NASCC

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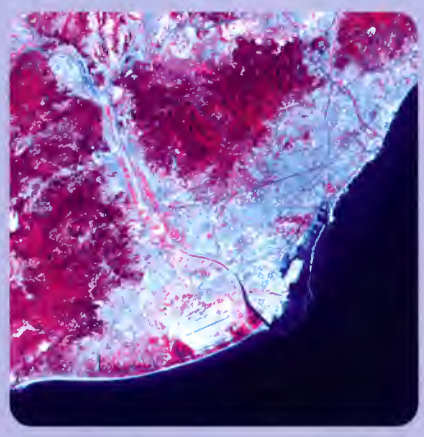
→ DRAGON 2 PROGRAMME

Brochure 2009

programme

projects

partners



DRAGON 2009

THE DRAGON 2 BROCHURE

This 2009 Dragon 2 Programme brochure presents the activities undertaken since the formal start of programme that was in April 2008 in Beijing, P.R. China. At this kick off Symposium, the 25 joint Sino-European teams presented their projects investigating land, ocean and atmospheric applications of ESA, TPM and Chinese EO data in P.R. China. Since then, ESA and NRSCC have organised a progress meeting in October 2008 in Beijing. At this meeting, Chinese scientists provided details about their project progress and further defined their EO data requirements. For ESA, TPM and Chinese EO data, detailed coordination of all requested acquisitions over China is being performed by ESA and NRSCC respectively.

Post graduate training is a key component of the Dragon 2 programme. An advanced course in land remote sensing was held in Wuhan University, Wuhan in October 2008. The course was attended by 60 scientists from all over China. European and Chinese experts gave lectures and practical sessions on data processing, product development, validation and assimilation of EO and other data in land applications.

The Dragon 2 website is the formal reporting portal and information about these courses can be found on the Dragon website: *land 2008*: http://dragon2.esa.int.

The 2nd Dragon 2 annual symposium is to be held in Barcelona, Spain from 22 to 26 June 2009 at which the latest project results will be presented for the 25 projects. In addition Dragon 2 young scientists will be in attendance and will take part in project team meetings and make research plans with Chinese institutes as part of their studies.

The next steps during 2009 are the preparation for the second advanced training course in atmospheric remote sensing that will be held at Nanjing University, Nanjing, P.R. China in October 2009.

The Dragon 2 programme has got off to an excellent start and we thank all of the Sino-European investigators for their contribution to this 4 year programme. We look forward to working with you and the results' reporting in the coming months.

Best regards,

The Dragon 2 programme coordinators,
ESA - **Yves-Louis Desnos**, e-mail: yves-louis.desnos@esa.int
NRSCC - **Li Zengyuan**, e-mail: zengyuan.li@caf.ac.cn

Background

ESA, together with the National Remote Sensing Centre of China (NRSCC), an entity under the Ministry of Science and Technology (MOST) of the P.R. China, have cooperated in the field of Earth observation application development for more than 15 years. In 2004 a dedicated three year science and exploitation Dragon programme was initiated in 16 priority areas using ESA ERS and Envisat data in P.R. China. In 2008, the follow on programme, Dragon 2 began. This 2nd programme has enlarged the cooperation to 25 projects composed of European and Chinese scientists exploiting jointly ESA, TPM and Chinese EO data for land, ocean and atmospheric science and application development in P.R. China. The programme will last for 4 years and will finish in 2012.

Objectives

The Dragon 2 Programme is targeted towards land, ocean and atmospheric investigations in P.R. China. The expected benefit and contribution is to:

- Promote the joint use of ESA, TPM and Chinese EO data for science and application development in China
- Stimulate scientific exchange in EO science and application by the formation of joint Sino-European teams
- Publish co-authored results of the research and applications development at the mid term stage and at the end of the programme
- Provide training for European and Chinese scientists for the exploitation of ESA, TPM and Chinese EO data in land, ocean and atmospheric applications

Project Themes

Land and Environment
- Forest Ecosystems
- Urbanisation
- Croplands in CO_2 Budget
- Drought Monitoring
- POLINSAR
- Hydrology
- Crop Monitoring
- Water Resources
- Sport Events Case Studies
- SMOS Cal/Val

Atmosphere
- Air Quality Monitoring
- Chemistry Climate Change
- LIDAR Cal/Val

Hazards and Topographic Mapping
- Coal Fires
- Wetlands
- Forest Fires
- Sea Ice Detection (ASAR)
- Topographic Measurement
- Crustal Deformation
- Monitoring Three Gorges

Ocean and coastal zones
- Monitoring China Seas
- DRAGONESS
- Coastal Zones
- River Deltas
- Monitoring Water Quality

The Dragon 2 programme web site

http://dragon2.esa.int

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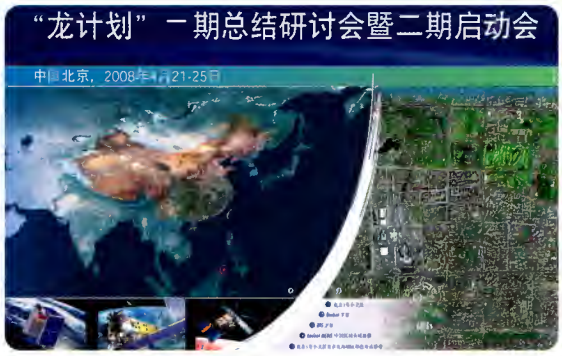


↑ 2008 Dragon 2 Symposium poster

DRAGON 1 FINAL RESULTS AND DRAGON 2 KICK OFF SYMPOSIUM, 2008 BEIJING

Date	21-25 April 2008
Place	Fragrant Hill Empark Hotel, Haidian District, 100093, Beijing
Hosts	MOST and ESA
Participants	344 scientists from China and Europe
Web	http://dragon2.esa.int/symposium2008

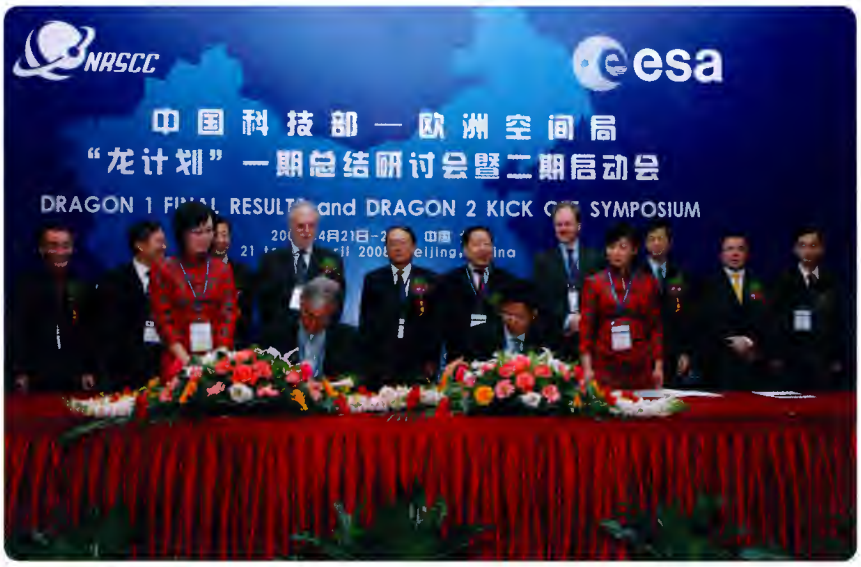
Main objectives of the Symposium:

1. Dragon 1 Final Results Reporting

The first three days of the 2008 Dragon symposium served as the close of the first phase of the Dragon Programme (2004 to 2007). A protocol agreement was signed between ESA and NRSCC on the Dragon 2 Programme covering the period of the programme i.e. 2008 to 2012 (top centre photo). The proceedings of the Dragon Programme final results (SP-655) were distributed on CD-ROM. On a project-by-project basis, the 16 project teams reported on their results of exploitation of ESA EO and third party mission data acquired during the course of the Dragon Programme. There were also reports on progress for the FP6 projects in atmosphere and ocean science.
On the afternoon of the second day, a special "poster" session was dedicated to research by young scientists. Prizes were awarded for the best poster papers in land, ocean and atmospheric EO science. The awards were judged by Dragon lead investigators.

2. Kickoff for the Dragon 2 Projects

The last two days of the Symposium served as the formal kick off for Dragon 2 projects. EO data delivery commenced in May 2008 and will last for four years. Presentations were made on the 25 successful projects from the Dragon 2 Announcement of Opportunity (AO). This AO concerns the exploitation of ESA, Chinese and TPM EO data for science and applications development in P.R. China. All of the project executive summaries were published in English and Chinese and were distributed at the Symposium.

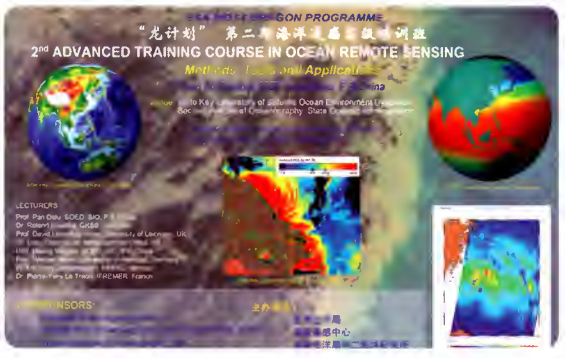


↑ Signing of the Dragon 2 protocol agreement between ESA and MOST representatives on 21 April 2008. The agreement concerns access to ESA, TPM and Chinese EO data for science and application development in P.R. China for a four year period, programme management, academic exchanges and training

↑ Chinese and European young scientists receiving awards for the best papers in atmosphere, land and ocean applications from ESA and NRSCC representatives

ADVANCED TRAINING COURSE IN OCEAN REMOTE SENSING

Date	15 to 20 October 2007
Hosts	ESA, NRSCC and State Key Laboratory of Satellite Ocean Environment Dynamics, Second Institute of Oceanography, State Oceanic Administration of China
Lecturers	Prof. Pan Delu SOED SIO P. R. China - Dr. Roland Doerffer GKSS Germany - Prof. David Llewellyn-Jones University of Leicester UK - Dr. Craig Donlon Meteorological Office UK - Prof. Huang Weigen SOED SIO P. R. China - Prof. Werner Alpers University of Hamburg Germany - Prof. Johnny Johannessen NERSC Norway - Dr. Pierre-Yves Le Traon IFREMER France



↑ Advanced training course in ocean remote sensing poster

↑ Photos from the 2nd ocean training course: opening session (top left); RA practical session (top right); optical / ocean colour and SAR lectures (bottom left and right respectively)

↑ Participants, lecturers and organisers of the 2nd ocean training course at SOED SIO, Hangzhou, China

Ph.D. students, postdoctoral and research scientists interested in ocean remote sensing from China were invited to a 6 day training course organised within the framework of the Dragon Programme. The course was hosted by Satellite Ocean Environment Dynamics at the Second Institute of Oceanography in Hangzhou, P.R. China. The goals were to provide theory and practical sessions on ocean remote sensing using ESA freeware software tools.

There were 9 European and 2 Chinese lecturers who gave lectures on:

- Current and future European and Chinese EO satellite missions and access to ESA EO data
- Principles of SAR, MERIS, (A)ATSR, and RA measurements
- Processing, products and applications in oceanography
- Practical exercises with BEAM, Bilko, BRAT and SARTool software tools
- Modelling and data assimilation

The course was attended by 64 trainees.

- Associate or assistant professors
- Senior scientists
- Engineers
- Ph.D. and M.Sc. students

↑ Advanced training course in land remote sensing poster

ADVANCED TRAINING COURSE IN LAND REMOTE SENSING

Date	13 to 18 October 2008
Hosts	ESA, NRSCC and Wuhan University - State Key Laboratory of Information Engineering in Surveying Mapping and Remote Sensing (LIESMARS)
Lecturers	Prof. Bob Su, ITC, The Netherlands - Dr. Daniele Perissin, POLIMI, Italy - Prof. Liao Mingsheng, LIESMARS, China - Prof. Eric Pottier, University of Rennes, France - Prof. Fabio Rocca, POLIMI, Italy - Prof. Wout Verhoef, ITC, The Netherlands - Dr. Herve Yesou, SERTIT, France - Dr. Thuy Le Toan, CESBIO, France - Prof. Yifang Ban, RIT, Sweden - Prof. Li Xingchao, CRESDA, China

Ph.D. students, postdoctoral and research scientists interested in land remote sensing from China and other Asian countries were invited to a 6 day training course organised within the framework of the Dragon 2 Programme. The course was hosted by Wuhan University - State Key Laboratory of Information Engineering in Surveying Mapping and Remote Sensing (LIESMARS) P.R. China. The goals were to provide theory and practical sessions on remote sensing for land applications.

There were 8 European and 2 Chinese lecturers who gave lectures on:

- Current and future European, Third Party Mission and Chinese EO satellite missions and access to EO data
- Principles of optical, thermal, active and passive microwave remote sensing for land applications
- Processing and products for flood mapping, rice mapping, land use change detection, forest mapping and parameter retrieval, terrain motion and water resources assessment
- Practical exercises with ESA software tools BEAM, NEST, BEST and POLSARPRO

For the full daily programme see:
http://dragon2.esa.int/landtraining2008/dr2_lt_programme.html

The course was attended by 60 trainees.
- Associate or assistant professors
- Senior scientists
- Post Docs.
- Ph.D. and M.Sc. students

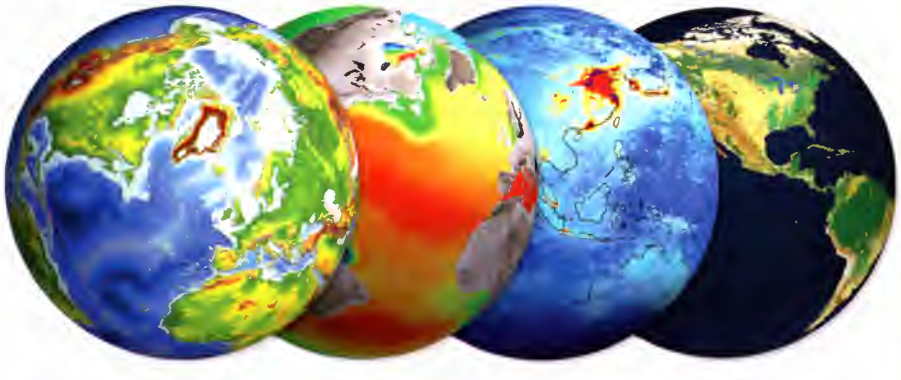
↑ Photos from the land training course: opening session (top left and right); students during a practical session (bottom left); trainees being awarded certificates of attendance during the closing ceremony (bottom right)

↑ Participants, lecturers and organisers of the land training course at LIESMARS, Wuhan University, Wuhan, China

PROCESSING TOOLS
NEST, BEAM, BEAT, POLSARPRO, BRAT

Software	ESA is providing, free of charge and on the internet, a collection of user-friendly and open-source software tools for the visualisation and exploitation of EO data, from Envisat, ERS and Third Party Missions. Upgrades, documentation, example data sets and support are available on the related websites.
Web	http://earth.esa.int/resources/softwaretools

↑ Trainees receiving tuition from Prof. Yifang Ban, Wuhan land training course, October 2008



NEST (Next ESA SAR Toolbox) is a completely new ESA toolbox with an integrated viewer for reading, calibration, post-processing and analysis of ESA and 3rd party SAR data starting from Level 1. NEST is distributed as fully open source, NEST first release 1-C is now available.
→ **www.array.ca/nest/tiki-index.php**

BEAM (Basic ERS & Envisat (A)ATSR and MERIS Toolbox) is a collection of executable tools and Interface which has been developed to facilitate the utilisation, viewing and processing of MERIS, (A)ATSR, ASAR and Third Party Mission data. The latest release BEAM 4.6 is now available.
→ **www.brockmann-consult.de/beam/index.html**

BEAT (Basic ERS & Envisat Atmospheric Toolbox) is a collection of executable tools and an interface which has been developed to facilitate the utilisation, viewing and processing of ESA GOMOS, MIPAS, SCIAMACHY and GOME data. The current release is BEAT version 6.0.1.
→ **www.stcorp.nl/beat**

POLSARPRO The Polarimetric SAR Data Processing and Educational Tool aims to facilitate the accessibility and exploitation of multi-polarised SAR datasets including those from ESA Third Party Missions (ALOS PALSAR), Envisat ASAR Alternating Polarisation mode products, RADARSAT-2 and TerraSAR-X.
→ **http://earth.esa.int/polsarpro**

BRAT (Basic Radar Altimetry Toolbox) is a collection of tools and documents designed to facilitate the use of radar altimetry data. It can read most distributed radar altimetry data, from ERS-1 & 2, Topex/Poseidon, Geosat Follow-on, Jason-1, Envisat to the future Cryosat missions.
→ **http://earth.esa.int/brat/html/data/toolbox_en.html**

↑ Dr. Daniele Perissin from POLIMI (Italy) with members of the Dragon 2 team at Wuhan University, P.R. China, in October 2008

ACADEMIC EXCHANGES

Post graduate training	Working within the framework of the Dragon 1 and 2 Programmes, several European universities have made agreements with universities in P.R. China to train Chinese scientists at Ph.D. level
Joint field visits	A number of project teams have undertaken joint field campaigns in P.R. China to collect ground data and validate their results
Academic exchanges	European scientists have visited their partner institutions in P.R. China and vice versa

POLIMI Italy and Wuhan University, China
The training agreement signed under the Dragon 1 Programme, has continued.
A Chinese PhD student is being hosted in Milan with a scholarship financed by POLIMI. Wuhan University was also visited by POLIMI scientists in April and October 2008 and seminars were presented. Joint field visits to the study areas in China were organized in 2005 and 2008.

ITC, The Netherlands
There are currently 7 students being trained at doctoral level (5 Chinese and 2 European). A regional scale soil moisture monitoring network has been installed covering 50 km by 70 km at the Maqu site on the northern Tibetan Plateau by team members in August 2008. Prof. Bob Su has performed instrument maintenance and data downloading at the eastern Tibetan Plateau in October 2008.

Université Joseph Fourier (LGIT), France
A new PhD studentship has started at LGIT with funding from Ecole Normale Supérieure de Paris. There is on going support coming from French ANR projects involving Dragon 2 team members. Dr. Hua Wang, Guangdong University of Technology visited Leeds, for 1 year and will visit again later in 2009. Dr. Sun Jianbao, the Chinese lead investigator is planning 2 visits to LGIT Grenoble in 2009 (June, November).

University Rennes (IETR), France
The Cooperation Convention signed between IECAS-MITL - IETR University Rennes 1 in April 2007 has continued under Dragon 2 with an active programme of seminars, student exchange, co-supervising of students and a comprehensive research programme using both satellite and airborne Polarimetric SARs.

↑ Soil moisture calibration and validation at the Nacu observation station on the Tibetan Plateau

↑ Joint Sino-European team meeting and workshop of the AMFIC project in October 2008 in Beijing

DRAGON 2 PROGRAMME MANAGEMENT

20-21 October 2008	Progress Meeting at Chinese Academy of Forestry, Beijing
9 December 2008	Visit to 2009 Symposium venue, Barcelona Spain
30-31 March 2009	Plannning meeting with Nanjing University, Nanjing in preparation for the 2009 advanced training course in atmospheric remote sensing

↑ Visit to the World Trade Center Barcelona, Spain to initiate organisation and planning for the 2009 Dragon 2 Symposium.

↑ Progress Meeting with ESA, NRSCC representative and Chinese lead investigators, 20 to 21 October 2009, Chinese Academy of Forestry, Beijing

↑ First planning meeting for the organisation of the 2009 advanced training course in atmospheric remote sensing, Nanjing University, Nanjing Monday 30 April 2009 with ESA, NRSCC and Nanjing University representatives

On 20 to 21 October 2008, ESA and NRSCC had a joint progress meeting with Chinese Dragon 2 lead investigators in Beijing. The progress and status of ESA, TPM and Chinese EO data delivery to the projects was reviewed. Further planning for EO data acquisitions was made. Since the start of the Dragon 2 programme, the project teams have been ordering ASAR and MERIS FR imagery which have been 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. ESA TPM imagery is being delivered by ftp. Chinese EO data is being delivered by ftp.

On 30 and 31 March 2009, the organisation for the 2nd advanced training course in atmospheric remote sensing was initiated following a visit to Nanjing University, Nanjing. This training course will take place from 19 to 24 October 2009.

In December 2008, following a visit to Barcelona Spain, ESA selected the venue for the 2nd annual Dragon 2 Symposium. The 2009 Symposium will bring the joint Sino-European teams together for reporting after more than 1 year's activity. There will also be a poster session dedicated to reporting by young scientists.

↑ Bas Mijling (KNMI) centre, with European and Chinese project PIs at the National Satellite Meteorological Centre in Beijing

DRAGON 2 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 at Dragon 2 Symposia

ESA has allocated resources to Dragon 2 projects for training of young scientists. The applicable period is in Phase 1, 2008 to end of 2010 and in Phase 2, 2011 to 2012. ESA has placed contracts with 14 European Institutions participating in Dragon 2 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 Dragon 2 Symposia
4. Any software developed as a result of the training support

During 2008 and 2009, several of the young scientists have and will undertake study periods and field data collection campaigns in P.R. China. They will work with their Chinese counterparts. At the 2009 Barcelona Symposium, they will report on their project activities and their latest results.

↑ Young Chinese scientists with Topographic mapping project PIs during a working meeting at LIESMARS Wuhan University in October 2008

↑ Chinese young scientists presenting posters at the 2008 Dragon 2 Kick-off Symposium

ESA, TPM AND CHINESE SATELLITE AND INSTRUMENT DATA

EO data For science and application development in China, ESA and NRSCC are providing EO data to the Dragon 2 joint Sino-European teams. The instruments are used for monitoring the ocean land and atmosphere exploiting archive, current, and future data.

TPM data ESA has made agreement with other agencies (e.g. JAXA) for the acquisition of ALOS data for science and application development. PALSAR in particular allows for acquisition of polarimetric SAR data at L-band and this is complementary to ASAR data at C-band.

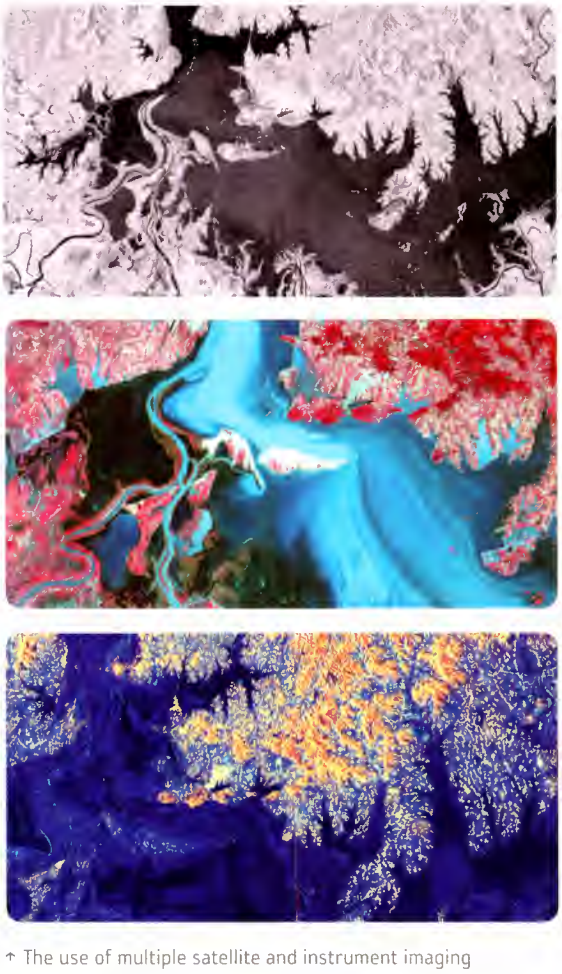
Satellite	Instruments
ENVISAT	Advanced Along Track Scanning Radiometer (AATSR) SCanning Imaging Absorption SpectroMeter for Atmospheric CHartographY (SCIAMACHY) MicroWave Radiometer (MWR) MEdium Resolution Image Spectrometer Instrument (MERIS) Advanced Synthetic Aperture Radar (ASAR) Doppler Orbitography and Radiopositioning Integrated by Satellite (DORIS) Global Ozone Monitoring by Occultation of Stars (GOMOS) Laser Retroreflector (LRR) Michelson Interferometer for Passive Atmospheric Sounding (MIPAS) Radar Altimeter-2 (RA-2)
ERS-1 & 2	Radar Altimeter (RA) Along Track Scanning Radiometer (ATSR) Global Ozone Monitoring Experiment (GOME) Microwave radiometer (MWR) Synthetic Aperture Radar (SAR) Wind Scatterometer (WS) The Precise Range And Range-Rate Equipment (PRARE)
SMOS	Soil Moisture and Ocean Salinity mission
ADM	Atmospheric Dynamics Mission (ADM-Aeolus)
PROBA	The Compact High Resolution Imaging Spectrometer (CHRIS)
ALOS	Phased Array L band Synthetic Aperture Radar (PALSAR) Advanced Visible and Near Infra Red Radiometer (AVNIR-2) Panchromatic Remote-sensing Instrument for Stereo Mapping (PRISM)

↑ ESA and TPM satellite missions and EO instruments

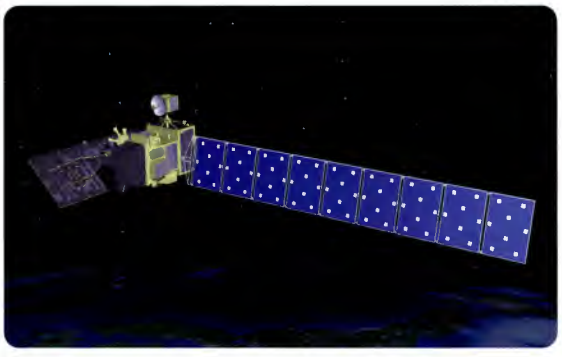
Satellite	Instruments
Beijing-1	Multi-Spectral Imager (MSI)
CBRS	CCD Camera (CBERS-01 and CBERS-02) Infrared Multispectral Scanner (IRMSS) (CBERS-01 and CBERS-02) Multispectral Camera (MUX) (CBERS-03 and CBERS-04) Wide Field Imager (WFI) (All CBERS satellites)
FY-3	Earth Radiation Measurement (ERM) Medium Resolution Spectra Imager (MERSI) Microwave Humidity Sounder (MWHS) Total Ozone Unit (TOU) Visible and Infrared Radiometer (VIRR)
HJ-1-A	Hyper-spectrum Imager Wide field multi-spectrum camera
HJ-1-B	Infrared scanner
HJ-1-C	Synthetic aperture radar

↑ Chinese EO satellite missions and EO instruments

↑ In-situ calibration target, Beijing-1 Calibration Campaign in An'hui, China, March 2006. Courtesy of Beijing Landview Mapping Information Technology Co. Ltd. (BLMIT)



↑ The use of multiple satellite and instrument imaging resources increases the temporal frequency of observations. E.g. changes in water extent during different seasons and over different years can be monitored for Poyang Lake. ASAR WSM image July 2006 (top), Beijing-1 XS July 2006 (centre) and ALOS bi-polarimetric imagery Nov. 2007 (bottom)



↑ ALOS satellite

LATEST FIGURES – ESA AND TPM DATA DELIVERY

As of end April 2009:

A total of 332 ASAR AP and IM mode images have been delivered

A total of 316 MERIS FR images have been delivered

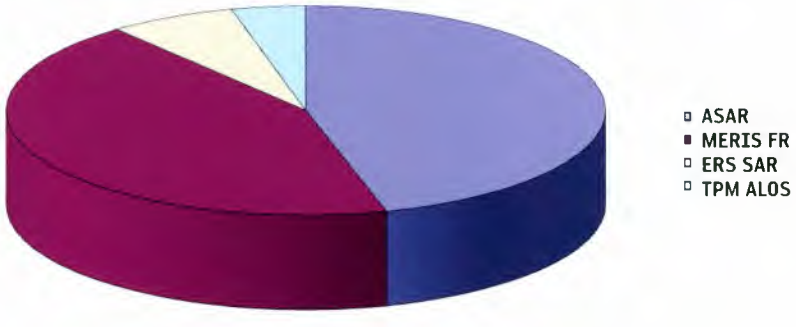
A total of 50 ERS SAR images have been delivered

A total of 29 ALOS images have been delivered

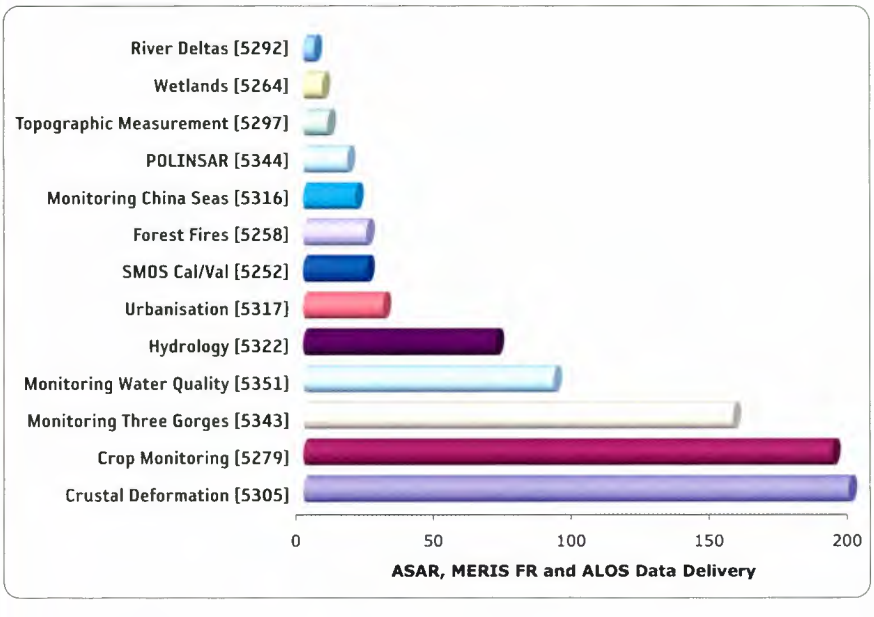
Overall 763 high bit rate scenes delivered

With reference to figure showing total data delivery for ESA and TPM high bit rate data

- The majority of ASAR images requested are for land and environment applications
- The MERIS FR images are mostly for ocean colour applications
- For time series analysis back to the 1990's several projects are requesting ERS SAR imagery
- ALOS data delivery includes PALSAR for POLInSAR applications (project id. 5344) and ALOS PRISM data for very high resolution DEM (~2.5m) generation (project id. 5252)



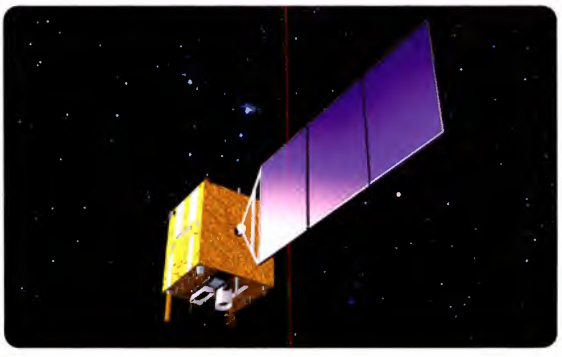
↑ ESA and TPM high bit rate data delivery (from April 2008 to April 2009)



↑ Delivery of ESA and TPM high bit rate data on a project by project basis (from April 2008 to April 2009) nb for atmospheric chemistry projects, and low resolution products (ASAR WS / GM, MERIS RR) data are delivered by ftp

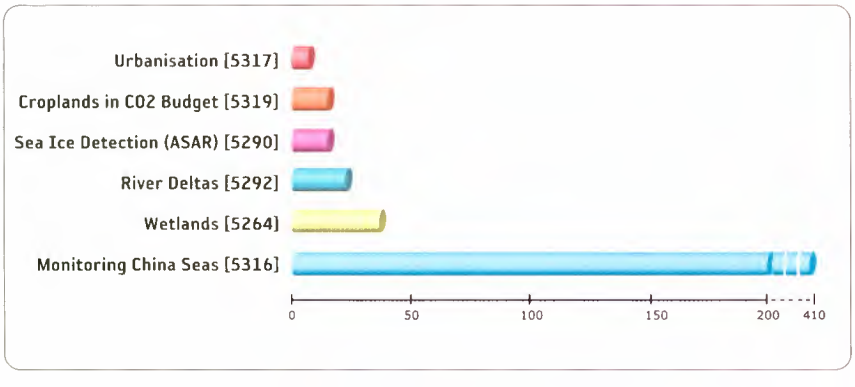
LATEST FIGURES CHINESE EO DATA DELIVERY

As of May 2009:
a total of 145 Beijing-1 MSI scenes delivered to PIs
a total of 254 CBERS-1/2 scenes delivered to PIs
a total of 160 HJ optical scenes delivered for Oceanography
Overall 559 scenes delivered



↑ CBERS satellite operated by CRESDA over China

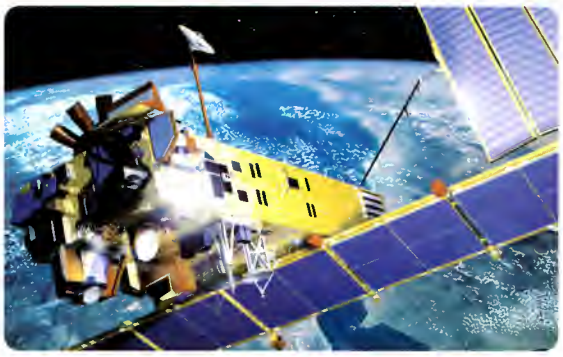
↑ Chinese EO data by satellite



↑ Chinese EO data delivery by project

HJ is a new constellation consisting of 3 satellites (A, B and C), A & B were recently launched in 2008, HJ-A carries a wide swath CCD and a hyperspectral imaging sensor, HJ-B carries a wide swath CCD and a thermal imaging sensor, and HJ-C is a SAR satellite and will be launched in 2009.

The largest user of CBERS and HJ data is oceanography project id. 5316. Beijing-1 MSI data is being requested by 6 land projects and 3 projects investigating seas and water quality. As yet, there are no requests for CBERS or HJ data over land



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

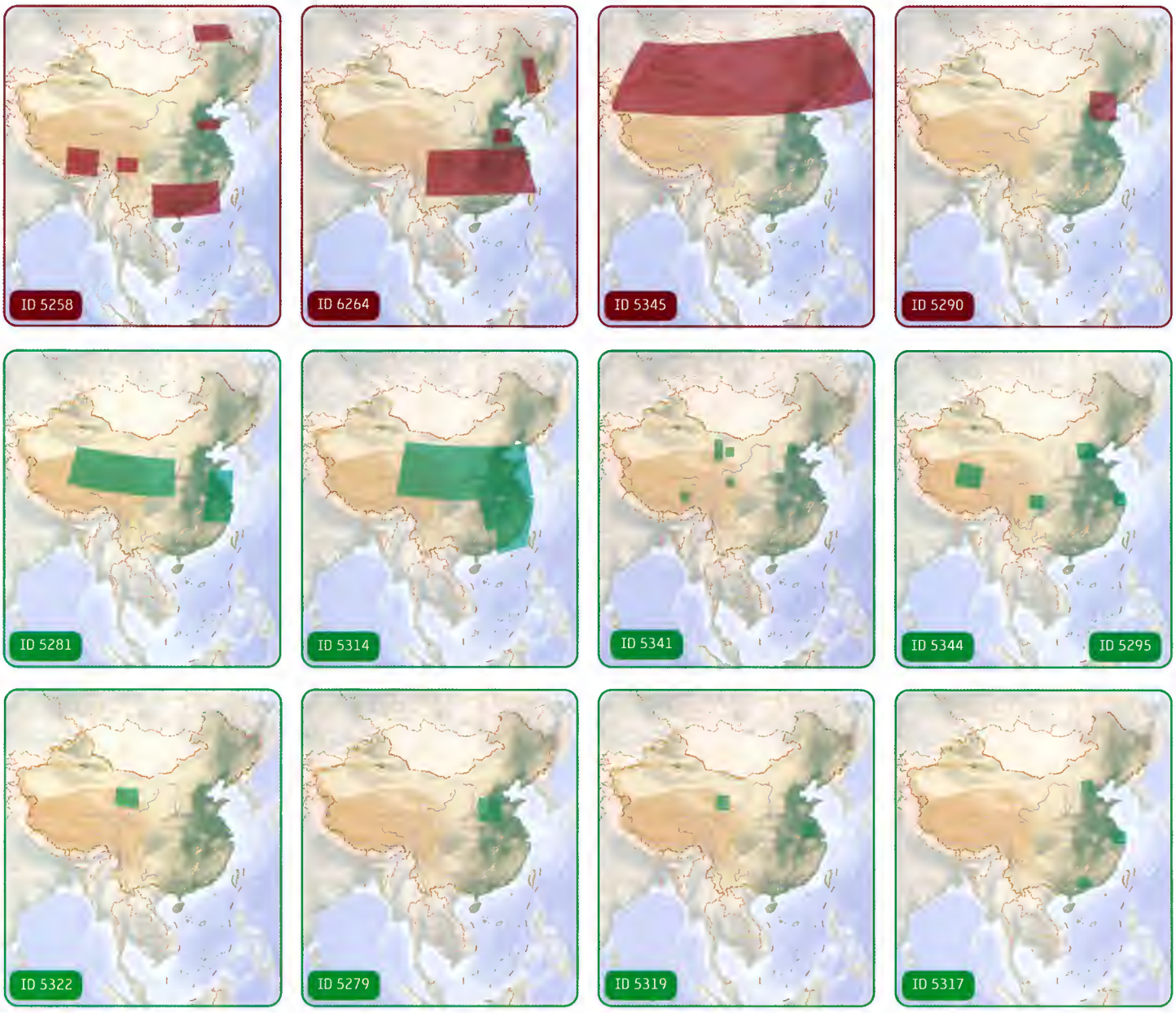
DRAGON 2 STUDY AREAS

The wide swath and high temporal revisit capability of Beijing-1 and CBERS multi-spectral sensors ensures multi-temporal coverage over the Dragon 2 study areas. Over China seas, ocean colour and thermal studies are being supported by optical and thermal instruments on board ESA and Chinese satellites, e.g. MERIS, AATSR on Envisat.

The all weather, day and night capability of SAR instruments such Envisat ASAR and HJ-C ensures large area mapping applications in China's cloud covered southern regions.

The acquisition of Envisat's atmospheric instrument data is global over China as will be the operation of SMOS and ADM instrument data in support of CAL / VAL projects.

Hazards projects | Land & Environment projects | Oceanography and Coastal Zones projects | Topographic Mapping projects | Atmosphere projects | CAL/VAL projects

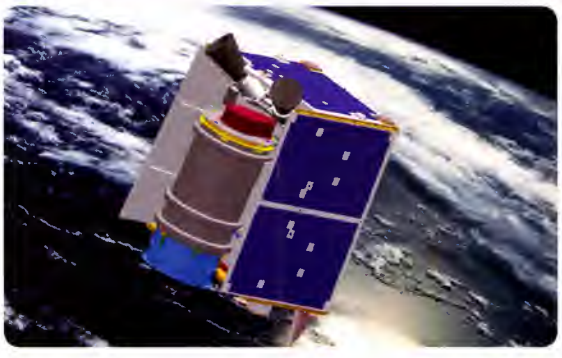


DRAGON 2 STUDY AREAS

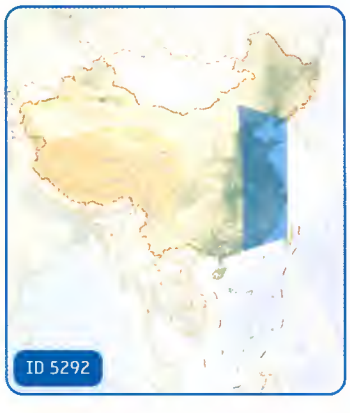
ESA instrument's planning conflicts are checked up-front following the Dragon 2 conflict free scheme thus a high percentage of requested acquisitions and modes of acquisition are provided to investigators.

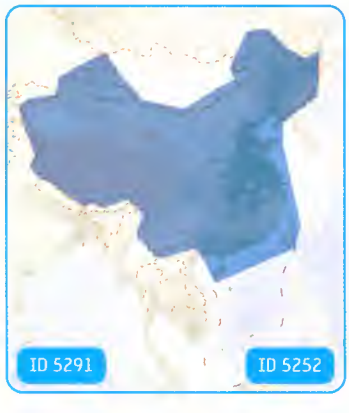
PIs are requested to provide their planning ahead of the acquisition cycles. Instrument and projects' conflicts are checked up front using the Project Impact Assessment Tool (PIAT). Following conflicts resolution, the PIs enter their conflict free requests into EOLI SA, the on-line interface for ESA data ordering.

Few requests over the Eastern part of China and seas were cancelled because the area is not in ARTERMIS visibility and therefore no simultaneous ASAR HR and MERIS FR acquisitions are possible.



↑ The Chinese Beijing-1 microsatellite was launched on 27 October 2005 and carries a panchromatic and a multi-spectral sensor payload





DRAGON 2 WEBSITE

DRAGON 2 Programme information & reporting portal

- News & Events
- Projects, partners and study areas
- Symposia - programmes, abstracts and presentations
- ESA, TPM & Chinese EO missions
- Access to documentation - EO data ordering, brochures and abstract books
- Advanced training courses – registration, programmes, lecturers and content
- Mid and final term proceedings

http://dragon2.esa.int

DRAGON UPCOMING EVENTS

2nd ADVANCED TRAINING COURSE IN ATMOSPHERIC REMOTE SENSING

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

Dates
From 19 to 24 October 2009

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

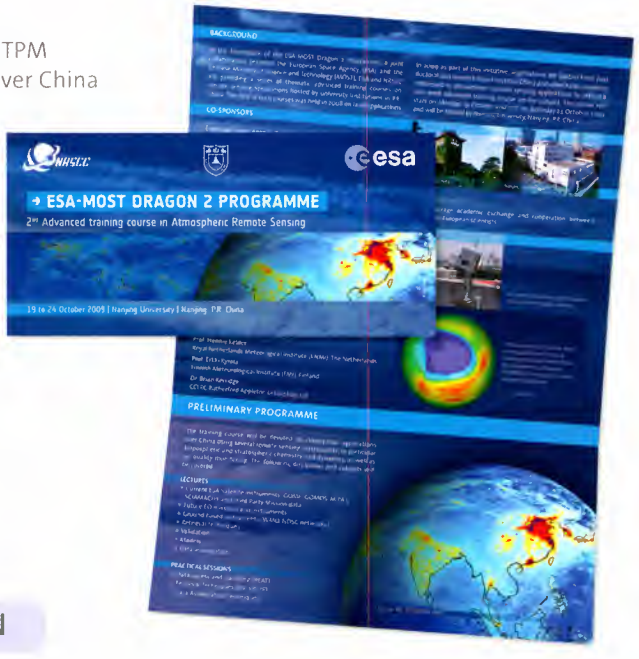
Sponsors
The course is being sponsored by MOST/NRSCC, Nanjing University and ESA

Course Content
The lectures and practical sessions shall cover theory and processing of ESA, TPM and Chinese EO data for atmospheric monitoring and parameter retrievals over China

Web
The training course programme and registration forms are available from the Dragon 2 website:

http://dragon2.esa.int/atmostraining2009.html

↑ North Great Building, Nanjing University P.R. China



MID TERM RESULTS CALL FOR PAPERS AND PUBLICATION

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

Objectives

- To provide the mid term results of the project teams' work at the half way stage of the four year Dragon 2 Programme
- Co-authorship of papers by European and Chinese scientists
- Make available the Special Publication (SP) as a DVD to all Dragon 2 investigators

Details on the call for papers and guidelines for submission will be made available following the 2009 Dragon 2 Barcelona Symposium. The mid term proceedings will be available following the 2010 Dragon 2 Symposium.

↑ In situ data collection at the Yuxi site in the Yunnan Province, South China. (Author Mr. Liu Qingwang, IFRIT CAF)

FOREST DRAGON 2: FOREST ECOSYSTEM OBSERVATIONS OF THE CHANGING EARTH FOR DRAGON 2 INCLUDING IDENTIFICATION AND MONITORING OF DISTURBANCES

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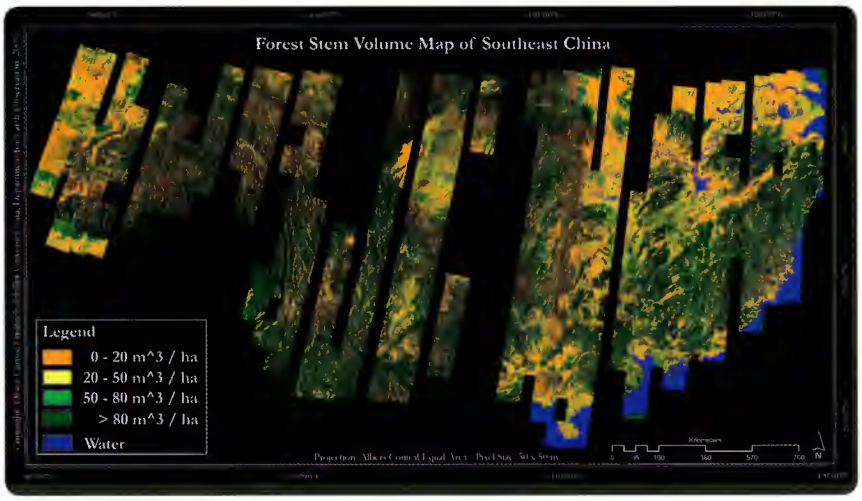
Prof. Li Zengyuan email: zengyuan.li@caf.ac.cn

Prof. Chen Erxue, Prof. Sun Guoqing, Dr. Fu Anming, Dr. Gao Zhihai, Dr. Guo Zhifeng, Dr. Thuy Le Toan, Dr. Li Shiming, Dr. Ni Wenjian, Dr. Pang Yong, Dr. Maurizio Santoro, Dr. Christian Thiel, Dr. Urs Wegmüller, Dr. Yang Yongtian, Ms. Bai Lina, Mr. Oliver Cartus, Mr. Ling Feilong, Mr. Tian Xin

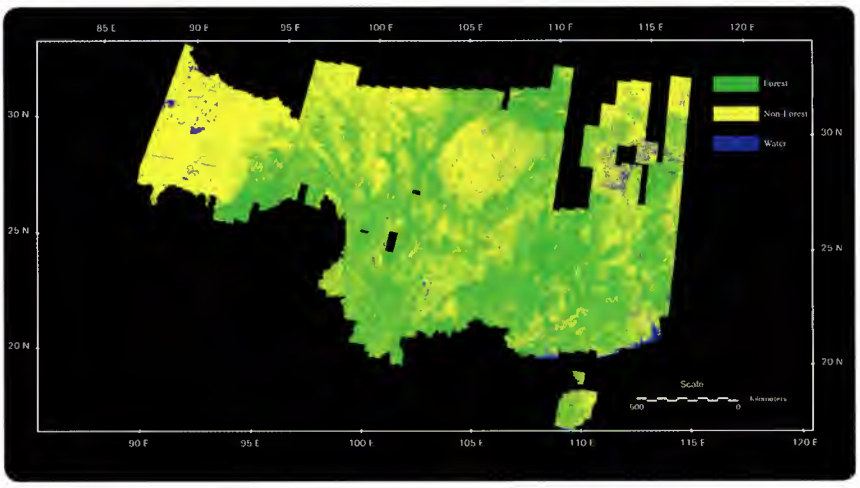
One of the goals of FOREST DRAGON 2 represents a further development, improvement and extension of the FOREST DRAGON 1 activity. During the initial part of the project, forest base maps were produced for Northeast and South China using ERS-1/2 tandem coherence images acquired between 1995 and 1998. In the first image, you can see a base map product (forest stem volume map) from the ERS 1/2 tandem coverage. More recent change detection updates were then generated using ENVISAT ASAR backscatter images acquired between 2004 and 2005. A change detection product (Forest/non-forest map) for South China is shown in the second image.

During the first year of the FOREST DRAGON 2 Project, Chinese and European teams completed forest maps covering specific areas of China. In Northeast China, an area of 1.5 Million km^2 was mapped, utilizing over 200 ERS and 900 ENVISAT ASAR images. In South China, approximately 3 Million km^2 were mapped using more than 1,000 ERS and 2,500 ENVISAT ASAR images.

Cross-validation of the thematic products has been another major activity of the first project year. The objective here is the publication of a validated 10-year Forest Cover Change Map for Northeast and South China. The validation assessment includes both geometric and thematic accuracy components. The geometric validation process of the forest maps is performed by feature matching with the corresponding satellite SAR images. The thematic validation is based on the GLOBCOVER-approach, mainly exploiting freely available Landsat and Quickbird archives, including the new MODIS VCF change product.



↑ Forest stem volume map of South China based on ERS-1/2 tandem coherence data from 1995 to 1998. (Author: Mr. Oliver Cartus, FSU Jena)



↑ Forest/non-forest map of South China based on ENVISAT ASAR backscatter data from 2004 and 2005. (Author: Mr. Tian Xin, IFRIT CAF)

SATELLITE MONITORING OF URBANIZATION IN CHINA FOR SUSTAINABLE DEVELOPMENT

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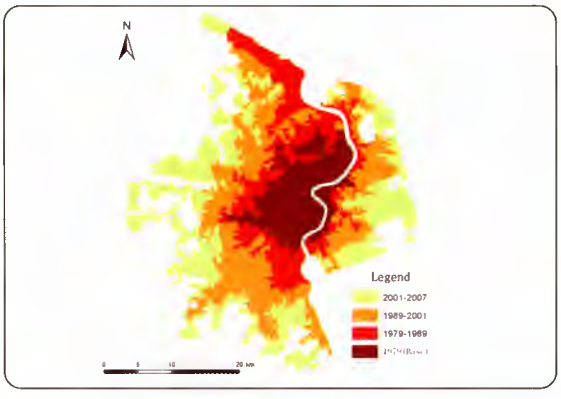
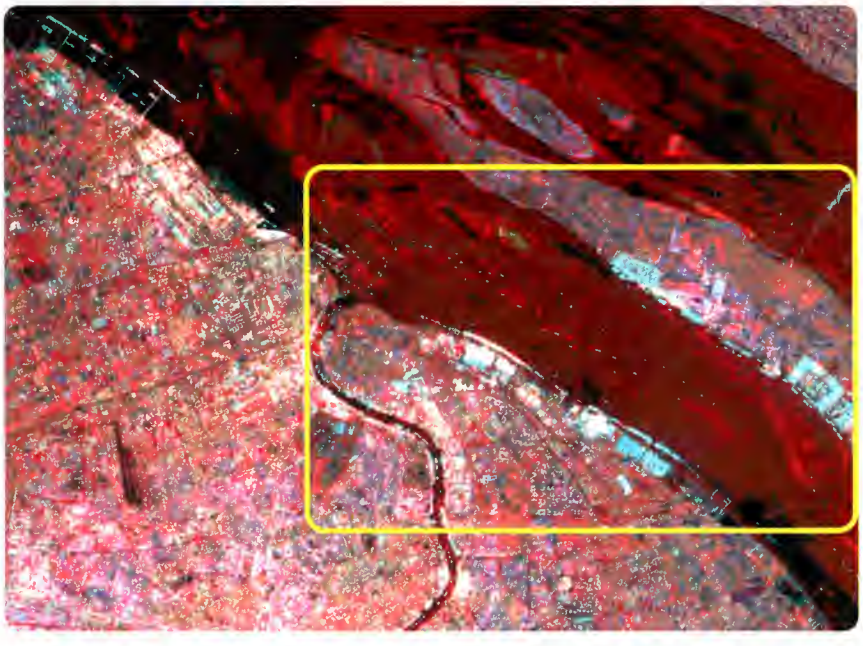
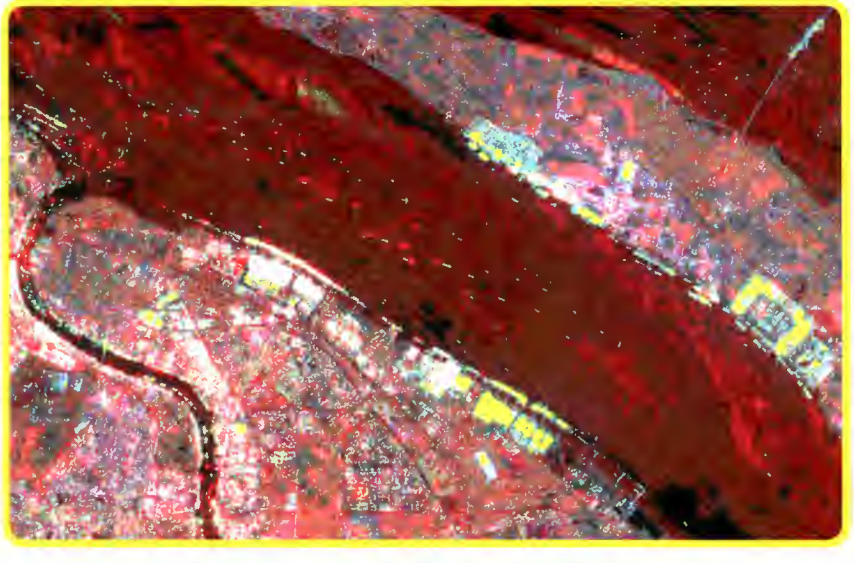


↑ Urban expansion in Shanghai, China from 1979 to 2007



↑ Cyan shows changes in Shanghai between 2002 and 2008 in composite images of 2002 ERS C-VV SAR (Red), 2008 ENVISAT ASAR C-VV (Green) and ASAR C-HH (Blue).



↑ New buildings are detected and shown in yellow (by comparison of SAR backscatter in ERS SAR 2002 and ENVISAT ASAR AP backscatter in 2008)

The unprecedented combination of economic and population growth since the early 1980s has led to dramatic changes in China's landscape. China is in transition from a largely rural society to a predominantly urban one. Two decades ago, fewer than 20% of China's people lived in urban areas; today it is 40%; and by 2020 it is expected to be 60%. Therefore, monitoring urbanization and their impact on the environment is of critical importance for sustainable urban development in China. The overall objective of this research is to investigate spaceborne SAR data and fusion of SAR and optical data for monitoring urbanization in China, and to assess the impact of urbanization on the environment for sustainable urban development.

ENVISAT ASAR data, ERS-2 SAR data, and Beijing-1 data were acquired over three case study areas, i.e. Beijing, Shanghai (see ASAR image, top) and Guangzhou. Fieldwork was conducted in Beijing and Shanghai in October, 2008 and in Guangzhou in March, 2009 to facilitate image analysis. Web-based data sharing was setup at KTH to share images and data with partners. Using ENVISAT ASAR data acquired on September 3, 2008 and ERS-2 SAR data acquired on August 27, 2002, a minimum error thresholding algorithm was tested for change detection in Shanghai. The preliminary result showed that the algorithm could identify major changes using multi-temporal SAR data (bottom image). Using Landsat data, the spatial and temporal patterns of urbanization in Shanghai were also analyzed. Other on-going research includes SAR and optical data fusion, SVM for image classification, and human settlement index computation.

↑ Team meeting with Chinese partners to discuss research and project planning in 2009 (29/12/08 in Beijing)

THE ROLE OF CROPLANDS IN THE CARBON BUDGET OF CHINA

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Dr. Alberte Bondeau, Dr Michael Buchwitz, M. Alexandre Bouvet, Prof. Li Zengyuan, Prof. Li Bingbai, Prof. Wang Qinmin, Dr. Wang Xiaoqin, Mr. Jiang Hong, Mrs. Chen Yunzhi, Dr. Zhang Wen , Dr. Sun Wenjuan, Mr. Ling Feilong, Associate Prof. Bai Lina, Dr. Li Shiming, Dr. He Guojin

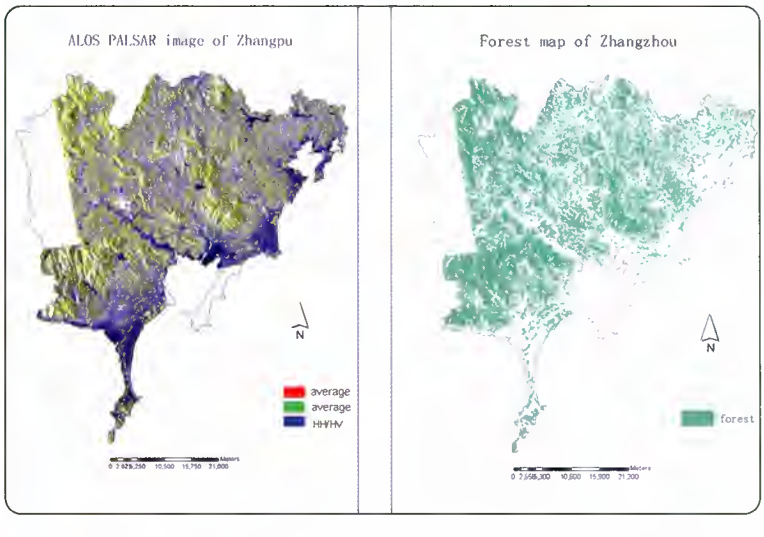
The overall objective of this project is to improve our knowledge of the role of croplands in the carbon cycle of China by bringing models and satellite data together in a scientifically sound manner.

The approach used has two balanced components: 1) An observation methodology bringing together datasets relevant to calculations of C fluxes. The data are from various sources (e.g. meteorological, soil maps etc.), and by EO methods using Chinese, ESA and TPM data developed or adapted to the environment under study. 2) Modeling work that adapts and validates existing models to estimate C fluxes in the soil-vegetation-atmosphere system.

Models are adapted by using EO-derived data to replace in situ measurements, statistics and literature. The models are also adapted to Chinese croplands (crop types, calendar, rotation, practices). The validation of the final C budget estimates makes use of measurements from the China flux network, and are compared to atmospheric measurements from space.

The work is conducted at two scales. The regional scale: Jiangsu province, dominated by intensive rice cultivation, Fujian province, with a diversity of crop types and rotation, and the Qinghai-Tibet plateau, a mainly grassland region with marked climate warming. EO data is used to derive land cover, crop maps, and vegetation biophysical parameters (see the 2 example EO derived products for Jiangsu, and Zhangpu, Fujian provinces). At China scale, vegetation activity, phenology, crop calendar and ecological switches are derived from EO data. Trends over 2 decades are derived for phenology, growing season length and seasonal NDVI.

↑ Beijing-1 MSI image of Xinhua test site, Jiangsu province, (R:1,G:2,B:3)



↑ ALOS PALSAR image and derived forest map of Zhangpu, Fujian

DROUGHT MONITORING, PREDICTION AND ADAPTATION UNDER CLIMATIC CHANGES

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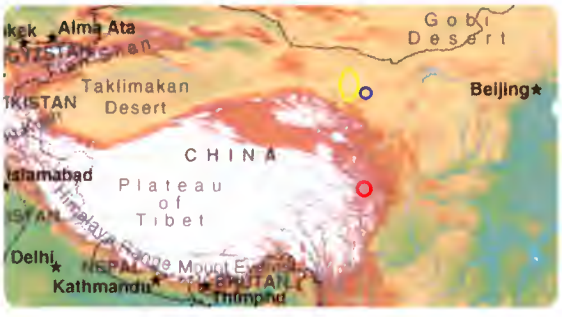
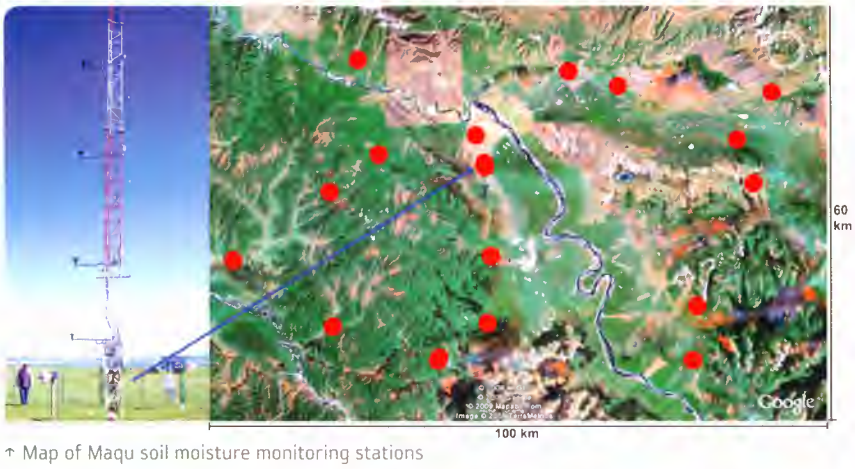
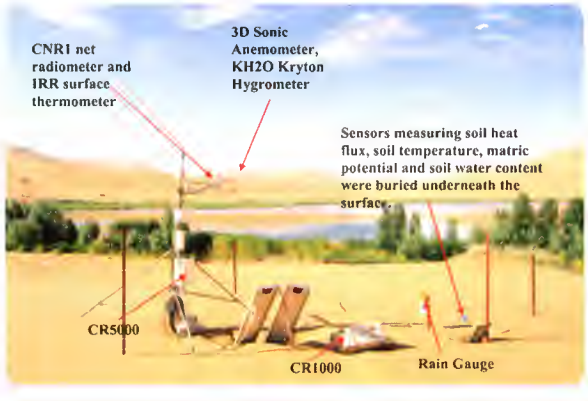
Prof. Massimo Menenti, Prof. Jose Sobrino, Prof. Li Zhaoliang, Dr. Wout Verhoef, Dr. Li Jia, Prof. Wen Jun, Dr. He Yanbo, Prof. Li Wan, Prof. Liu Qinhuo, Prof. Yu Qiang, Prof. Li Xin, Rogier van der Velde, Laura Dente, Zhong Lei, Zeng Yijian, Tian Xin, Li Longhui, Qin Changbo



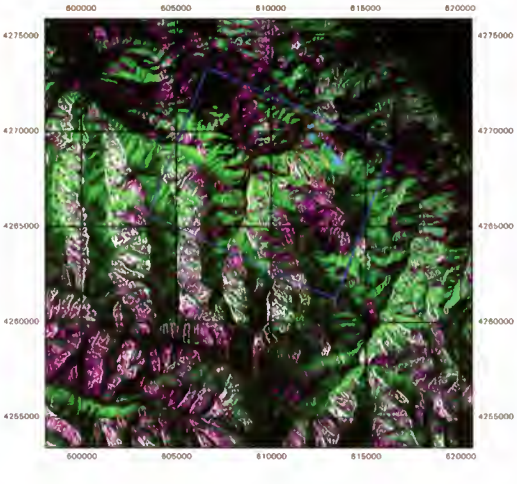
↑ Locations of Maqu monitoring site (red), Badain Jaran Desert experiment (blue) and WATER experiment (Yellow)



↑ Map of Maqu soil moisture monitoring stations



← Field site in the Badain Jaran Desert



→ Geocoded ALOS PALSAR Data (Red:HH, Green:HV, Blue: HH). The blue box is the area for airborne campaign observed by LIDAR and CCD in the Water Campaign

Historically, droughts have often caused great hunger, social instability, large scale population migrations and the extinction of civilizations. Water resource supply and demand constitutes the biggest problem for food security in China, and drought has become a key factor constraining China's economic development.

The objective of this project is to develop a quantitative and operational system for nation wide drought monitoring and drought impact assessment for application in agriculture and water resources and environment in China using ESA, Chinese and other relevant satellite data as major data source in combination with other data source (e.g. meteorological and drought statistics, etc.). An extension to drought prediction and adaptation to climate change will be made compared to the Dragon I drought monitoring proposal.

The project will generate: (1) real time drought monitoring and prediction system, (2) improved understanding of land surface processes and land-atmosphere interactions over different terrains (e.g. agriculture land, forest, Gobi desert, high plateau, polar environment), (3) algorithms for estimation of land surface parameters and heat fluxes, (4) assessment of economic loss caused by drought and adaptation measures under climatic change, (5) training of young scientists in the area of water, climate and environment. An Internet based system will be developed to provide information concerning the drought evolution situation and to support drought relief decision-making. The system will be implemented at the China National Meteorological Center and accessed in real time by decision-making agencies at national, provincial, local levels via Internet.

↑ Graphic shows dual frequency X/P band SARs and mounting on aircraft

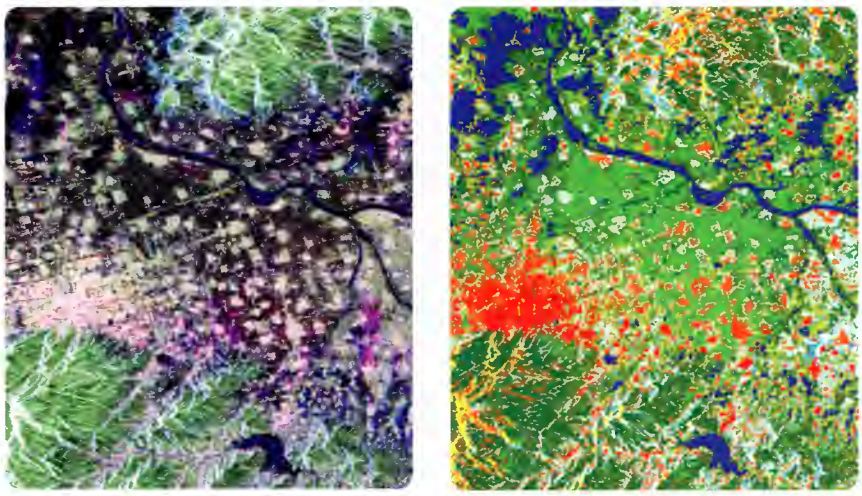
TECHNIQUES FOR DERIVING LAND COVER AND EARTH SURFACE DEFORMATION INFORMATION FROM POLARIMETRIC SAR INTERFEROMETRY

Prof. Eric Pottier email: eric.pottier@univ-rennes1.fr
Prof. Chen Erxue email: chenerx@caf.ac.cn

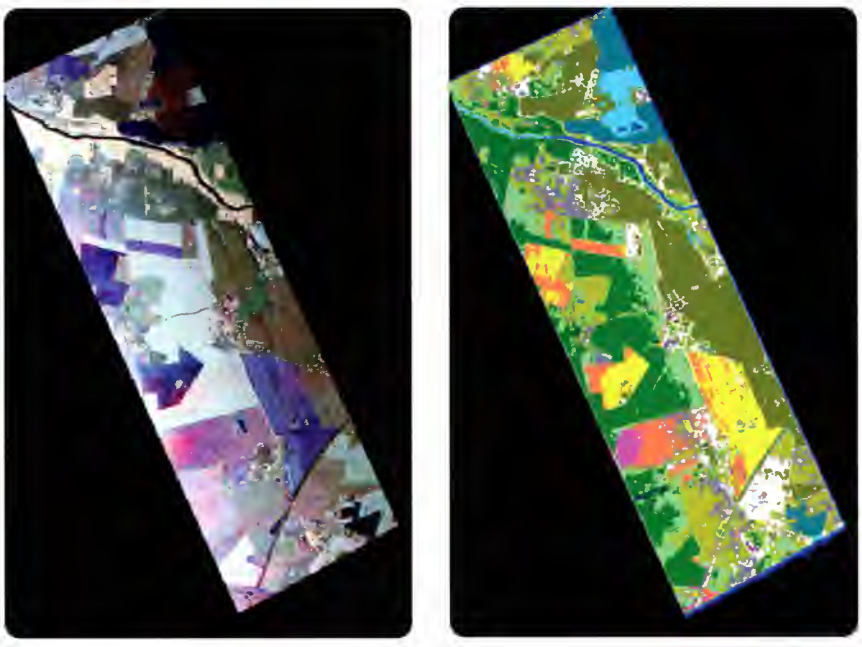
Based on the experience accumulated and gained during the DRAGON-1 project, the DRAGON-2 project is intended to strengthen the established and already fruitful collaborations between European and Chinese partners and experts in polarimetric interferometric SAR (PolInSAR) and quantitative forest sciences. The project includes investigation also of the potential application capabilities of the advanced PolInSAR airborne dual-frequency (X/P) SAR system, developed by IECAS under project supported by MOST (top of page photo).The project contains four main scientific topics covering land cover analysis, Earth Surface Deformation Monitoring and DEM Extraction, Forest Vertical Structure Parameters Extraction and PolSARpro Software Development.

Land Cover Analysis
The proposed research activities conducted in this topic aim at developing and validating a general and original supervised and/or unsupervised PolSAR and PolInSAR segmentation methodology (see examples provided on this page).

Earth Surface Deformation Monitoring and DEM Extraction
Earth surface deformation due to hydrocarbon or groundwater exploration usually occurs as subsidence or uplift with consequences to water management, infrastructure and coastal zone defense. Improvements in the methodology for deformation analysis are necessary to enhance the understanding of deformation processes. Polarimetric SAR interferometry is such a technology with a high potential in this aspect. The proposed research activities conducted in this topic aim at developing a general methodology for the Earth Surface Deformation Monitoring and DEM extraction.



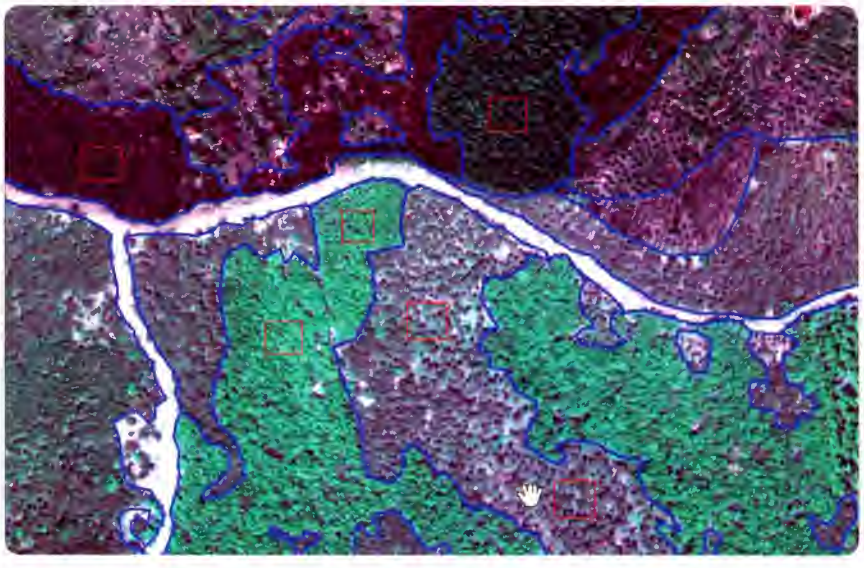
↑ Pauli vector color-coded image (left), unsupervised PolSAR segmentation (right), ALOS PALSAR image of Culai test site – Shangdong Province, China



↑ Pauli vector color-coded image (left) unsupervised PolSAR segmentation (right), ESA Airborne Campaigns (ESAR) – AGRISAR Campaign

Dr. Shane R. Cloude, Dr Konstantinos P. Papathanassiou, Prof. Li Zengyuan, Dr. Hong Wen, Dr. Cao Fang, Dr. Xiang Maosheng, Prof. Wang Chao, Dr. Zhang Hong

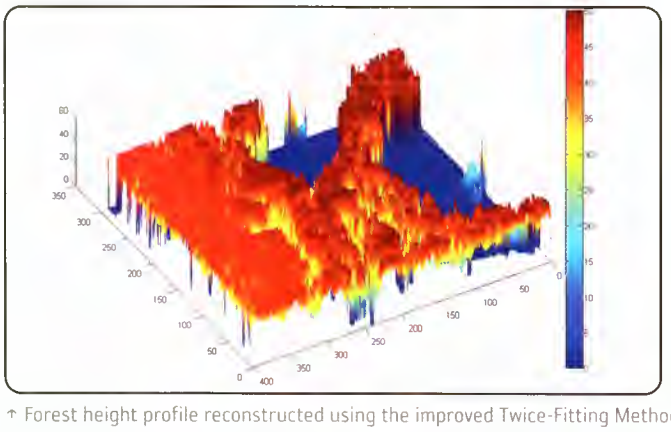
↑ Locating forest plots in the field using maps derived from imagery and GPS



↑ Culai Test Site – Shandong Province, China

↑ Warm temperate broad leaved forests

Black locust (pure forest)



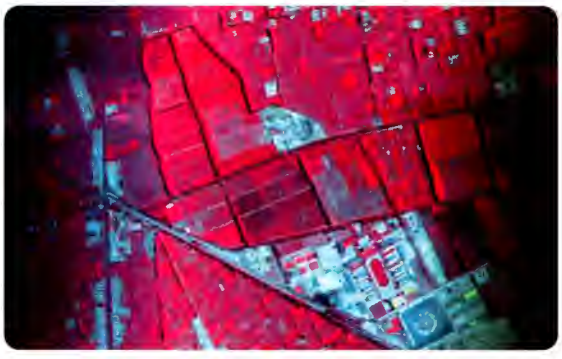
↑ Forest height profile reconstructed using the improved Twice-Fitting Method

Forest Vertical Structure Parameters Extraction

The structure of forest vegetation is a key ecosystem parameter for biomass stock successions, and growth dynamics. Tree (forest) height parameter is a critical input to biomass determination and its estimation from space borne and airborne sensors would enable ecosystem change monitoring and modeling. The proposed research activities conducted in this topic aim at developing a general methodology and approach to forest parameters extraction from single-baseline and dual-baseline polarimetric and interferometric SAR (PolInSAR) data. New scientific concepts like the Polarization Coherence Tomography (PCT) procedure are being introduced. Validation campaigns in support of these activities are being conducted at test sites in China, in the aerial imagery and photos of forest types).

PolSARpro Software Development

PolSARpro Software v4.0 is a polarimetric SAR data processing and educational tool developed under contract to the European Space Agency. All the new algorithms and scientific procedures that will be developed during the DRAGON-2 project will be included in the software, thus increasing the great collection of well-established algorithms and tools designed to handle PolSAR and PolInSAR data from airborne and spaceborne sensors. The PolSARpro software could thus become an important communication tool, advertising the international Geoscience and Remote Sensing community for promoting the most important scientific developments conducted during the DRAGON-2 project (see also page 9).



↑ Airborne OMIS II infrared image over croplands

KEY ECO-HYDROLOGICAL PARAMETERS RETRIEVAL AND LAND DATA ASSIMILATION SYSTEM DEVELOPMENT IN A TYPICAL INLAND RIVER BASIN OF CHINA'S ARID REGION

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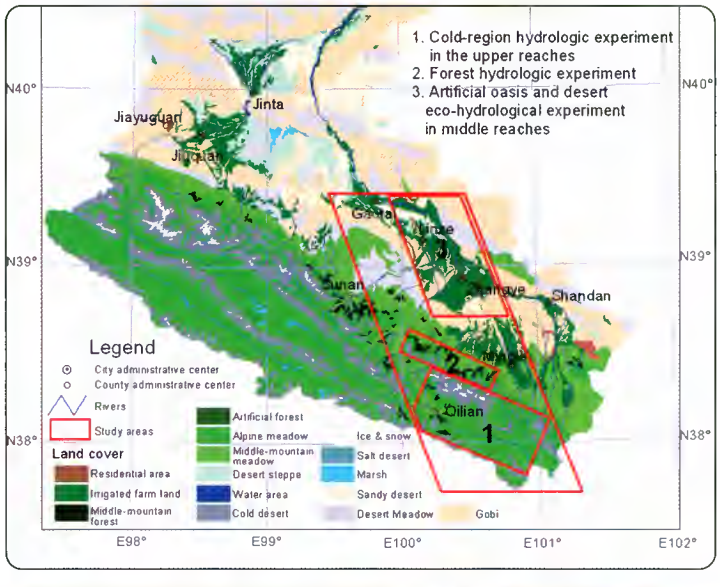
Prof. Wang Jian, Prof. Wang Jiemin, Dr. Ma Mingguo, Prof. Hu Zeyong, Dr. Lu Ling, Dr. Wang Weizhen, Dr. Che Tao, Dr. Liu Qiang, Dr. Zhuotong Nan, Dr. Rui Jin, Dr. Frank Veroustraete, Prof. Bob Su, Dr. Li Jia, Dr. Li Zhaoliang, Dr. P.A. Brivio, Dr. F. Maselli, Dr. Run Wang, Tian Xin

Over the last year, with the fund from the project WATER (http://water.westgis.ac.cn), we have carried out a large-scale intensive field experiment in the Heihe River Basin. The top figure shows the distribution of the sampling regions. The WATER experiment is a simultaneous airborne, satellite-borne and ground based remote sensing experiment aiming to observe the major components of water cycle in cold region, forest, and arid region hydrology experimental areas (see map showing location and distribution of the study areas).

The goal of the project is to improve the monitoring, understanding, and predictability of hydrological and ecological processes at catchment scale, and promote the applicability of quantitative remote sensing in watershed science. Some key hydrological and ecological variables will be retrieved in virtue of ESA, TPM and Chinese EO data and will be merged into hydrological modeling for a more coherent and precise representation of water cycle at catchment scale.

The main achievements are: 1) obtained numerous data, including airborne remote sensing data from passive microwave radiometer, hyper-spectral imager, thermal imager, and lidar, satellite remote sensing data, hydro-meteorological observations, precipitation observed by Doppler Radar, atmospheric meteorological sounding data, and ground observations of snow properties, frozen soil, forest structure, forest hydrology, bio-geophysical parameters, spectral reflectance and albedo, land surface temperature, evapotranspiration, soil moisture and so on, see photos right. 2) In total, 25 airborne missions were flown, with 8 flights in the cold region, 4 flights in the forest region, and 13 flights for arid region hydrology experiment. The flying time amounted to 110 hours, with most of them to be flown during the overpass of satellite sensors for concurrent analysis.



← Distribution of Arid, forest and cold region study areas in the Heihe River Basin, China

↑ Desert region – calibration of the passive microwave radiometer (GBMR)

↑ Collection of atmospheric sounding data by balloon

↑ Cold region - measurement of snow reflectance properties

↑ Collection of plant parameters and vegetation sampling in the field

IMPROVING METHODS OF CROP MONITORING WITH ENVISAT DATA

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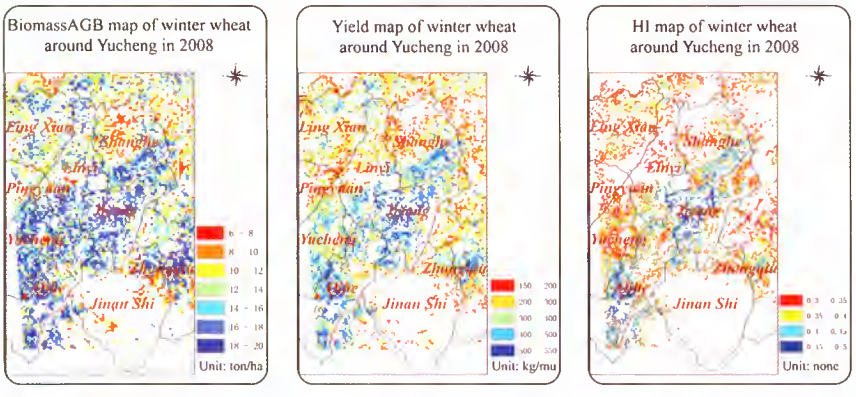
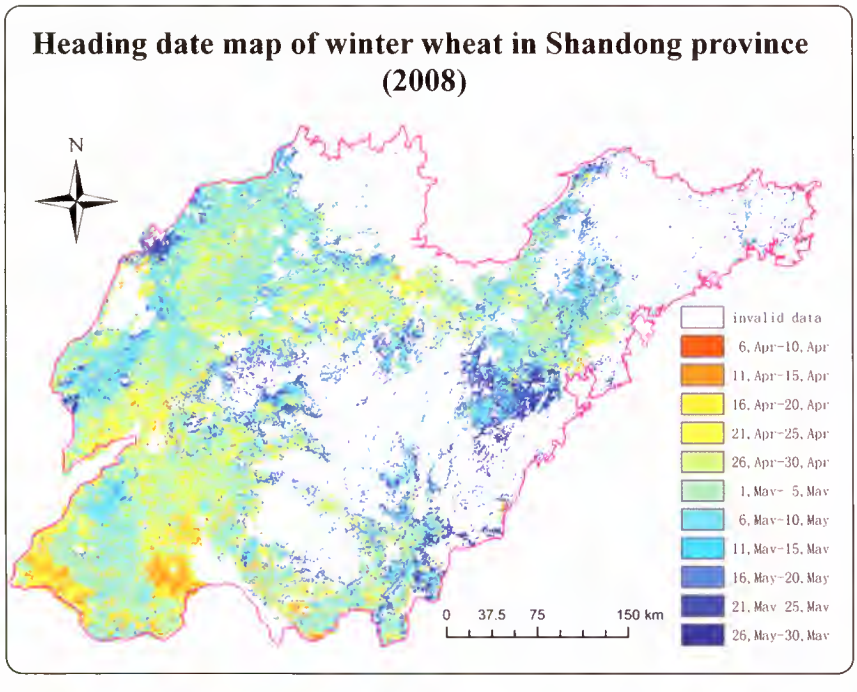
Dr. Li Qiangzi, Dr. Meng Jihua, Dr. Jia Kun, Dr. Tian Yichen, Dr. Zeng Yuan, Dr. Wen Meiping, Dr. Yang Shaoe, Dr. Du Xin, Dr. Dong Qinghan

↑ Collection of winter wheat spectral profiles in the field



↑ Biomass, HI, Yield map of winter wheat around Yucheng in 2008



↑ Heading date for winter wheat in Shandong

This project uses MERIS data for estimating crop yield, and to calculate crop biomass by means of a biomass model. The simple computation of crop biomass during the growing season is insufficient for an accurate estimation of crop yield, which is strongly controlled by partitioning processes (HI) occurring during the grain filling stage. Based on crop characteristics, a good correlation between HI and the ratio of NDVI pre (the average value of NDVI form emergence to anthesis) and NDVI post (the average value of NDVI from anthesis to maturity) has been found. With the NDVI, we can estimate the crop HI for every pixel. Finally, we use the follow expression to calculate the crop yield, YIELD = BIOMASS _ HI, and HI = f(NDVI), as shown in the three product examples for Yucheng in 2008.

After the time series NDVI was computed from MERIS data, a Savitzky-Golay filter was used to smooth out noise in NDVI time-series at pixel scale, and produced a time-series NDVI dataset at day frequency. Then indicators such as the peak were extracted from the crop NDVI profile for each pixel. See the map of showing heading date for Shangdong Province in 2008. After that the relation between these indicators and different phonological stages for winter wheat was analyzed and a model to estimate certain phonclogical stage for winter wheat was developed from the analysis.

For crop identification, ENVISAT ASAR and CBERS CCD optical data has been integrated in Fengqiu area, Henan province in 2008. An object-oriented classification method has been adopted to identify maize, rice, peanut, soybean and sweat potato. Field investigation showed the accuracy for maize and rice is up to 85%.

↑ Carex vegetation on the shores of Dongting Lake

APPLICATION OF REMOTE SENSING AND OTHER SPACE TECHNOLOGY TO HYDROLOGY AND WATER RESOURCES

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European PI to be nominated

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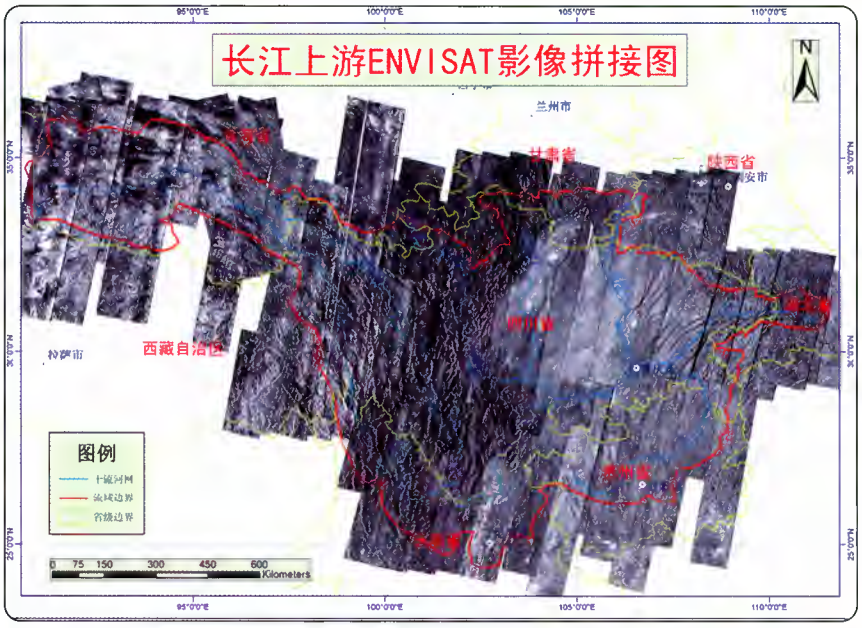
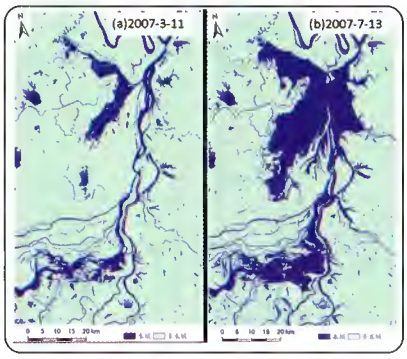
Various EO data sets have been collected for the water resources assessment and management study in the Upper Yangtze River. This includes ESA, Chinese and Third Party Mission data. Envisat ASAR coverage is shown in the top figure.

This activity has 7 major objectives: 1) To develop a modeling framework to simulate the hydrologic cycle of Hengjiang River basin, located in the upper Yangtze River; 2) To investigates interaction mechanism between the karst hydrological cycle and ecological system on the basis of water transfer simulation among interfaces of hydrology, rock and soil, and vegetation in Wujiang Basin; 3) To develop a modeling framework to simulate hydrodynamic scenario of the plain river networks areas located in Taihu Basin, Yangtze River Delta; 4) I investigate historical storm surge mapping and risk management, quasi real-time storm surge mapping and risk management; 5) To integrate remote sensing, land surface models and data assimilation to build an Internet based system for regional soil moisture monitoring and prediction in China; 6) To link remote sensing data to observable features for management of biological and ecological resources in wetlands; 7) To use satellite RS combined with nonlinear physics for rainstorm process and flood monitoring.

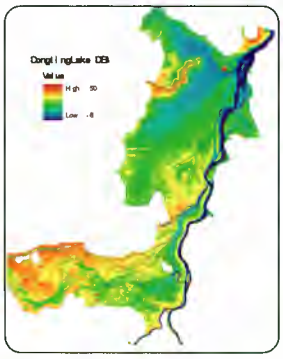
Recent result covers some initial investigations on automatic extraction of water bodies from ASAR images as shown in the classification results (bottom left), the combination of EO data and hydrological modeling; methodology for the inversion of soil moisture content using ASAR images; simulations of pollutant concentration in rivers; wetlands monitoring for surface water area, vegetation type, biomass and structure; coastal studies for the Changjiang River Delta; investigation of the effect of the 2008 earthquake and the urgent investigation of soil erosion post event.



↑ Coverage of ESA Envisat ASAR in the Upper Yangtze River



← Classification of water and non water from ASAR imagery – Dongting Lake area



→ Bathymetric map of Dongting Lake

USE OF EARTH OBSERVATION IN SUPPORT OF MAJOR SPORT EVENTS: CASE STUDY FOR THE ATHENS, BEIJING AND LONDON OLYMPIC GAMES

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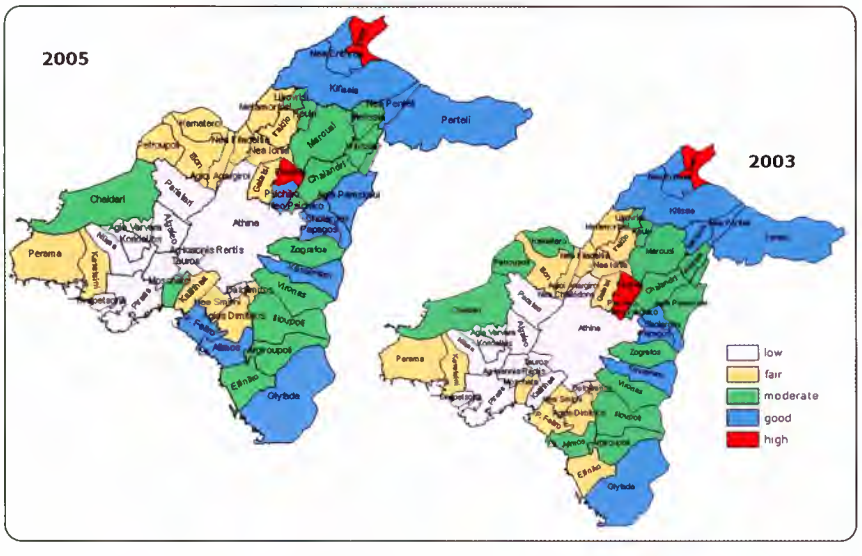
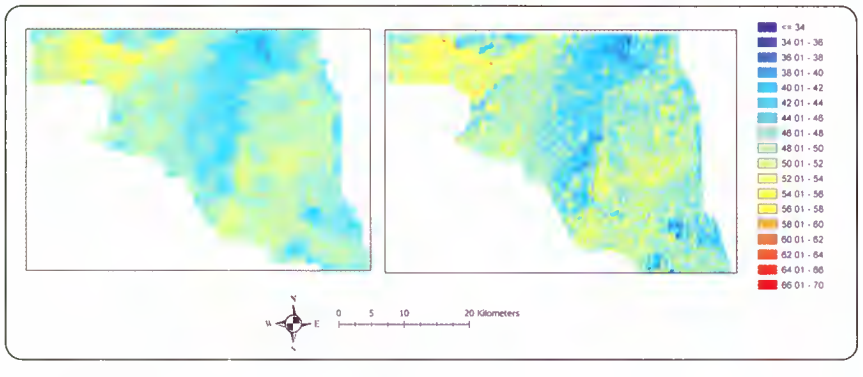
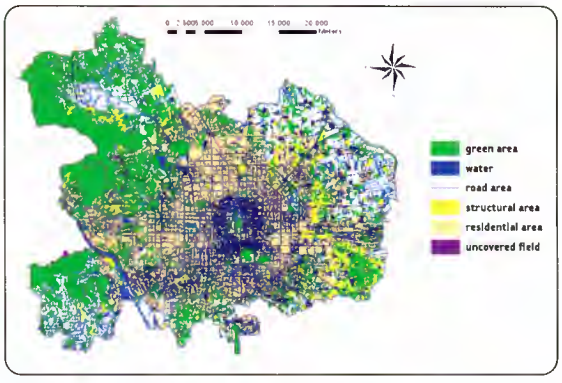


↑ Life quality for the Athens urban agglomeration prior and after the 2004 Olympic Games



↑ Pilot application in terms of the downscaling of thermal infrared satellites images of low resolution (left image) to the resolution of 120 meters (right image). Scale in the right part of the image reflects land surface temperature in degrees Celsius



↑ Land use classification of Beijing derived from EO data

Background

The innovation of the research is mostly to investigate the use of Earth Observation (EO) and other geo-spatial data to provide indicators of changes to cities prior to, during and following the hosting of major sporting events. The research focuses on the following products: 1. Quality of life indicators: definition and estimation 2. Air quality (aerosol particles) 3. Urban microclimate, including thermal comfort 4. Change detection 5. Satellite oceanography/meteorology. The research concentrates on the post games assessment of the sporting events of the Olympic Games 2004 and 2008, as well as on the definition of the potential of EO for supporting the Olympic Games 2012.

Latest results

In terms of the 2004 Athens Olympic Games, the latest results reflect the life quality changes in the overall Athens agglomeration on the basis of satellite image analysis (see the top left of page graphic for quality of life indicators prior and following the Athen Olympic in 2004) as well as a pilot application for the downscaling of thermal images of low resolution to the resolution of 120 meters (as shown bottom of page). The latter application is of prime importance for the exploitation of AATSR images in urban agglomerations.

For the 2008 Beijing Games, the latest results include the mapping of changes in the urban fabric around the Olympic park as well as in the city, the definition of aerosol optical thickness, the spatial and temporal analysis of urban green and the development of a GIS system which combines EO with other geo-spatial data. Results also include oceanographic information for the Qingdao area where the Olympic sailing event took place and changes in the urban fabric of Beijing in the period 2000-2006.

↑ Apparatus to measure heat convection in the field

DETECTION, ANALYSIS AND RISK ASSESSMENT OF COAL FIRES IN NORTHERN CHINA

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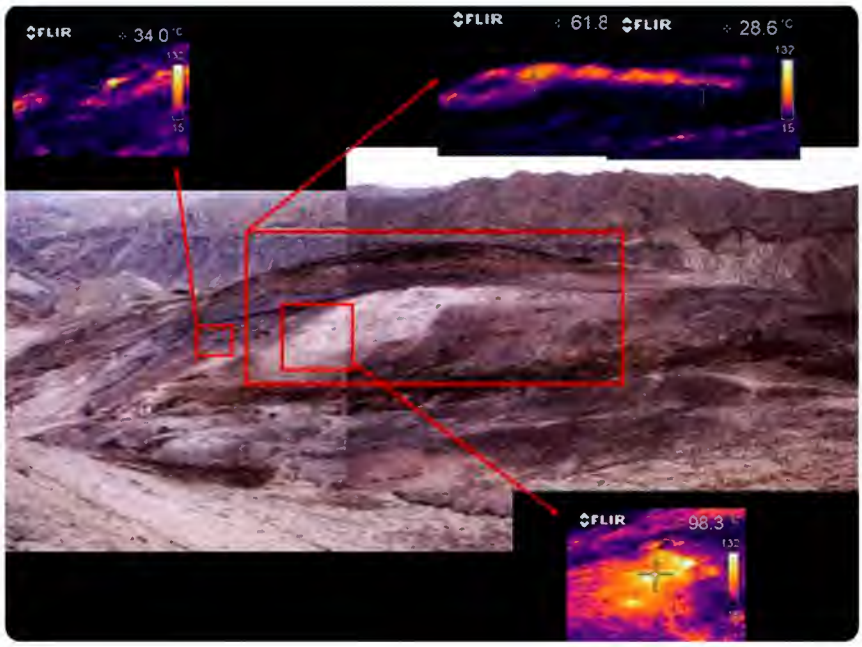
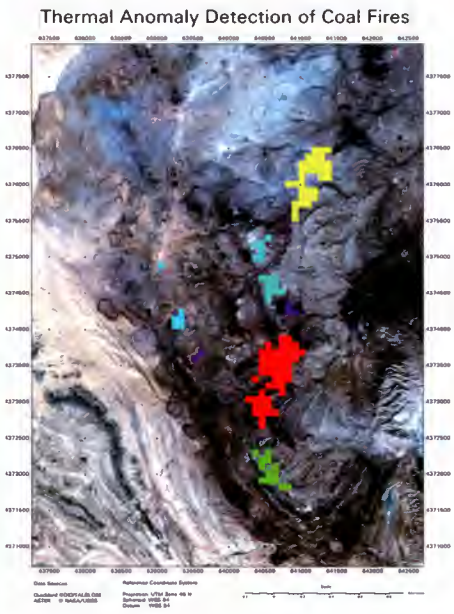
Uncontrolled coal seam fires are an environmental and economic problem of international magnitude. China is the leading country of coal production, consumption and export. The annual Chinese coal production (approx. 2.4 Mt per year) faces a problem of numerous uncontrolled coal fires, mostly located in the northern China coal belt. Current predictions estimate more than 50 coal fields are affected by coal fires of different size and intensity. Besides subsurface coal fires, surface coal fires occur directly on outcropping seams and associated small-scale mining locations. Numerous areas heavily affected by severe coal fires for many years are currently under investigation.

Detecting fire radiative energy (FRE) is a new remote sensing technique used to quantify forest and grassland fires. New methodologies are under development to quantify the amount of radiative energy released by different types of coal fires (CFRE) focusing on multi-sensor and multi-temporal data uses in detected changes in surface and gas temperature over time. This approach depends on accurately measuring near surface temperatures as well as information about gas temperatures and flux data. Currently, the preprocessing routines underestimated the atmospheric water vapor content in arid regions. The rising trend energy output in the second half of 2007 (as shown in the graph right) seems to be related to the ongoing excavation activities exposing more heated rocks.

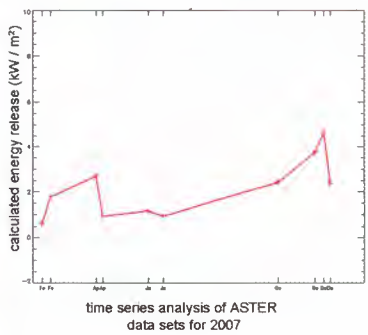
These developments contribute to the Sino-German Research Initiative, and aim to establish specific remote sensing analyses and geophysical measurement techniques, as integral elements to detect and assist in extinguishing coal fires. This falls within the framework of CDM activities of the Kyoto-Protocol.



↑ Coal fire thermal surface anomaly (CFSA) identified by TIR camera



↑ Mapped thermal anomalies due to coal fires using ASTER night time imagery



↑ Calculated coal fire energy release using ASTER night time images based on 13 time points in 2007

LOW LYING WATER BODIES AND WETLAND MONITORING EXPLOITING IN SITU DATA AND EARTH OBSERVATION IMAGERY, IN TERMS OF QUALITY, BIODIVERSITY DYNAMIC TRENDS AND RISK MANAGEMENT

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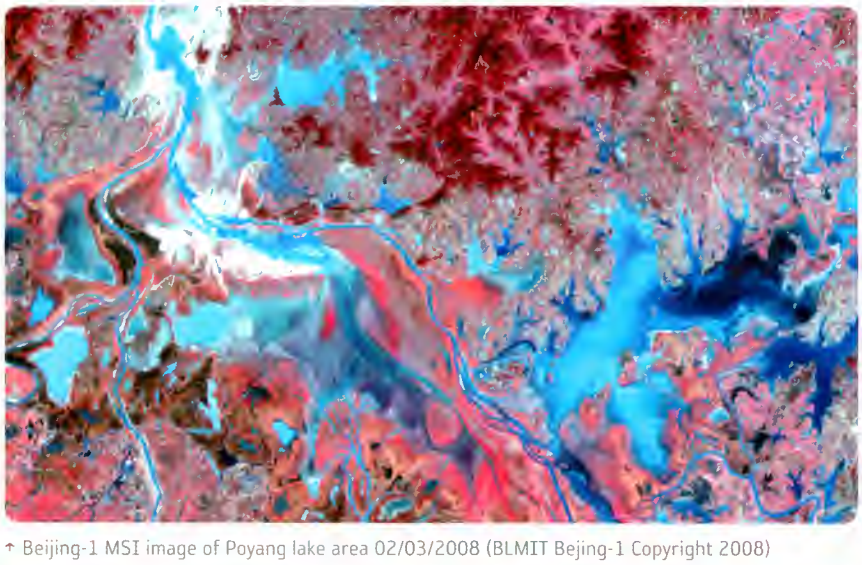
↑ Water quality testing team

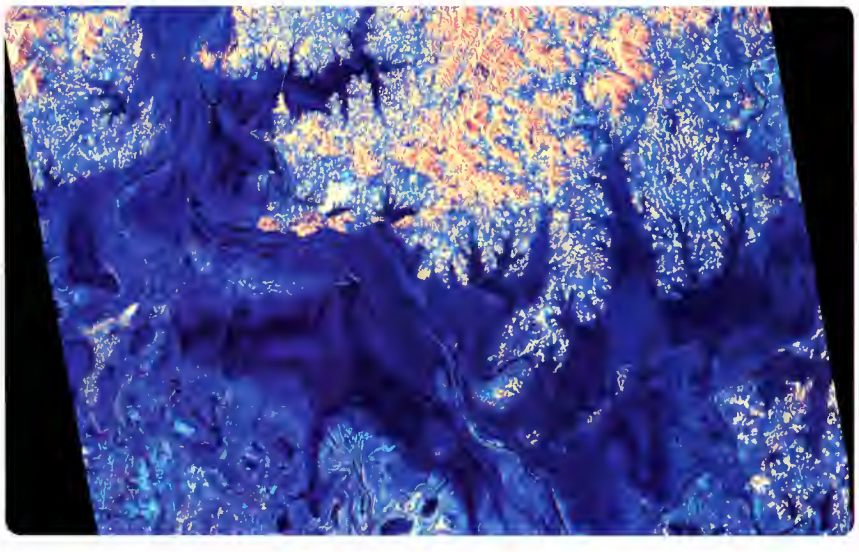
The first year of the project, a large part of the work was focused on ground data collection for water quality analysis (photo top) exploiting laser sensors, wetland vegetation recognition, biodiversity assessment and water level validation. These field surveys have been carried out mostly in the Poyang lake area (Jiangxi Province), but important work has also done at the Zhalong reserve (Heilongjiang province), and to a lesser degree in the Dongting lake area (Hunan province).

Some of this data was collected in parallel with the acquisition of ASAR and MERIS EO data, and will be exploited for vegetation recognition. In parallel, the DRAGON Earth Observation database over Poyang lake was enhanced with the integration of the first data set from Beijing 1 (as shown by the image), ALOS PASLSAR (bottom image) and AVNIR-2. The first products related to human activities impact will be produced soon, including maps indicating the impact of fishing nets and dragging activities in the Poyang area. An ENVISAT ASAR time-series for 2003, 2007 and 2008 have been integrated, and will be used to monitor water extent from 2003 to 2008 with a weekly observation frequency.

The first comparison of water extent and water levels derived from EO altimeter measurements and in situ recordings have been carried out. The activity highlighted the potential and problems to be resolved in order to adequately monitor water levels in the Yantgze middle basin area. (river and lakes). Information on time of inundation derived over 6 years of observation will be explored as input for building epidemiological indices.



↑ Beijing-1 MSI image of Poyang lake area 02/03/2008 (BLMIT Bejing-1 Copyright 2008)



↑ ALOS PASLSAR (HV, HH, difference) image of Poyang lake area, 28/11/2007

↑ Burning after deforestation Pingxiang City, Guangxi autonomous Region, China.

EARLY WARNING AND DAMAGE ASSESSMENT FOR FOREST FIRE

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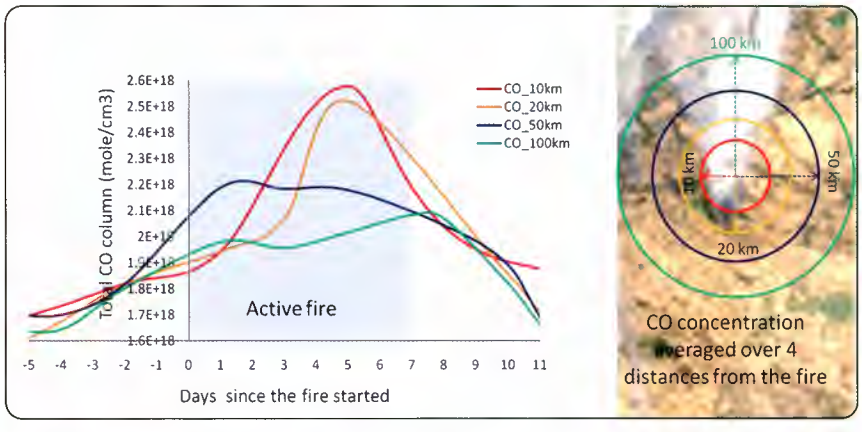
The project concerns methodological improvements for forest fire impact assessment namely. 1. The quantification of CO gas emissions during and following fires 2. The use of ASAR data for burn scar mapping following fires.

1. CO gas emission during and following forest fires
A methodology to analyze CO concentrations from forest fires has been carried out by means of MOPITT and SCIAMACHY sensors. The graph right shows the temporal evolution of the CO emitted by a large fire. This fire was active during 7 days and the maximun CO concentration appeared near the end of the fire. A circle of 10 km of radius, around the fire, shows a 50% of increased CO values above the CO mean value, while circles of 20, 50 and 100 km of radius only increased the CO values on 39%, 22% and 17% respectively.

2. ASAR for forest burn scar mapping
A methodology has been developed to obtain burnt scar areas by means of ASAR images. The RGB (852) MERIS image shows burnt areas in Guangdong province, near the Wanlu Lake with 300-m resolution. The same burnt areas obtained by means of a RGB composite image of ASAR Image Mode (IM) VV images are shown bottom of the page. In this composite, the Red channel is the situation after the fire, the Green & Blue channels are the situation before the fire. The spatial resolution is 20 m. This composite image has been geocoded by means of a DEM obtained by InSAR processing using two ASAR IM acquisitions of the same frame separated in time.



↑ Temporal and spatial evolution of CO column following a large fire

← MERIS FR (852) composite showing burnt areas near Wanlu Lake, Guangdong province (300-m resolution)

↑ ASAR (IM) VV composite near Wanlu Lake, Guangdong province (R-post fire, G & B-pre fire)

APPLICATION OF ENVISAT ASAR DATA FOR SEA ICE DETECTION AND CLASSIFICATION IN THE BOHAI SEA

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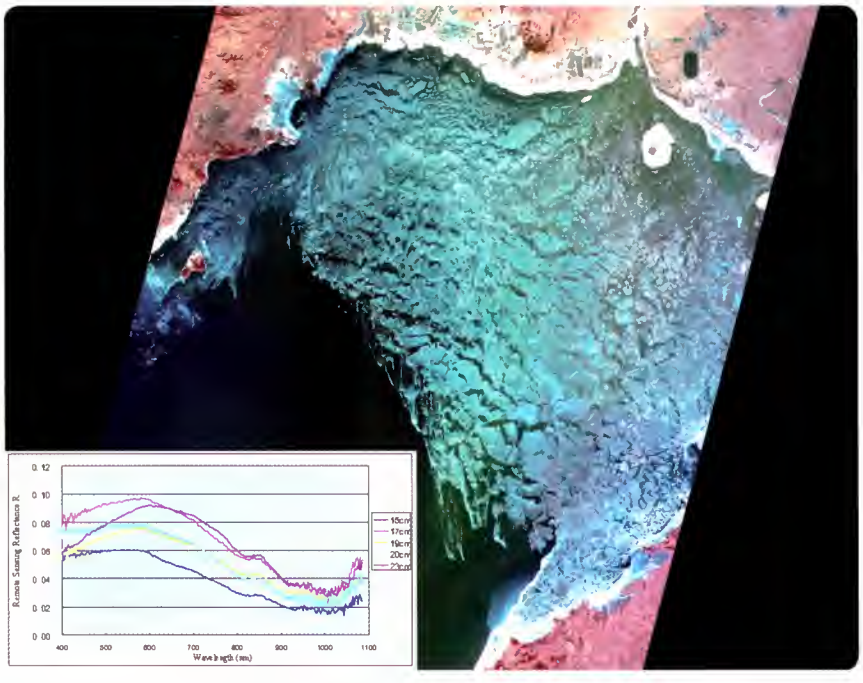
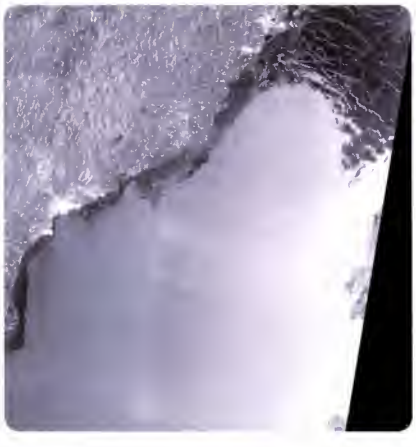
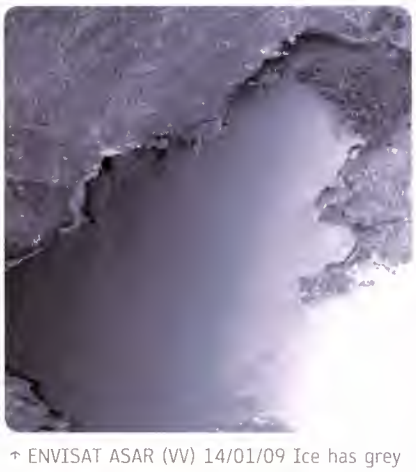
↑ Examples of sea ice, Xiaoliaodong Bay Bohai Sea - hummocked ice (top left), level and rough ice (top right), Grey-white ice (bottom left), rafter ice (bottom right)



↑ CBERS-02B CCD image 14/01/09 R (0.77-0.89μm), G (0.63-0.69 μm),B (0.77-0.89 μm); Also with spectral reflectance of ice measured with ISI921VF spectral radiometer



↑ ALOS PALSAR 11/01/09 Ice has dark backscatter signatures at the north end of the bay and along coastal areas



↑ ENVISAT ASAR (VV) 14/01/09 Ice has grey signatures the north end of top of bay

The objectives of this project are to understand the radar characteristics of different sea ice types in Bohai Sea with SAR data, and develop automatic ice detection and classification methods. Through the research work in this project, young Chinese researchers will co-operate with European young scientists working in the same field, and both sides will have a good opportunity to learn about the respective research topics, applied methodologies, and gathered experiences of each partner. During January 13 to 16, 2009, field experiments were carried out on the fast land ice in Xiaoliaodong Bay of Bohai Sea. The main ice types are shown in the top of the page photo. The ice parameters measured included ice thickness, density, temperature as well as surface and sub-surface water temperature, surface spectral reflectance and backscatter. During the ground campaign, the visible and infra-red reflectance in the spectral range 380nm to 1080nm of the different ice types and thicknesses was measured using a spectral radiometer (ISI921VF). Acquisition of EO data has included Envisat ASAR ALOS PALSAR and CBERS imagery (as shown by the imagery).

The main objectives are:

1. To derive backscatter statistics and the characteristics of different sea ice types in Bohai sea
2. Assessment of ice detection capacity of SAR data of different polarizations and different frequencies
3. To derive effective textural features and corresponding parameters
4. Comparison of Support Vector Machine (SVM) method and Maximum Likelihood Classification method
5. Improvement of ice detection results
6. Ice products extraction, such as ice edge, lead, ice concentration, ice

↑ Three Gorges Dam with sluices operating

TOPOGRAPHIC MEASUREMENT

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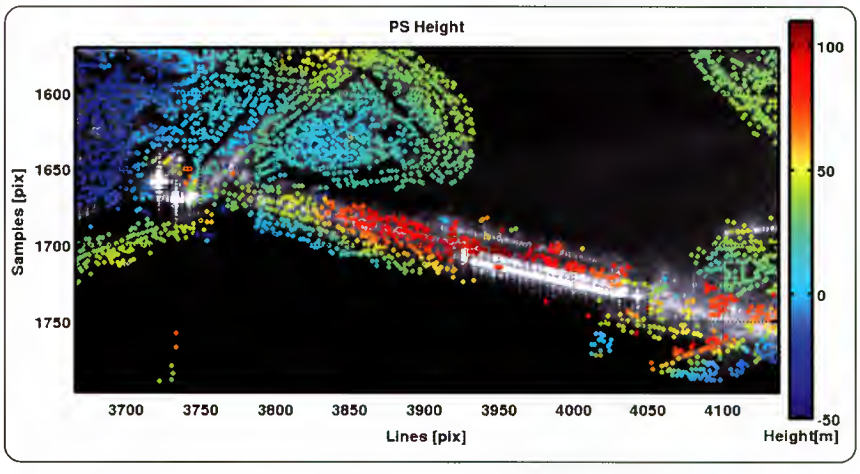
This activity focuses on topographic mapping and earth deformation monitoring using Envisat ASAR, ALOS PALSAR and HJ-1-C data sets. SAR data provides a potential in this field because large areas in China are covered with cloud and mist through the year. InSAR data gives a new set of tools to measure topography, tiny shifts and deformations on the Earth's surface,. This is valuable in the study of landslides, urban subsidence, earthquakes, floods and other natural cataclysms in China.

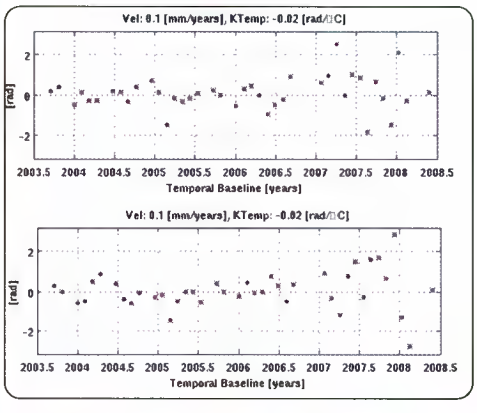
The POLIMI group began the program by studying the build up and the motion of the Three Gorges Dam from SAR data. Exploiting about 40 Envisat SAR images over the dam area, spanning the period 2003-2008, permanent and partially coherent scatterers were processed (as shown top right), and their height and linear deformation trend were estimated.

The analysis of the movements of the dam highlights a possible sinusoidal slight motion was detected, most probably due to the seasonal water level changes of the Yangtze river. This seasonal trend is likely due to the generation of higher pressure on the dam when the water level increases (see temporal profiles from 2005 to 2008, centre).

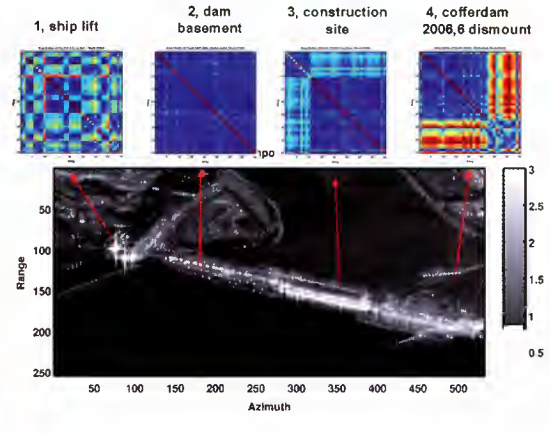
Through additional analysis of the amplitude SAR images, various changes were detected in and around the dam structure over the observation time-scale. These include the following: construction yard dismantled at the end of the building works; structural modifications to the cofferdam; new devices installed after the dam construction; and the operational status of the ship lift (see bottom of page figure), and spillway gates opened for spilling water or closed for retaining it (see top of the page photo).



↑ Detected Permanent Scatterers on the Three Gorges Dam. Color scale: height with respect to a reference point in the image.



← Millimetric deformation time series estimated for two Permanent Scatterers on the dam.



← Different amplitude behavior for different scattering structures detected on the Three Gorges Dam.

MONITORING GROUND SURFACE DISPLACEMENT IN THE THREE GORGES AREA, DANGXIONG-LASHA AND JIANGSU PROVINCE AREA

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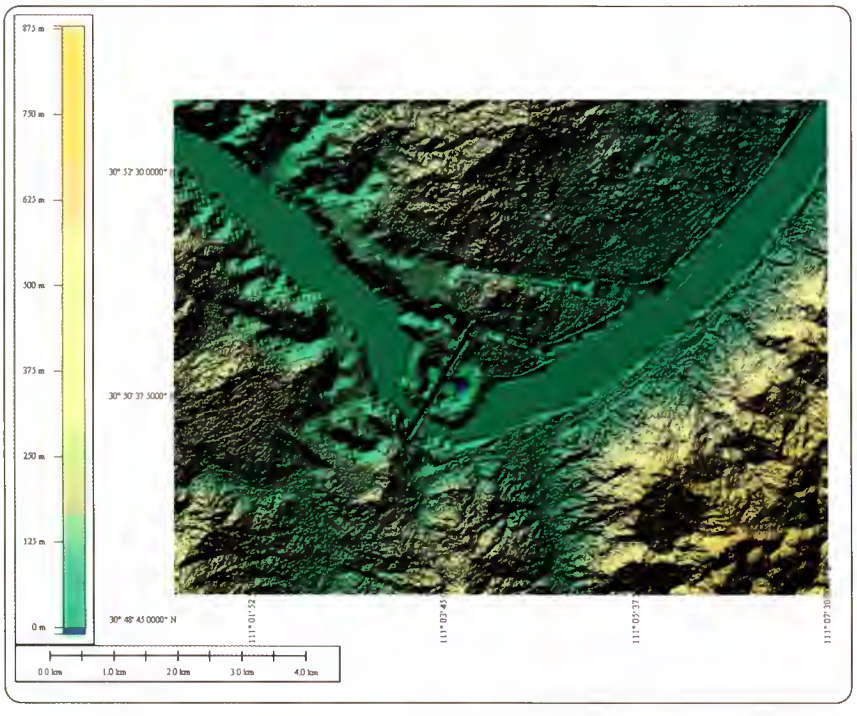
↑ Most landslides in 3 gorges are less than 100m in area, and should therefore be more detectable using 1m spotlight SAR imagery

↑ TerraSAR-X 1m SPOTLIGHT of the 3 Gorges Dam area, incidence Angle between 40.2° and 41.0° acquired 17/11/07



↑ ALOS-PRISM DEM at 2.5m created by JAXA (courtesy of T. Tadono)

Since the Three Gorges reservoir began filling with water in 2003, over 100 landslide events were reported. Research continues to focus on the use of Envisat interferometric ASAR data as a cost effective means to assist in monitoring these and new landslides. New resolution SAR data has also become available with 1m spotlight mode from TerraSAR-X (see image left). ALOS-PRISM 2.5m DEMs (shown bottom of page) of the largest urban conurbations (Badong, Fengjie, WanXian) along the Yangtze river will be used to orthorectify the TerraSAR-X SPOTLIGHT 1m datasets. These will be employed both using InSAR and COSI-Corr (US Caltech phase correlation ENVI plug-in) to investigate pre-landslide solid earth motions. The results will be compared against ENVISAT and ALOS-PALSAR InSAR measurements.

Monitoring of the Dangxiong fault (Tibetan plateau) is also a topic of the study. This is an active fault, 100 Km from Lasha city where there have been several strong earthquakes in this area. Monitoring the ground surface displacement not only helps with a better understanding of tectonic activity, but is also important to protect the safety of Lasha city and key transport links. The studies indicate there is very low cloud cover, favourable for interferometric WV correction.

The project also focuses on Jiangsu which is densely populated and economically developed province in China. The occurrence of landslides can result in large amount of casualties and property losses. InSAR, GPS, and survey leveling, along with finite element, distinct element and simulated annealing methods, will be employed to provide deformation maps.

↑ A clock tower with clock stopped at 14:28, the precise moment of the 12 May 2008 earthquake, Hang Wang town, China

CRUSTAL DEFORMATION IN CHINA ASSOCIATED WITH THE SEISMIC CYCLE OF MAJOR FAULTS OR RELATED TO LAKES LOADING ON THE LITHOSPHERE: MEASUREMENT BY SAR INTERFEROMETRY

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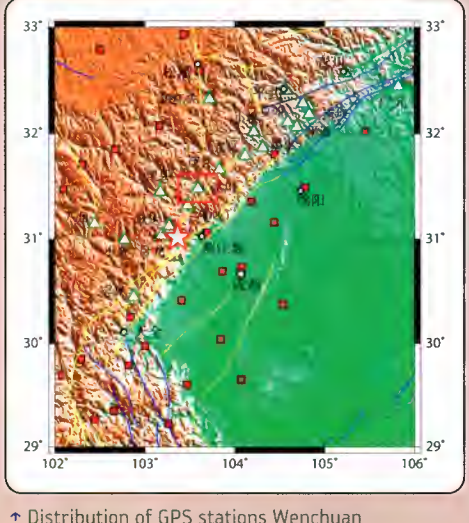
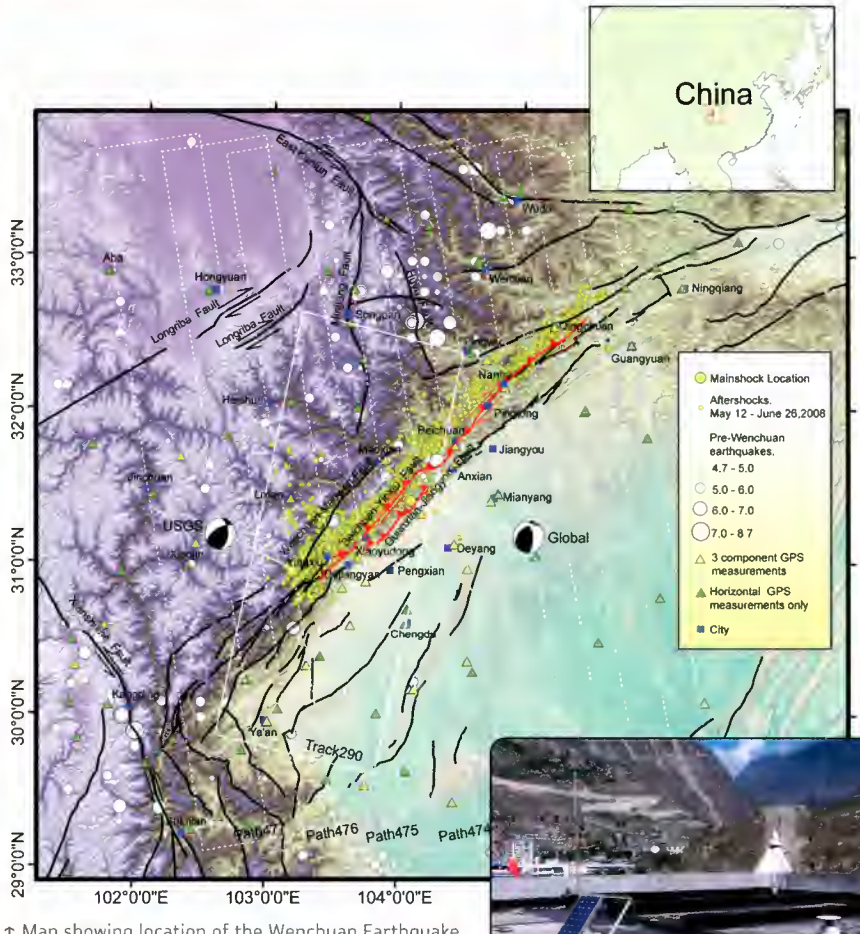
Measuring and modelling surface deformation related to earthquake cycles and loading of the lithosphere are amongst the major challenges in solid-earth geophysics today.

Great advances have been made in the past years with the advent of space-based geodesy (GPS, InSAR), allowing in particular the detection of processes (post-seismic deformation, silent earthquakes, deep ductile flow) which do not release seismic energy but contribute a significant fraction of the long-term deformation of the lithosphere and play an important role in the distribution of stress within the seismogenic part of the crust, therefore influencing the generation of earthquakes.

To characterize the temporal evolution of stress on a fault during the seismic cycle, and strain localization within and below the seismogenic zone, one must constrain both the deformation through time near the fault and the rheology of the layered lithosphere, from its deep ductile part to its upper brittle section. Indeed, the stress applied to the fault at various depths varies during the seismic cycle, concentrating either in the shallow part of the

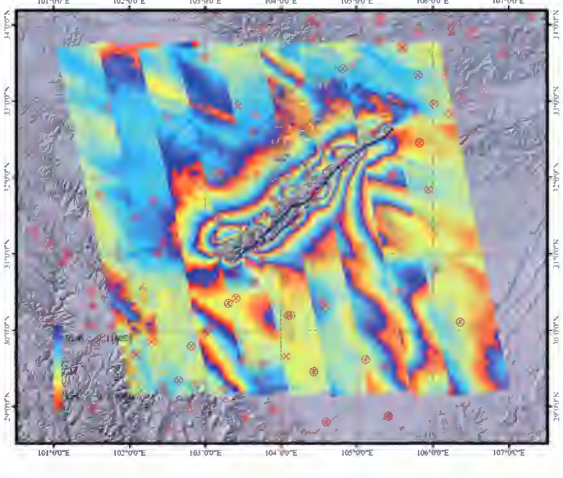


↑ Distribution of GPS stations Wenchuan



↑ Map showing location of the Wenchuan Earthquake faults (red lines) and the radar data that we used (white outlines).

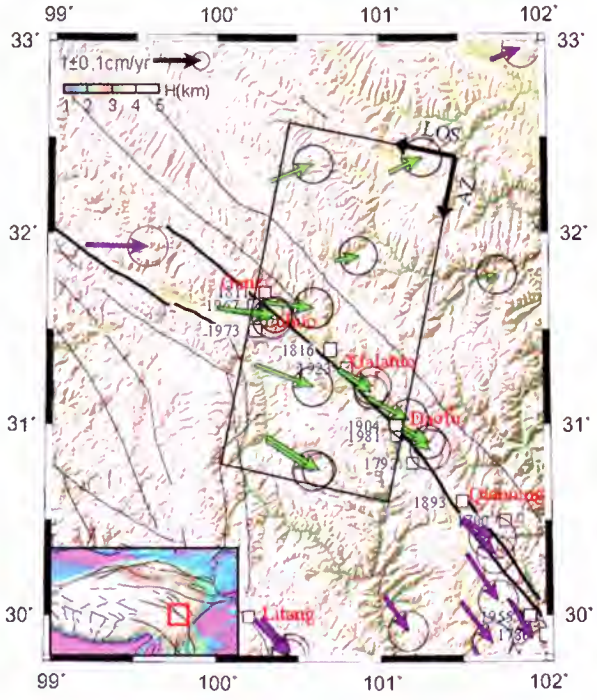
↑ Wenchuan GPS station



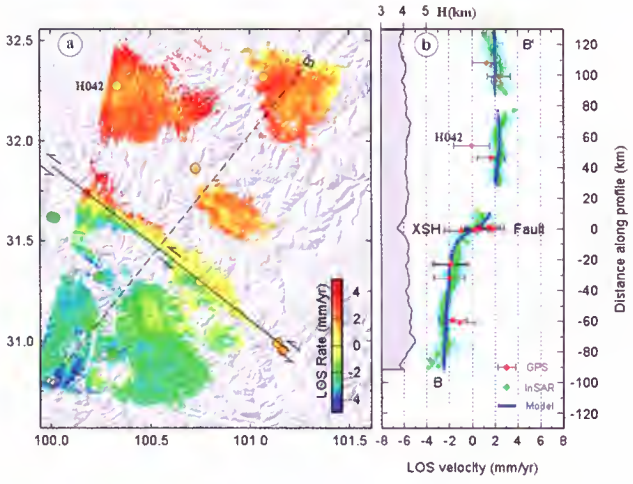
← ALOS PALSAR interferograms showing the deformation occurring during the Wenchuan earthquake. Each fringe is approximately 20 cm of motion in the satellite line of sight.

Prof. Shen Zhengkang, Prof. Xu Xiwei, Dr. Liu Zengjing, Ms. Liang Fang, Prof. Ding Xiaoli, Prof. Zhong Lu, Prof. Zhang Jingfa, Dr. Xu Caijun, Prof. Xu Lisheng, Prof. Xu Zhonghuai, Mr Feng Wanpeng, Ms Gong Lixia, Mr Jiang Wenliang, Dr. Li Tao, Dr. Marie-Pierre Doin, Dr. Yann Klinger, Dr. Beatrice Pinel-Puyssegur, Dr. Anne Socquet, Dr. Li Zhenghong, Prof. James Jackson, Prof. Philip England, Dr. Richard Walker, Dr. Hua Wang

↑ A school located on the Wenchuan earthquake fault. The girl in the foreground stands next to the fault scarp. Courtesy of Xu Xiwei and Yang Hu (IGCEA).



↑ Map showing the location of the Xianshuihe Fault, and the black outlines shows SAR scenes coverage. Arrows show GPS velocities with respect to the Eurasian plate, and numbers indicated dates of previous earthquakes.



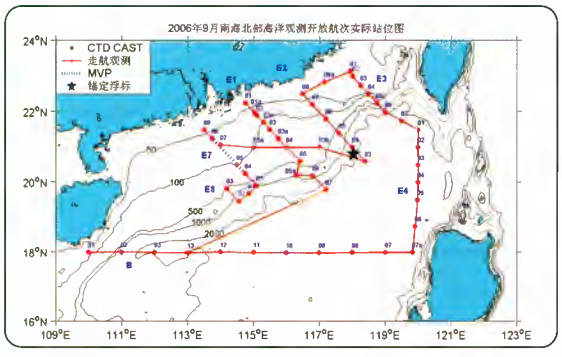
↑ Line-of-sight deformation map showing interseismic strain on the Xianshuihe Fault. Circles show the GPS displacements projected into the look direction. (b) Profile through the deformation map along line B-B'.

lithosphere or at greater depth. This results in changes in the elastic strain rate distribution and therefore in surface velocities at short and intermediate distances from the fault, which could potentially be observed by densely spaced geodetic measurements.

Envisat ASR image mode and ASAR wide-swath InSAR are being used to (A) study the seismic cycle of major continental faults and (B) place constraints on the ductile behavior of the lower crust and upper mantle from their mechanical response to water level changes of high elevation lakes in Tibet.

During the first year of the project, a significant research effort has been put into the devastating Wenchuan Earthquake, which struck the eastern margin of the Tibetan plateau on 12 May 2008. The disastrous earthquake took the local population and scientists by surprise. We have used GPS and InSAR data to invert for fault geometry and slip distribution of the earthquake. From southwest to northeast the fault geometry changes from moderately northwest dipping to near vertical, and the rupture changes from predominantly thrust to dextral faulting. We estimate that earthquakes occur on these faults once every 4000 years.

An additional highlight during the first year has been an investigation of the interseismic slip rate on the XianShuihe Fault using InSAR and GPS data (Fig 4-5). The fault is a highly active strike-slip fault system near the eastern margin of the Tibetan plateau. We used a decade of ESA SAR data to estimate a slip rate of 9-12 mm/yr with a shallow locking depth of 3-6 km. This fault has been brought closer to failure by the Wenchuan earthquake.



↑ Transect of in-situ ship based measurements in August to September 2008, South Chine Sea

DEMONSTRATING SAR AND OPTICAL SENSOR MONITORING OF CHINESE SEAS

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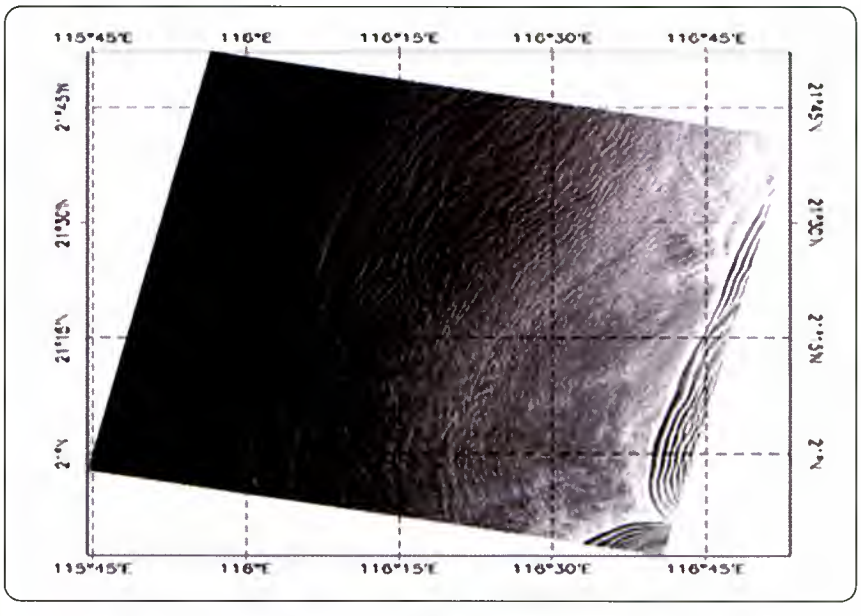
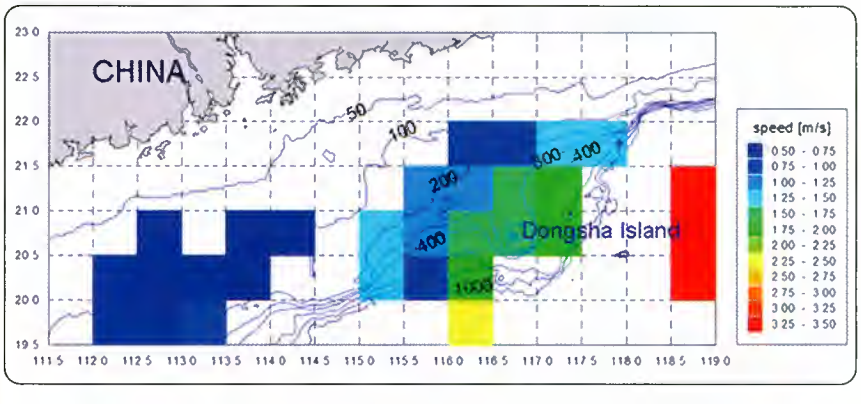
The objectives of the project are as follows: 1) Advance the understanding of oceanic internal waves and other oceanic and atmospheric features from SAR imagery; 2) Advance and test retrieval methods for SAR monitoring of coastal oceans and shelf seas; 3) Demonstrate near-real-time SAR monitoring of Chinese Seas; 4) Contribute and train young scientists.

There is currently an extensive activity in developing systems for operational monitoring and prediction of the marine environment including the coastal zones and shelf seas (figure top shows the NRT system components). Apart from waves, the most common parameter of significant importance is the upper layer current and its mesoscale variability. The oceanographic mesoscale in the coastal zones is comprised of highly energetic features, including narrow coastal current systems and their eddy fields with strong zones of convergence and divergence. Adding to this is the frequent occurrences of wind driven upwelling and existence of Internal Waves (IWs).

In SAR image interpretation and classification, surface currents are associated with the manifestation of IWs (as shown in bottom left image) and shallow water bathymetry. As the IW induced surface current lead to zones of convergence and divergence the presence of IWs can also be manifested in thermal IR, visible and near IR images under cloud free conditions. The corresponding sensor synergy (as shown in the bottom right figure) has provided a means to measure the velocity of IWs using both MODIS and ASAR imagery.



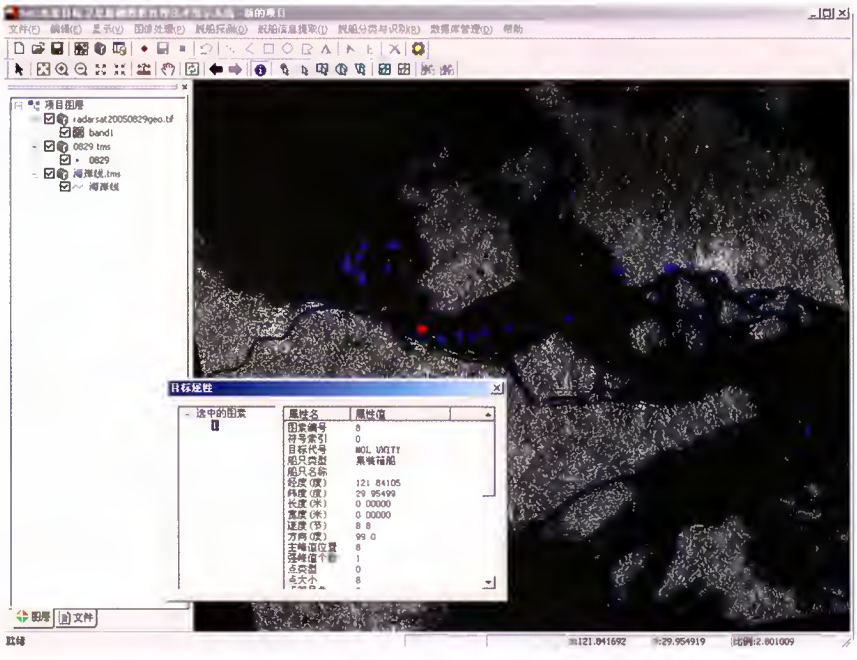
↑ Components of the system to demonstrate NRT monitoring include integration of satellite, ground, ship, shore and in-situ data observations



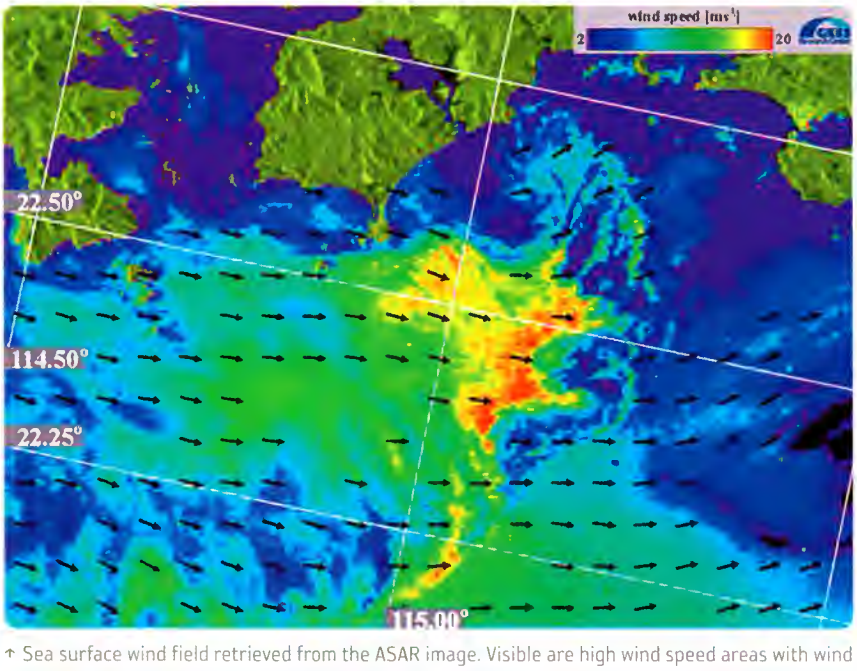
↑ Internal wave propagation speed distribution retrieved from ASAR and MODIS images

Dr. Yang Jinsong, Dr. Fu Bin, Dr. Chen Peng, Dr. Chen Xueen, Dr. Chen Choming, Dr. Meng Junmin, Dr. Tang Danling, Prof. Werner Alpers, Dr. Fabrice Collard, Dr. Bertrand Chapron, Dr. Knut-Frode Dagestad, Dr. Vladimir Kudryavtsev, Ph.D. Morten W. Hansen

↑ The ground receiving station at SIO SOA receives and processes Chinese EO data



↑ Software for ship detection and tracking ship movements using SAR imagery



↑ Sea surface wind field retrieved from the ASAR image. Visible are high wind speed areas with wind speeds around 20 m s-1 behind the squall line and cyclonic curvature at the locations of the vortices. (courtesy: J. Horstmann, GKSS)

In this projects' investigations the following EO data will be requested: HY-1B COCTS sensor for biophysical retrievals of chlorophyll, suspended matter and sea surface temperature; FY-3 VIRR and MERSI for sea surface temperature and ocean colour sensing; HJ-1-C S-band SAR for ship detection, shallow water bathymetry, waves, oil spill, sea ice and IWs.; ALOS PALSAR L-band SAR for ocean surface observations and a ScanSAR mode; Envisat ATSR, ASAR and MERIS for marine environmental monitoring.

Three field campaigns were conducted in the South China Sea in 2008. The CTD casts data and mooring data were collected for the comparison of in-situ measurements with remote sensing observations of oceanic internal waves. Oceanic and atmospheric features are both imaged by SAR. The imaging mechanisms of oceanic and atmospheric features have been studied using SAR images, optical images, oceanographic data, meteorological data and numerical models. Methods have been proposed to assist in distinguishing oceanic and atmospheric features. Additionally, oceanic internal waves in the South China Sea have been investigated using satellite images, in-situ measurements and numerical simulations. These investigations focus on the generation and distribution of oceanic internal waves.

Furthermore, new and updated retrieval methods are being developed for coastal ocean monitoring using SAR data. These methods include methodologies for the estimation of the propagation speed of oceanic internal waves, oil spill detection, ship detection, shallow water bathymetry measurement, sea surface wave measurement and near surface wind speed measurement (top and bottom of page figures show examples of software tools and information retrieval from SAR imagery).

↑ Fishing vessels may take benefit from improved ocean monitoring

DRAGON 2 IN SUPPORT TO HARMONIZING EUROPEAN AND CHINESE MARINE MONITORING FOR ENVIRONMENT AND SECURITY

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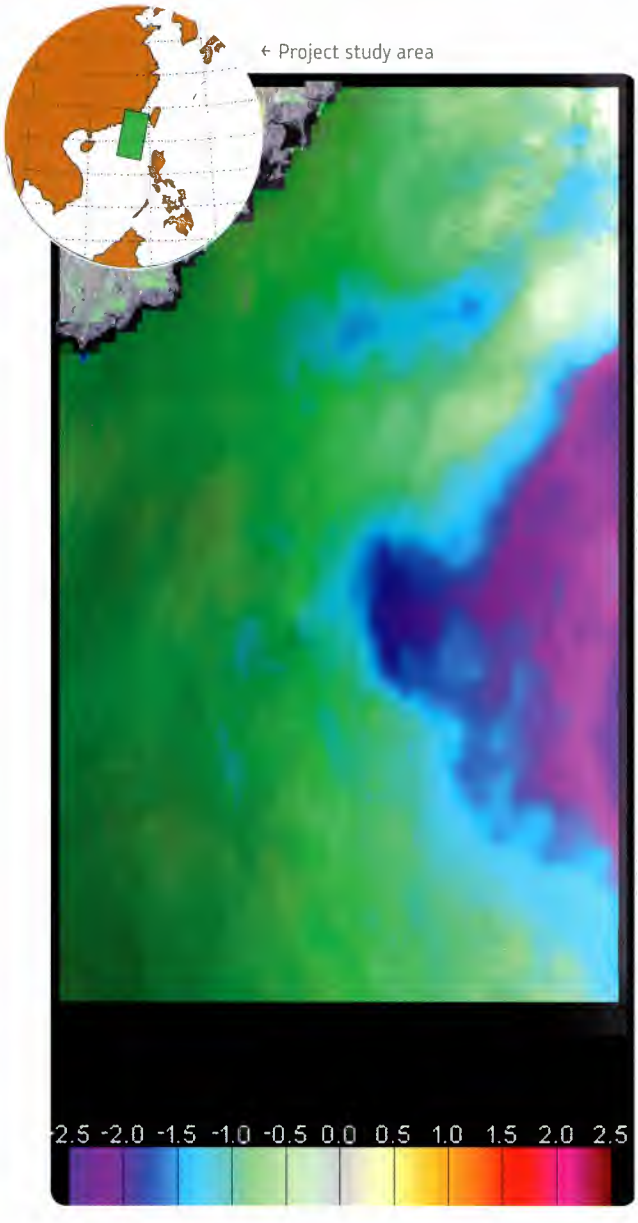
Dr. Chen Xueen, Dr. Hu Chuanmin, Dr. Fang Mingqiang, Dr. Chen Ge, Dr. Tang Junwu, Dr. Zhu Jiang, Dr. Du Keping, Dr. Guan Lei, Dr. Li Hongping , Dr.Wang Yunfei,Dr. Zhang Tinglu, Dr. Zhao Chaofang, Dr. Liu Zhishen, Dr. Gao Yongqi, Dr. Wang Zifa, Dr. Shao Liqin, Dr. Zhang Guocheng, Mr. Liu Qinzheng, Dr. Werner Alpers, Dr. Bertrand Chapron, Dr. Fabrice Collard, Dr. Roland Doerffer, Dr. Helene Etienne, Dr. Jean-Francois Piolle, Dr. Lasse Pettersson, Dr. Laurent Bertino, Dr. Craig Donlon, Dr. Gilles Larnicol, Dr. Jürgen Fischer

The specific objectives of the proposal are: 1) to assess current Chinese (and European) services and information products arising from integrated use of networks of remote-sensing, in-situ observations, models and data assimilation methods against the GEOSS requirements; 2) to develop activities to jointly combine and merge satellite observations from ESA and Chinese EO data for better marine environmental monitoring.

Envisat's Advanced Synthetic Aperture Radar (ASAR) instrument measures backscattered radar echoes in amplitude and in phase, providing Doppler signals used in the processing for enhanced image resolution. Over the ocean, the Doppler signal differs from a predicted signal which is based on the a priori known motion of the satellite and the Earth rotation. Recently it has been demonstrated that this Doppler signal difference is a measure of the line-of-sight velocity of the moving ocean surface.

The project seeks to advance the understanding of wind, waves and current interaction, and their signatures in SAR NRCS backscatter and Doppler, predominantly from Envisat ASAR and ERS-2 SAR. By use of a Radar Imaging Model (RIM) we will apply an inverse modelling routine to iterate a best fit to the observations, such that a partitioning among the three parameters may be accomplished. The research shall assist in the ongoing work related to internal waves, and it shall contribute to a demonstration of the potential in near-real-time monitoring of the Chinese Seas with SAR. In-situ measurements by surface drifters, HF-radars, and ship measurements may be used in validation of the SAR Doppler data products.



← Example of Envisat ASAR radial surface Doppler velocity (positive towards right) resulting from a mixed signal from wind, waves and current. Wind toward west gives an offset to negative values

COASTAL ZONE REMOTE SENSING MONITORING IN YELLOW RIVER, YANGTZE RIVER AND PEARL RIVER DELTA

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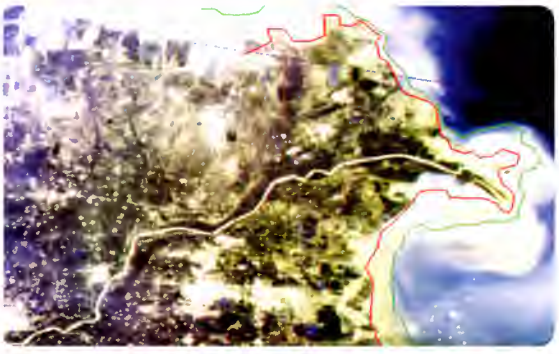
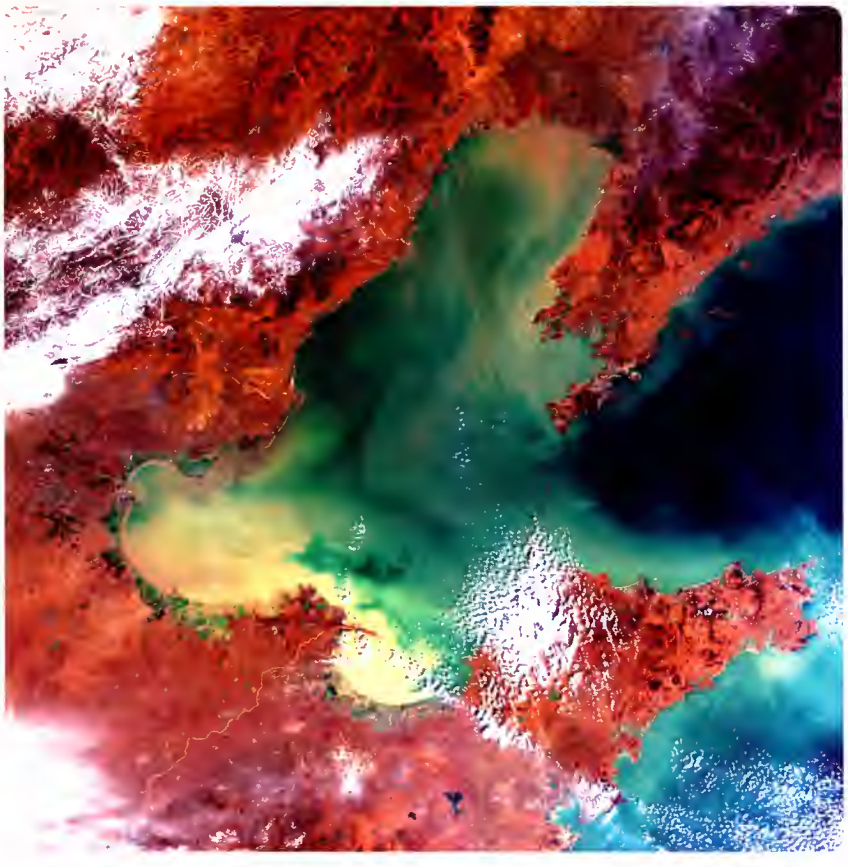
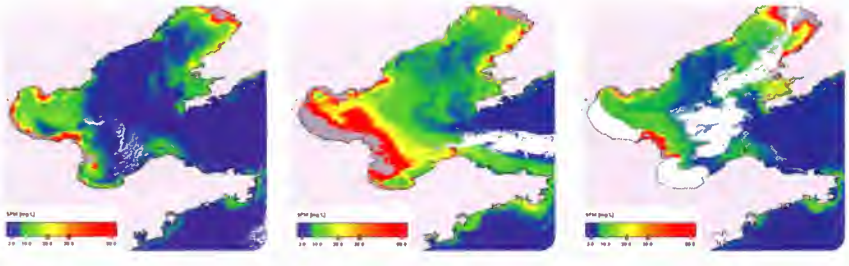
Dr. Chen Chuqun, Dr. Cui Tingwei, Ren Guangbo, Liu Yanfen, Zhao Wenjing, Hao Yanling, Li Xiaomin, Wu Qingsong, Liu Shanwei, Gao Ning, Dr. Vittorio Barale, Dr. Juergen Fischer, Dr. Samantha Lavender



↑ Analysis of time series of optical satellite imagery allows to map the shore line (in red) and inter-tidal zone (in green) - Yellow River Delta, Bohai Sea



↑ MERIS FR composite image of the Bohai Sea on Nov. 11th, 2003



↑ SPM distribution in the Bohai Sea (a) 2004-11-21, before strong wind (b) 2004-11-7, during strong wind (wind speed 15m/s); (c) 2004-11-30, after strong wind (wind speed 5m/s)

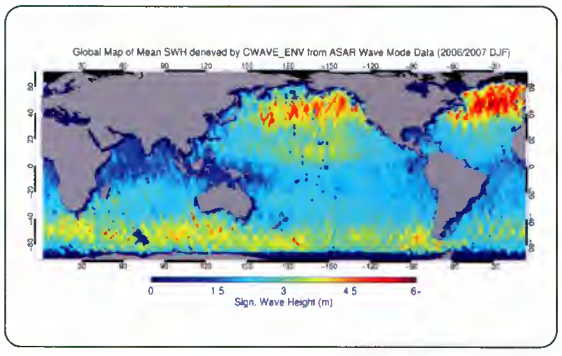
The statistical retrieval model for the concentration of suspended particulate matter (SPM) is developed based on the in situ measurements in the Bohai Sea of China. The spatio-temporal distribution characteristics of SPM are analyzed in terms of its spatial pattern, disturbance by sustaining strong wind and seasonal variation.

(1)The area with the highest SPM content in the Bohai Sea is located in the Laizhou Bay and the coastal part of Bohai Bay. SPM load is also relatively high in the coastal part of the Liaodong Bay. The other parts of the Bohai Sea are characterized by relatively low SPM concentration.

(2) The SPM from the Yellow River into the sea is mainly transported toward south and east-south. High load of SPM distributed near the river mouth reflects the feature of the SPM's rapid deposition.

(3) Weather process of sustaining strong wind can significantly alter the spatial pattern of SPM distribution in the Bohai Sea in short period (~d). The local responses in the Bohai Bay and Laizhou Bay are intense and that in the Liaodong Bay is relatively weak, which could be explained by the local water depths, different types of bottom and particle size distributions of SPM in these areas.

(4) The seasonal feature of SPM distribution in the Bohai Sea is characterized by high values in autumn and winter and low values in spring and summer. The seasonal variation of SPM distribution could be attributed to the climate factors such as wind. Besides, river runoff is another key factor.



↑ Global mean significant wave height – from ASAR Wave Mode data, 2006 and 2007 and by CWAVE_ENV empirical algorithm.

OCEAN WAVES, OCEAN WIND, OCEAN CURRENTS APPLICATION RESEARCH IN COASTAL ZONES BASED ON MULTI-SENSOR SATELLITE DATA

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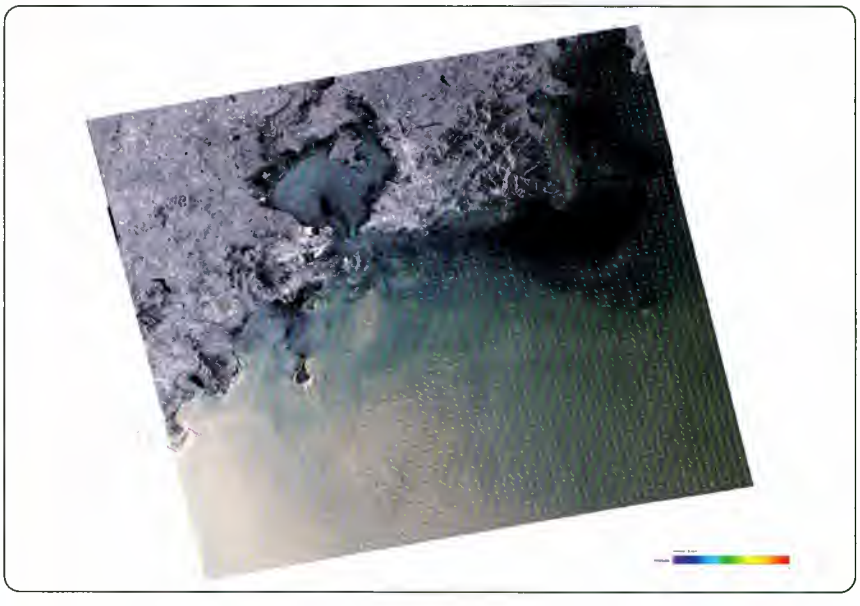
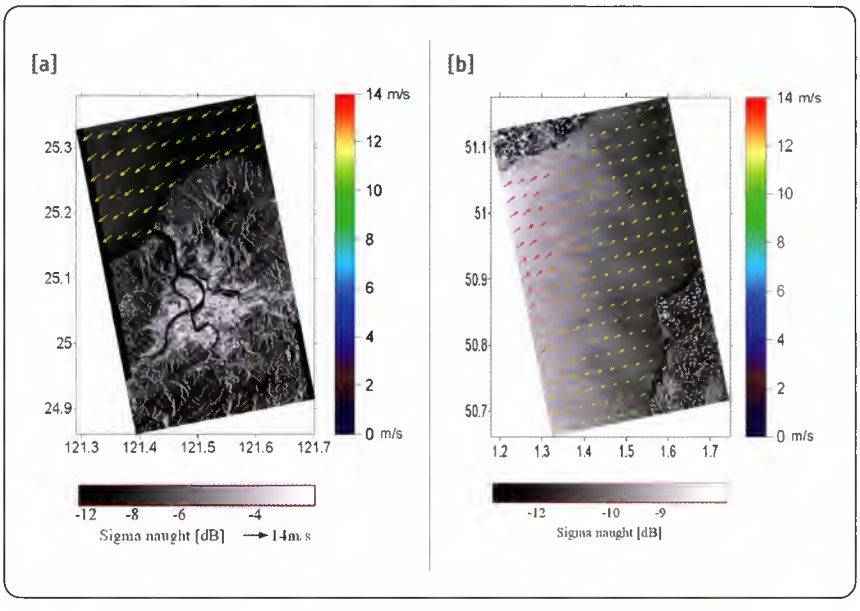
Mr. Li Xiaoming, Dr. Wolfgang Rosenthal, Mr. Stephan Brusch, Prof. Liu Zhishen, Prof. Zhu Meihui, Prof. Wu Songhua, Dr. Chong Jingsong, Dr. Wang Yunhua , Mr. Ren Yongzheng, Mr. Zhao Yili, Mr. Ji Sha

Coasts are heavily influenced by human activities, such as shipping, fishing, oil exploration and naval operations. In the past decades, the development of numerical ocean models and space-borne satellite ocean observations has been very fruitful in the investigation of the respective processes. There is still room for improvement however concerning the analysis of small scale processes. Of particular interest are processes taking place at the air sea interface. The goal of the project is to exploit ocean wave, ocean wind and ocean currents behavior in coastal zones using high resolution SARs. In this project higher level products like wind field, sea state parameters including 2D wave spectra, integral wave parameters and individual wave parameters and current parameters will be derived from ERS-2 SAR, Envisat ASAR, HJ-1-C (China S-band SAR) and TerraSAR-X and compared to models and in situ measurements.

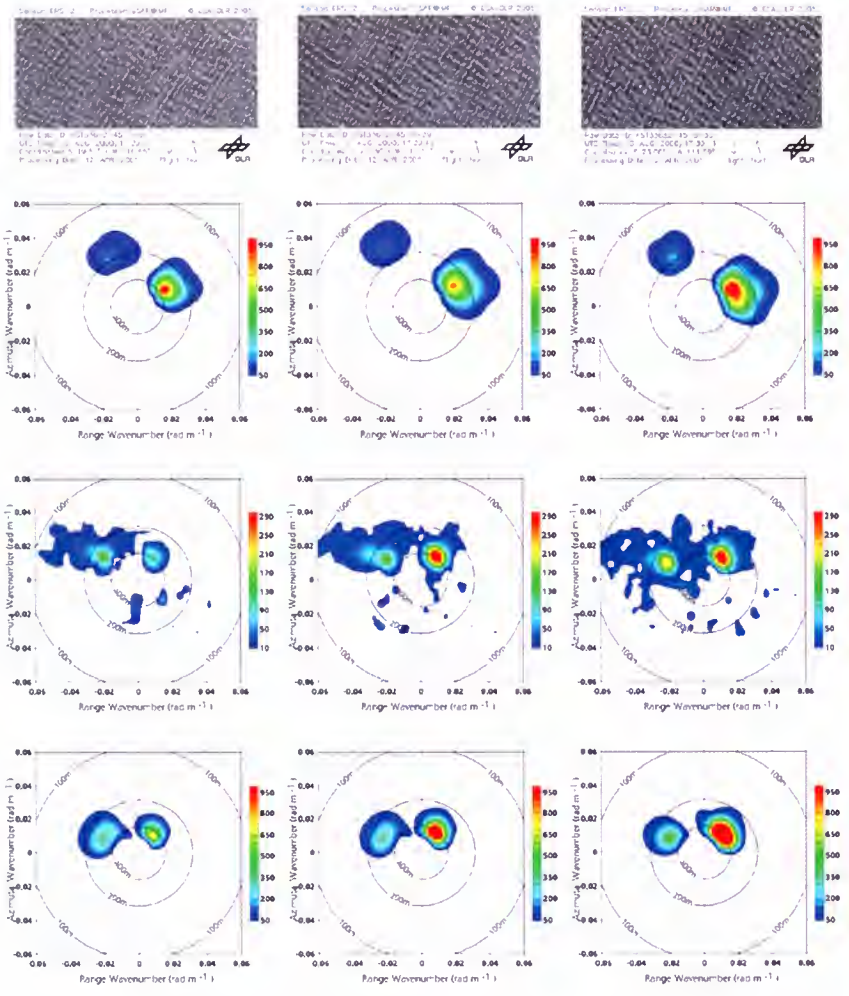
Sea surface wind field of Qingdao coastal area were retrieved from ENVISAT ASAR to provide weather service for 2008 Olympic sailing regatta, high resolution sea surface wind field was retrieved from ENVISAT ASAR data using CMOD5 (top figure provides an example). A new X-band wind field algorithm (XMOD) based on a linear approach was developed, which relates to the SAR NRCS to surface wind speed and direction, as well as the incidence angle. The polarization ratio model is investigated for making use of the XMOD to retrieve sea surface wind from HH polarization TerraSAR-X data. Two examples of 10m height surface wind speed retrieved by XMOD from TerraSAR-X images acquired in VV and HH polarization are shown (bottom figures, left and right respectively)



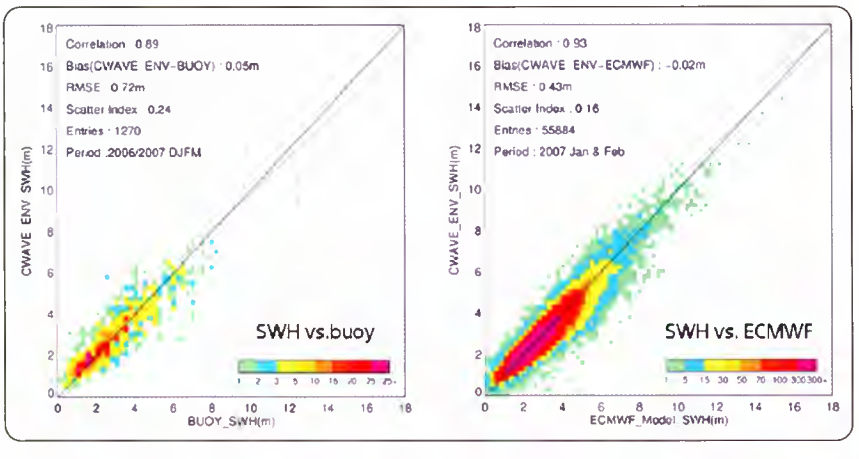
↑ Sea Surface Wind Field Retrieved from ENVISAT\ASAR 20/08/2007 13:46 UTC, VV



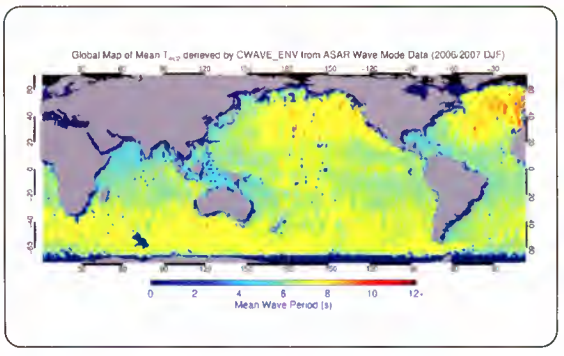
↑ Sea Surface Wind Field Retrieval using TerraSAR-X Data **a**: English Channel, 02/07/2007 17:35 UTC, VV,StripMa. **b**: The East China Sea (Northern Taiwan), 25/05/2008 09:51UTC, HH, StripMap



↑ SAR images (first row), WAM Model spectra (m4) (second row), SAR cross spectra (m2) (third row), PARSA retrieved spectra (m4) (last row) for the cross sea case.



↑ Validation of CWAVE_ENV empirical model by comparing retrieved integral wave parameters to in situ buoy measurements and ECMWF wave models.



↑ Global mean wave period – from ASAR Wave Mode data, 2006 and 2007 and by CWAVE_ENV empirical algorithm.

Global sea state statistics using three months ENVISAT ASAR wave mode acquired globally have been generated. The top of page 42 and 42 figures show these statistics. The SWH and Mean wave period were retrieved using CWAVE_ENV empirical model. It is interesting to note that SWH is highest in the northern Pacific Ocean. At the global level, this pattern is repeated for the north Atlantic Ocean and to a lesser extent in the Southern and Antarctic seas. The equatorial regions experience smaller SWH compared to both the northern Pacific and Antlantic Oceans and the Southern seas.

New algorithms to derive sea state from SAR wave mode data were developed and used to determine two-dimensional wave spectra, integral wave parameters as well as individual wave parameters (see figure top). As an example of cross sea occurred in South East Pacific was captured by consecutive ERS-2 SAR wave mode data acquired on August 10, 2000. Retrieved ocean wave spectra are compared to the WAM wave model spectra and cross spectra derived from SAR wave mode complex data.

The empirical algorithm CWAVE_ENV has been validated by comparing to in situ buoy measurements, ECMWF reanalysis wave model and DWD forecast wave model using two months ENVISAT ASAR wave mode data. The bottom of page figure shows validation results for in situ buoy measurements and ECMWF wave model. Although not shown here, similar correlations have been found by comparing CWAVE_ENV with DWD forecast wave model.

↑ Deployment of the AC-S absorption and attenuation meter and BB9 backscattering meter in the Yangtze estuary during the summer campaign of 2008 (courtesy of Fang Shen, LECR ECNU)

ESTUARINE, INLAND AND COASTAL WATER QUALITY MONITORING USING EARTH OBSERVATION DATA

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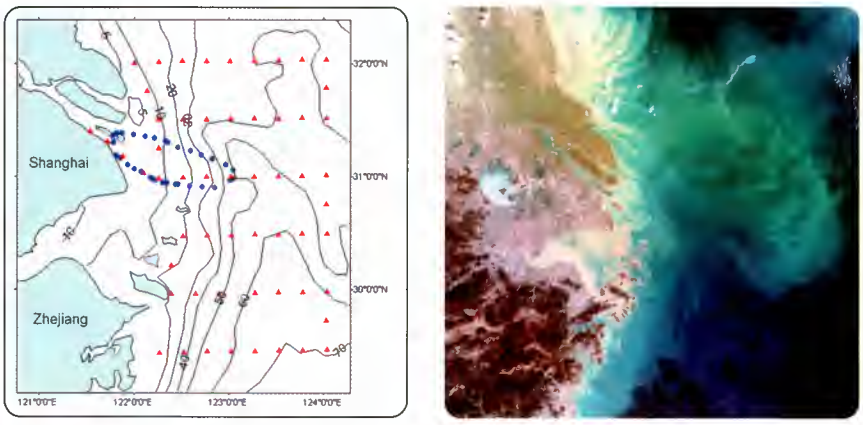
Prof. Zhou Yunxuan, Prof. Suhyb Salama, Prof. Ma Ronghua, Dr. Stefan Simis, Dr. Bai Yan, Dr. Mao Zhihu, Dr. Shen Fang, Prof. Bob Su, Prof. Duan Hongtao

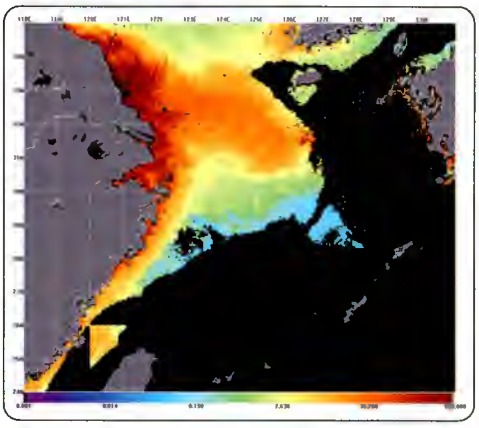
The quality of water is one of the top environmental issues worldwide. In this project we investigate water quality parameters of inland waters, estuaries and coastal zones by using Envisat MERIS data and HY-1B sensors COTCS and CZI. The project focuses on the development and application regarding two important tasks: monitoring of suspended matter and associated turbidity / light attenuation and of plankton blooms in particular of cyanobacteria and red tides. The areas considered are the Yangtse River Estuary with the coastal zone of the Yellow Sea, Lake Taihu in China and the Southern North Sea in Europe.

Campaigns in Yangstse River area in 2008
Several cruises have been performed in spring and summer 2008 to determine the inherent optical properties of the coastal waters as well as to measure the spectral reflectance. The data will be used to improve and validate the algorithms including atmospheric correction. During the cruises, absorption and attenuation and backscattering meters were deployed (see top of page photo). The cruises were in the Changjiang estuary and coastal waters. The map shows the gauging stations measured in these waters in April and August 2008.

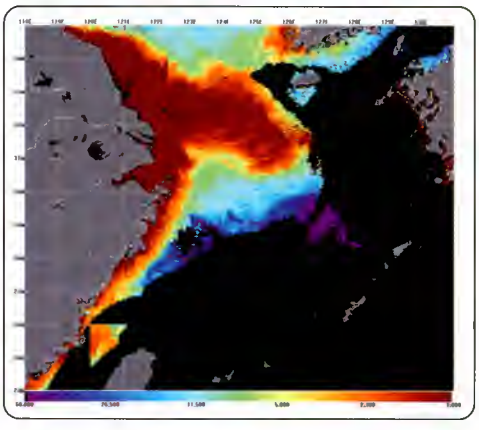
The COTS HY-1B image shows the situation in the Changjiang estuary and coastal waters on 1 March 2008. The cruise data have been used to provide calibration relationships between bio-physical parameters and sea surface reflectance. From COTS and MERIS FR imagery, it is possible to provide maps showing water transparency and total suspended matter concentration (COTS shown bottom of page 44, MERIS FR shown on page 45).



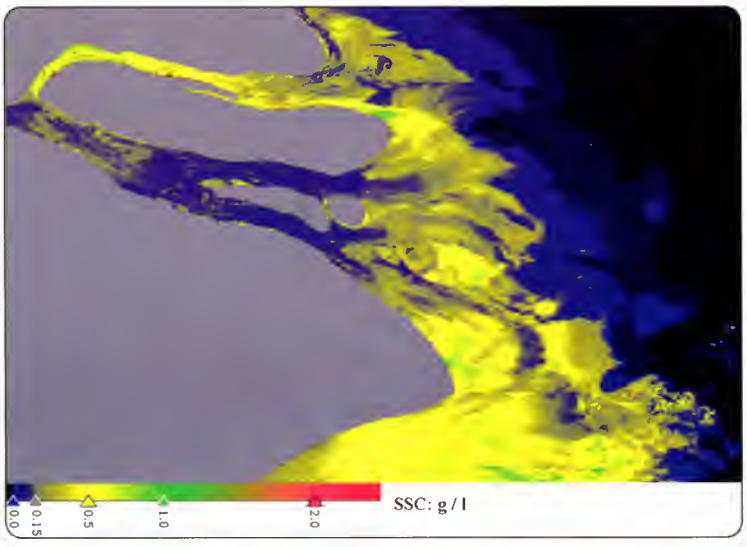
↑ Changjiang estuary and adjacent coastal waters including isobaths (triangle symbols gauging stations in the spring cruise of April, 2008. Circle symbols denote gauging stations in the summer cruise of August, 2008 (Courtesy Dr. Fang Shen LECR ECNU)



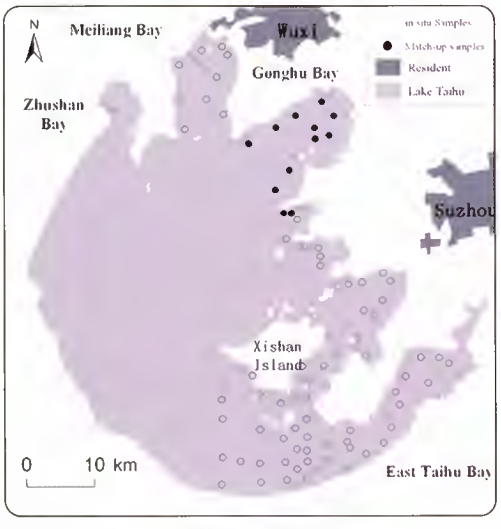
← Map of water transparency (Secchi-Disk Depth, SDD) on 1 March, 2008 by COCTS/HY-1B (unit is m)
(provided by Bai Yan, SOED SIO, SOA)



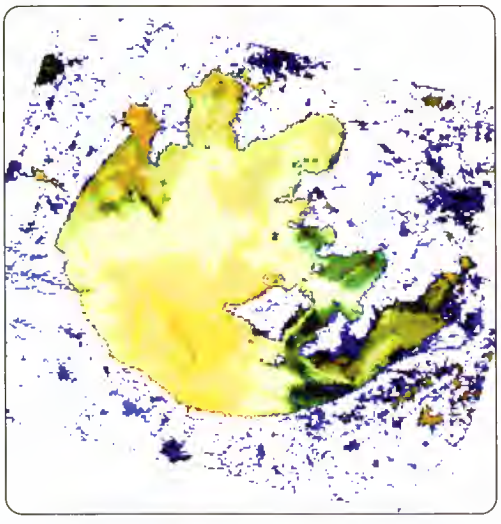
← Map of total suspended matter concentration on 1 March, 2008 by COCTS/HY-1B (unit is mg/L)
(Courtesy of Bai Yan, SOED SIO, SOA)



↑ Estimate of suspended sediment concentration from MERIS FR data in the Yangtze estuary (Courtesy of courtesy of Fang Shen, LECR ECNU)



↑ Sampling points on Lake Taihu in China (provided by Duan Hongtao, NIGLAS, CAS)



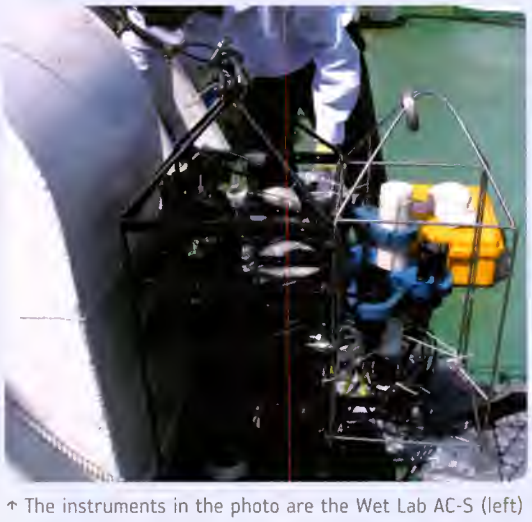
↑ Turbidity of Lake Taihu as determined from MERIS FR data using the C2R algorithm in BEAM (provided by Duan Hongtao, NIGLAS, CAS)

↑ Water reflectance of Lake Taihu measured with an ASD Field Spec FR spectroradiometer (Courtesy of Hongtao Duan, NIGLAS, CAS)

Campaigns in Lake Taihu area in 2008

Cyano-bacteria are an important group of organisms in inland and coastal waters, which are potentially toxic and harmful. Massive blooms of cyano-bacteria, in Lake Taihu can cause amenity, water quality and treatment problems. In drinking water reservoirs they can totally spoil the water quality.

For detecting also the early stage of blooms the bands at 620 nm and 665 nm of MERIS are investigated because they cover the absorption maxima of the pigments phycocyanin (found primarily in cyanobacteria) near 620 nm and of Chlorophyll a near 675 nm. To develop special algorithms for Lake Taihu water sampling and measurements were performed at 94 sites during a cruise in October 2008. Water reflectance was measured with an ASD Field Spec FR spectroradiometer.



↑ The instruments in the photo are the Wet Lab AC-S (left) binding with the Submersible Multi-channel loggers XR-620 (RBR Ltd.) (Courtesy of Bai Yan, SOED SIO, SOA)

↑ MaxDOAS at Institute of Atmospheric Physics, Beijing (Bird's nest Olympic stadium in background)

AIR QUALITY MONITORING AND FORECASTING IN CHINA

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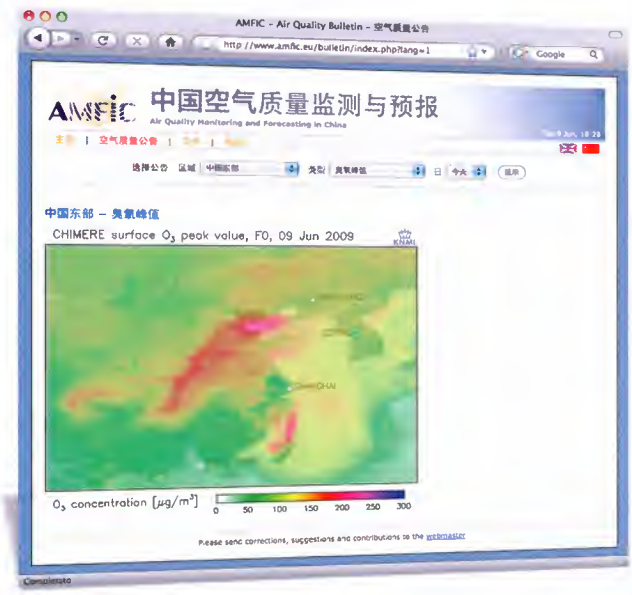
The AMFIC project aims to develop an integrated information system for monitoring and forecasting tropospheric pollutants over China. The system uses satellite and in situ air quality measurements and modelling to generate consistent air quality information over China. The data will cover the recent years and the actual situation including an air quality forecast for several days ahead (the figure shows the on-line system http://http://www.knmi.nl/samenw/amfic/index.php. Air pollutants covered are ozone, nitrogen dioxide, sulphur dioxide, formaldehyde, carbon monoxide, methane and aerosol/particular matter. The proposed system will supplement and broaden the existing ground-level monitoring and air quality assessment activities in China. Satellite data will cover regions where no ground-based stations are available; air quality models fill-in the sparse temporal and spatial sampling of the measurements and connect them in a physically consistent manner. The system targets environmental agencies in China, and assists them in their reporting duties on air quality. This will improve the understanding of the transport of air pollution within, from and to China.

During the 2008 Olympic and Paralympic Games in Beijing (from 8 August to 17 September), local authorities enforced strong measures to reduce air pollution during the events (the bottom of page photos show the results on traffic volumes). The direct affect of these measures were evaluated using ground and satellite observations with model results. By comparing GOME-2 and OMI observed tropospheric NO_2 with simulations from a regional chemistry transport model CHIMERE for 2008, a reduction of about 60% was found for the NOx emissions in Beijing during the Olympic period.



↑ Air quality forecast for the Beijing region at the AMFIC web site: http://www.amfic.eu/bulletin/index

← Morning traffic flow on the East 4th Ring Road in Beijing: during the restrictions on Friday 19 September (top), and after the restrictions on Monday 22 September (bottom). Source: China Daily

EXPLOITATION OF GOMOS, OSIRIS, OMI AND MIPAS MEASUREMENTS FOR STUDYING CHANGE IN THE MIDDLE ATMOSPHERE (EGOMO)

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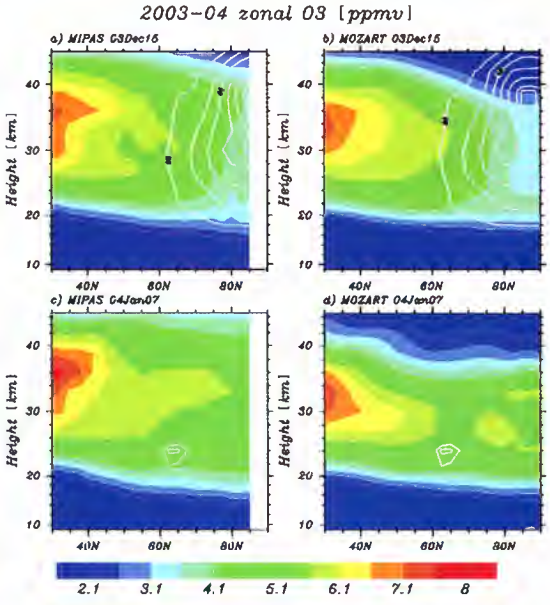
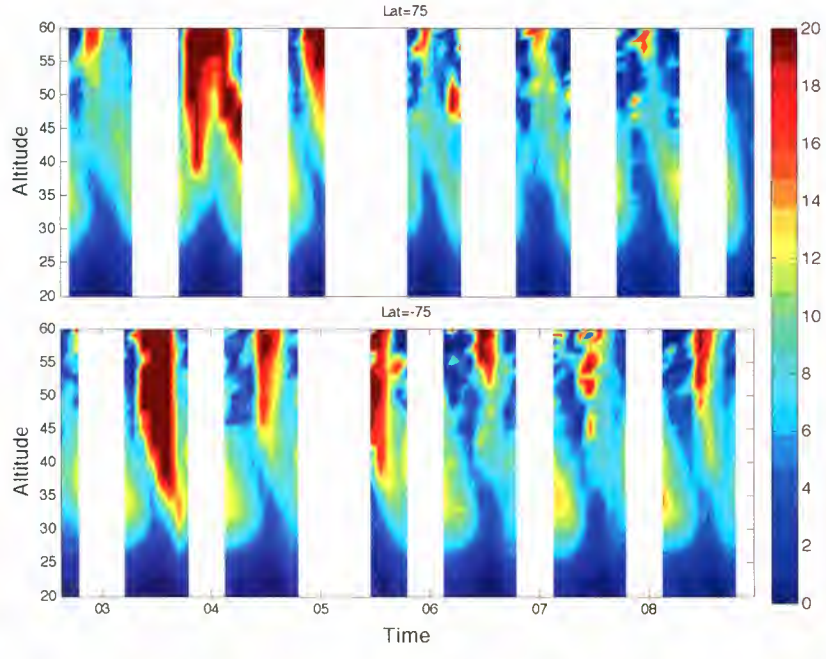
↑ Ms. Li Min from Key Laboratory of middle Atmosphere and Global Environment Observation (LAGEO) launching an ozone sonde



↑ MIPAS measurements and MOZART-3 model results for the 2003/04 stratospheric sudden warming event, before and after event (a) MIPAS O3 on 15 Dec 2003;(b) MOZART O3 on 15 Dec 2003; (c) MIPAS O3 on 7 Jan 2004; (d) MOZART O3 on 7 Jan 2004.



↑ NO2 mixing ratio (ppb) in the polar regions. Measurements are from GOMOS on ENVISAT

In the EGOMO project the middle atmosphere is being studied using dynamical and chemical models and data from satellite, ground based, and balloon-borne instruments (see top photo). Here-in provided are the first results comparing satellite observations with model output.

In the polar areas the wintertime vortex provides an isolated "laboratory" for unusual chemical reactions leading to ozone loss. The vortex is often disturbed by sudden stratospheric warming events. The top figure shows comparisons between MIPAS measurements and MOZART-3 model results for the 2003/04 stratospheric sudden warming event. Meridional cross-sections of the zonal mean O_3 mixing ratio (ppb) pole ward of 30°N before and after the event are shown.

In the darkness of the polar winter the NO2 distribution is enhanced by the chemistry driven by solar proton events and by the intrusion of NO from the mesosphere and thermosphere. The bottom of page figure shows the NO_2 mixing ratio (ppb) in the polar regions.

↑ First joint Sino-European EGOMO team meeting that took place during the DRAGON 2 Kick Off Symposium in Beijing, April 2008

↑ Mobile Doppler wind lidar during Shenzhou 7 Spacecraft landing campaign.

VALIDATION OF ADM-AEOLUS DATA USING GROUND-BASED DOPPLER WIND LIDAR

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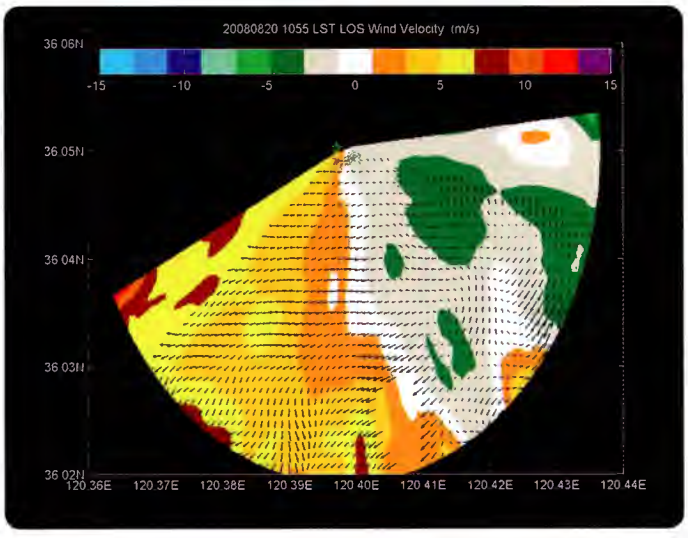
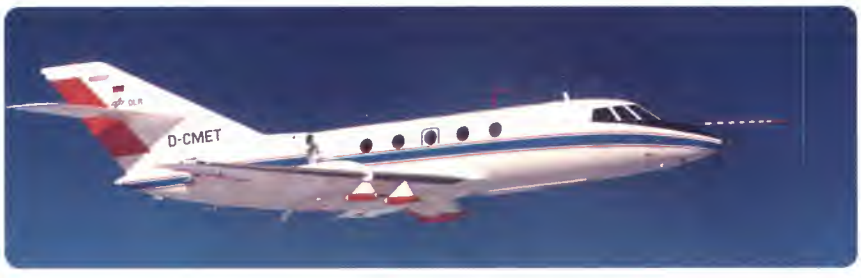
The global observation of atmospheric wind profiles remains to be the highest priority need for weather forecast. A satellite Doppler LIDAR (LIght Detection And Ranging) is the most promising candidate to meet the requirements for global wind profile observations with high vertical resolution and accuracy.

Ocean Remote Sensing Institute of Ocean University of China (ORSI/OUC) has developed and tested a mobile Doppler LIDAR that can accurately measure wind speed and direction over large areas in real time - an application useful for ADM-Aeolus validation, aviation safety, weather forecasting and sports. Last year, the instrument was successfully tested at the Qingdao sailing competitions during the Olympic Games. The LIDAR was located the sailing course, and made a horizontal scan over the sea surface, making the wind measurement in real time and then uploading the data to the local meteorological station every 10 minutes (a scan is shown in the figure). In addition to the sea surface wind campaigns, ORSI/OUC Doppler lidar was deployed on the China's Shenzhou 7 spacecraft landing zone in the Inner Mongolia steppe. The wind profile was tracked by the mobile Doppler LIDAR system to assist the prediction of the module's landing site (see top of the page photo).

An airborne prototype of the instrument on ADM-Aeolus was developed by DLR to validate the instrument concept and retrieval algorithms before satellite launch. It is the first airborne direct-detection Doppler lidar for atmospheric observations worldwide and was deployed during field campaigns on the DLR Falcon 20 aircraft and on ground during the past years (see bottom of page photos).



↑ Sea-surface winds during Olympics 2008 (Color indicates the line-of-sight velocity and arrow shows the wind direction).



↑ The DLR Falcon 20 in flight

↑ The 2-µm wind lidar (front) and the ADM-Aeolus prototype (back) wind lidar installed in the DLR Falcon 20 aircraft.

SMOS DATA CALIBRATION AND VALIDATION OVER CHINA

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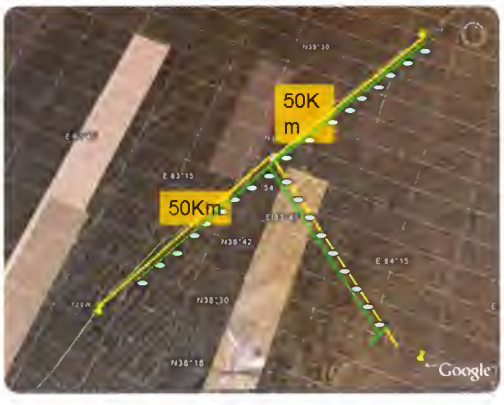
↑ Workshop to discuss to SMOS commissioning phase activities in China, 9 Feb. 2009 in Beijing

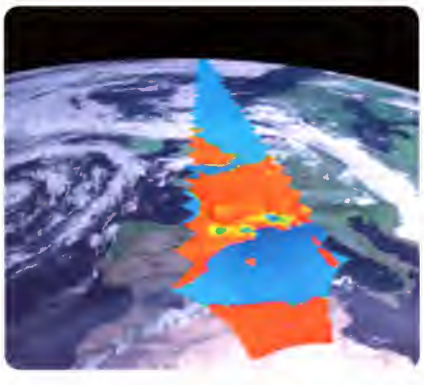


↑ Proposed layout of soil moisture sampling stations (white points) and passive microwave measurements for SMOS-MIRAS calibration during the commissioning phase Taklamakan Sand Desert reference site

↑ Typical set-up for a desert soil moisture sampling station, multiple probes ensure reliability of measurements

↑ Soil moisture probes being placed in the desert

↑ Graphic of SMOS satellite in space with MIRAS antennas deployed in Y-shaped formation



↑ SMOS-MIRAS footprint will be hexagonal and approximately 1000km across

Calibration and validation play a key role between satellite products and users. The major problem for calibration of space borne passive microwave instruments is to find suitable places on earth which are large, stable and predictable with a scale of tens of kilometers. Previous studies have shown that the Takla Makan desert is rather stable both in spatial and temporal scales and is therefore suitable as a reference site for SMOS calibration. The desert is the second largest desert in the world. Even so, microwave emission of the site is strongly influenced by physical soil temperature profile distribution, and other factors. It is aimed to understand these influential factors more clearly by carrying out investigations during SMOS life cycle which covers most of the Dragon-2 term. The most intensive ground experiments will be held during satellite commissioning phase. The top figure shows the sampling layout for soil moisture monitoring and ground based passive microwave measurements, the photos show probes being placed in the desert in preparation for the commissioning phase.

In order to prepare for the SMOS commissioning phase campaign, a SMOS CAL/VAL and Soil moisture application workshop has been held in the framework of Dragon-2 in Beijing at 9th, Feb. (top of page photo). Relative experts have discussed their ongoing works and plans focused on SMOS. PIs of the project had visited the calibration site after the meeting. It is confirmed the site is suitable for SMOS calibration, long term monitoring, soil moisture validation and dielectric model development.

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Institute of Disaster Management, Beijing Normal University (BNU)	China
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Laboratory for the Middle Atmosphere and Global Environmental Observation (LAGEO),	
Laboratory of Applied Geology, UMR CNRS SISYPHE, Paris School of Mines	France
Laboratory of Applied Geology, UMR CNRS SISYPHE, University of Paris VI	France
Laboratory of Atmospheric Physics, Aristotle University of Thessaloniki	Greece
Laboratory of Geomorphology, Ecole Pratique des Hautes Etudes	France
LAPC, Institute of Atmospheric Physics, Chinese Academy of Sciences (CAS)	China
LIESMARS, Wuhan University (WU)	China
Meteorological Data Analysis and Collection, National Climate Data Center	China

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Nansen-Zhu International Research Center, IAP/CAS	China
National Aerospace Laboratory (NLR) and ITC	The Netherlands
National and Kapodistrian University of Athens, Laboratory of Remote Sensing	Greece
National Marine Environmental Forecasting Center	China
National Meteorological Center	China
National Meteorological Satellite Application Center	China
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