan@forestry.ac.cn
Dr. Aliberte Bondeau, Mr. Alexandre Bouvet, Prof. Li Bingbai, Prof. Li Zengyuan, Prof. Shaun Quegan, Prof. Huang Yao, Dr. Zhang Wen, Mr. Yang Shenbin, Dr. Sun Wenguang, Mr. He Wei, Prof. Shao Yun

The overall objective is to refine remote sensing methods and rice production and biochemistry models to monitor changes in rice cultivation and to evaluate their impacts on rice production and Green House Gases (GHG) emissions in China.

For monitoring rice cultivation and production, remote sensing methods have been developed and assessed using data acquired at the main test site in Jiangsu province in 2004 and 2005, and tested at other sites in 2006. The following methods have been developed:

1. Mapping of rice areas using ASAR APP and WSM reported 05 and 06.
2. Monitoring mid season drainage using high temporal WSM data (see Figure top).
3. Retrieving rice biomass using polarisation ratio from ENVISAT APP.
4. Mapping of cropping system (single-double crop per year) using SPOT VGT.

For monitoring GHG emissions (CH4), a biochemistry model (CH4MOD) has been run for a 45 year period (see Figure at top of page and Figure bottom). Data of rice cultivation including plantation area, grain yields, rice straw and farm/green manure incorporation was collected on provincial scale year by year from 1995 to 2000. Daily air temperature of more than 756 meteorological stations all over China were obtained from http://cdc.cma.gov.cn. Soil sand percentage data, rice [single and double rice rotations] calendars were also acquired. Spatial pattern analysis has also been performed and shows that high methane emission were in Hunan, Hubei, Jiangxi, Jiangsu, Guangdong, Guangxi, Zhejiang and Anhui provinces. In the next phase of the work model results will be compared to methane concentrations observed from satellite observations particularly SCIAMACHY.
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, aimed at the generation of forest and biomass maps for Northeast China (Fig. 1). The generation of a wall-to-wall forest biomass map is based on a dataset of ENVISAT ASAR AP images in HH/HV mode acquired between fall 2004 and spring 2005. Accurate geocoding, SRTM-based radiometric correction to avoid classification errors, and masking of layover areas has been performed for a dataset including more about 900 images covering the study region (Bottom Figure shows examples). This enhanced dataset is used to produce a forest map for finally accurately identifying cover changes occurred after the ERS acquisitions.

**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 imagery. By means of MERIS and ASAR imagery, a new procedure has been developed in order to map burn scars following forest fires. In the MERIS FR composite (300m) shown left, the burnt areas in light colour compared to the surrounding forest shown in red. The ASAR APP multi-temporal composite shows the same burnt scar, but at higher resolution (30 m).

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

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| Prof. Li Zengyuan | email: zengyuan.lidi@caf.ac.cn |
| Dr. Chen Erxue, Dr. Stefan Erasmus, Dr. Thuy Le Tien, Dr. Jens Nescuthe, Dr. Pang Yong, Dr. Achim Roth, Dr. Maurizio Santoro, Dr. Urs Wegmüller, Dr. Andreas Wiesmann, Mr. Oliver Cartus, Mr. Tian Xin, Ms. Zhu Haiizhen, Dr. Li Xiaosong, Mr. Julian L’Hermitte |

**Forest Fire Monitoring Demonstration by Satellite Remote Sensing in China**

| Prof. José Luis Casaneva | e-mail: jos@latuv.uva.es |
| Dr. Qin Xianlin | e-mail: Neagol@forestry.ac.cn |
| Dr. Johann G. Goldammer, Dr. Federico Gonzalez-Alonso, Dr. Charalabos Kontoes, Prof. Li Zengyuan, Ms. Cristina Moctá |

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

Since 2004, an assessment of Envisat data potentialities for mapping and monitoring, insuring thematic accuracy and maximize coverage and revisit over the tests sites well representative of Asian major flood plains and Mediterranean fast flood, CEVENOL phenomenon, has been carried out.

The project has delivered major steps in term of ASAR and MERIS data processing and information merging. An ASAR assimilation procedure, plus a robust and semi-automatic flood extraction procedure have been defined and validated. Exploiting 3 year of regular acquisition, a large panel of Envisat derived products have been generated consisting in monthly and yearly submersion maps, change and land cover maps etc. Furthermore, 2005 and 2006 typhoons and monsoon floods affecting Chinese major flood prone and coast have been monitored based on Envisat resources. These Near Real Time actions have exploited both emergency programming and rolling archive.

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

Objectives and background
For this project, the MOD COU model is being used to predict discharge for the Shiguanhe sub-catchment of the Huai River basin in China. The terrain database was populated using SRTM DEM and derived hydrological network, LandSat ETM land use map, and Google Earth maps to characterise the irrigation network (see top figure). Other geo-spatial data includes soil maps, meteorological and stream discharge data from 1982 to 1991. Since the first model runs reported last year, model performance has been refined and improved.

Analysis on model results
Analysis of the observed and modelled discharge shows two phenomena which are not explained by MOD COU model, 1. a significant amount of water that was released from the dams did not appear in the observed discharge during the irrigation season, 2. several peaks could be observed which are not modelled and several discharges are underestimated (see Figure centre). These differences are due to water being extracted from the river to supply an irrigation network outside of the basin. So an amount of 100 m3/s was retrieved from Mei Shan discharge during the irrigation period.

Up-date and improvements
A hypothesis was made that, during the irrigation season, the water released by Mei Shan dam is used for irrigation in the Pi Shi Hang irrigation network outside of the basin. So this water has to be retrieved from the river (difference between green and blue curve).

Integration of rice farming techniques into the model: storage in the rice fields from mid-July and filling out of these fields on 15 July

External irrigation: a significant part (100 m3/s) of the water released by Mei Shan dam is used for irrigation in the Pi Shi Hang irrigation network outside of the basin. So this water has to be retrieved from the river (difference between green and blue curve)

Google earth map of the water extraction to the Pi Shi Hang irrigation network

Drought Monitoring and Prediction over China

The drought project combines satellite observations acquired by Envisat and "state of the art" land surface modeling to improve the monitoring and prediction of drought related land surface variables, such as root zone soil moisture and evapotranspiration. Within the project, Advanced Along Track Scanning Radiometer (AATSR) and Advanced Synthetic Aperture Radar (ASAR) wide swath mode (WMS) observations are utilized for the retrieval of evapotranspiration and soil moisture, respectively. Extensive ASAR WSM and AATSR data sets have been collected over the Tibetan Plateau and other study areas. Retrieval of the top 5-cm soil moisture has been performed over the Tibetan Plateau from the ASAR WSM observations. Based on these soil moisture products, data assimilation is being performed using different techniques (e.g. Direction Insertion Assimilation framework is under further development to improve drought monitoring and prediction through soil moisture assimilation. Application is on the Tibetan Plateau only that serves as a pilot area.

Google earth map of the water extraction to the Pi Shi Hang irrigation network

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Google earth map of the water extraction to the Pi Shi Hang irrigation network
Monitoring gas emissions using satellite observations

The figures show the results of NO retrievals from Envisat SCIAMACHY. As can be seen air pollution and emissions have become an increasingly important problem due to large-scale fossil fuel combustion related to an increasing energy demand and inherent fuel consumption. Particularly badly affected are the Beijing-Tianjin-Tangshan region (area 1) and the Yangtze delta region (area 2). Annual variations of tropospheric NO over east and west of China have also been investigated and it is clear that there is an expected maximum of NO in winter–time in the east of China. In the west of China, there is a summer maxima in NO, concentration caused by natural emissions.

Modeling results on gas emissions

The spatial and temporal characteristics of CO and NO simulations in China in 2003 have been modeled by the two-way nested global chemistry-transport zoom model. The modeling has shown that the seasonal variations of CO and NO are obvious in China, and there are the high CO concentration in the eastern China (30-40 °N) and the high NO concentration in the eastern and southwestern China. It is also found that the CO vertical variations are significantly changed with different seasons, while the NO, vertical profile variations of different seasons are very little. Further more, it could be seen clearly that the NO model result fits the satellite measurements very well.

Retrieval of aerosol optical depth from MERIS data

Aerosol optical depth distribution of MERIS channel center at 565nm over seas has been studied for near shore waters in China. The research shows that the aerosol retrieval algorithm still needs improvement in turbid near-shore waters to correct for the influence of the significant signal coming from water.

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In this project opportunities are being investigated to enhance the exploitation of Envisat GOMOS, MIPAS and OMI data for atmospheric research. OMI is a joint effort between 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 at various spatial scales.

For examples the two figures on the left show the development of NO, vertical profiles as measured by GOMOS between 1.9. 2002 and 31.12 2004. The observations cover latitudes 20°N-53°N and longitudes 80°E-134°E. The NO2 values are shown by mixing ratio (top) and number density (bottom). Both show annual maxima during summer seasons. White areas indicate that no measurements were available. In January-August GOMOS measurements were disrupted by the malfunction of the steering point mechanism. 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 changes.

Common research projects for Chinese and ESA earth observation satellites will be investigated.
The coupled Southeast Asian Monsoon and ocean system is a regular seasonal climate feature that has profound and coupled connection with and impact on the atmospheric and oceanic 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 current features including fronts, eddies and near surface wind, SST, ocean colour and water quality. 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. Within SAMOS a system has been set up to automatically download and process ASAR WSM scenes for the South and East China Seas. The scenes are automatically calibrated, and wind speed is derived with the CMOD-4 algorithm based on an ASAR image and wind directional data taken from a global weather forecast model. North of Luzon (Philippines) the wind is around 18 m/s, but drops to 5 m/s or even less in the wakes behind the smaller islands.

The figure shows one example of a variable wind field in the South China Sea calculated with the CMOD-4 algorithm based on an ASAR image and wind directional data taken from a global weather forecast model. North of Luzon (Philippines) the wind is around 18 m/s, but drops to 5 m/s or even less in the wakes behind the smaller islands.

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

Prof. Werner Alpers  e-mail: alpers@ifm.uni-hamburg.de

Prof. He Mingxia  e-mail: mxhe@orsi.ouc.edu.cn

OCEAN COLOUR ANALYSIS
Remote sensing reflectance (Rs\(r\)) retrieved from ENVISAT MERIS Level-1 data using the FUB BEAM-plugin and MERIS Level-2 product from 26 measurement stations has been compared with in-situ measurements acquired using HyperTSRB (see top figures). In the comparison between in-situ and retrieved Rs\(r\), the FUB retrieval performance is better than MERIS Level-2 products. However they both overestimated the Rs\(r\).

This overestimation has been further investigated by plotting spectral reflectance profiles for clear and turbid waters (see bottom figures). In the case clear water, in the wavelength region 400 to 550 nm, the FUB reflectance better approximates the in-situ reflectance, however for turbid water in the wavelength region 580 to 750 nm the MERIS L2 product is closer to the measured reflectance. More work is therefore required to better understand the differences and provide up-dated algorithms for product generation in such heavily sediment laden waters.

RED TIDES
Red tides develop mainly in coastal areas and they affect directly fishing and shellfish 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. The latest results will be reported at the Aix-en-Provence Symposium.

Envisat ASAR image (left) and ERS SAR image (right) acquired on 21 April 2006 in the East Sea with 30 minutes time delay

Overlay of ASAR and ERS SAR images acquired on 21 April 2006, using such imagery the length and velocity of internal waves can be determined as well as ship velocity.


Comparison between in-situ measured reflectance and MERIS reflectance, left MERIS FUB product from BEAM toolbox and right MERIS Level-2 product

Comparison between in-situ reflectance and MERIS products for clear waters (left) and turbid waters (right)

Envisat ASAR image (left) and ERS SAR image (right) acquired on 21 April 2006 in the East Sea with 30 minutes time delay

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Comparison between in-situ reflectance and MERIS products for clear waters (left) and turbid waters (right)
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<tr>
<th>Institute of Remote Sensing and GIS, Peking University</th>
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<td>Research Institute of Forest Resources Information Techniques, Chinese Academy of Forestry, China</td>
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<td>Partner institution joining the Dragon Programme since April 2004</td>
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<td>New partner institution joining the Dragon Programme in October 2005</td>
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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

Ph.D. 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 on:**
- Land Applications Using SAR data
  - Theory and principles of 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

**Participants and lecturers:**
- The lecturers
- Participation to the training course by country
- 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
A total of 57 PhD students, postdoctoral and research scientists participated to a one-week advanced training course dedicated to atmospheric remote sensing applications. The training course was organized jointly by ESA and NRSCC and hosted by the prestigious Peking University. More than 30 different institutions were represented by the participants.

Lectures and Practicals
- EO Instruments (GOME, GOMOS, SCIAMACHY, TPM)
- Ground-based instruments (WMO, NDSC network)
- Retrieval techniques
- Validation, Models
- Data Assimilation and Applications

Participants, lecturers and organizers of the atmosphere training course
In April 2007, Mr. Tian Xin joined the International Institute for Geo-Information Science and Earth Observation (ITC) as a sandwich Ph.D. student jointly supported by ITC and the Institute of Forest Resources Information Techniques Chinese Academy of Forestry.

The National Key Laboratory of Microwave Imaging Technology, from the Institute of Electronics, Chinese Academy of Science (MITL IECAS) is a new partner in the Dragon Project ID2556. In July 2006, Prof. Eric Pottier from IETR, University of Rennes, visited IECAS and attended Ms. Cao Fang's Ph.D. thesis defence on April 3rd, 2007. A convention between the two institutes (MITL IECAS–IETR) is in preparation.

There have been cultural exchanges between Politecnico di Milano and Wuhan University with a delegation of Chinese scientists visiting POLIMI in March 2007 to sign an academic exchange programme. A Chinese student will be hosted in Milan with a scholarship funded by POLIMI for a co-tutored Ph.D. programme.

In July 2006, a field survey was organized by Prof. Li Jiren team in order to validate the ENVISAT product as well as to present Dragon results to the institutes involved in flood monitoring in the Jiangxi province. Water resource and drought bureau, Flood control headquarter office, in Nanchang and flood retention basin agency such as the Flood and Dike management Agency of Kangshan.

Sun Jianbao, Graduate University, Chinese Academy of Sciences, visited ENS Paris in December 2006. A GPS campaign across the Haiyuan fault (people from ENS, Paris and CEA, Beijing and Xian); (above) the Flood Dragon team during the field survey in the Jiangxi province.

In November 2006, following a visit to Aix-en-Provence, ESA selected the venue for the fourth annual Symposium to be held in Aix-en-Provence. On 12 March 2007 ESA and NRSCC had a progress and planning meeting with the Chinese partners for the EO and sport project at which data delivery and early results were discussed. On 13 March 2007, ESA and NRSCC had a second planning and organisation meeting with the Chinese partners for the EO and sport project at which data delivery and early results were discussed. On 12 March 2007 ESA and NRSCC had a second planning and organisation meeting with the Chinese partners for the EO and sport project at which data delivery and early results were discussed.

NRSCC representatives with Chinese Dragon investigators, 1st Dragon Progress meeting 11) 13 March 2007, Chinese Academy of Forestry, Beijing

On 17 October 2006, ESA and NRSCC had a joint progress meeting with Chinese Dragon investigators in Beijing. The progress and status of EO data delivery to the projects was reviewed. Further planning for EO data acquisitions was made. In the last 6 months overall 86% of requested ASAR and MERIS FR imagery were delivered to the projects. ASAR WSM and GMM, AATSR, MERIS RR and atmospheric chemistry instrument data are being accessed by ftp and the web file selector by several teams. On 19 October 2006, the organisation for the 2nd advanced training course in ocean remote sensing was initiated following a visit to the Second Institute of Oceanography, Hangzhou.

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LATEST FIGURES

As of April 2007, a total of 13000 ASAR and SAR scenes delivered to PIs.

DRAGON STUDY AREAS

Instrument’s planning conflicts are checked up-front following the “Dragon conflict free” scheme.

The 16% 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).

As of April 2007, a total of 4000 MERIS FR and AATSR scenes delivered to PIs.

Systematically available products accessed through the Internet (e.g., ASAR Medium Resolution, MERIS RR etc).

Several ESA Third Party Missions data available to PIs.

As of April 2007, a total of 12000 ASAR and MERIS FR planning requests, 84% were successfully planned.

ENVISAT ASAR and ERS SAR DATA

• ASAR and ERS 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 and AATSR DATA

• 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 all projects in Near Real Time, via Internet through the Rolling Archive and the Envisat Web File Server.

ATMOSPHERIC DATA

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

As of April 2007, a total of 5100 ASAR and SAR scenes delivered to PIs.

Several ESA Third Party Missions data available to PIs.

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

The Dragon study areas for land and ocean projects. N.B. the Atmospheric Chemistry instruments coverage is global, the PolInSAR project is currently not requesting ESA data.
In both Europe and P.R. China young post graduate scientists are working on the Dragon projects. The type of studies supported include Master of Science, Ph.D. and post doctoral research. The first reporting by the young scientists was at the Santorini Symposium in June 2005 and the second was at the 2006 Lijiang Symposium where a total of 22 presentations were made in three sessions.

Research topics presented included land, ocean and atmospheric applications. In session 1, results were presented on interferometric processing and research for DEM construction and mapping in the particularly complex terrain of the three gorges area. There were also presentations on mapping deformation using coherent targets in Shanghai and on the measurement of strain across the Haiyuan fault. The second session covered the results on ocean research by Chinese scientists including studies on mapping internal waves and sea state categorisation and various land applications results in forest biomass and forest fire mapping as well as flood and drought mapping. In the third session there were presentations that covered rice mapping and methane modelling, NO2 monitoring and forest/non forest classification using SAR and InSAR data.

During 2006 and 2007, several of the young European scientists have undertaken extended study periods and field data collection campaigns in P.R. China. They have been working with their Chinese counterparts. At the 2007 Envisat and Aix-en-Provence Symposia in April and June 2007 respectively, the young scientists will report on their further progress to date.

### Dragon Young Scientists

**ESA & NRSCC**

- **Supported post graduate training for Chinese and European young scientists in land, ocean and atmospheric applications**
- **Degrees**
  - Master of Science, doctoral degrees and post doctoral research supervised by leading EO scientists in Europe and China
- **P.R. China**
  - Study periods, field work, and data collection
- **Reporting**
  - In dedicated sessions at Dragon Symposia
- **Latest results**
  - Presentations at the 2007 Envisat Symposium, Montreux, Switzerland

### Dragon Upcoming Events

**2nd advanced training course in ocean remote sensing**

**Venue**

The course will be hosted by Satellite Ocean Environment Dynamics, Second Institute of Oceanography, Hangzhou, P.R. China

**Date**

From 15 to 20 October 2007

**Registration**

Registration is free of charge. The course is open to Chinese and SE Asian nationals

**Sponsors**

The course is being sponsored by MOST/NRSCC, Second Institute of Oceanography and ESA

**Course Content**

The lectures and practical sessions shall cover theory and processing of EO data from ESA’s ERS and Envisat satellites for ocean monitoring and bio-geo-physical retrievals over the China seas

**Web**

The training course programme and registration forms are available from the Dragon website: [http://earth.esa.int/dragon/oceantraining2007.html](http://earth.esa.int/dragon/oceantraining2007.html) (English)


### Final results call for papers and publication

NRSCC and ESA propose that the final results are published as an ESA/NRSCC joint publication

**Objectives**

- To provide the final results of the project teams’ work at the end of the three year Dragon Programme
- Co-authorship of papers by European and Chinese scientists
- Make available the Special Publication (SP) as a CD-ROM to all Dragon investigators

**Schedule**

- **The call is open from the end of 2007**
- **Papers must be submitted at the 2008 Symposium**
- **The proceedings shall be available in the summer of 2008**
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: cartal@cphys.uoa.gr
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Mrs. Marina Stathopoulou, e-mail: michas@phys.uoa.gr
Dr. Iarla Kilbane-Dawe, Dr. Roger Saunders, Dr. Roger Proctor, Dr. Jack Lee, Mr. Steve Grose, Dr. Yu Too, Dr. Zhang Yong, Dr. Li Xiaojuan, Dr. Wang Yanbing, Dr. Li Xiaojing, Dr. Zeng Kan, Dr. Zhu Chen, Prof. Yang Minghui, Prof. Wang Chao, Prof. Zhang A-Qin

Use of Earth Observation for the:
• Planning and organisation of major sport events,
• Planning and development of the host city,
• Monitoring of prevailing environmental and meteorological conditions (with emphasis during the Olympic period),
• Assessment of the impact of the sport event to the host city,
• Change detection due to the sport event with emphasis in environmental and quality of life changes.

For the Athens Games of 2004, results so far include the assessment of the thermal environment, the spatial depiction of the Thom discomfort index, the spatial definition of the cooling degree days, the spatial depiction of aerosol thickness in the lower atmosphere and the definition of a special indicator which by comprising satellite and ground data provides a snapshot of the quality of life in Athens (see Figure top). The above are tested for the periods prior and following the Games.

For the 2008 Beijing Games, results so far include the mapping of changes in the urban fabric around the Olympic park, the definition of aerosol optical thickness, the spatial and temporal analysis of urban green and the development of a GIS system which combines EO and other geo-spatial data. Results also include oceanographic information for the Qingdao area where the Olympic sailing event is to take place (see Figure bottom).

The consortium participated in the 2006 Lijiang Symposium PRC and has also demonstrated the project to the Beijing Organising Committee for the Olympic Games and to the International Olympic Committee.

Topographic Measurement

Prof. Li Deren, e-mail: dli@whu.edu.cn
Prof. Fabio Rocca, e-mail: roc@ifc.polimi.it
Dr. Alessandro Ferretti, Prof. Liao Mingsheng, Dr. Daniele Perissin, Prof. Yang Minghui, Prof. Wang Chao, Prof. Zhang A-Qin

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

Background
Interferometric Synthetic Aperture Radar (InSAR) data gives researchers a new set of tools to measure topography, tiny shifts and deformations in the Earth’s surface. This has application in the study of landslides urban subsidence, earthquakes, floods and other natural cataclysms in P.R. China where persistent cloud cover is limiting for optical sensors. The scientific investigations have focused on the application on topographic mapping and earth deformation monitoring using ERS-1/2 SAR and Envisat ASAR data.

Latest results
From the scientific point of view, for the very first time a multi-track Permanent Scatterers (PS) analysis has been carried out exploiting ASAR data acquired over Shanghai from two different parallel tracks. The developed technique is based on the use of dihedrals as a common network of PS’s that can be observed by sensors flying along parallel tracks. For example in the top figure, dihedral scatterers are seen by the two parallel descending orbits (T3 and T275) and not by the two parallel ascending ones (T268 and T497). In such a way the ASAR data acquired by the ESA satellite ENVISAT can be fruitfully processed in a multi-temporal framework in order to retrieve deformation measurements, even when a low number of images per track is available (which happens due to unavoidable conflicts in the request of different acquisition modes of the ASAR sensor). The bottom figure shows the deformation field mapped using this method and the deformation history for a dihedral scatterer.