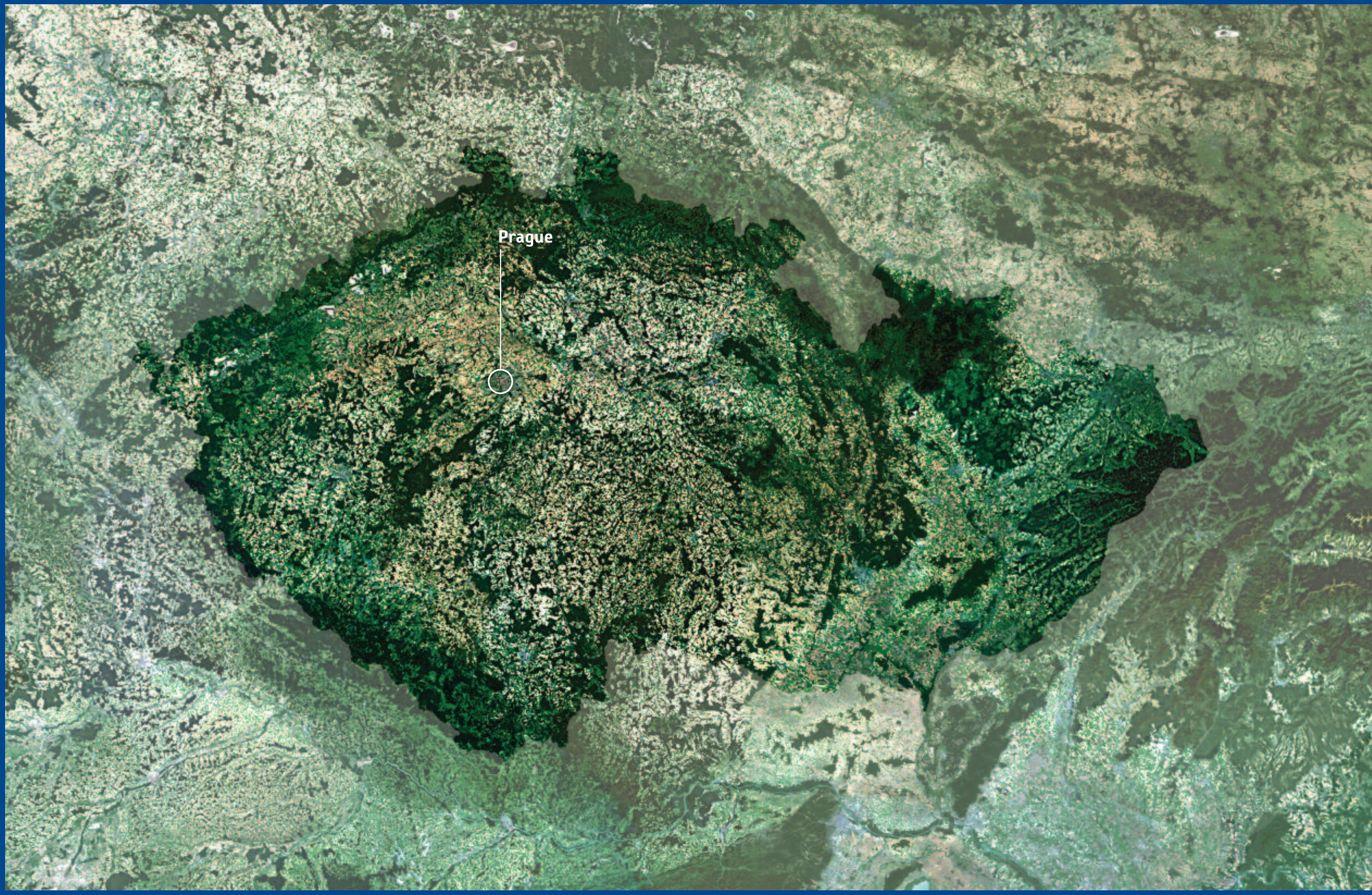
DRAGON 2 PROGRAMME

Brochure 2011



http://dragon2.esa.int

programme

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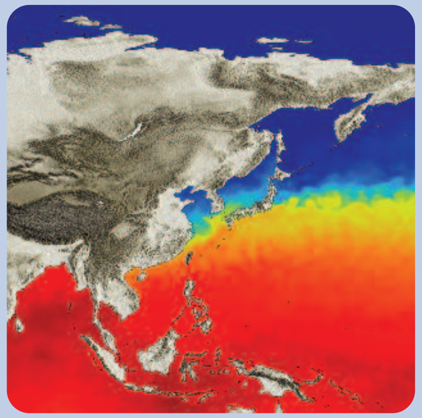
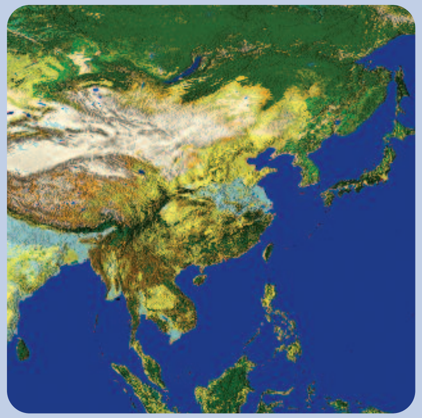
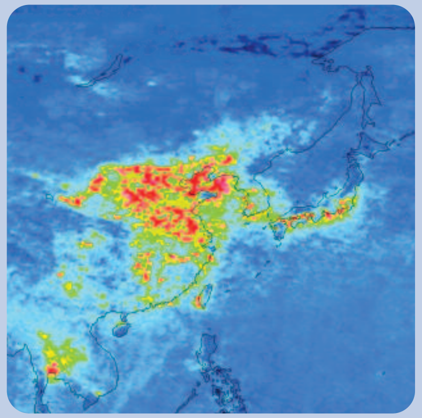
partners







DRAGON
2011

THE DRAGON 2 BROCHURE

This 2011 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 two annual Symposia, Barcelona, Spain in 2009 and the mid term results Symposium in Guilin, China, in 2010. The proceedings of the mid term results Symposium have been published by ESA and NRSCC [ESA-SP684] and are available on DVD. For ESA, TPM and Chinese EO data, detailed coordination of all requested acquisitions over China is being performed by ESA and NRSCC respectively leading to a very high success rate in terms of planned data acquisitions.

Post graduate training is a key component of the Dragon 2 programme, and three advanced training courses have been organized in China. An advanced training course in land remote sensing was successfully held at Wuhan University, Wuhan in October 2008 and this was followed by an advanced training course in atmospheric remote sensing that was held at Nanjing University, Nanjing in October 2009. An additional land training course was held at Cold and Arid Regions Environmental and Engineering Research Institute, Chinese Academy of Sciences, Lanzhou in 2010. All of these courses were attended by 60 or more post graduate scientists from all over China. European and Chinese experts have given lectures and practical sessions on data processing, product development, validation and assimilation of EO and other data in atmospheric and land applications. In 2011, an advanced training course in ocean remote sensing will be held at East China Normal University, Shanghai, China.

The 3rd Dragon 2 annual symposium is to be held in Prague, Czech Republic from 20 to 24 June 2011 at which the latest results will be presented for the 25 projects. In addition, the Dragon 2 young scientists will be in attendance and will present their research results at a dedicated poster session.

The next steps during 2011 and 2012 are the preparation for the final results symposium and to plan the continuation of the Dragon 2 Programme beyond 2012. ESA and NRSCC will also open a call for the final results papers in January 2012, with paper submission by June 2012.

The Dragon 2 Programme teams continue to deliver world class results in all of the application fields under investigation. We thank all of the Sino-European investigators for their contribution to this 4 year programme. We look forward to working with you for the remainder of the programme and to new and exiting possibilities in 2012 and beyond.

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 3 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 exploiting 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 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 in processing, algorithm and product development from 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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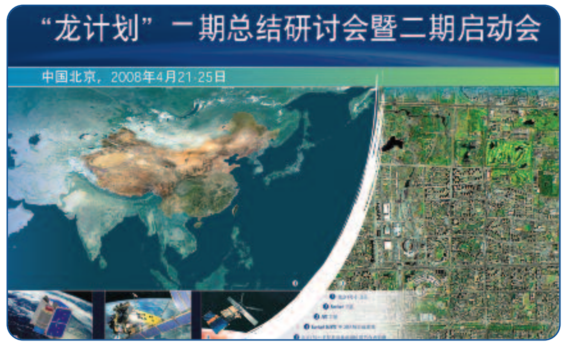
PROGRAMME

PROJECTS

PARTNERS



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

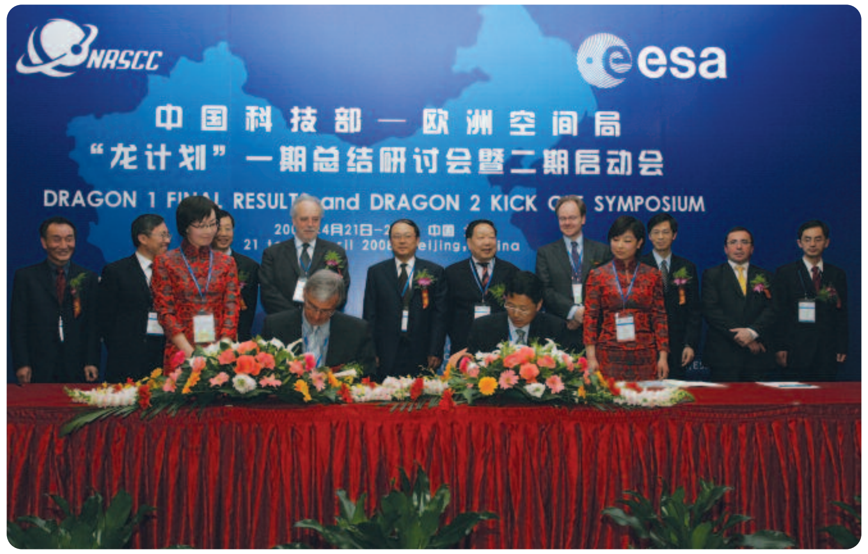
Main objectives of the Symposium:

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.

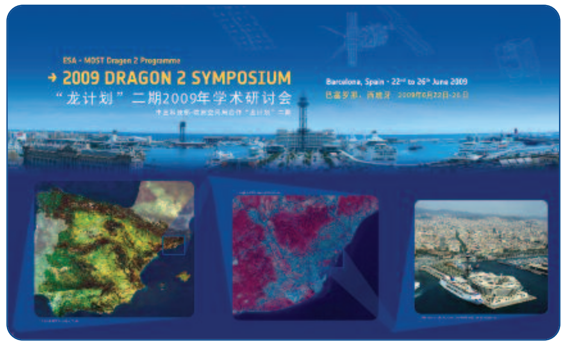


Signing of the Dragon 2 protocol agreement between ESA and MOST representatives on 21 April 2008. The agreement concerns access to ESA, TPM and Chinese EO data for science and application development in P.R. China for a four year period, programme management, academic exchanges and training

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

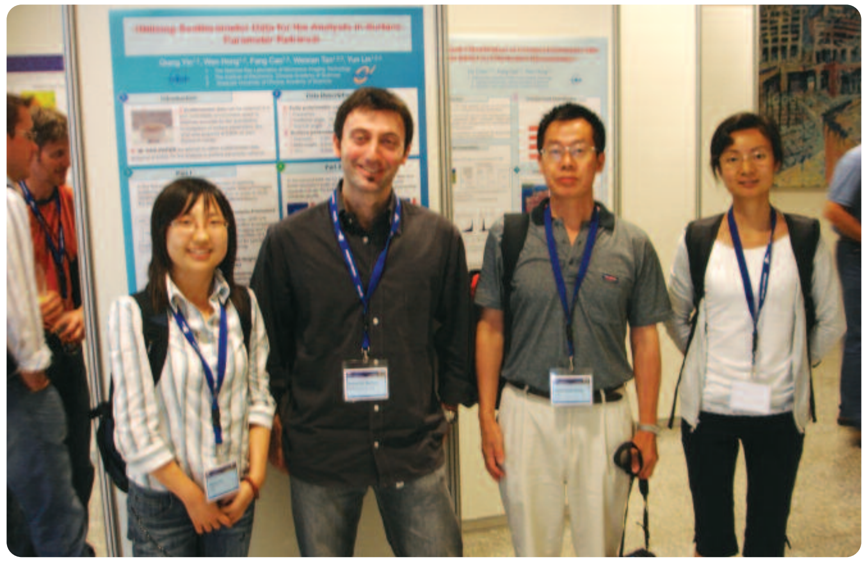
2009 DRAGON 2 BARCELONA SYMPOSIUM, SPAIN

Date	22-26 June 2009
Place	World Trade Center, Barcelona, Spain
Hosts	ESA and NRSCC
Participants	142 scientists from China and Europe
web	http://dragon2.esa.int/symposium2009



2009 Barcelona Symposium poster

European and Chinese participants of the 2009 Barcelona Symposium



Young scientists presenting poster papers during the Barcelona Symposium poster session

The 2009 Dragon 2 Symposium brought together the joint Sino-European teams after 1 year of activity. On a project-by-project basis, the 25 project teams reported on their progress. On the afternoon of the first day, a poster session dedicated to research by young and Dragon 2 scientists was opened. The posters outlined the aims and achievements of the research being undertaken, the EO and other data utilised, the methodology used and the latest results. A total of 68 posters were presented in land, ocean and atmospheric applications exploiting a wide range of space and air borne EO data. The posters remained on view for the duration of the Symposium.

The Symposium was formally opened on 22 June 2009, with presentations by ESA and NRSCC / MOST representatives. The Dragon 2 programme coordinators provided an up-date on the programme and the activities since kick off and informed on the activities that were planned for remainder of 2009 and 2010. This included the atmospheric training course scheduled to take place at Nanjing University in October 2009 and the location of the 2010 Mid Term Results Symposium. The technical sessions formally commenced on the afternoon of the first day and lasted for 4 days. The project teams had the opportunity to undertake meetings in parallel to the technical sessions. The morning of the last day was dedicated to summary reporting on each of the sessions and the teams informed on their future planning and activities. The Symposium closed on 26 June 2009. All of the technical session presentations are available to view on-line: http://dragon2.esa.int/symposium2009/programme2009.html.

↑ Official opening of the 2010 Guilin Symposium by Vice Minister MOST China, Dr. Cao Jianlin

2010 DRAGON 2 MID TERM RESULTS SYMPOSIUM

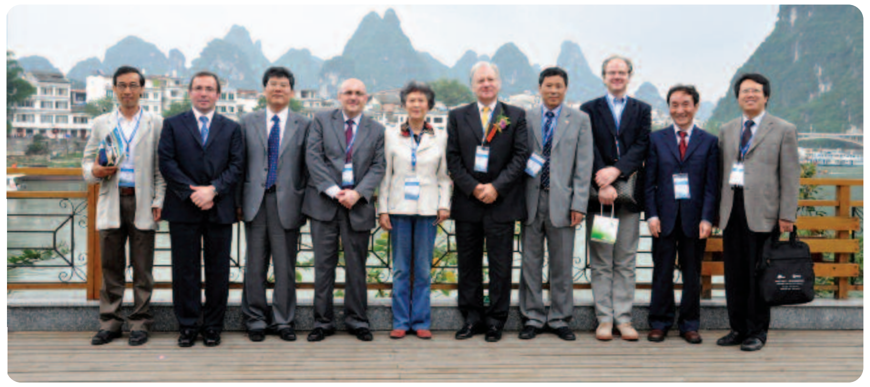
Date	17-21 May 2010
Place	Yangshuo, Guilin P.R. China
Hosts	NRSCC and ESA
Participants	252 scientists from China and Europe
Web	http://dragon2.esa.int/symposium2010

The Guilin Symposium took place from 17 to 21 May 2010 and was the occasion of the joint teams' reporting at the mid term stage of the programme. There were 252 participants. Opening the symposium on the morning of the second day, MOST Vice Minister Dr. Cao Jianlin said: "The Dragon Programme has offered a successful model in the field of Earth observation and received widespread international attention."

The teams reported on their latest results over 4 days in 2 parallel sessions. There were 54 technical presentations made which are available to view on-line. The Dragon 2 young scientists also presented their research results in a poster session. In all 67 posters were presented in 8 categories and certificates were awarded for the best poster papers in each category. To support data ordering and delivery, EO data ordering support desks were available for the duration of the week and operated by ESA and NRSCC respectively.

The results at the mid term stage of the programme have been published as a joint ESA and NRSCC publication entitled "Proceedings of the Symposium, Dragon 2 Programme Mid Term Results [ESA SP-684].

↑ Symposium participants at the opening plenary session

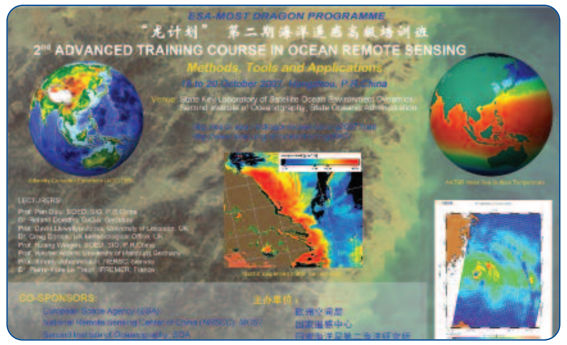


↑ Representatives of ESA and MOST-China at the Guilin Symposium bilateral meeting, 18 May 2010

↑ The participants of the 2010 Guilin mid term results Symposium

2007 ADVANCED OCEAN TRAINING COURSE

Date	15-20 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 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

2008 training course poster

2008 ADVANCED LAND TRAINING COURSE

Date	13-18 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

2009 ADVANCED ATMOSPHERIC TRAINING COURSE

Date	19-24 October 2009
Hosts	ESA, NRSCC and Nanjing University
Lecturers	Prof. Peng Zhang - National Satellite Meteorological Centre, China; Prof. Yi Liu - Institute of Atmospheric Physics, Chinese Academy of Sciences, China; Prof. Jiang Hong - Institute for Earth System Science, Nanjing University, China; Prof. Bruno Carli - Italian National Research Centre (CNR), Italy; Prof. Hennie Kelder - Royal Netherlands Meteorological Institute, The Netherlands; Dr Brian Kerridge - CCLRC Rutherford Appleton Laboratory, UK; Prof. Hendrik Elbern – University of Cologne, Germany; Prof. Erkki Kyrola, Finnish Meteorological Institute, Finland; Sander Neimeyer – S & T, The Netherlands

2009 training course poster

Practical session on the ESA BEAT software tool (top left), theoretical lecture (top right) and trainees being awarded certificates of attendance (bottom)

Trainees, lecturers and organisers of the advanced atmospheric training course at Nanjing University, Nanjing, China

Ph.D. students, postdoctoral and research scientists interested in atmospheric remote sensing from China were invited to a 6 day training course organised within the framework of the Dragon 2 Programme. The course was hosted by Nanjing University - School of Geographic and Oceanographic Sciences, P.R. China. The goals were to provide theory and practical sessions on remote sensing for atmospheric applications using ESA and TPM EO data.

There were 6 European and 3 Chinese lecturers who gave lectures on:

- Principles and advanced theory of atmospheric remote sensing
- Explain basic measurement principles, processing algorithms, data products and their use in atmospheric applications
- Demonstrate the practical use of the BEAT and appropriate software for the analysis of GOME, MIPAS, GOMOS, SCIAMACHY data in Atmospheric research
- The key concepts of ESA's ERS and Envisat missions and access to data
- Demonstrate the synergy between different atmospheric data for applications (e.g. trace gases in the troposphere)
- Present assimilation techniques and their applications

For the full daily programme and the lecturers that were presented see: http://dragon2.esa.int/atmostraining2009/daily_programme_e.html

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

↑ 2010 training course poster

2010 ADVANCED LAND TRAINING COURSE

Date	6-11 September 2010
Hosts	ESA, NRSCC and CAREERI - Cold and Arid Regions Environmental and Engineering Research Institute, Chinese Academy of Sciences, Lanzhou, Gansu, China
Lecturers	Dr. Sun Jianbao - CEA, China; Profs. Gong Peng & Shi Jiancheng - IRSA, CAS, China; Prof. Liu Jiyuan (Prof. Deng Zengxiang) - IGSNRR, CAS;Profs. Pan Zhiqiang & Hou Minghui - CRESDA, China; Prof. Daniele Perissin & Dr. Wang Zhiyang - CUHK & POLIMI, Italy; Dr. Thuy Le Toan - CESBIO, France; Prof. Eric Pottier - Univ. Rennes-1,France; Prof. Christiane Schmullius - Uni. Jena, Germany; Profs. Bob Su & Wout Verhoef - Uni. of Twente, The Netherlands; Dr. Hervé Yésou - SERTIT, France

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 CAREERI, Lanzhou, China. The goals were to provide theory and practical sessions on remote sensing for land applications.

There were 6 Chinese and 8 European 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, dry land crop mapping, land use change detection, forest mapping and parameter retrieval, terrain motion, water resources assessment, snow parameter retrieval and urban development
- Practical exercises with ESA software tools BEAM, NEST, and POLSARPRO

For the full daily programme see:
http://dragon2.esa.int/landtraining2010/programme_e.html

The course was attended by 80 trainees.

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

↑ Practical classes covered hands on processing of ESA data using BEAM, NEST and POLSARPRO software tools

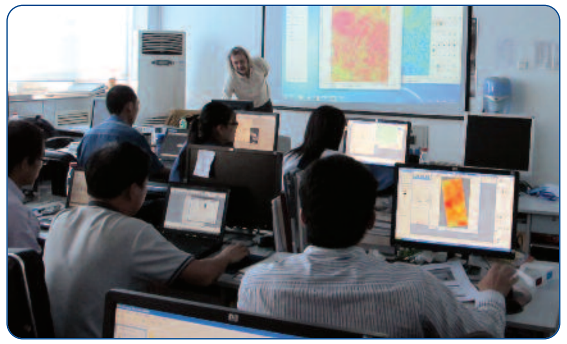
↑ Theoretical lecture (right) and trainees being awarded certificates of attendance (left)

↑ Participants, lecturers and organisers of the 2010 land training course atCAREERI, Lanzhou, Gansu Province, China

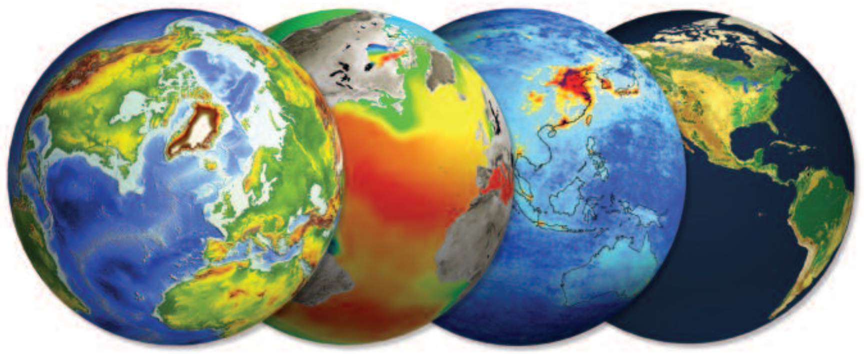
DRAGON 2 PROGRAMME

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. Please register to download the software and receive the latest up-dates.
Web	http://earth.esa.int/resources/softwaretools



↑ Prof. Eric Pottier demonstrating the use of POLSARPRO (land training course, CAREERI, Lanzhou in October 2010)



NEST (Next ESA SAR Toolbox) has an integrated viewer for reading, calibration, post-processing and analysis of ESA and 3rd party SAR data starting from Level 1. Distributed as fully open source, NEST allows users to easily develop new readers and post-processors for SAR data by means of an Application Programming Interface (API). Visit the website at **www.array.ca/nest/tiki-index.php**.

BEAM (Basic ERS & Envisat (A)ATSR and MERIS Toolbox) is a collection of executable tools and an Application Programming Interface (API) which has been developed for viewing and processing MERIS, (A)ATSR and ASAR, SMOS and TPM (ALOS and PROBA) data. Visit the website at **www.brockmann-consult.de/cms/web/beam**.

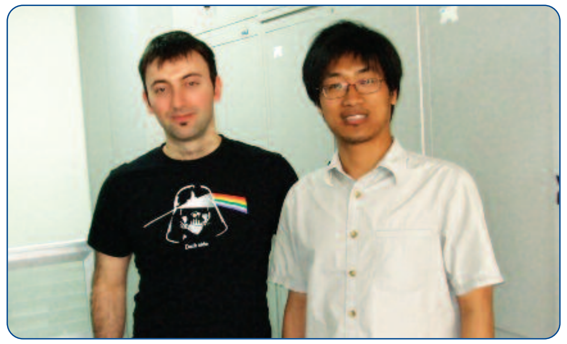
BEAT (Basic ERS & Envisat Atmospheric Toolbox) is a collection of executable tools and an application programming interface (API) which has been developed to facilitate the utilisation, viewing and processing of ESA GOMOS, MIPAS, SCIAMACHY and GOME data. Visit the website at **www.stcorp.nl/beat**.

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. Visit the website at **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, and can perform processing and data editing, extraction of statistics, and visualisation of results. Visit the website at **http://earth.esa.int/brat/html/data/toolbox_en.html.**

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



Exchange visit by Armando Marino (left) during April & May 2010, with Dr Feilong Ling (right), at the Chinese Academy of Forestry, Beijing

POLIMI Italy and Wuhan University, China
A Chinese Ph.D. student has been hosted in Milan. Joint field visits to the study areas in China were organized in 2008 and 2009. In January 2010, the Wuhan Dragon 2 team, in cooperation with CHUK. HKSPRS and NRSCC, launched the workshop on "Spatial Information Technologies for Monitoring the Deformation of Large-Scale Man-made Linear Features".

University of Twente, The Netherlands
There are 6 Chinese and 1 European being trained at Ph.D. level, A regional soil moisture and soil temperature observatory has been established at Naqu site (East), Maqu site (northeast) and Nagri (southwest) on the Tibetan Plateau. The data are currently used for calibration and validation of AMSR-E, ASCAT, and SMOS products.

Université Joseph Fourier (ISTerre), France and team members
In the last 2 years, field work has been done along the Haiyuan fault and Kunlun faults and there have been several exchange visits. For example, ISTerre, IPGP members visited institutes in China; COMET members participated in a joint COMET+/BGS/CEA workshop; Chengsheng Yang (Chang'an University) and Yang Liu (Wuhan University) visited the University of Glasgow; three UK team members visited the Institute of Geology in Beijing.

IECAS – MITL and IETR University Rennes-1
The cooperation is on-going since April 2007 with seminars, student exchange, co-supervision of students and research using satellite and air-borne Polarimetric SARs. A working visit to China was made in April & May 2010 with the aim of strengthening current and future research. Young scientists A. Fontana, P. Wang and A. Marino each received awards for their research in 2010.

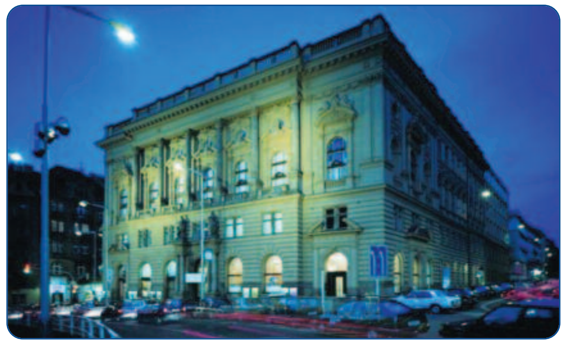
Ngari Desert Observation and Research Station (NADORS) established in 2008 by the Institute of Tibetan Plateau research Chinese Academy of Science (ITP/CAS); soil moisture sampling shown bottom

Seismology Project id. 5305 European and Chinese (IG, CEA Beijing main & SIL, CEA inset) team members, at the Haiyuan fault (rupture trace of the 1920, M~8 Haiyuan earthquake, south of the Hasi Shan, Gansu province)

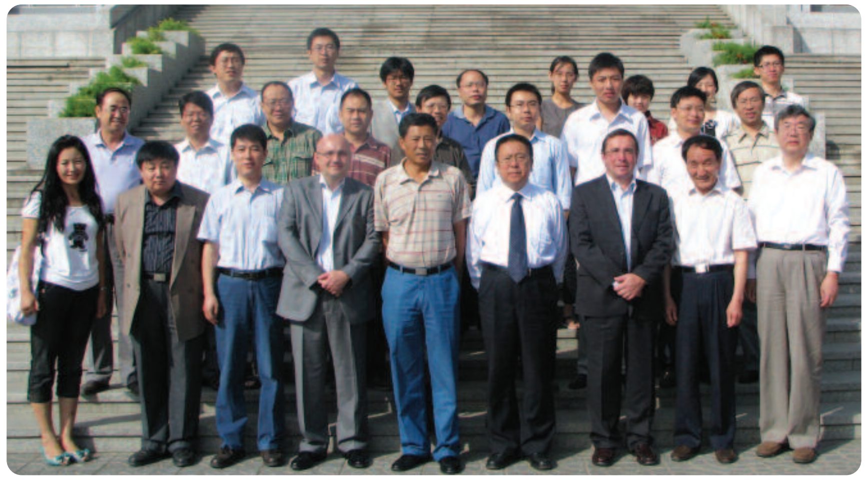
DRAGON 2 PROGRAMME

DRAGON 2 PROGRAMME MANAGEMENT

9 June 2010	Visit to the 2011 Symposium venue, Národní dům na Vinohradech, Prague Czech Republic
2-3 September 2010	ESA and NRSCC Progress Meeting with Chinese PIs, Hohhot, Inner Mongolia
21-22 February 2011	Meeting with East China Normal University, Shanghai in preparation for the 2011 advanced training course in ocean remote sensing
23-24 February 2011	Dragon 3 Programme preparation meetings in Beijing



Visit to Národní dům na Vinohradech, Prague Czech Republic, to initiate organisation and planning for the 2011 Dragon 2 Symposium.



Participants of the Dragon 2 Progress meeting, 2 Sept. 2010 Hohhot, Inner Mongolia, China

Dragon 3 Programme preparation, visit by ESA and NRSCC representatives to Beijing Landview Mapping Information Technology Co. Ltd.

Dragon 3 Programme preparation, visit by ESA and NRSCC representatives to the Centre of Space Science and Applied Research (left) and the Chinese Academy of Forestry (right)

In May 2010, following a visit to Prague, Czech Republic, ESA selected the venue for the 3^{rd} annual Dragon 2 Symposium. The 2011 Symposium will bring the joint Sino-European teams together for reporting after more than 3 year's activity. There will also be a poster session dedicated to reporting by young scientists.

On 2 and 3 September 2010, ESA and NRSCC had a joint progress meeting with Chinese Dragon 2 lead investigators in Hohhot, Inner Mongolia. ESA informed the PIs about the up-coming 2011 Dragon Symposium in Prague Czech Republic. ESA and NRSCC requested the Dragon 2 scientists to submit abstracts for the ISRSE 34 which will be held in Sydney in 2011 and for which there will be an invited session on the Dragon 2 Programme. The status of the mid term results proceedings was reviewed and actions to complete the proceedings were made.

On 21 and 22 February 2011, the organisation for the advanced training course in ocean remote sensing was initiated following a visit to East China Normal University, Shanghai.

On 23 and 24 February, ESA and NRSCC representatives visited institutions in Beijing and met to discuss continuation of the Dragon 2 programme to a follow on programme, Dragon 3. Both ESA and China plan to launch several continuity and new missions in land, ocean and atmospheric science and applications. So there is potential to continue cooperation for a further 4 year period starting in 2012.

Reik Leiterer and Johannes Reiche from Uni. Jena, Germany undertook a field visit with CAF staff to Hebei Province in September 2009

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, 2009 (Barcelona), 2010 (Guilin), 2011 (Prague)**

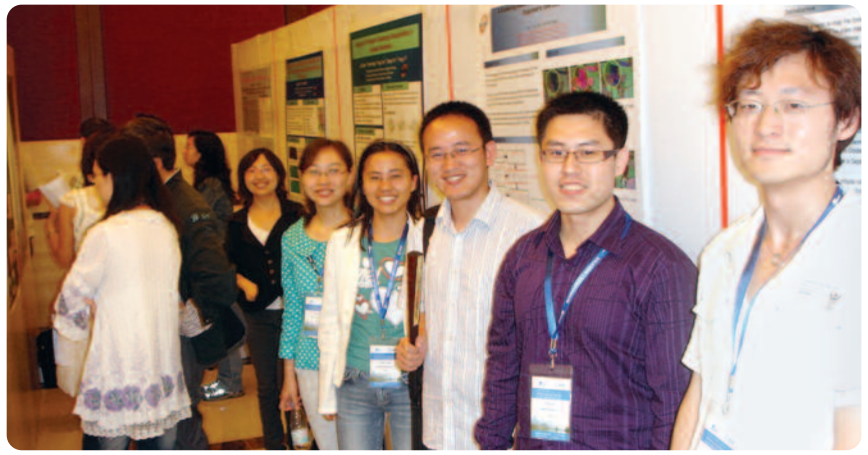
ESA has allocated resources to Dragon 2 projects for training of young scientists. The applicable period is in Phase 1 2008 to end of 2010 and in Phase 2, 2011 to 2012. ESA has placed contracts with 18 European Institutions participating in Dragon 2 projects. The types of training supported include:

- 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

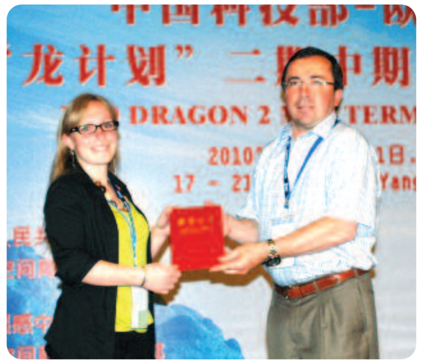
ESA has requested the following deliverables to set up the contracts and monitor student progress:

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 2009 to 2011, 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 2011 Prague Symposium, they will report on their project activities and their latest results.



Chinese young scientists presenting posters at the 2010 Mid Term Results Symposium



2010 Guilin Symposium – presentation of best paper awards to Chinese and European young scientists

Rogier van der Velde receiving his PhD degree from Professor Bob Su (University of Twente) on 5 November 2010 in Enschede, The Netherlands

DRAGON 2 PROGRAMME

ESA, TPM AND CHINESE SATELLITES AND INSTRUMENTS' 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.

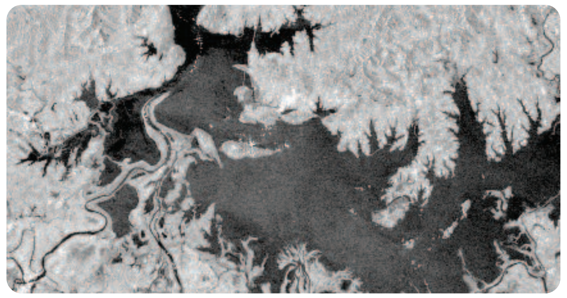
Satellite	Instruments
ENVISAT	Advanced Along Track Scanning Radiometer (AATSR) SCanning Imaging Absorption SpectroMeter for Atmospheric CHartographY (SCIAMACHY) MicroWave Radiometer (MWR) MEdium Resolution Imaging Spectrometer Instrument (MERIS) Advanced Synthetic Aperture Radar (ASAR) Doppler Orbitography 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)

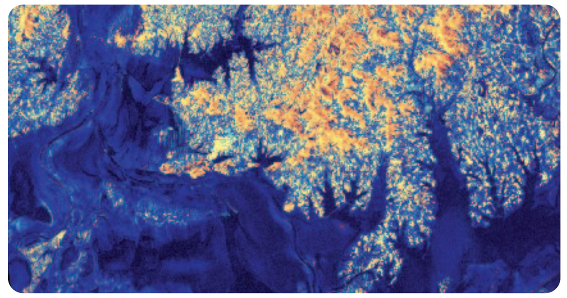
ESA and TPM satellite missions and EO instruments

Satellite	Instruments
Beijing-1	Multi-Spectral Imager (MSI)
CBERS	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

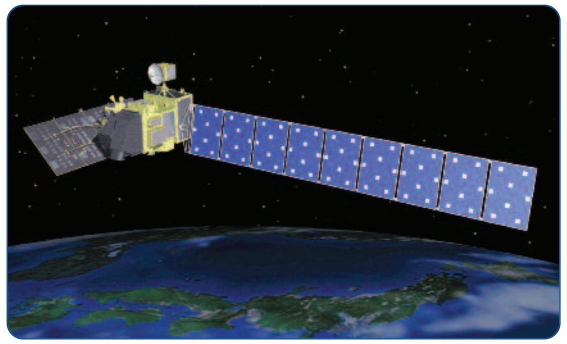
Chinese EO satellite missions and EO instruments

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)



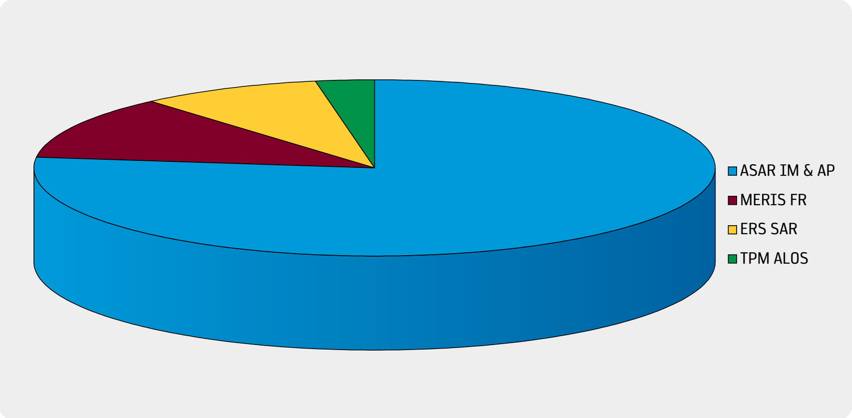
↑ ALOS is operated by JAXA and ESA has agreed access to data over China from its optical and polarimetrc L-band SAR instrument payload

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

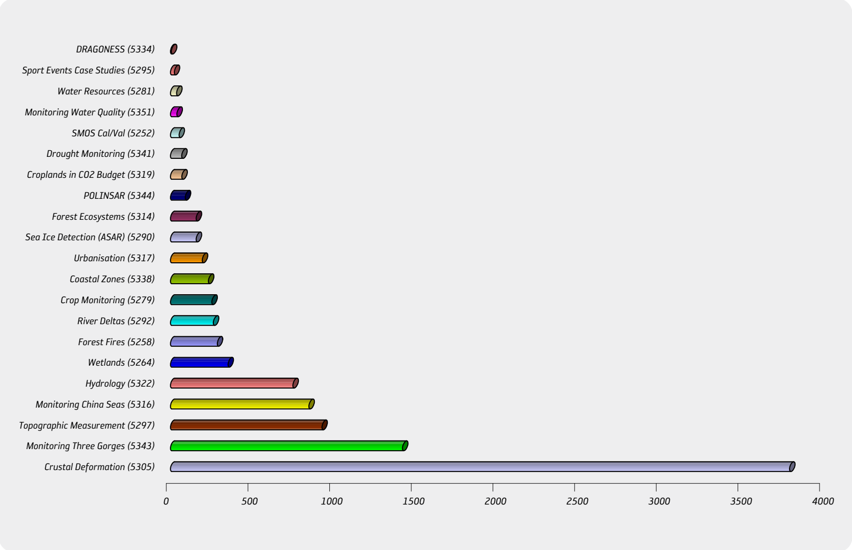
- The majority of ASAR images requested are for land and environment applications
- The MERIS FR images are mostly for ocean colour applications
- For time series analysis back to the 1990's several projects are requesting ERS SAR imagery
- ALOS data delivery includes:
  - PALSAR for POLInSAR applications (projects id 5317, 5343 and 5344), environmental monitoring (projects id 5258 and 5322), sea and sea-ice monitoring (projects id 5290 and 5338);
  - PRISM data for very high resolution DEM (~2.5m) generation (projects id 5252, 5322 and 5343);
  - AVNIR-2 data for high resolution urban imagery (project id 5295)

ESA AND TPM EO DATA DELIVERY

Sensor	04/08 to 01/11
ASAR IM & AP	7718
MERIS FR	1181
ERS SAR	866
TPM ALOS	265
Total	10030



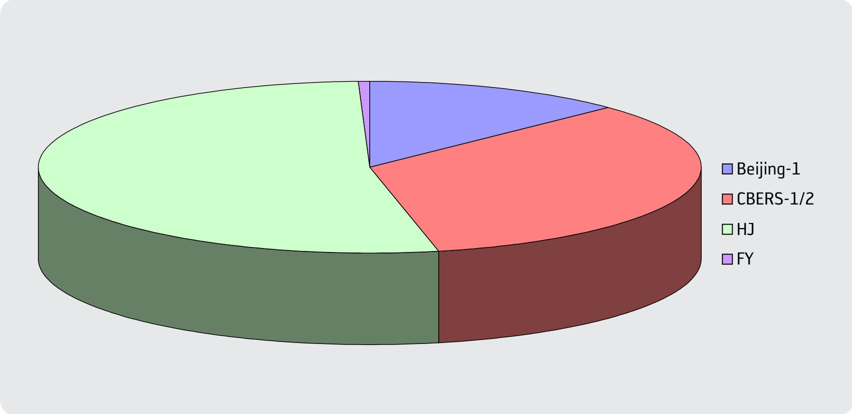
↑ Total ESA and TMP high bit rate data delivery (from April 2008 to January 2011) by instrument



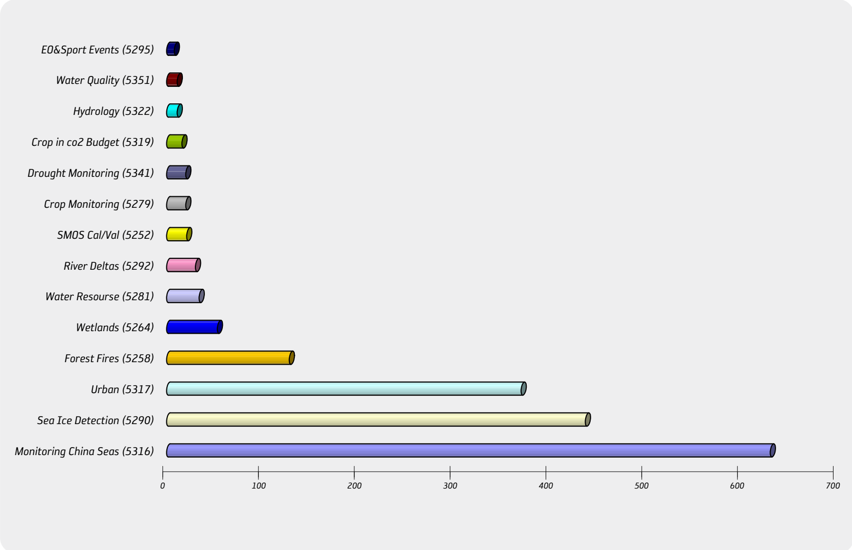
↑ Delivery of ESA and TPM high bit rate data on a project by project basis (from April 2008 to January 2011); NB for atmospheric chemistry projects and low resolution products (ASAR Medium Resolution and MERIS Reduced Resolution) data are delivered via FTP or HTTP

CHINESE EO DATA DELIVERY

Sensor	04/08 to 01/11
HJ	946
CBERS-1/2	606
Beijing-1	226
FY	10
Total	1788



↑ Total Chinese data delivery (from April 2008 to January 2011) by instrument



↑ Delivery of Chinese data on a project by project basis (from April 2008 to January 2011)

↑ CBERS satellite is operated by CRESDA over China

"Beijing-1" satellite was launched in October 2005 by China. The satellite, weighing 166.4 kilograms, is in an orbit 686 kilometers above Earth. It carries a wide swath CCD with 32m spatial resolution and a panchromatic sensor with 4m resolution. It could be used to earth observation for Disaster Monitoring Constellation (DMC) and research.

The China-Brazil Earth Resource Satellite (CBERS) is a remote sensing satellite jointly developed by China and Brazil. CBERS-1, CBERS-2 and CBERS-2B were separately launched in 1999, 2003 and 2007. CBERS-2C shall follow, with respective launch planned for the end of 2011.

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 2012.

FY series is Chinese meteorological satellites and consisted with 3 series now (1, 2 and 3). As for FY-3 series, the first two is experimental satellite and the last two is operational satellites. The first experimental satellite (FY-3A) was launched on May 7, 2008 and the second satellite was launched on November 2010.

With reference to figures Chinese EO data delivery

- Beijing-1 data is being requested by 10 land projects and 4 projects investigating sea and water quality.
- The number of CBERS images is 606 which are mostly used in ocean application.
- HJ images are for land and ocean applications.
- Only project ID.5292 has applied FY images into the research.

DRAGON 2 PROGRAMME

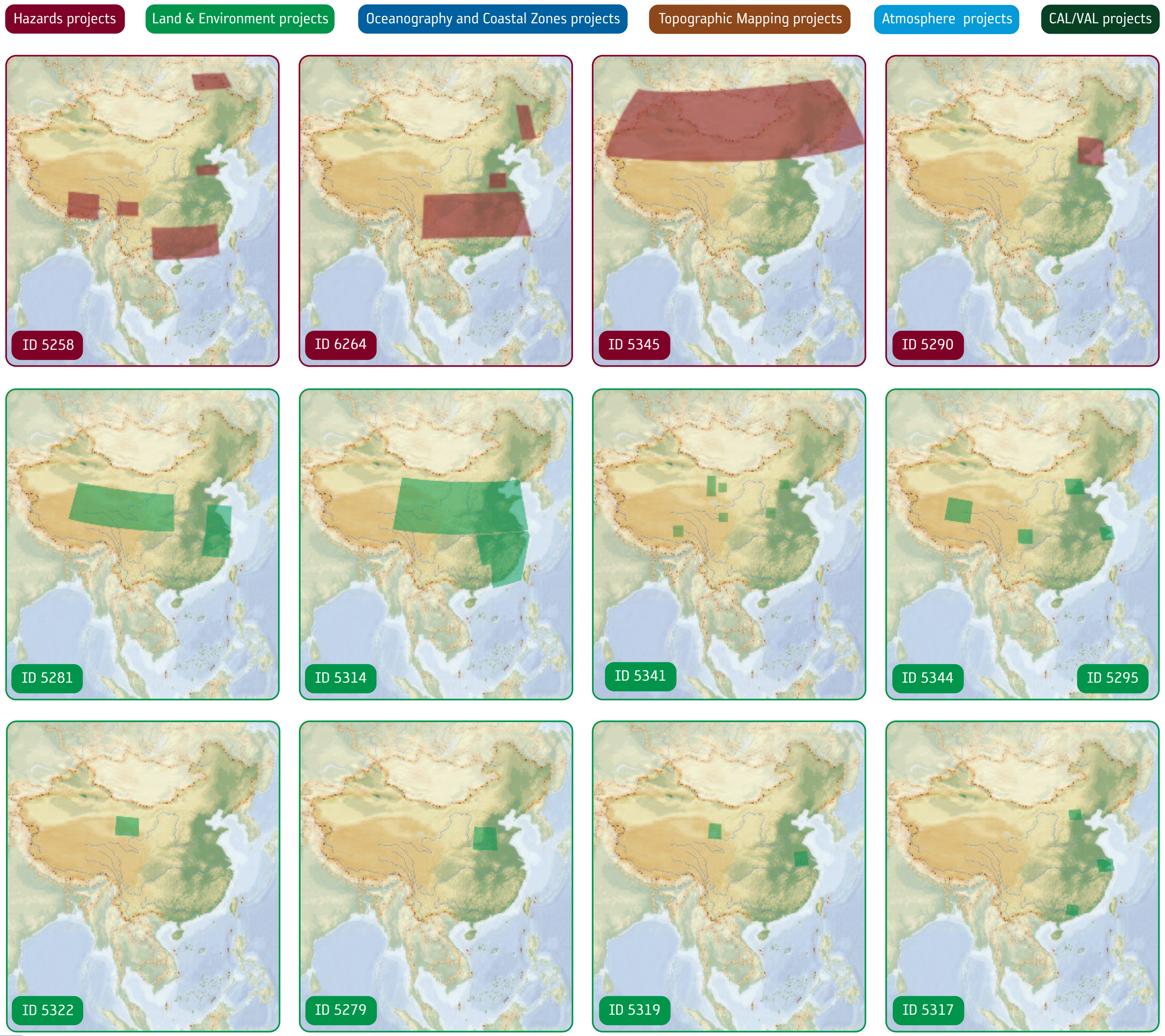
ENVISAT is the largest Earth Observation spacecraft ever built. It was launched from French Guiana by Ariane 5 on the 1st March 2002

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-Censures 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.



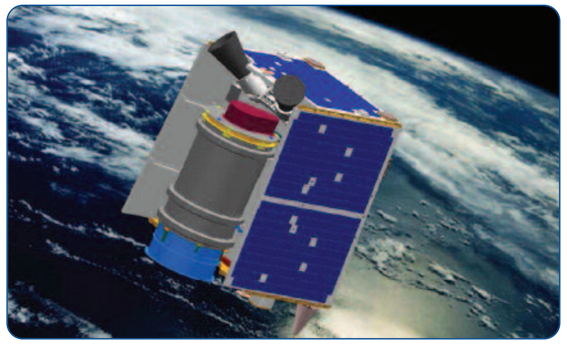
DRAGON 2 PROGRAMME

DRAGON 2 STUDY AREAS

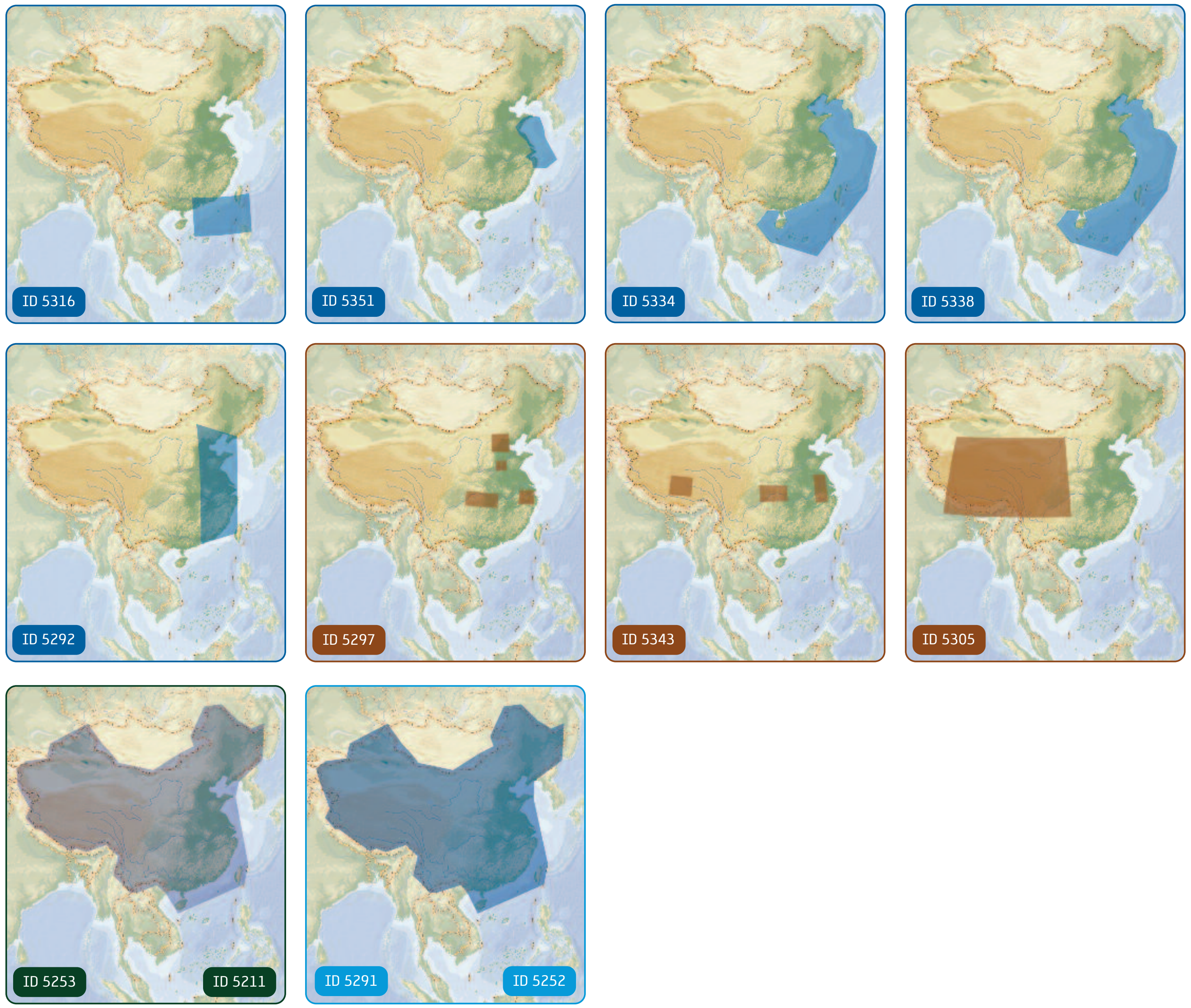
ESA instrument's planning conflicts are checked up-front following the Dragon 2 conflict free scheme thus a high percentage of requested acquisitions and modes of acquisition are provided to investigators.

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 (published 2010) and final term proceedings

http://dragon2.esa.int

DRAGON UPCOMING EVENTS

Advanced Training Course in Ocean Remote Sensing

State Key Laboratory of Estuarine and Coastal Research, ECNU, P.R. China

Venue
The course will be hosted by the State Key Laboratory of Estuarine and Coastal Research East China Normal University (ECNU SKLEC), Shanghai, P.R. China

Dates
From 24 to 29 October 2011

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, East China Normal University and ESA.

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

Web
The training course web sites are available in English and Chinese:

[ENGLISH VERSION]
http://earth.eo.esa.int/trainingcourses/OceanTrainingCourse2011

[CHINESE VERSION]
www.dragon2.ecnu.edu.cn

DRAGON 2 Final Results and DRAGON 3 KO Symposium

Dates
From 25 to 29 June 2012

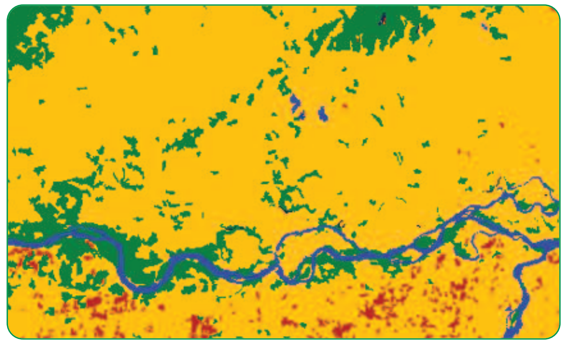
Location
The Symposium will be held in Beijing, P.R.China

Final Results, Call for Papers and Publication

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

Objectives
- To publish the final results of the 4 year programme
- Co-authorship of papers by European and Chinese scientists
- Make available the Special Publication (SP) as a DVD to all Dragon 2 investigators

Schedule
- The call for papers is open from 1 January 2012
- Papers must be submitted by 29 June 2012
- The DVD shall be available 30 September 2012



Forest/non-forest map at the Russia-China border based on a Envisat ASAR AP image from 2005. (Authors: Dr. Feilong Ling and Ms. Ynaping Huang, IFRIT CAF)

The FOREST DRAGON 2 project has overall goal to improve knowledge of the forest ecosystem in China. To this scope, ERS SAR data from 1995-1998 and Envisat ASAR data from 2005-2010 are used to compile a unique time series on forest cover and forest growing stock volume (GSV) information at regional and national scale for the last 15 years.

ERS-1/2 tandem coherence has been used to estimate forest GSV for Northeast and South China at 50 m resolution over 4.5 million km² (see figure). Validation against land cover products showed an agreement of more than 70 % in terms of forest/non-forest information. The accuracy of the GSV classes was 79% for a test site in the Changbai mountain range.

Envisat ASAR dual-pol backscatter from the Alternating Polarization (AP) Mode is used to determine forest and non-forest classes for 2005 and, consequently, changes with respect to the 1995 baseline. Recently, an improved approach for forest/non-forest classification has been developed, which proved to be automatic, robust and accurate (> 80%). The classification shown top of the page, shows an example of a classified ASAR image at the Russia-China border.

Continuous acquisitions of ASAR at kilometric resolution are the basis for mapping beyond 2005. The figure shows on the left-hand side a GSV map derived from hyper-temporal ASAR Global Mode backscatter data for Northeast China at 1 km resolution for the years 2007/2008. In terms of forest/non-forest information, the agreement with the National Land Cover Dataset of China shown on the right-hand side of the figure is 79%.

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

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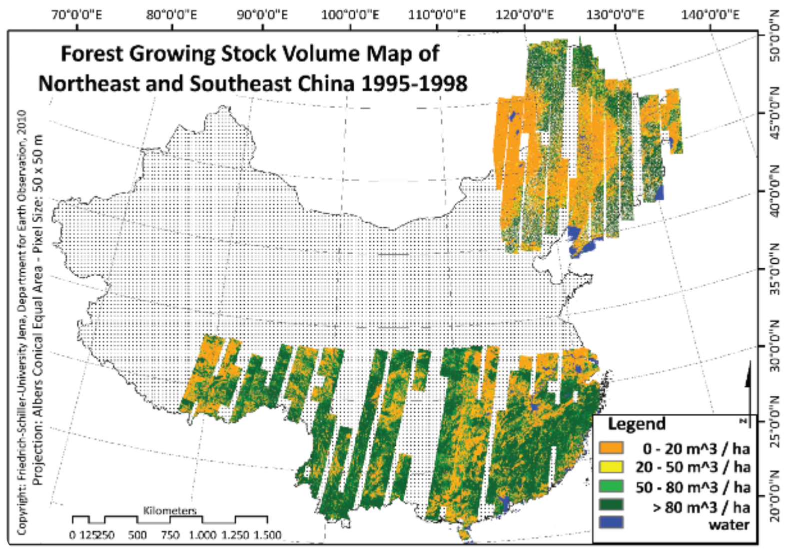
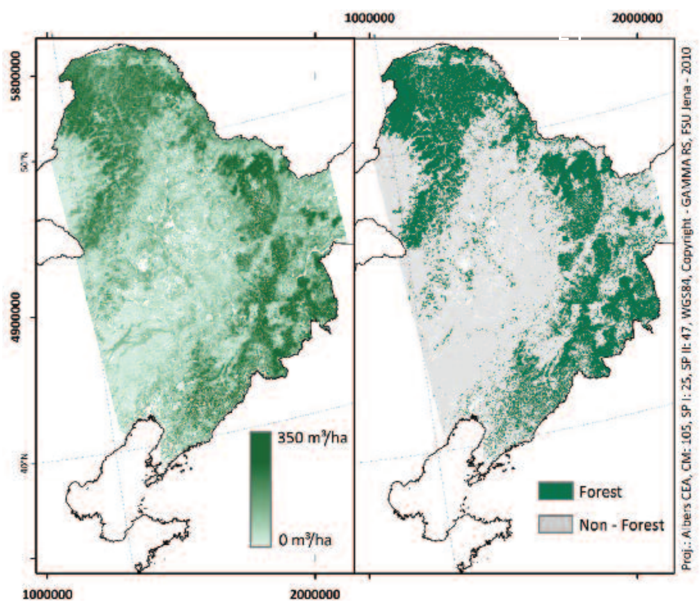
Prof. Li Zengyuan email: zengyuan.li@caf.ac.cn

Dr. Maurizio Santoro, Dr. Ling Feilong, Dr. Tian Xin, Prof. Chen Erxue, Dr. Pang Yong, Dr. Christian Thiel, Dr. Urs Wegmüller

Young scientists: Mr. Johannes Reiche, Mr. Reik Leiterer, Ms. Huang Yanping, Ms. Kerstin Traut



Forest GSV map of China based on ERS-1/2 tandem coherence data from 1995 to 1998. (Authors: Mr. Reik Leiterer and Mr. Johannes Reiche, FSU Jena)



Forest GSV map of Northeast China based on Envisat ASAR GM backscatter data from 2007/2008. (Authors: Dr. Maurizio Santoro, GAMMA, and Mr. Reik Leiterer, FSU)

SATELLITE MONITORING OF URBANIZATION IN CHINA FOR SUSTAINABLE DEVELOPMENT

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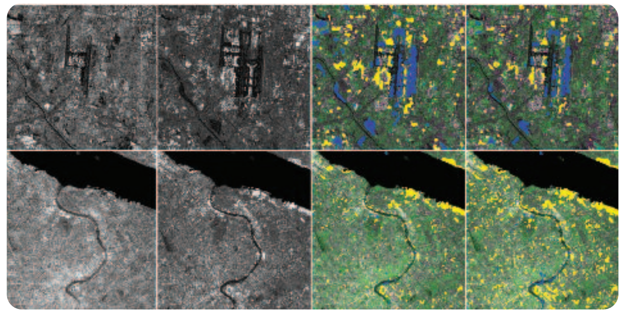
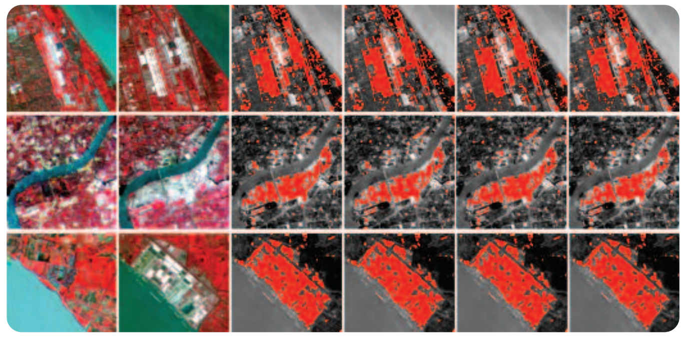
Prof. Paolo Gamba, Prof. Peijun Du

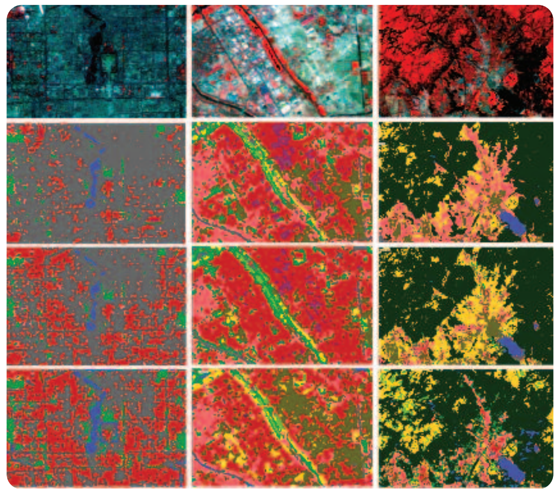
Young scientists: Alexander Jakob, Jan Haas, Osama A. Yousif, Massimiliano Aldrighi, Junshi Xia and Sicong Liu, Concong Li, Jie Wang, and Lei Wang.



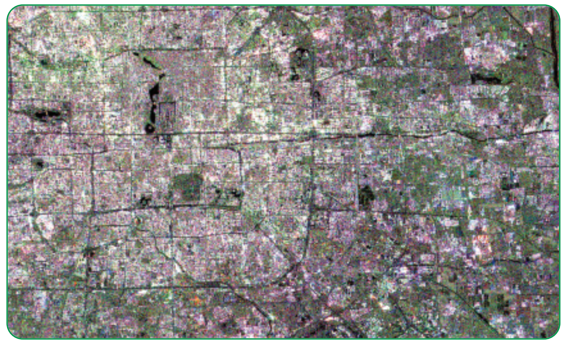
ERS-2 SAR (1998 & 1999) and ENVISAT ASAR (2008) images and the detected positive and negative changes in yellow and blue overlaid in a false color composite using (a) Log normal and (b) Generalized Gaussian; Top: Beijing International Airport, Bottom: Shanghai



Row1: Pudong International Airport. Row2: Expo Park. Row3: Jiangnan Shipyard. (a) 2002 (b) 2008 (c) FS (d) MV (e) DS (f) FI. False colour composite images and change detection results for different fusion strategy (detailed analysis on three image blocks



HJ-1B (row 1), MLC HJ-1B (row 2), MLC HJ-1B & ASAR (row 3) and Decision Tree (row 4). Column 1: City center. Column 2: Golf course and bare field. Column 3: Mountain areas, agriculture and build-up



ASAR composite image of Bejing: 2008-07-15 HH (R), 2008-07-31 VV (G), 2008-09-01 HH (B)

The overall objective of this research is to investigate space-borne SAR data, optical data and fusion of SAR and optical data for urbanization monitoring in China, and to assess the environmental impact of urbanization for sustainable urban development.

Using ENVISAT ASAR data from 2008 and ERS-2 SAR data from 1998 & 1999, several change detection algorithms including a minimum error thresholding algorithm were tested for detecting urban expansion. Based on CBERS data from 2002 and 2008, a change detection procedure by fusing change information obtained from multiple difference images was implemented. For urban land cover mapping, the synergistic effects of ASAR and HJ-1B data were investigated while fusion of EVNISAT ASAR, ALOS PALSAR and Terra SAR-X data are being evaluated. Local Indicators o Spatial Autocorrelation (LISA) indexes were developed to extract urban extent from ENVISAT ASAR data. Beijing-1, HJ-1, and CBERS were evaluated and compared for urban land cover classification.

The results show that the minimum error threshholding algorithm based on the modified ratio operator and log normal or Nakagami ratio of multitemporal SAR data was effective to detect urban growth. The method based on integration of multiple spectral change difference images was feasible for land cover change detection. Fusion of ENVISAT ASAR and HJ-1B multispectral data using decision tree classification proved to be advantageous for urban land cover mapping over ASAR or HJ-1B data alone. For comparison of multiple Chinese earth observation data for urban land use classification, the preliminary results showed that the BEIJING-1 data were superior to HJ-1B and CBERS data when they were classified based on spectral information.

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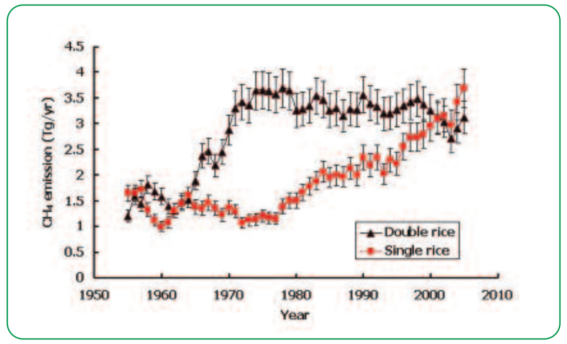

↑ CH_4 emission from Chinese rice paddies increased in general, but the growth rate has decreased since the mid 1970s, Source: Wang P, Huang Y, Zhang W, Adv. Clim. Change Res.,2009

THE ROLE OF CROPLANDS AND GRASSLANDS IN THE CARBON BUDGET OF CHINA

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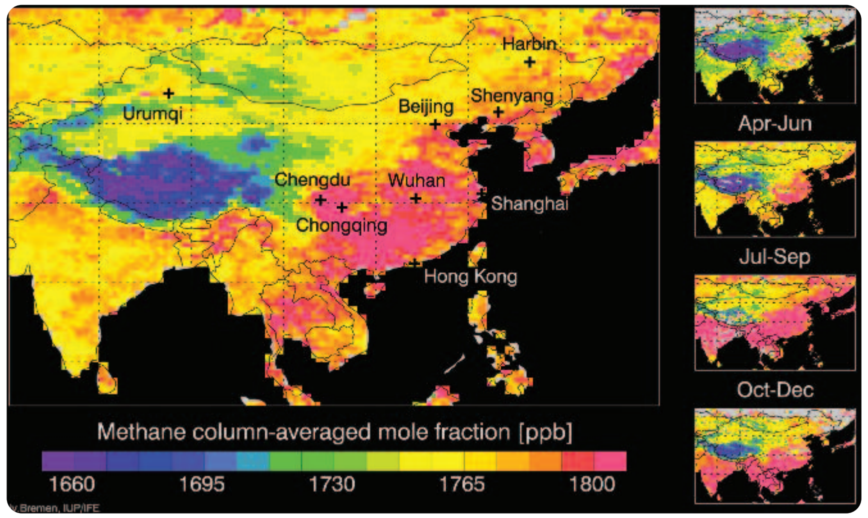
Prof. Tan Bingxiang, Prof. Shaun Quegan, Dr.Wang Xiaoqin, Dr.He Guojin, Dr.Alberte Bondeau, Dr. Michael Buchwitz

Recent studies suggest a net northern mid-latitude terrestrial carbon sink of 1–2.5 Pg C/yr distributed relatively evenly between North America and Eurasia but with considerable uncertainty in its magnitude, geographical distribution and causes. Much attention has been paid to the contribution of forest ecosystems to the C sink, while less attention has been paid to agriculture. However, it is becoming recognized that agricultural management can play an important role in mitigating climate change by reducing carbon losses from soils and methane production from rice cultivation. The overall objective of this project is to improve our knowledge of the role of croplands and grasslands in the carbon cycle of China by bringing models and satellite data together.

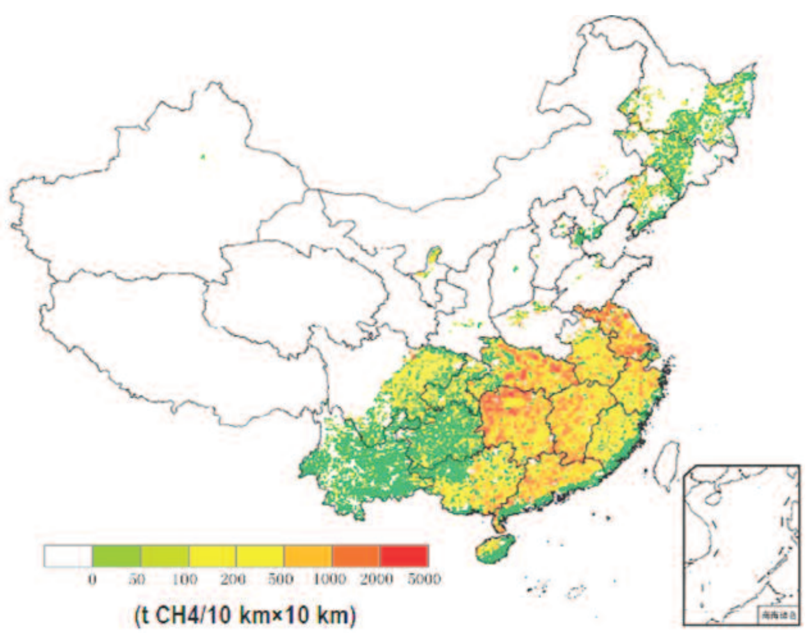
In the project, the proposed approach has two balanced components:

1) the observation methodology bringing together datasets relevant to calculations of C fluxes. The data are from various sources (e.g. meteorological, soil maps..), but the most important sources are information provided by EO. EO methods using ESA, China and ESA TPM data are developed or adapted to the environment under study;

2) modelling work that adapts and validates existing models to estimate C fluxes in the soil-vegetation-atmosphere system (see graph top of page). Preliminary comparison between EO and modelling output on the methane emissions over China appears promising (as shown page centre).



↑ Mean annual methane production over China from SCIAMACHY. Strong annual variation is seen with highest concentrations from April to December due to double rice cultivation



↑ Modeled rice paddy CH_4 production (mean from 2001 to 2005)

ID: 5341

DROUGHT MONITORING, PREDICTION AND ADAPTATION UNDER CLIMATIC CHANGES

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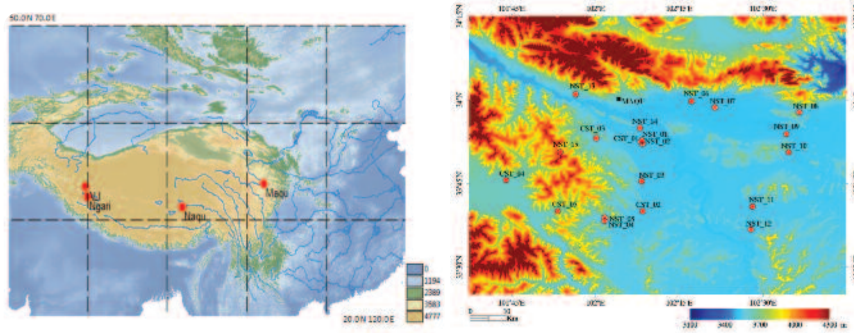
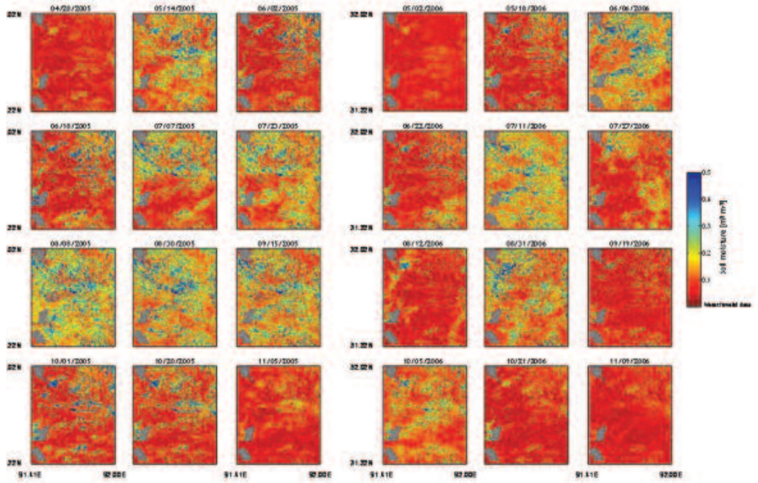
Team members: Ir. Wim Timmermans, MSc. Lichun Wang, Eng. Murat Ucer, Ir. Marcel van Helvoirt, Dr. Christiaan van der Tol, Dr. Suhyb Salama, Dr. Zoltan Vekerdy, Prof. W. Verhoef

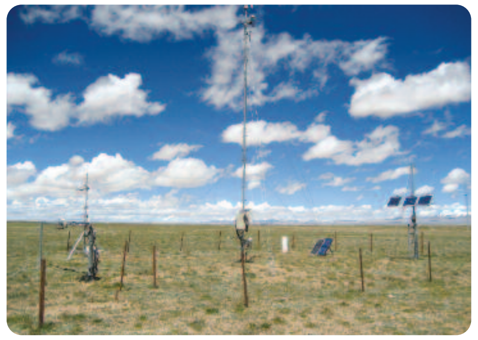
↑ Wind profiler at Mt. Everest station



↑ Tibetan Plateau Observatory of soil moisture and soil temperature (left); SRTM DEM of Maqu area and location of the 20 monitoring sites of the network (right)



↑ Series of soil moisture maps retrieved from ASAR WS mode images collected over the central part of the Tibetan Plateau during the 2005 and 2006 Monsoon seasons



↑ Soil moisture and weather monitoring stations on the Tibetan Plateau

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 project.

In detail 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 can be accessed in real time by decision-making agencies at different levels (national, provincial, local authorities) via Internet.

In addition to existing monitoring networks, three regional soil moisture and soil temperature observations sites have been established in Naqu, Maqu and Agri areas. Several peer reviewed papers have been published and three PhD theses have been completed as part of the project output.

ID: 5344

DRAGON 2 LAND & ENVIRONMENT PROJECTS

Field visit to check the vegetation types in the burned area of the test site

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

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Background:

The innovation of the research project ID 5334 is mostly to investigate the application of Pol-InSAR to deriving land cover and Earth Surface deformation information. This 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.

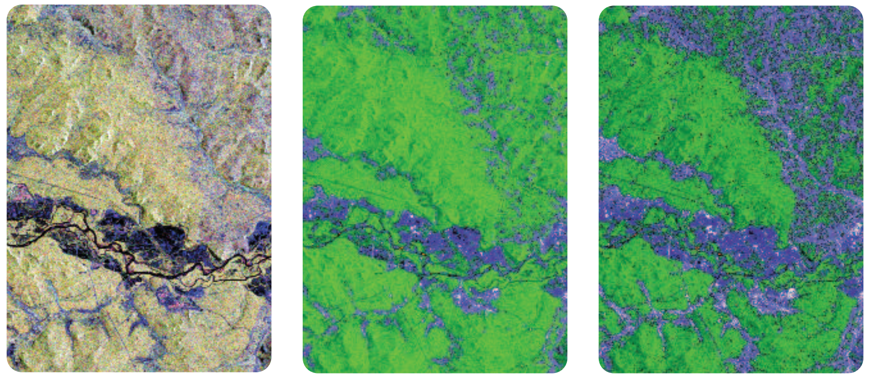
New POLSAR Land Cover Classification Test Site (Tahe, Heilongjiang Province)

A new test site in Northeast of China, Tahe County of Heilongjiang Province has been established where a wild forest fire occurred here in September, 2003, burning and damaging more than half of the study area. One quad-polarization ALOS PALSAR image (Sept. 7, 2008), and two quad-polarization Radarsat-2 SAR images (July 14 and Oct. 18, 2009) have been acquired for this study. One scene of SPOT5 image (2.5m pan and 10m multi-spectral) dated July 27, 2006 was also acquired. Ground truth data were surveyed during Sept., 2010 (test site conditions are shown in the top photograph).

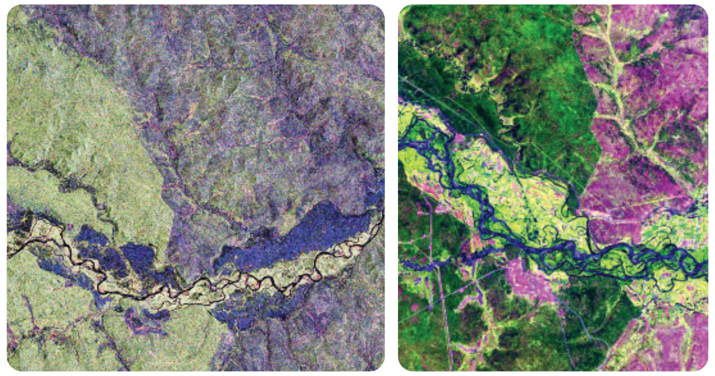
Latest Results:

Polarimetric Fire Scars Detection

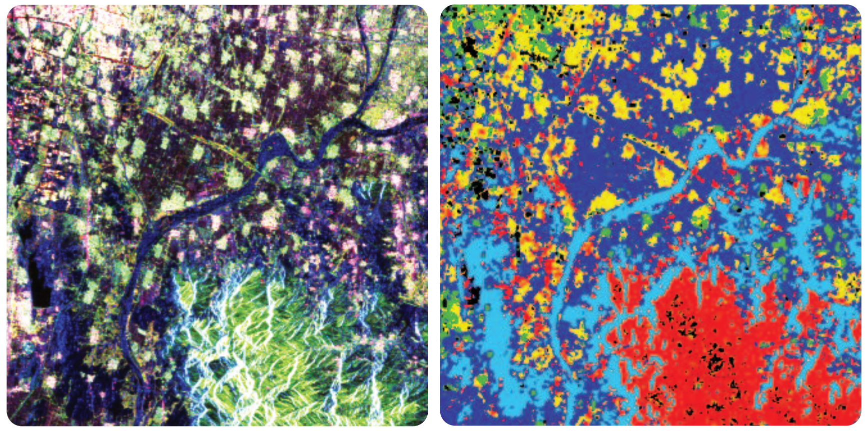
This project aims to monitor, detect and map fire scars from space borne fully polarimetric SAR data. If the reflection symmetry condition is satisfied after the polarimetric compensation processing, the classification accuracy is improved and the boundary between fire scar and forest area can be achieved automatically. This new and original application presents good classification results as can be seen in the top of the page figure.



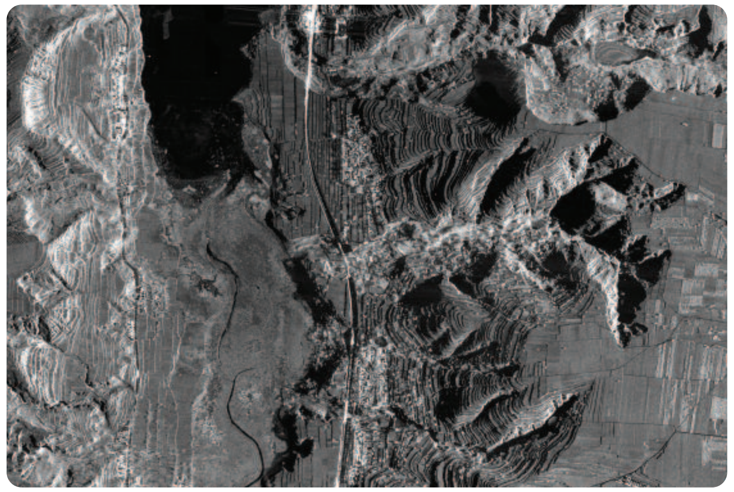
Forest scar mapping result before orientation angle compensation (middle) and that after compensation (right) using ALOS PALSAR Sept. 7, 2008 SAR data (left)



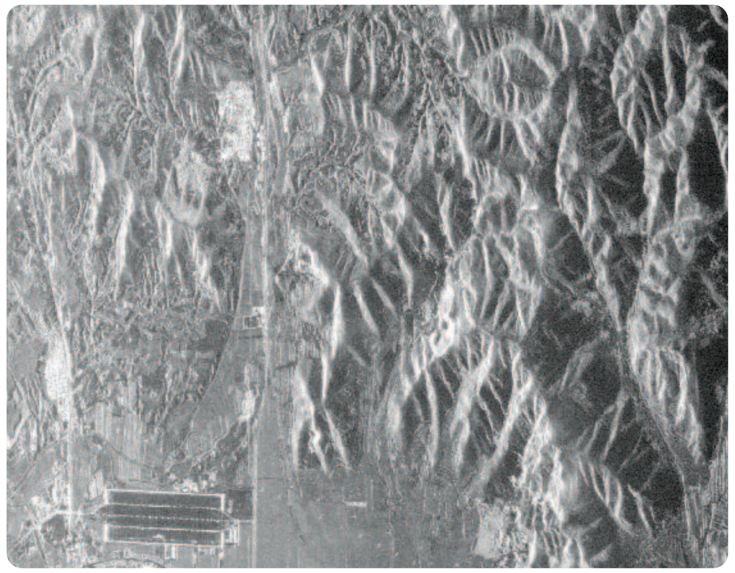
SPOT5 image (10m multi-spectral, R: SWIR band; G: NIR band; B: Red band) dated July 27, 2006 (right); Radarsat-2 quad-polarization data imaged 18 Oct. 2009 (left) (3looks in azimuth, 2 looks in range)



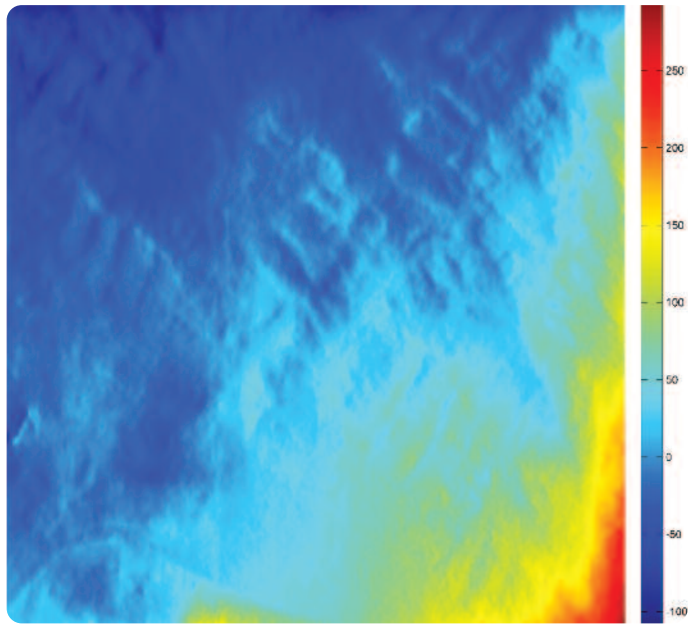
ALOS PALSAR – Tain test site (China) Pauli color coding (left) and proposed classifier based on the Geometric Perturbation Filter (right)



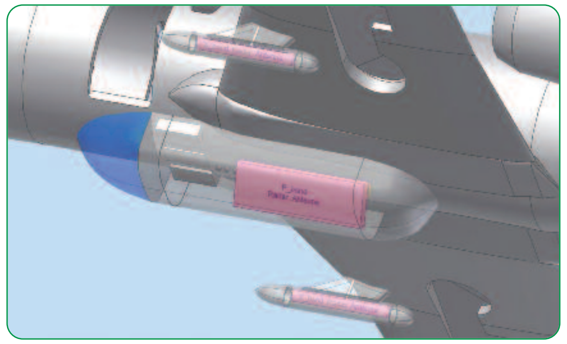
IECAS-X/P-SAR system X-Band high resolution SAR image



Span image of quad-polarization data acquired by IECAS P-band SAR system



DEM extracted from IECAS P-band SAR system acquired polarimetric SAR data



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

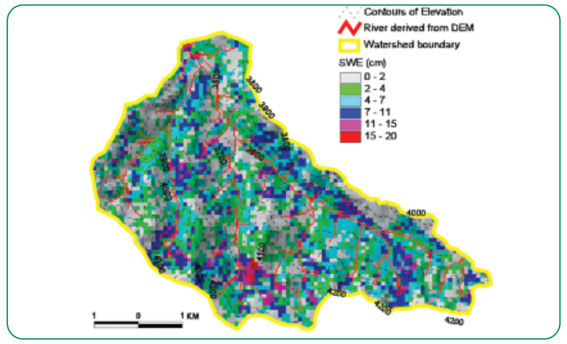
The Geometric Perturbation Filter

This project aims to develop new coherence based filtering and classification techniques for application to polarimetric (POLSAR) and polarimetric Interferometric (POLInSAR) space-borne data for land applications. This will be the first time such techniques have been applied to EO data and several innovative developments are foreseen. Basically it employs a projection of the complex [S] matrix data onto predetermined reference states and then estimates the coherence by perturbation of the states about this reference. Classification is then achieved performing several detections of the typologies of areas to discriminate and deciding for the maximum among the obtained detection masks. Validation against L-band full polarimetric ALOS-PALSAR data shows good discrimination capability. Specifically, the improvement provided by the new technique seems to be the independence on the total backscattered power from the target (shown bottom of page). This is particularly advantageous on mountainous areas where geometrical effects can introduce a modulation of the total power leading to misclassifications.

Earth surface deformation monitoring and DEM extraction

The proposed research activities conducted in this topic aim at developing a general methodology for the Earth Surface Deformation Monitoring and DEM extraction and to investigate the potential application capabilities (Western China mapping) of the advanced PolInSAR airborne dual-frequency (X/P) SAR system, developed by IECAS under project supported by MOST. First results of the P-band polarimetrc SAR system's image acquisition campaign and DEM retrieval are illustrated.

ID: 5322



↑ Snow water equivalent retrieved by the airborne radiometer observations in the Binggou watershed

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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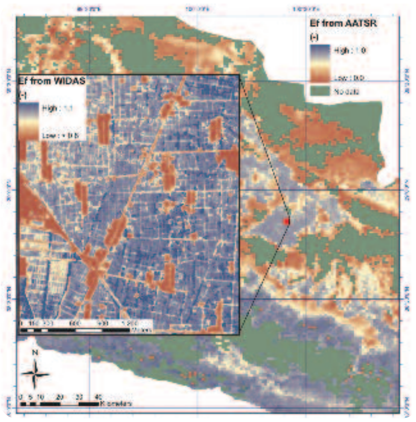
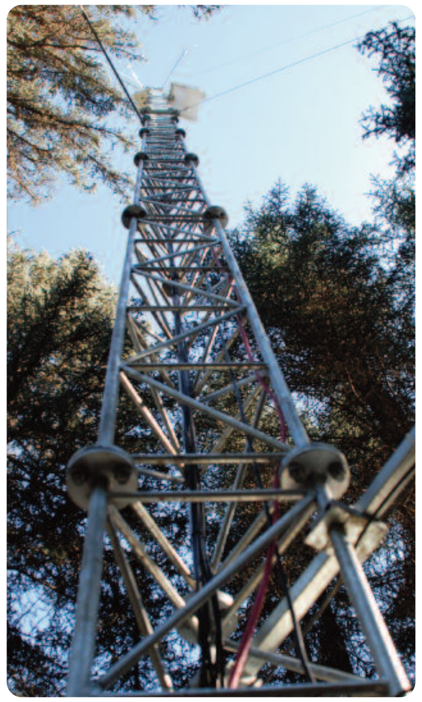
As an interdisciplinary, intensive, coordinated and multi-scale experiment, the data obtained from the field campaigns in WATER, both acquired from airborne and satellite-borne remote sensing, and observed on the ground, having been used to generate a high-resolution and spatiotemporally consistent data set for the development of integrated watershed sciences. Additionally, substantial results have been achieved: **1)** Snow water equivalent (SWE) and snow depth (SD) were derived using K and Ka-bands microwave radiometers. An empirical method was used to derive SD and SWE. Snow albedo was extracted by Hyperion image. **2)** Soil freeze/thaw status was captured by the airborne/track-mounted radiometer observations. Ground penetrating radar measurements were carried out to obtain the heterogeneities of soil moisture at the field scale and frozen/thaw penetration depth. **3)** A two-layer surface energy balance parameterization scheme was proposed for the estimation of surface heat fluxes using thermal infrared (TIR) data over sparsely vegetated surface. **4)** Imaging LIDAR measurements were used to estimate the aerodynamic roughness length and a DSM and a DEM from multiple flight passes over an heterogeneous irrigation area, with a ground resolution of 1 m. **5)** A two-step retrieval scheme was proposed to acquire surface roughness and soil moisture based solely on multi-angle ASAR data, while airborne multi-angular TIR images were also attempted to retrieve soil moisture. **6)** Based on the hybrid canopy reflectance model, a new hyperspectral directional second derivative method (DSD) was proposed to estimate LAI accurately through analyzing the canopy anisotropy.



↑ Maps of evaporative fraction obtained from AATSR and WiDAS observations


↑ Cold region – Tower with Large Aperture Scintillometer


↑ Desert region – Measurement of sand surface parameters


↑ Forest region - observation tower for measurement of tree canopies and parameters


↑ Crop region – recording and collecting plant parameter data

ID: 5279

IMPROVING CROP MONITORING WITH ENVISAT DATA

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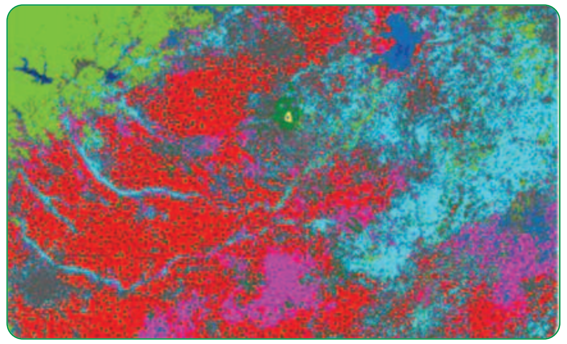
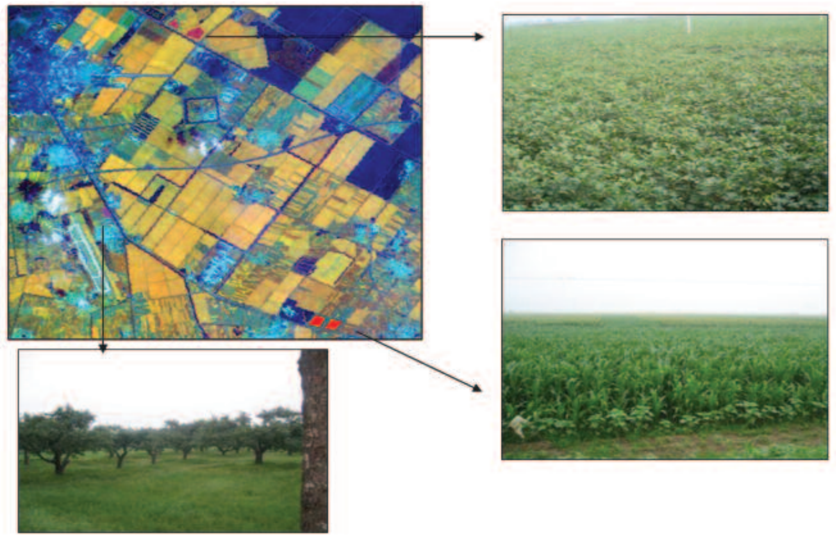
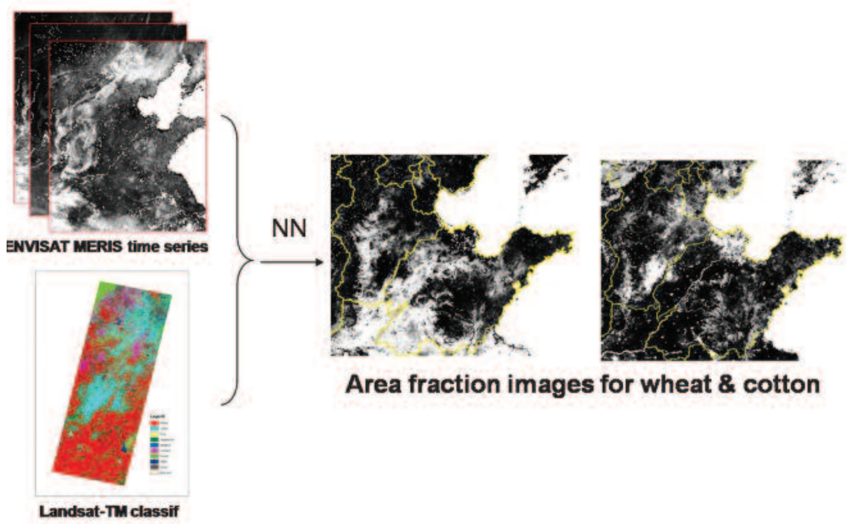
Dr. Qinghan Dong	email: qinghan.dong@vito.be


↑ Crop land classification using the one AWiFS and two HJ-1 registrations as input.

A reliable and cost-efficient approach for crop area estimation has been developed by using hard and soft image classification techniques. The method is applied on the North China Plain. It takes advantage of remote sensing techniques in combination with ground surveys. Classical high resolution imagery such as LANDSAT TM (30m resolution) allows to distinguish detailed spatial cropping systems. However, because of their low temporal resolution and limited coverage per scene, these images are not suitable for mapping large areas. In recent years, new wide-swath EO-systems have been launched (e.g. IRS-AWIFS from India or HJ-1 from China) covering areas of more than 600x600 km and combining high spatial resolution with frequent coverage (2-3 days) and as such offering new opportunities for crop mapping of large areas. Coarse resolution sensors such as NOAA-AVHRR, SPOT-VEGETATION, EOS-MODIS or ENVISAT-MERIS also provide near-daily global coverage, but their low spatial resolution pixels (250m to 1km) mostly cover several fields with different land-use classes or crops. The sub-pixel classification approach has been developed to overcome this limitation. This approach allows estimating the area fractions covered by each crop, but not the exact location of crop fields within a (coarse) pixel. It can be easily implemented for operational use, even at real-time basis, provided that ground truth information is available and reliable.

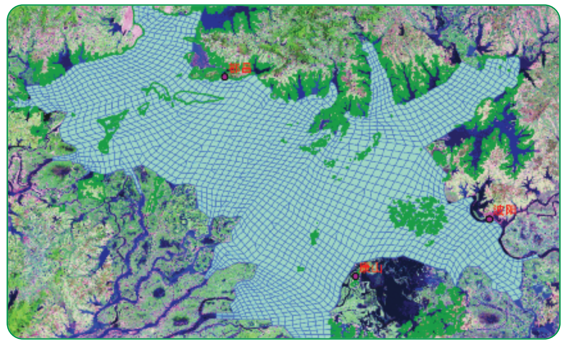

↑ Ground in-situ data collection by field survey



↑ The fuzzy classification led to estimated area fraction images (AFI's) for winter wheat (left) and cotton (right)

ID: 5281

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



Flow field simulation for the Poyang Lake

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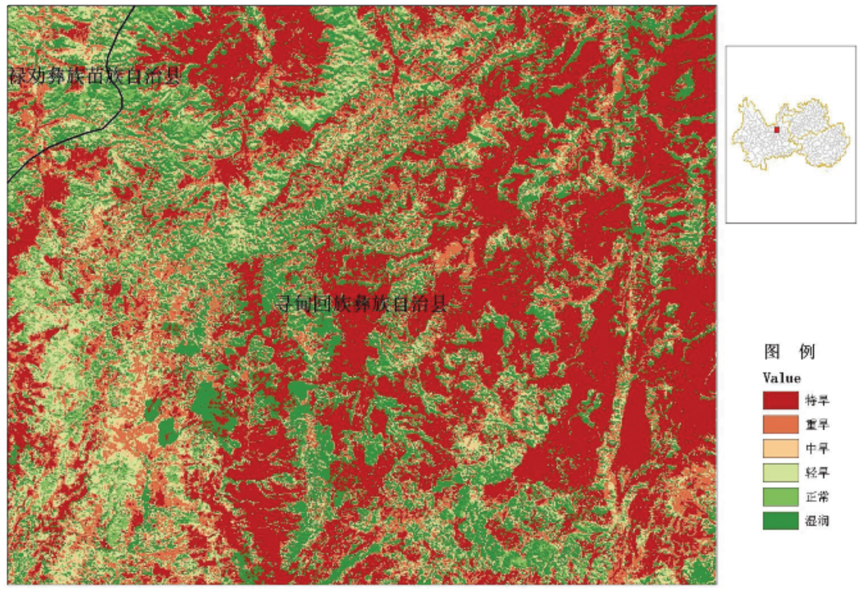
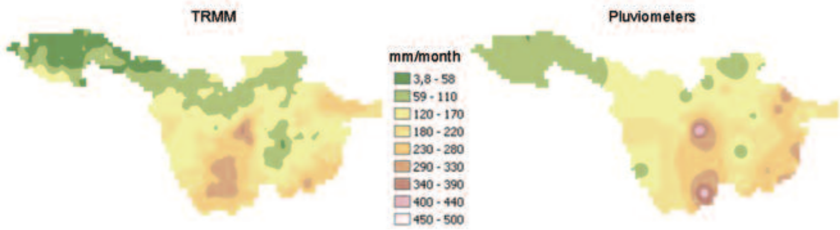
Jinfeng Xin, Jianli Zhang, Xingnan Zhang, Xiaoxiang Zhang, Chiara Corbari, Bob Su, Giovanni Ravazzani, Massimo Menenti, Josè A. Sobrino, Guido D'Urso, Wolfgang Wagner

The main objective of the project is to assess water resources availability under human and natural pressure on the Yangtze River basin combining remote sensing data with distributed hydrological models. Satellite images and ground measurements have been analyse in order to provide the necessary data for input to the model or for model validation. Advanced Along Track Scanning Radiometer (AATSR) is used for land surface temperature estimate, while MEdium Resolution Imaging Spectrometer Instrument (MERIS) for snow cover area computation. Digital elevation model (DEM) has been retrieved from Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER). Maps of daily precipitation have been computed from the Tropical Rainfall Measuring Mission (TRMM). Ground data of precipitation, air temperature, shortwave radiation and wind velocity have been spatially distributed according to basin topography and a GIS system for all the database has been implemented. The distributed hydrological model, FEST-EWB (Flash-flood Event-based Spatially-distributed rainfall-runoff Transformation-Energy Water Balance) and the Xinanjiang Model, which compute all the main components of water balance, have been configured for Yangtze River basin modelling simulation.
In this framework other specific results are: drought monitoring by HJ data, hydraulic modelling for low-middle reach of Changjiang River and flow field simulations for Poyang Lake.

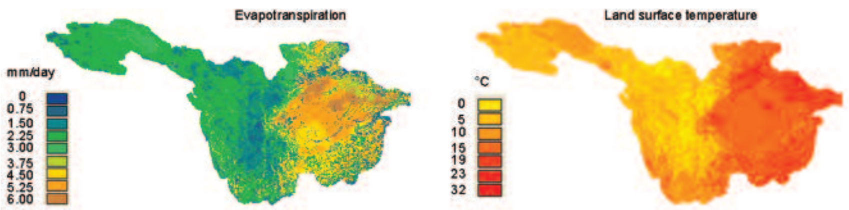
At the present stage of research, these data are the basis for distributed model validation and future data assimilation of land surface temperature to improve evapotranspiration and water availability estimates. Moreover SMOS data of soil moisture will be used as a comparison of model outputs.



Drought monitoring by HJ data in 2011



Precipitation mapsfor July 2004 from TRMM and ground pluviometers at 0.25° of spatialresolution for the Upper Yangtze river basin



Land surface temperature and latent heat flux from hydrological model simulation at 0.045° of spatial resolution for the Upper Yangtze river basin for 8 August 2004

ID: 5295

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

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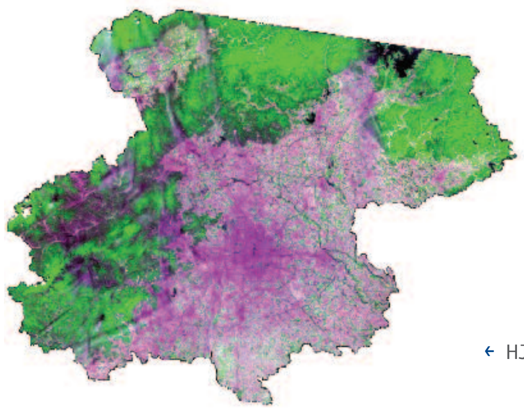
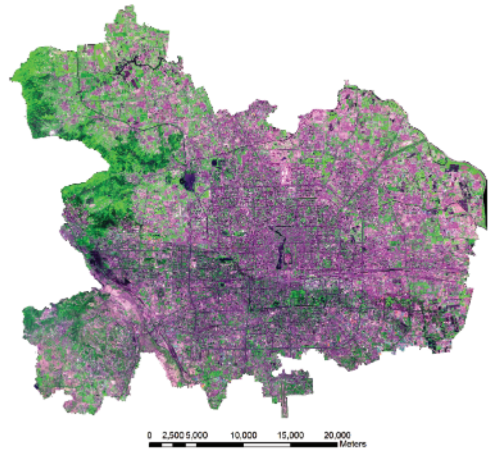
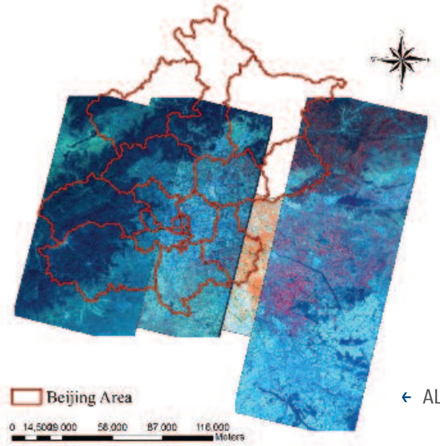
Field-sampling in 2009 winter in Beijing city



HJ-1 obtained on 13/08/2009



SPOT5 obtained on 19/05/2007



ALOS images

This Project aimed at the needs of making use of earth observation technology to support major sports events. Firstly, two methods were applied to retrieve PM10.

The first one: The distribution of aerosol optical depth (AOD) is studied on an urban-scale. The AOD data is obtained from 30m resolution Landsat Thematic Mapper (TM) imageries. This method is suitable for city imagery under a variety of atmospheric and surface conditions. The results show that the AOD distribution over Beijing could be retrieved by this method. The urban scale PM10 distribution matches the AOD distribution retrieved by TM imagery quite wel1.

The second one: This study built a model with DVI, which is computed by near-infrared and red bands of SPOT-5 image, and observed concentration of PM10 to retrieve concentration of PM10 in SPOT-5 image of Beijing urban acquired in 2007. Spatial distribution trends of PM10 are basically identical between retrieved result and observed data.

The relationships between the atmospheric concentrations of several main contaminations, such as SO_2, NO_2 and PM10, and several meteorological elements, such as wind speed, temperature and precipitation were analyzed. The non-linear regressive equations were developed to describe the relationships. The spatial and temporal distribution pattern of thermal environment in Beijing capital region has been investigated using meteorological data, multi-source remote sensing data (Landsat, ALOS et al.). Effects of different land use types, vegetation coverage and the typical urban landscape on the IPM environment.

ID: 5345

Chinese and German experts working on measurement installations on site

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

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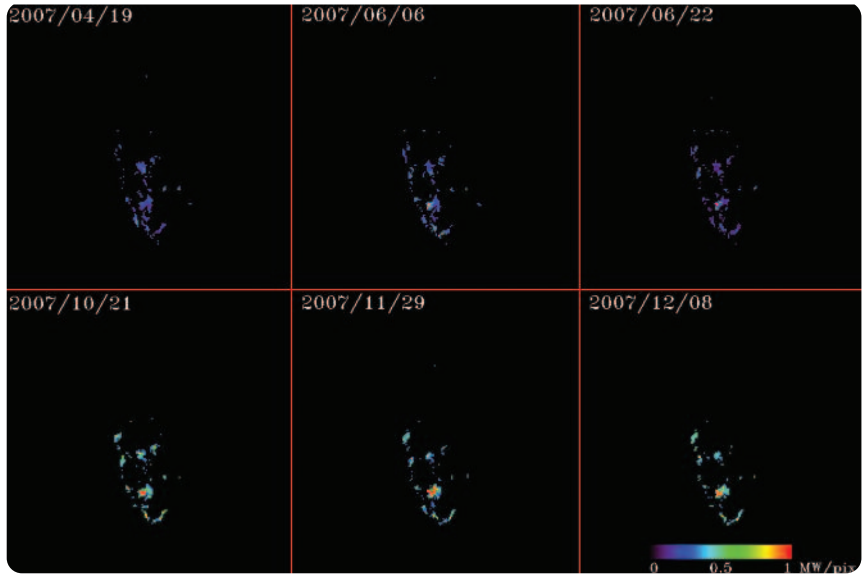
Uncontrolled coal seam fires are an environmental and economic problem of international magnitude. The annual Chinese coal production, which is about approx. 2.4 Mt per year, faces a problem of numerous uncontrolled burning coal fires mostly located in the northern Chinese coal belt. At present it is expected that 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 where small-scale mining takes place. Different areas that are heavily affected by severe coal fires since years are currently under investigation.

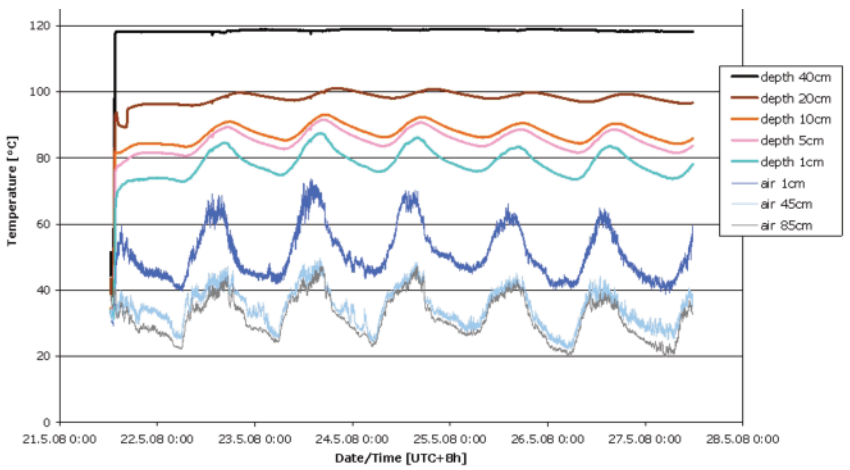
The determination of coal fire radiative energy (CFRE) has been introduced recently as a new remote sensing technique to support quantification analysis of the energy budget released by different types of coal fires. Ongoing research focuses on multi-sensor and multi-temporal data analysis to contribute to the estimation of coal fire related CO_2 greenhouse gas emissions. This energy approach highly depends on accurate estimation of near surface temperatures.

An energy balance model of the topographic surface was developed consisting of three linked parts, which are (i) attenuation of solar irradiation in the atmosphere, (ii) energy conversion at the surface and (iii) dissemination of temperature in the sub-surface. Reference measurements have been made on different fires zone by using temperature logging systems to ensure permanent measurements. Based on these measurements, time series analyses using ASTER night time images have been done, currently investigations focus on HJ-1B- data.

These developments aim to establish a methodology to extinguish coal fires within the framework of CDM activities within the Kyoto-Protocol and beyond.



Coal Fire Radiative Energy (CFRE) distribution for the area under investigation near Wuda (Inner Mongolia Autonomous Region) based on ASTER night time images



Temperature measurements to link surface-subsurface temperatures, taking climate influences into account

ID: 5264

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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Carlos Uribe, Tiphanie Marie, Prof. Andrew K. Skidmore, Dr Yousif Hussin, Dr. Fred de Boer, Daillet-Rochette Sylviane, Jean-François Crétaux, Muriel Bergé-Nguyen, Mognard Nelly, Dr. Nicolas Baghdadi, Jeb Barzen, Mike Engels, James Burnham, Dr. Li Fengshan, Su Liying, Dr. Xue Yong, Prof. Huang Shifeng, Prof. Lai Xijun, Li Suju, Dr. Wang Xingling, Prof. Li Xiufen, Prof. Chen Xiaoling, Dr Wu Guofeng, Prof. Cao Chunxiang, Prof. Li Jing, Prof. Tang

Field survey in 2009 on Poyang lake with NIGLAS (Nanjing) and LEGOS, SERTIT team members

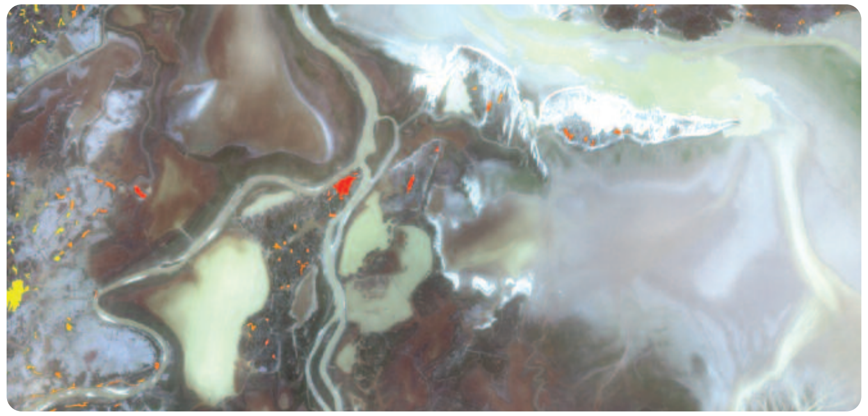
Here in reported are the results of the continuing research work on the Poyang Lake area, namely: Epidemiology and mapping of areas prone to schistosomiasis disease transmission; Lake water level retrieval from space (with radar altimeters); Lake surface variations captured by DEIMOS.

Using multi-sensor EO data, it has been possible to provide an analysis of the areas prone to schistosomiasis disease transmission The figure shown has been generated as using ASAR & MERIS and Beijing-1 imagery (water variation), Beijing-1 imagery for detailed vegetation mapping, fused ALOS AVNIR and PRISM for settlement mapping.

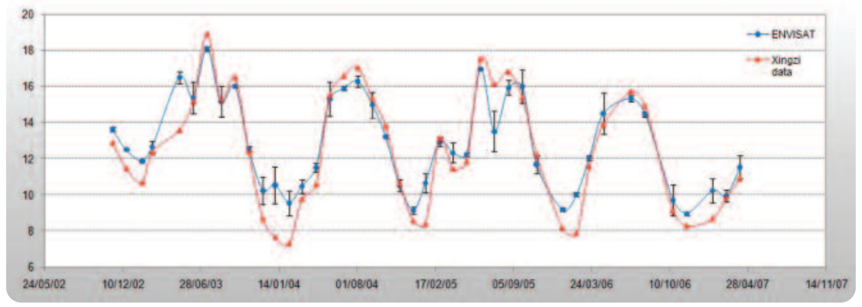
In term of rapid mapping, the 2010 would be considered as a milestone as both Dongting and Poyang Lakes and Songhua River in the Jilin province experienced extreme flood events. With ESA support, from July to September 2010, ENVISAT data were processed in a NRT. Data were downloaded and processed in hours after acquisition. Maps showing flood extents and a brief situation report were sent to authorities as well as to project partners.

Water height monitoring was realized over both Lakes and the several locations on the Yangtze River using the RA-2 and Topex altimeters. The coherencies between space borne water height and gauge stations are very high (see figure) even during periods of low water levels.

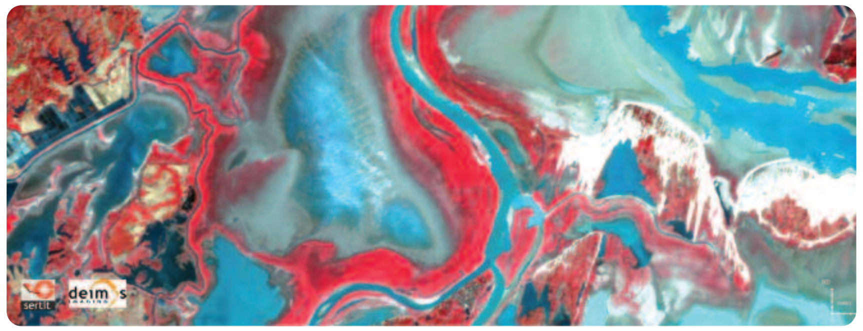
The project team has been granted access to new missions' EO data, such as Deimos and Cosmo Skymed, see Deimos image provided. These data will enrich the already existing database and also allows continuity of the monitoring as well as further improving temporal revisit capability using EO sensors.



Villages in Poyang Lake area threatened with schistosomiasis transmission, from multi-sensor optical and SAR imagery: Risk levels - red (very high) to yellow (low) (Credits SERTIT)



Changes in Poyang Lake water levels from gauge stations and Envisat RA-2 measurements



Deimos RGB composite of the Poyang Lake nature reserve - Courtesy Deimos 2010

EARLY WARNING AND DAMAGE ASSESSMENT FOR FOREST FIRE

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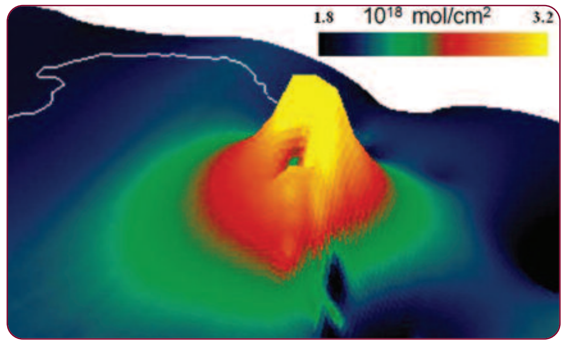
Dr. Abel Calle, Mr David de la Fuente, Dr. Federico González Alonso, Dr. Deng Guang, Prof. Li Guoqing, Prof. Cai Huide, Prof. Johann G. Goldammer, Dr. Julia Sanz, Dr. Liu Qingwang, Dr. Qin Xianlin, Prof. Zhang Xu, Prof. Li Zengyuan, Dr. Huang Zhenchun

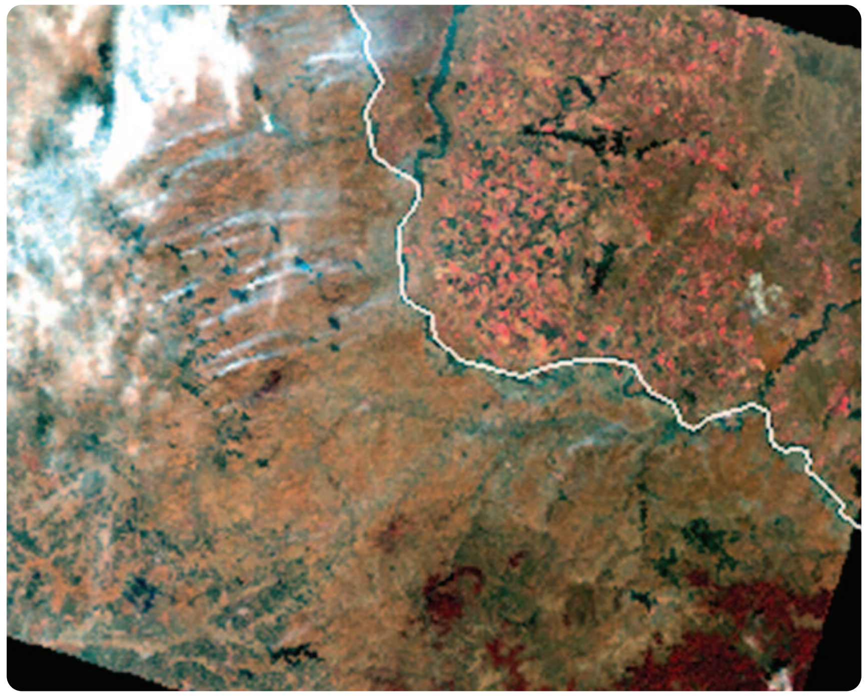


Interpolation of carbon monoxide coming from emissions of large forest fires in the province of Heilongjiang, near of the Russian border

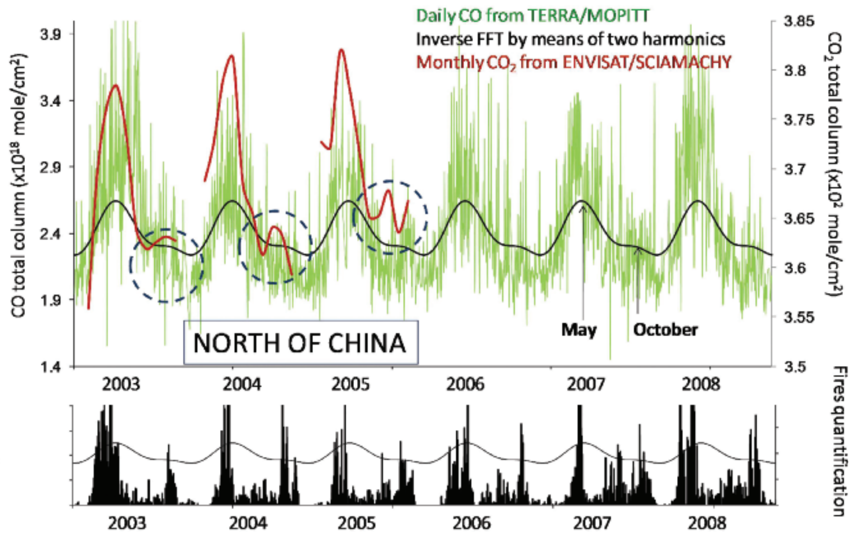
Concerning CO_2 contribution in the atmosphere, ENVISAT-SCIAMACHY was used in order to make a seasonal analysis. Two regions in China were selected according to criteria of fire occurrence. First region is the north-east of China, including the provinces of Neimenggu and Heilongjiang; this area is characterized by fire occurrence, short distance to Russian fires and low population density. Second region is South-eastern China.

Fire detections algorithm applied to ENVISAT-AATSR images (the image shows on active fire), together with CO total column measurements were used to determine the exact CO-CO_2 origin. On the Heilongjiang province the total emissions coming from China fires were of 29.8 Kilotons of CO and fires from Russia were of 37.7 Kilotons. A strong impact of Russian emission over China can be observed (see the hot-spot shown at the top of the page).

Daily CO total column data from MOPITT shows strong fluctuations, but FFT analysis shows the presence of two maximum values along the year: first maximum appears at the final of winter (fires and human heating activities) and the second maximum is due to forest fires occurrence (the trends can be observed in the graphs).



Large forest fires detected by ENVISAT-AATSR sensor. Image shows the smoke plume, at the Heilongjiang province, near of the Russian border. Smoke plumes are enhanced by using RGB composition (RGB: 0.87, 0.67, 0.55 μm spectral bands)



Evolution of CO (data from TERRA-MOPITT) and CO_2 (from ENVISAT-SCIAMACHY) together with forest fires occurrence at Heilongjiang and Neimenggu provinces

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

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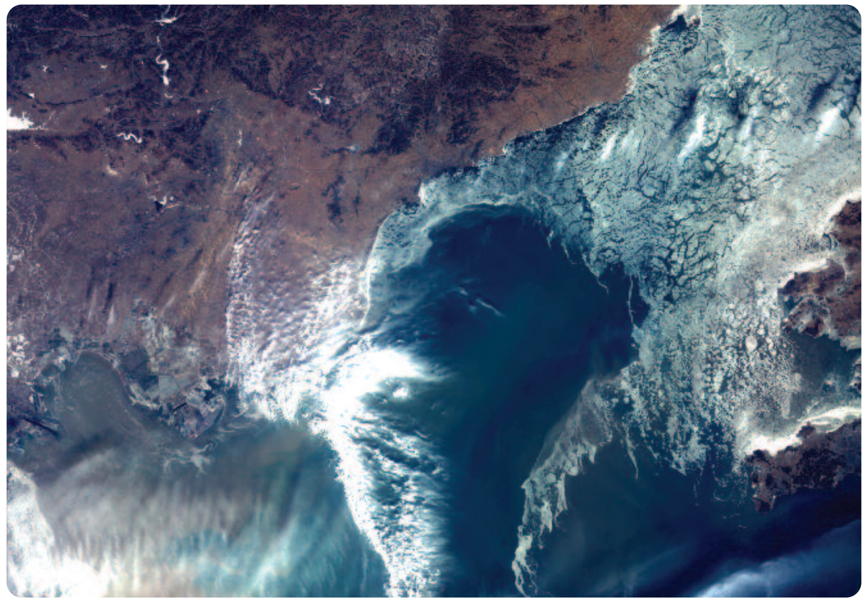
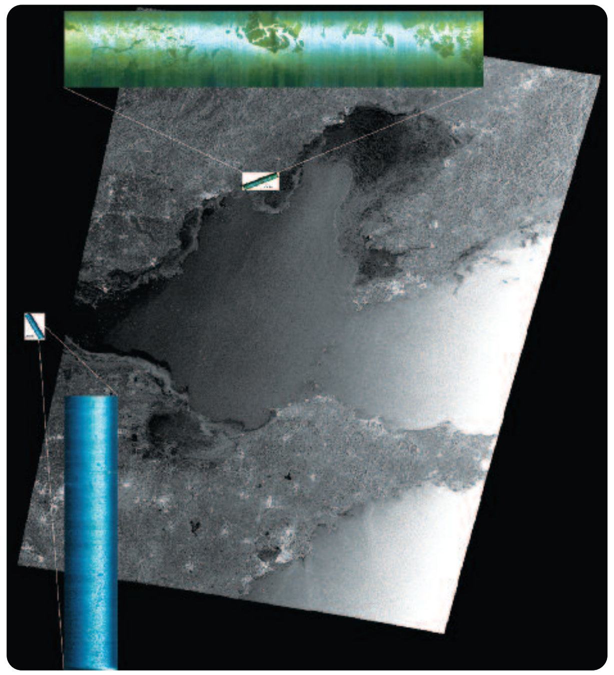
Examples of sea ice, Xiaoliaodong Bay, Bohai Sea - grey-white ice (top left), pancake ice (top right), snow-covered ice (bottom left), pancake ice (bottom right)



HJ-1B CCD image 15/02/2010, R(0.63-0.69μm), G(0.52-0.60μm), B(0.43-0.52μm)



ENVISAT ASAR (VV) 15/01/2010, with airborne SAR sea ice imagery acquired on 08 & 09/02/2010 superimposed

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 photo. The ice parameters measured included ice thickness, density, temperature as well as surface and subsurface water temperature, surface spectral reflectance and backscatter. During February 8 to 9, 2010, airborne SAR sea ice detection experiments were carried out in Bohai Sea (as shown by the imagery). Acquisition of EO data has included Envisat ASAR and HJ-1B 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.

ID: 5297

Group photo taken in Wuhan during the Chinese visit of the Italian young scientist Guido Gatti (first line, third from the left, beside prof Liao Mingsheng).

TOPOGRAPHIC MEASUREMENT

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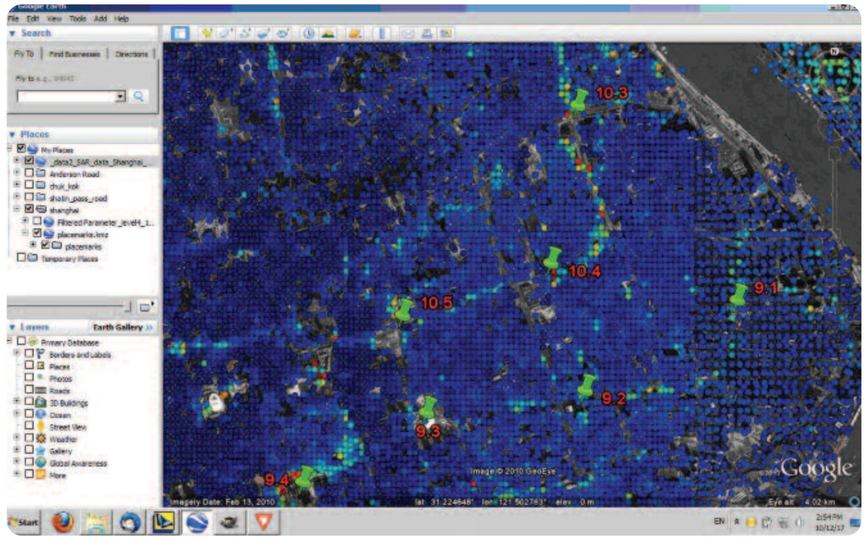
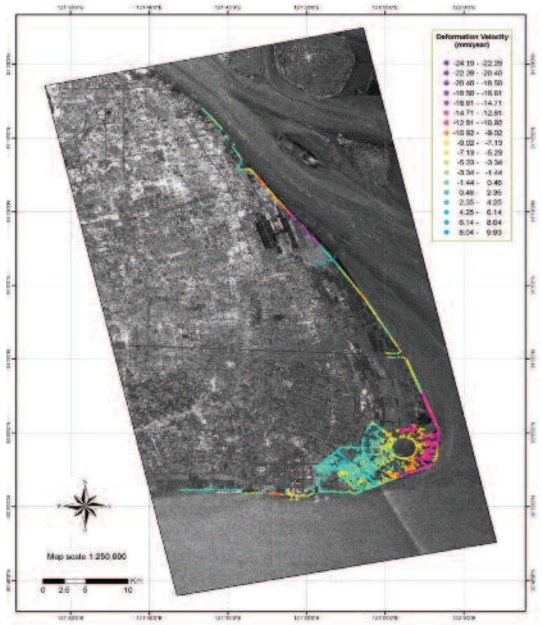
The group "topographic mapping" is currently active in analyzing several geological parameters over the Chinese territory by means of Synthetic Aperture Radar Interferometry. The data that have been processed up to now have been acquired by ESA satellites as ERS and Envisat, by the Japanese ALOS, but also by the new X-band sensors as the German TerraSAR-X and the Italian Cosmo SkyMed. Two examples of analysis carried out in Tibet (with Envisat data) and in Shanghai (Cosmo data) are shown in the reported pictures. The SARPROZ software, implementing various SAR and InSAR techniques (among which Permanent Scattereres -PS- and Quasi-PS), has been used in the analysis. In Tibet, corner reflectors deployed in 2008 have been automatically detected by SARPROZ, and their relative displacement time series reveal slight seasonal ground motion. In Shanghai, newly excavated subway tunnels are detected through the consequent surface deformation, with impressive details. Besides, researchers in Wuhan detected coastal deformation in Shanghai through the analysis of the seawall along the Yangtze border of its delta.

The group team, composed by researchers from Italy and China, is also very active in academic exchanges. In the pictures, Mr Guido Gatti and Dr Wang Teng during a visit in Wuhan university, with Prof Liao Mingsheng.



Average deformation trend of urban targets in Shanghai as detected by processing Cosmo SkyMed data with SARPROZ (red -20 mm/year, blue no motion). Placemarks are in correspondence of stations of two new metro lines. Strips of surface subsidence (in yellow-red color) highlight the subway paths



Subsidence distribution in coastal line area in Shanghai, as detected by researchers in Wuhan

ID: 5343

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

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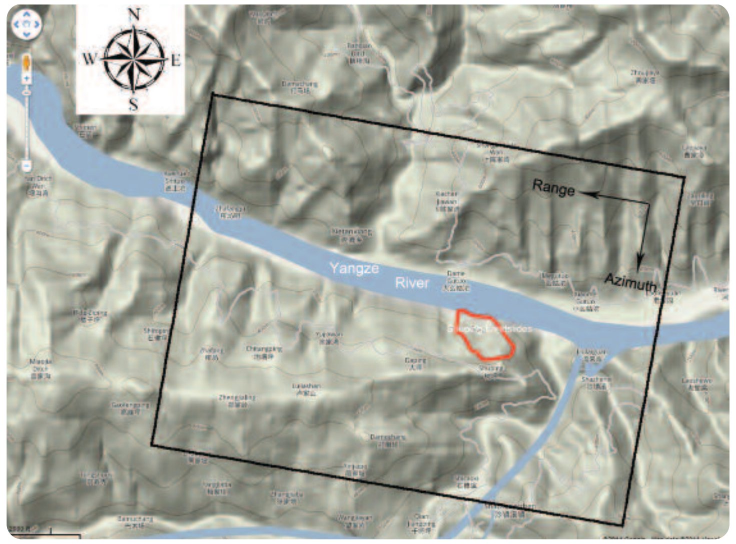
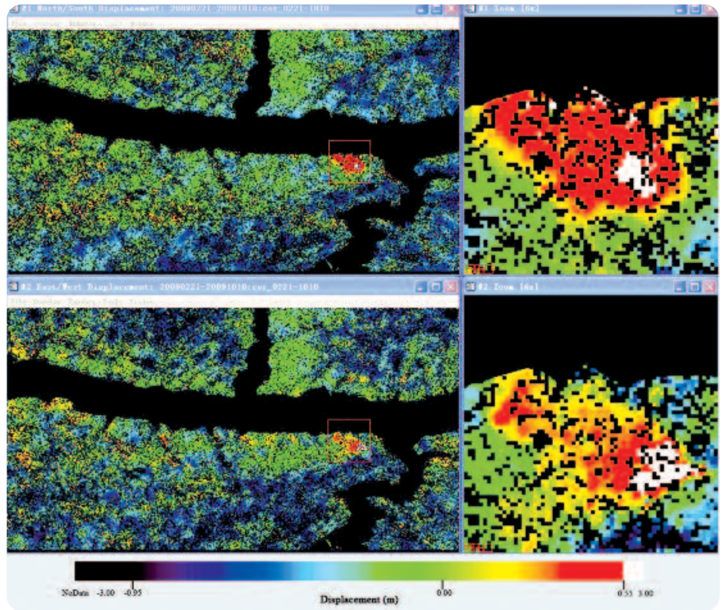
Cracks in the northward direction visible on the road above the landslide



A shaded relief of the DEM of the region of the interest (taken from Google). The black rectangle shows the approximate location of the TSX data. The slide body indicated by our result is approximately delineated by the red polygon



Displacement fields derived from the phase correlation of 2009-02-21 and 2009-10-10 showing the total deformation. The upper portion shows the northward (positive) displacement components in the azimuth direction with the right image showing a zoom-in of the inset red rectangle in the left one. Similarly, the lower figure shows the right-left (i.e. eastward) displacement components in the range direction. A point represents an area of approximately 15m*15m

The Three Gorges Dam was the largest construction project on the planet. It is believed that the weight of the additional water caused by the dam is likely to lead to an increasing frequency of landslides. In theory, land slippage prior to landslides should be observable using sub-pixel correlation of SAR amplitude images. The launch of the German TerraSAR-X (TSX), with high resolution (1-3m) and better wavelength stability (X-band), offers an unique opportunity to study this region since the dam was completed in 2009. Work in the Department of Geophysics at Peking University in collaboration with UCL-MSSL is focused on measurements of landslides in the Shuping area along the south riverbank of the Yangtze River close to the dam location. TerraSAR-X amplitude images have been employed using sub-pixel phase correlation to map the deformation fields of the landslides which occurred in 2009 and reveal their temporal evolution. The location of the TSX scene with the area highlighted is shown in the top figure, whilst the displacement field measured over a 231 day time period (21 11-day repeats) showing the significant displacements (>35cm) is shown in the lower Figure. The top of the page photograph showns the cracks in the road as a result of this displacement and which were also observed during fieldwork in the region that was undertaken on 23 October 2009.

ID: 5305

DRAGON 2 TOPOGRAPHIC MAPPING PROJECTS

CRUSTAL DEFORMATION IN CHINA ASSOCIATED WITH THE SEISMIC CYCLE OF MAJOR FAULTS OR RELATED TO LAKE LOADING ON THE LITHOSPHERE: MEASUREMENTS BY INSAR

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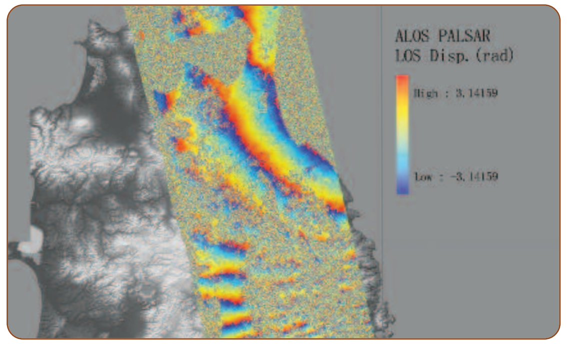
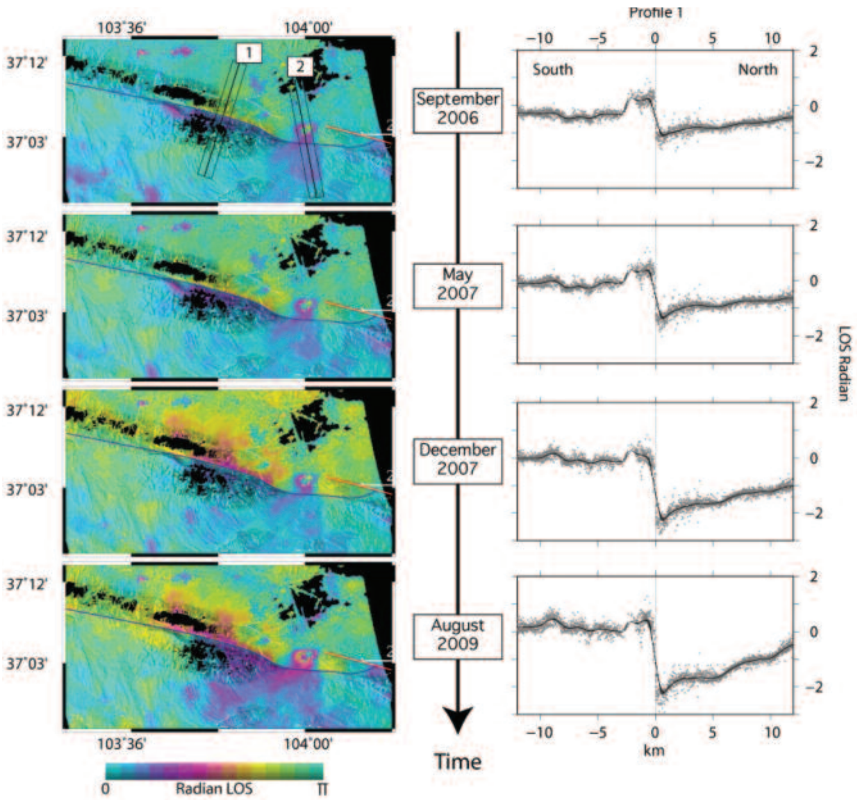


ALOS PALSAR interferogram generated before and after 11 March 2011 earthquake (SAR data acquired 2010/10/28 - 2011/03/15). The Japan quake also affected the Chinese mainland.

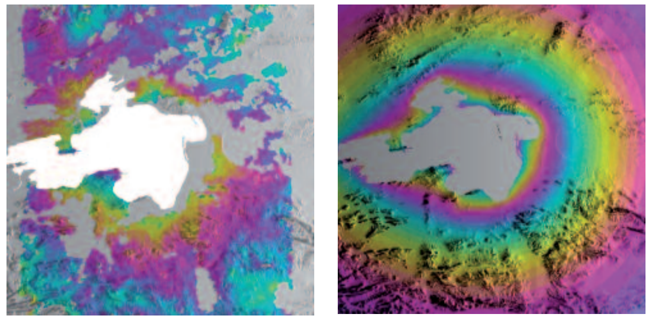
The complete archive of radar images acquired by the ERS and Envisat satellites over the Tibetan plateau and its margins has been exploited. It allows the present-day behavior of active faults in China to be characterized within the seismogenic crust and below, to probe the short-term rheology of the lithosphere, and to analyze the large scale crustal velocity field in terms of mechanical processes of continental deformation. The coseismic and postseismic displacement fields associated with several recent earthquakes that occurred in China (as the 2008 Mw 7.9 Wenchuan earthquake in Sichuan or the smaller Mw 6.3 Dangxiong Yangyi earthquake in Tibet) have been measured and modeled.

Using a time-series analysis, based on the small-baseline approach and including tropospheric phase delays mitigation, the along-strike variations of interseismic strain accumulation along strike-slip faults in northern Tibet (Haiyuan, Kunlun and Altyn Tagh faults) have been mapped and modeled. In particular, evidence for transient, shallow creep at a rate of ~8 mm/yr at the eastern end of the 'Tianzhu' seismic gap along the Haiyuan fault, near the junction with the fault section that ruptured during the M~8 1920 earthquake has been shown. Temporal variations in this creep rate have been detected.

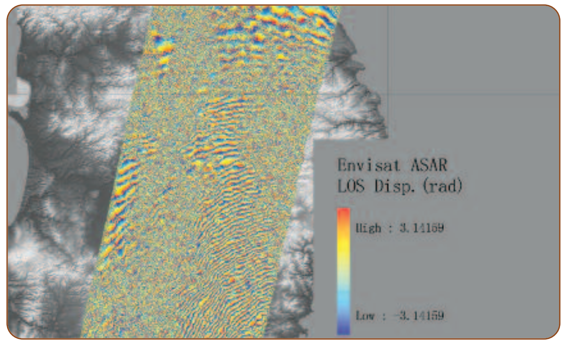
From a similar type of time series analysis, the crustal flexure associated with the increase of the Siling Co lake load on the lithosphere in central Tibet has been detected (bowl-shaped subsidence at a rate of ~5 mm/yr near the lake shores, as a response to a ~1m/yr lake level increase since 2000). See the measured and modeled subsidence rates shown at top of the pages. The subsidence modeling should bring constraints on the lithosphere visco-elastic behavior at short time scales.



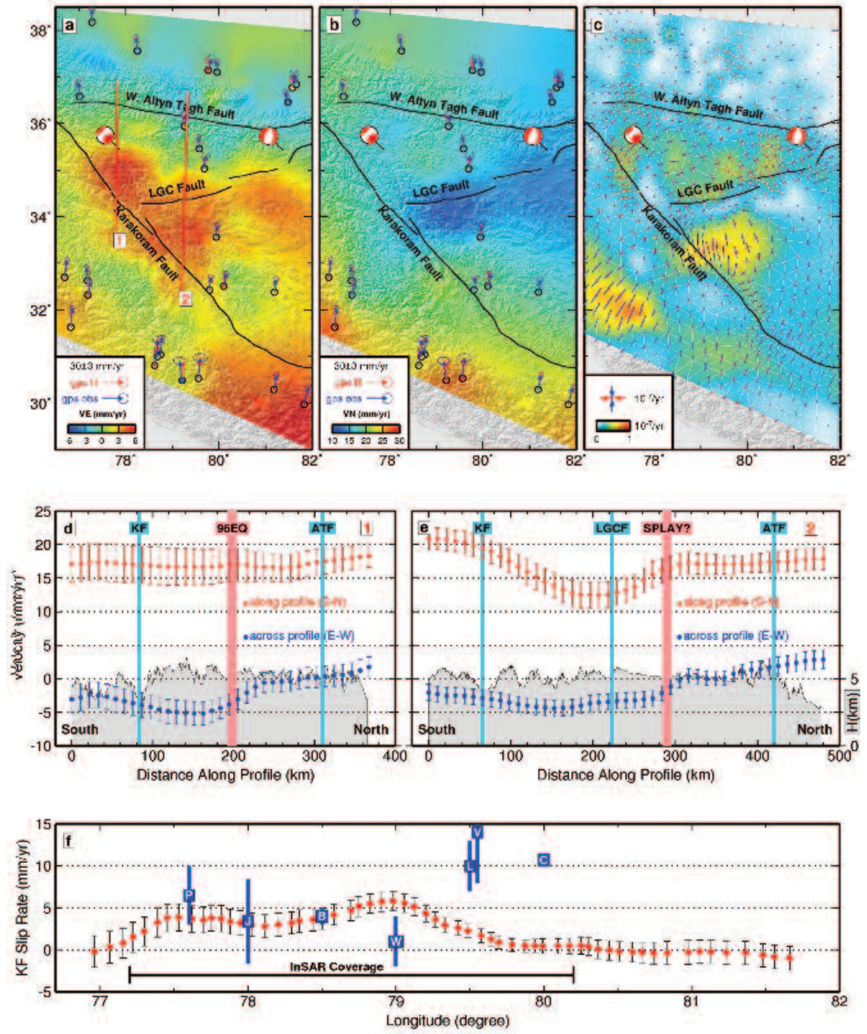
Time and space evolution of surface creep along the eastern section of the Haiyuan fault from 2006 to 2009 : inverted, cumulative LOS displacement shown in map (left column) and profile across fault (right column) - Courtesy of R. Jolivet



Example of interferogram 1996-2006 over lake Siling Co, showing ground subsidence due to lake level increase (left); Viscoelastic model for the period 1992-2010 (viscosity 5 x 1018 Pa.s). 1 color fringe: 2.8 LOS displacement. From M.-P. Doin. (right)



Envisat ASAR interferogram generated before and after 11 March 2011 Japan earthquake (SAR data acquired 2010/2/9 - 2011/03/21)



Velocity field from GPS and InSAR reveals internal deformation in western Tibet. (a-b) East and north components of the velocity field. (c) Strain rate field derived from the velocities on the vertices. (d-e) Profiles through the velocity field. (f) Slip rates along the Karokoram Fault with one-sigma uncertainties. Blue bars are slip rates compiled from the previous studies

Finally, GPS and InSAR data in western Tibet were combined to provide a large scale velocity field. This joint geodetic data analysis allows the strain distribution across and in between the major active faults within the Tibetan plateau to be well described, and provides evidence of the validity of rigid block models in modeling continental deformation in China (strain rates are shown in the centre section figures).

The team has undertaken joint field visits and there has been exchange of researchers. Field work has been done in 2009 and 2010 along the Haiyuan and Kunlun faults. Exchange visits in 2009 include: ISTerre, IPGP members visited institutes in China (Beijing and Lanzhou); Hua Wang, (Guangdong University of Technology), visited Leeds for 5 months; COMET members participated in a joint COMET+/BGS/CEA workshop; there was a Dragon 2 team meeting at the Fringe workshop. In 2010 and 2011: Yang Liu (Wuhan University) visited the University of Glasgow from March to; three UK team members visited the Institute of Geology in Beijing in May and July; Chengsheng Yang (Chang'an University) is visiting the University of Glasgow from October to March 2011.

ID: 5316

DEMONSTRATING SAR AND OPTICAL SENSOR MONITORING OF CHINESE SEAS

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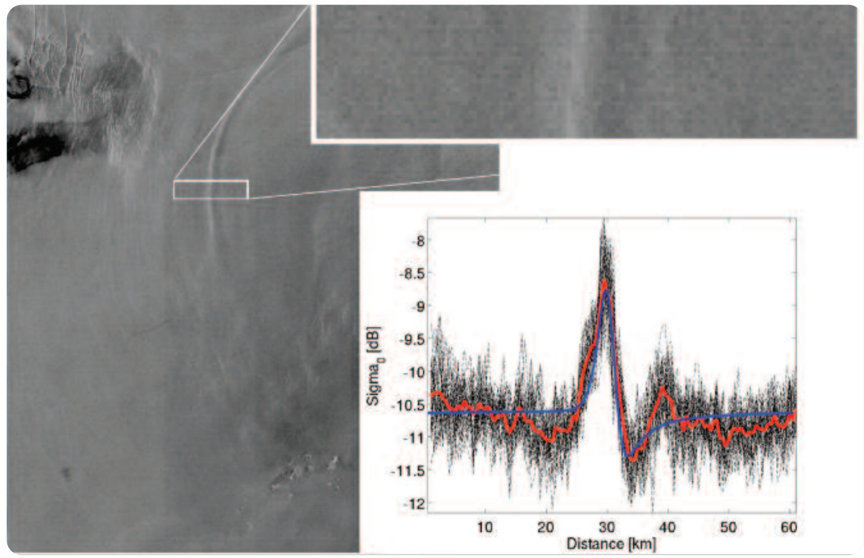
Validation of ship detection by using AIS system

The objectives of the project are to:
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) train young scientists.

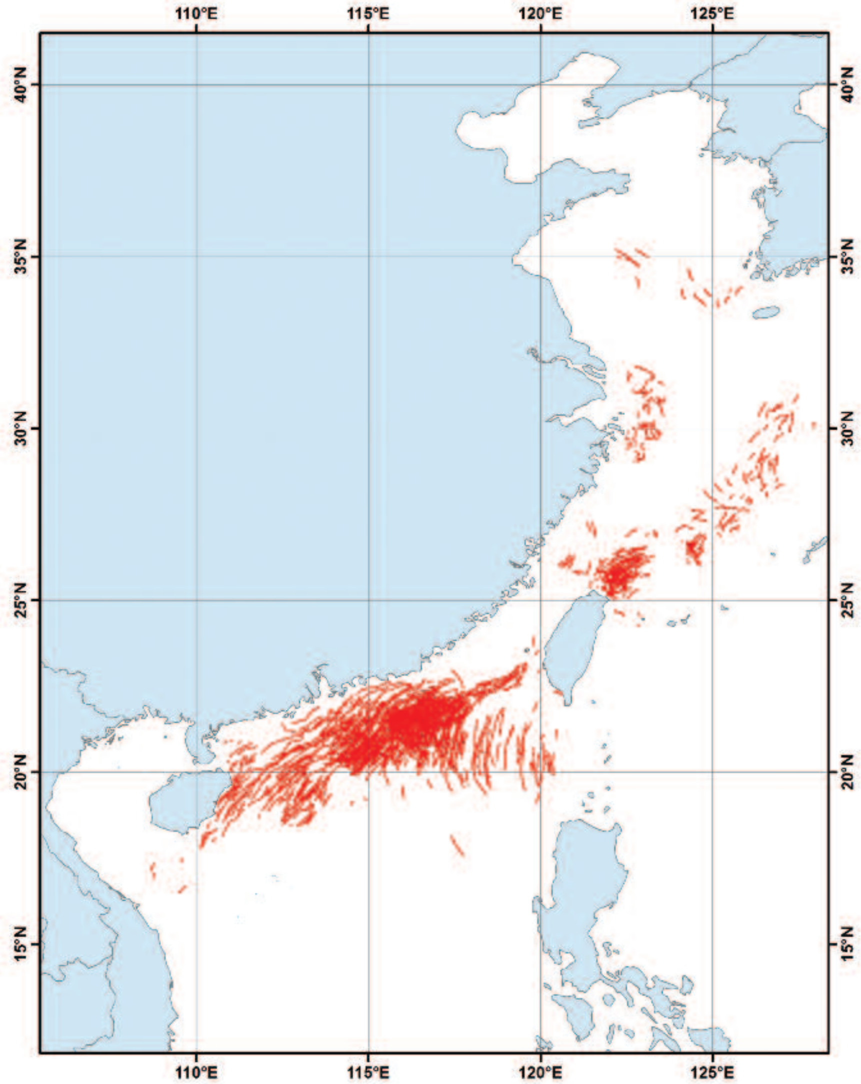
Extensive activity is ongoing globally in developing systems for operational monitoring and prediction of the marine environment including the coastal zones and shelf seas. Apart from waves, the most common parameter of significant importance is the upper layer current and its mesoscale variability. 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).

The imaging mechanisms of several oceanic and atmospheric features in the Chinese seas 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. In particular, 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, as well as improving the understanding of the involved physical processes and the associated SAR imaging mechanism.

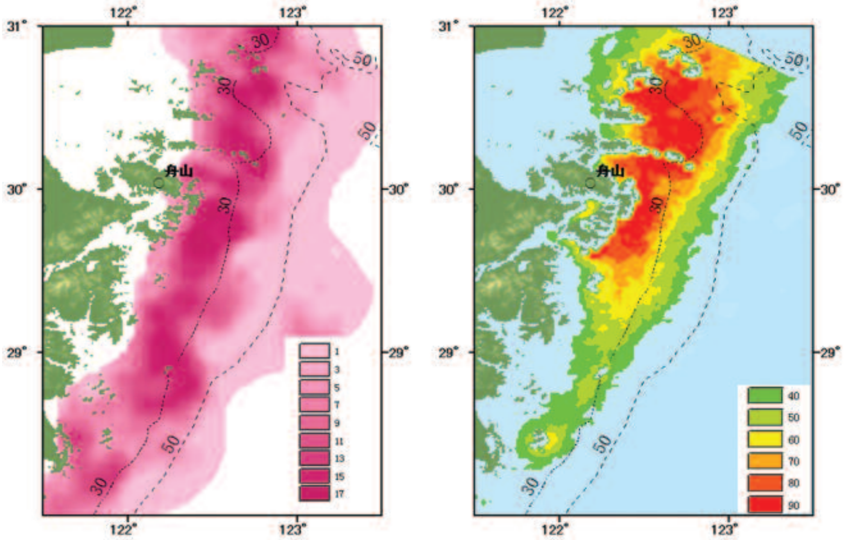
Ship routes derived from SAR imagery



An internal wave soliton observed by Envisat ASAR 18 May 2006. The black lines correspond to profiles of NRCS across the IW, and the red line is their mean. The blue line is NRCS modelled NRCS with a Radar Imaging Model



Internal waves distribution derived from SAR and optical imagery

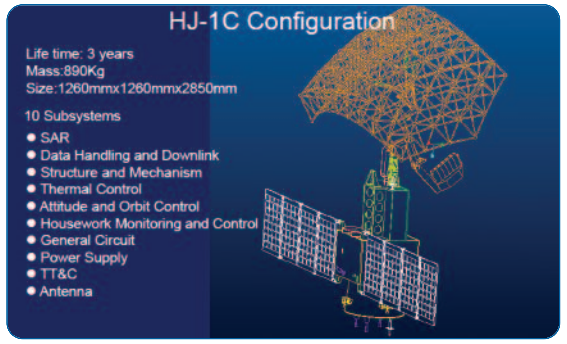


Comparison between the frequencies of occurrence of red tides (left) and those of upwelling (right) in the coastal waters of Zhejiang province

Tracking of ships identified by AIS system and direct observation

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 has been used to measure the velocity of IWs using both MODIS and ASAR imagery.
The observed radar backscatter modulations of IWs are due to induced surface current variations, but the degree of modulation depend on several factors, such as the phase speed of the internal waves, the ambient wind and viewing geometry. Simplified expressions relating the observed radar backscatter modulation to relevant geophysical parameters have been found using dimensional analysis. The derived expressions agree well with simulations with a sophisticated radar imaging model, which has been used to determine the free parameters. The resulting model can be used to extract geophysical information directly from SAR imagery of IWs. Validation against in situ measurements coincident in time and space with SAR imagery is remaining work.

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.



Artist's impression of HJ-1-C S-band SAR will provide all weather, day and night time imaging over China area and seas

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

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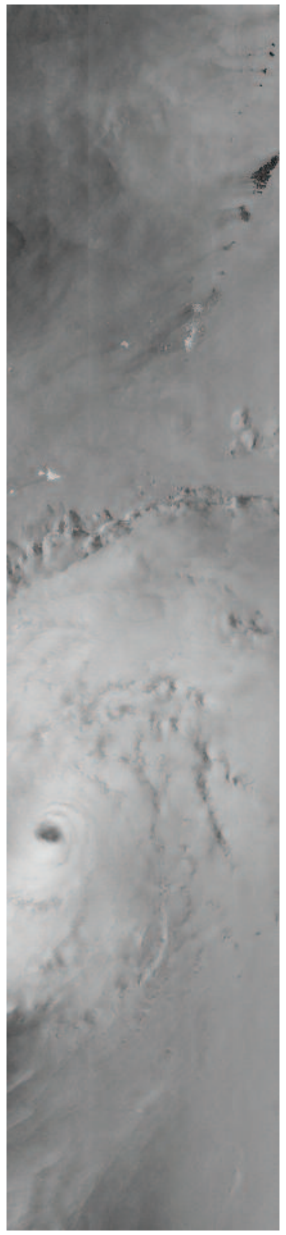
The specific objectives of the proposal are:

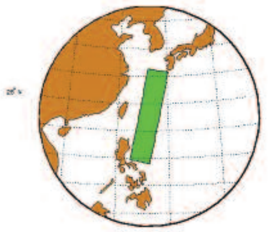
1) to assess current Chinese (and European) services and information products arising from integrated use of networks of remote sensing, in-situ observations, models and data assimilation methods against the GEOSS requirements;
2) to develop activities to jointly combine and merge satellite observations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

It has recently been demonstrated the Doppler Centroid Anomaly from Envisat's Advanced Synthetic Aperture Radar (ASAR) is a useful new resource for marine remote sensing and monitoring, as a measure of the line-of-sight velocity of the moving ocean surface. The contribution from wind is evident on the Doppler image of the typhoon Sinlaku (bottom centre), and corresponding surface current signatures of the Kuroshio current have been validated against in situ drifter data, with good agreement.

The project seeks in particular 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-K SAR. By use of a Radar Imaging Model (RIM) an inverse modeling routine will be used 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.



Envisat ASAR image captured 10 Sept 2008 0130UTC, showing the typhoon Sinlaku



Corresponding ASAR radial Doppler velocity. Positive (reddish) values means motion (wind and/or currents) towards right, negative (blue/green) values towards left. Wind contribution to the Doppler velocity is evident for Sinlaku at the bottom, but also signature of the Kuroshio Current is seen in the northern part, as indicated by the arrows

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

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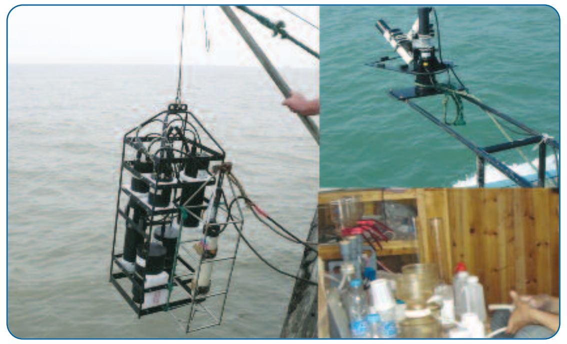
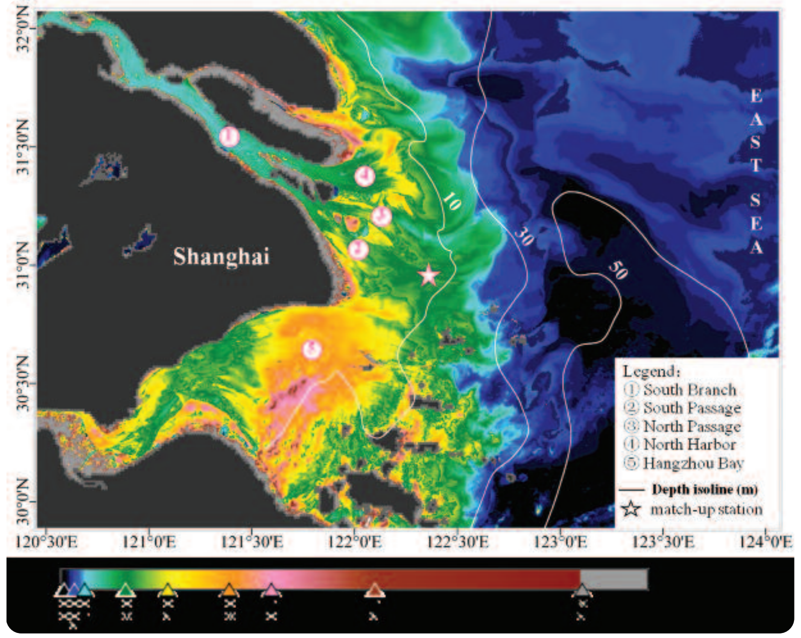
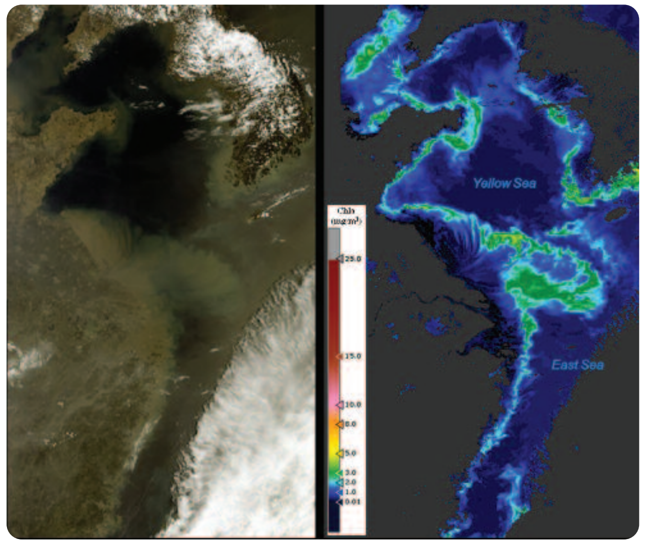
Prof. Yunxuan Zhou, Prof. Fang Shen, Dr. Suhyb Salama, Prof. Wouter Verhoef, Prof. Bob Su



In situ measurements during a ship campaign in the Yangtze River estuary and adjacent coastal waters



MERIS-derived suspended sediment concentration (SSC) in the Changjiang Estuary from the ESA MERIS full resolution data on 25April 2008, by using a Semi-Empirical Radiative Transfer (SERT) model detailed in Shen et al. (2010) Estuaries & Coasts. This figure was from Shen et al. (2010) Estuaries & Coasts



MERIS RGB image (in the left panel) and MERIS-derived chlorophyll-a concentration (Chla) in China Sea from the MERIS reduced resolution data on 30 April 2010 (in the right panel), by using a Synthetic Chlorophyll Index (SCI) algorithm detailed in Shen et al. (2010) Int. J. Remote Sens

Latest research and results

The Changjiang (Yangtze) estuarine and coastal waters are characterized by suspended sediments over a wide range of concentrations from 20 to 2,500 mg l−1. Due to the limited application of current algorithms for high SSC, a semi-empirical radiative transfer (SERT) model to estimate SSC from MERIS data over turbid waters was developed. In addition, based on the sensitivity analysis for remote-sensing reflectance to the SSC, the SERT model coupled with a multiconditional algorithm scheme was proposed for the satellite retrieval of wide-range SSC. Results suggest that this method is more effective and accurate in the estimation of SSC over turbid waters. The detailed work was described in Shen et al. (2010) Estuaries & Coast.

Estimation of chlorophyll-a concentration (Chla) in turbid waters with the presence of sediments is challenging for satellite ocean colour. A synthetic chlorophyll index (SCI) was designed for extracting chlorophyll information and minimizing the interference of sediments. As a result, the SCI is better related to the Chla in the turbid waters than the FLH (florescence line height). The details were described in Shen et al. (2010) Int. J. Remote Sens.

Reference:

[1] Shen Fang, Verhoef Wouter, Zhou Yunxuan, Salama Mhd. Suhyb, Liu Xiaoli. (2010), Satellite estimates of wide-range suspended sediment concentrations in Changjiang (Yangtze) estuary using MERIS data. Estuaries and Coasts, Vol.33, No.6, 1420-1429.

[2] Shen Fang, Zhou Yun-Xuan, Li Dao-Ji, Zhu Wei-Jian and Salama Mhd. Suhyb. (2010), MERIS estimation of chlorophyll-a concentration in the turbid sediment-laden waters of the Changjiang (Yangtze) Estuary. Int. J. of Remote Sensing, Vol. 31, No. 17, 4635–4650.

ID: 5338

DRAGON 2 OCEANOGRAPHY AND COASTAL ZONES PROJECTS

Prof. He Ming-Xia (left 3) and Prof. Susanne Lehner (left 4), both are lead investigators of project ID 5338, were awarded for joint work in PORSEC 2010

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

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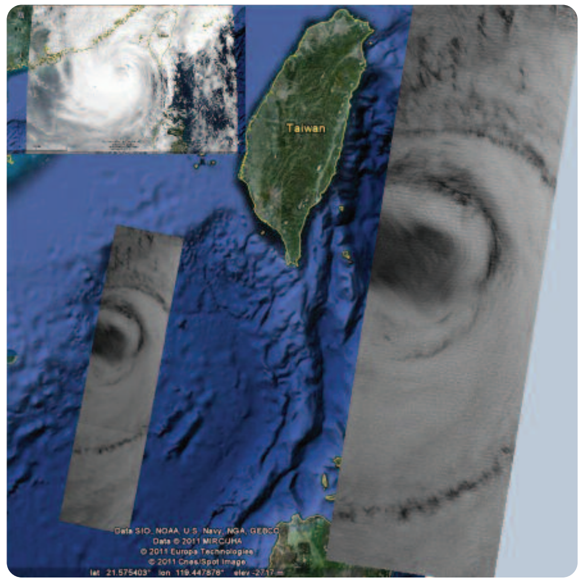
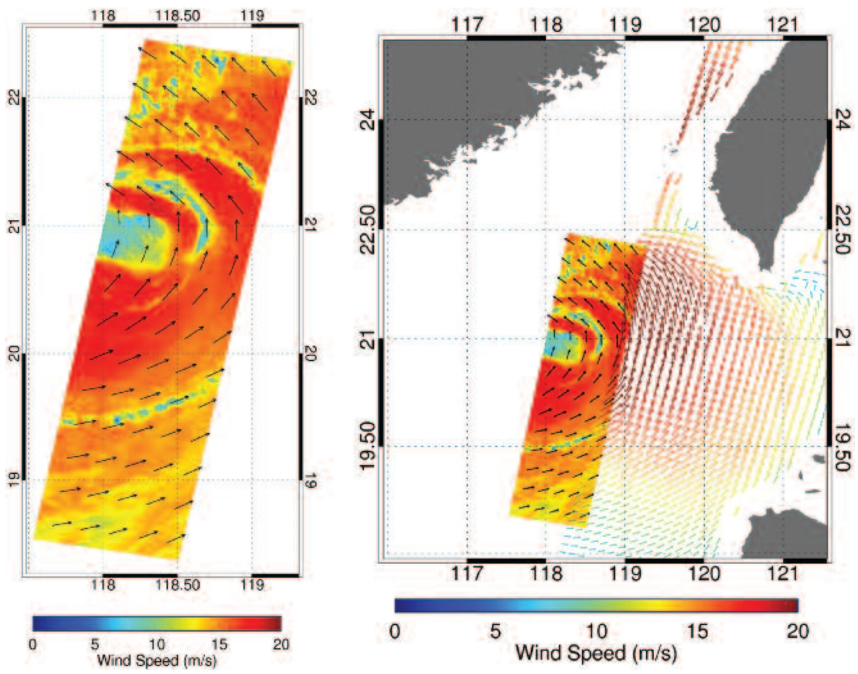
The goal of project ID 5338 is to derive high resolution sea surface winds, waves and currents field from spaceborne SAR, scatterometer and radar altimeter data to exploit micro- and meso-scale processes taking place at the air-sea interface. In this project, higher level oceanographic products including sea surface wind field and integral wave parameters are derived from ERS-2/SAR, ENVISAT/ASAR and TerraSAR-X data.

Particular attention is paid to severe weather situations, e.g., tropical and extra-tropical cyclones occurring over the Chinese and European coastal regions. As an example, we analyze the TerraSAR-X (TS-X) ScanSAR image acquired over typhoon Megi occurring in the South China Sea on Oct. 21 at 22:09 UTC, 2010 (as shown top right). High resolution sea surface wind field is retrieved from the TS-X image using the newly developed XMOD algorithm (see plot lower right). Comparison of the TS-X retrieved surface wind field to the measurements of scatterometer ASCAT (with spatial resolution of 12.5 km) is shown also in the lower right Figure. The acquisition of TS-X data is around 3 hours earlier than the Scatterometer. The colored arrows present wind speed and wind direction of the ASCAT measurements. The black arrows present the wind direction derived from the TerraSAR-X data. Wind structure over the typhoon eye is out of swath of the ASCAT, while one can still obtain the high resolution surface wind measurements over Megi's center.

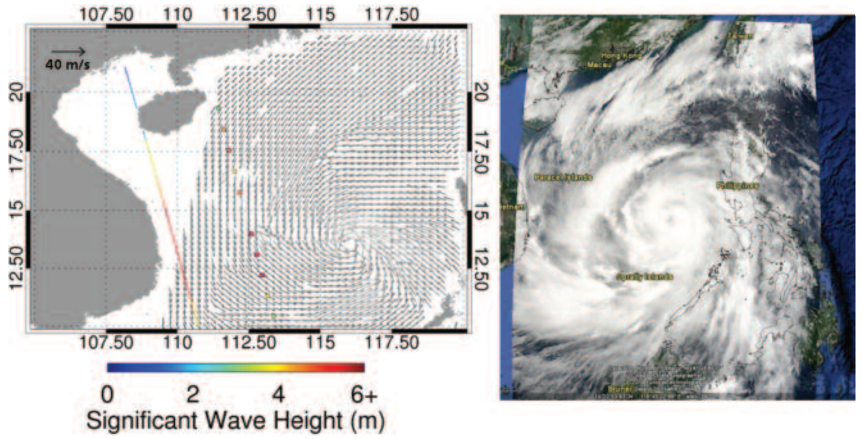
A joint experiment for validating the sea surface wind retrieval using TS-X and ENVISAT/ASAR data were conducted in July, 2010 over Bohai Sea by the Chinese partner from the CEODE (Center for Earth Observation and digital earth, Chinese Academy Sciences) and the European partner of DLR. The cruise route chart is shown in the top of the page graphic. The triangle indicates the area where the in situ measurements were conducted. Further experiments are being planned in summer/autumn season in 2011 over the South China Sea.



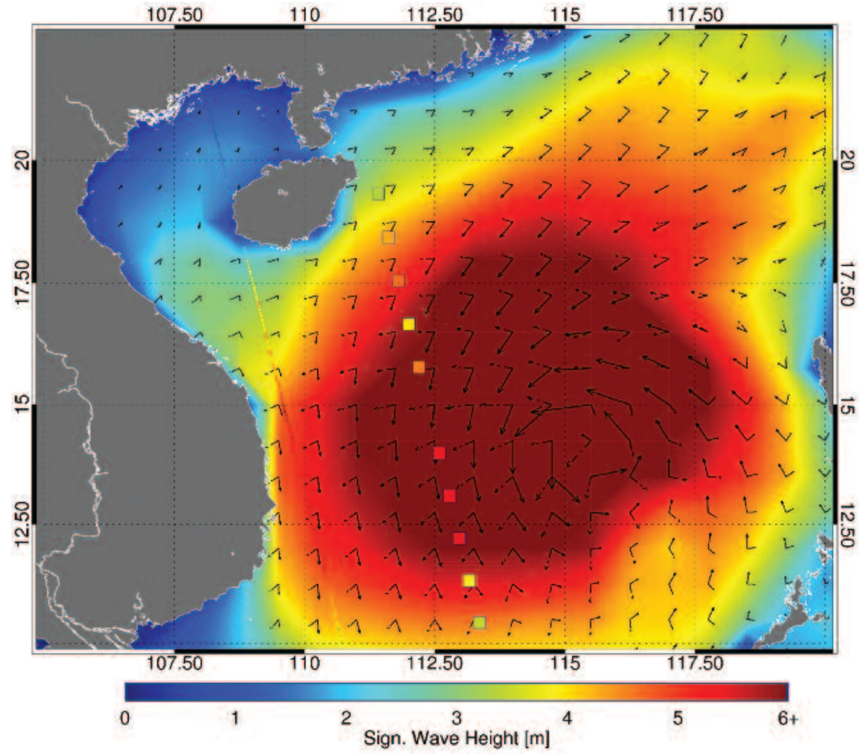
Three continuous TS-X ScanSAR mode data (with spatial pixel size of 8.25 m, and VV polarization) acquired over typhoon Megi on Oct. 21, 2010 at 22:06 UTC



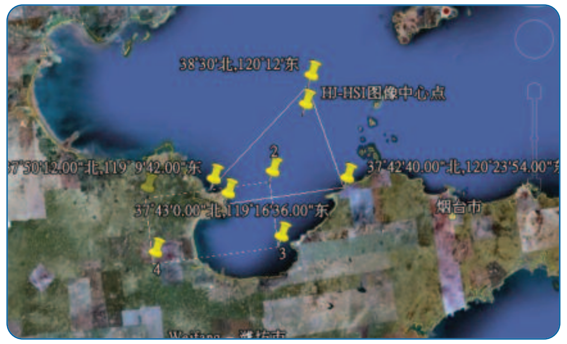
Sea surface wind field retrieved from TS-X data using XMOD (left) - Comparison of TS-X derived sea surface wind field to Scatterometer measurements of the ASCAT (right)



Left plot shows the significant wave height derived from ASAR wave mode data (right track as presented by small squares) and Radar Altimeter, which were acquired on May 14, 2006 at 14:30 UTC. Both are onboard the ENVISAT satellite. The black arrows presented sea surface wind field derived from the Scatterometer QuikSCAT which was acquired at 11:30 UTC in the same day. The maximum wind speed derived from the QuikSCAT is around 40 m/s. The Aqua/MODIS data was acquired at 02:05 UTC, as shown in the right panel



Comparison of SWH derived from the ASAR wave mode data (as presented in the small and colored squares) and RA to the DWD numerical wave model results from 15:00 UTC on May 14. The black solid and dashed lines indicate the windsea and swell wave direction, respectively. The ASAR wave measurements show slight underestimation in the center of typhoon, which may be induced by the heavy rainfall. However, in the southern part of the typhoon, based on the both measurements derived from RA and ASAR, one can observe that the DWD wave model overestimates wave height. This indicates that the northward translation speed of typhoon is underestimated by the atmospheric model



Bohai cruise experiments in July 2010 were conducted by the Chinese partners from CEODE. The triangle indicates the in situ measurement area (Courtesy Dr. Ren YongZheng, CEODE)

A novel technique (i.e., empirical algorithm CWAVE) of using ERS/SAR and ENVISAT/ASAR wave mode data to measure global surface wave height without the need for first guess information has been successfully developed. Validation results show that the integrated wave parameters derived by the CWAVE algorithm provide a reliable estimation of significant wave height with scatter index less than 20 % when comparing to in situ buoy measurements. It is worth noticing that the ASAR and RA-2 mounted jointly onboard the ENVISAT platform. RA-2 acquires the nadir sea surface measurements while ASAR looks right with a spatial distance of around 300 km on ground from the RA track. Using both sensors for measuring sea surface waves brings a twofold advantage, especially under high sea state. On one hand it can increase spatial sampling over the open ocean and simultaneous observations reduce uncertainties of measurement. On the other hand, the spatial variations of SWH, e.g., wave height gradient, under wind storms situations can be investigated using the parallel tracks having a spatial distance of 300 km. As an example, the ASAR and RA measurements are used jointly for investigating sea state over typhoon Chanchu (Category 4) which occurred in May, 2006 over the South China Sea. The centre of page figures show the comparison of SWH derived from both sensors onboard the ENVISAT to the reanalysis wave model provided by the DWD (German Weather Service).

ID: 5292

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

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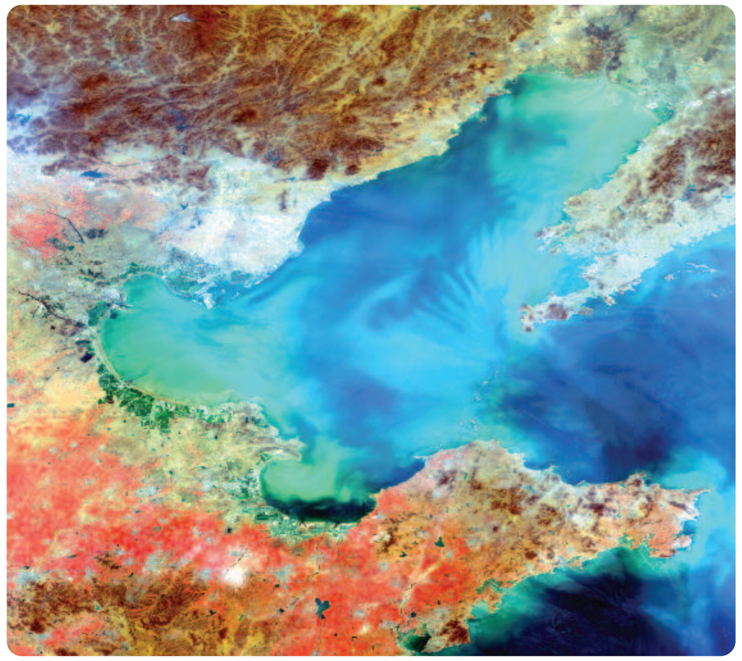
Wetland in the Yellow River Delta and field data collection during the June 2009 ground campaign

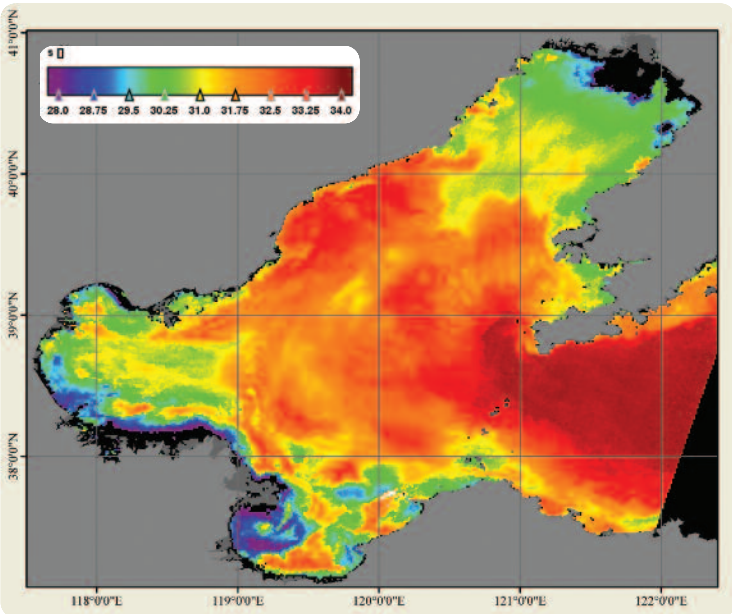
The study area of the project is the three largest river deltas: the Yellow River deltas, Changjiang (Yangtze River) deltas and Zhujiang (Pearl River) deltas. The main contents include the following 5 parts: (1) land use/cover remote sensing monitoring and drive factors analysis; (2) wetland remote sensing monitoring and evaluation; (3) shoreline remote sensing monitoring and annual change analysis; (4) water quality monitoring and integrated evaluation; (5) cross-calibration of COCTS and CZI with MERIS.

Land use/cover remote sensing monitoring: A 10-day field work in the Yellow River Delta was performed in June 2008. Information of ground control points by differential global positioning system was collected for the geometrical correction of satellite data. Besides, field photos were taken for the interpretation of remote sensing images. Lots of classification experiments were carried out for ENVISAT MERIS and HY-1B CZI images. In January 2011, a new field work for the validation of classification results was conducted.

Coastal line remote sensing monitoring: The relationship between satellite (MERIS and CZI) images features and the field coastal line was established. A new method to automatically extract coastal line was developed using the instantaneous water lines from the long time series satellite images. Compared with the results from the "908 project" of china, the new method was proved to work well.
Wetland remote sensing monitoring: Texture characteristics of 4 types of typical coastal wetland (culture zone, salt field, tidal flat and reservoir) in ENVISAT ASAR image was analyzed by the method of gray level co-occurrence matrices. The supervised classification was performed, the result of which indicates that SAR imagery has the response capability of the different kinds of wetland.



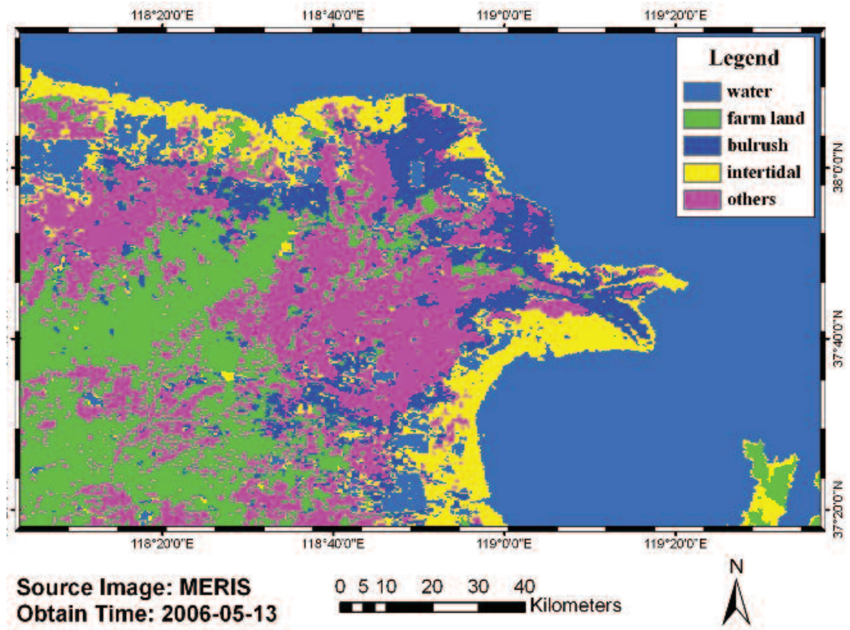
MERIS composite image of the Bohai Sea on 9 April 2009



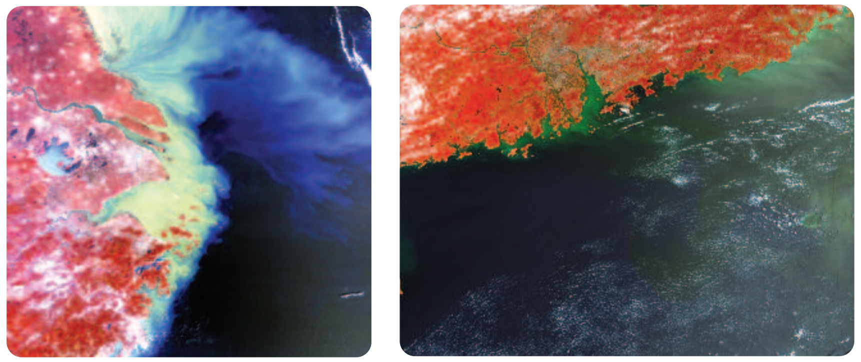
Surface salinity retrieved by MERIS on 14 October 2009, Bohai & Yellow Sea

Examples of wetland vegetation and mudflats in the Yellow River Delta

Field work group in the Yellow River Delta, January 2011



Yellow Rive estuarine land use / cover classification result

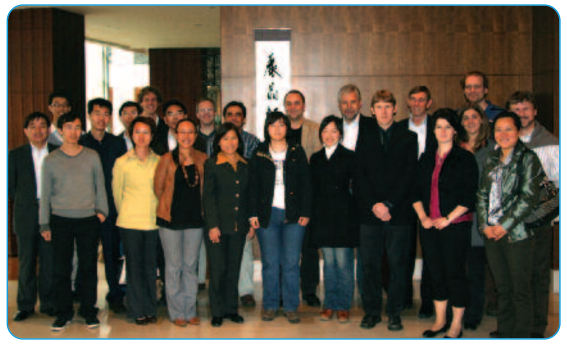


MERIS composite image of the Yangtze River on 26 April 2009 (left); MERIS composite image of the Pearl River on 5 July 2010 (right)

Water quality monitoring: The statistical retrieval models for the concentration of suspended particulate matter (SPM) in Bohai Sea of China by ENVISAT MERIS, FY-3 MERSI, HY-1B CZI and CEBRS-02 CCD data were developed. Spatio-temporal distribution of SPM in the Bohai Sea was analyzed in terms of its spatial pattern, disturbance by sustaining strong wind and seasonal variability. QAA (Quasi-Analytical-Algorithm) was modified and validated by field data in the Bohai Sea, Yellow Sea and East China Sea to retrieve inherent optical properties (IOPs). Two new models for retrieving surface slinity and particle size of SPM in the Yellow River estuary were developed and validated.

Calibration and validation: Extensive in situ data in the Bohai Sea of China were collected to assess MERIS radiometric properties and concentrations of ocean color constituents, including spectral normalized water leaving radiance, concentrations of SPM and chlorophyll a. During the analysis, a relatively strict spatio-temporal match-up method was adopted regarding the complexity of marine environment and its variation in the turbid coastal area.

ID: 5253



AMFIC group at the fifth Regional Air Quality Management (RAQM) Conference

AIR QUALITY MONITORING AND FORECASTING IN CHINA (AMFIC)

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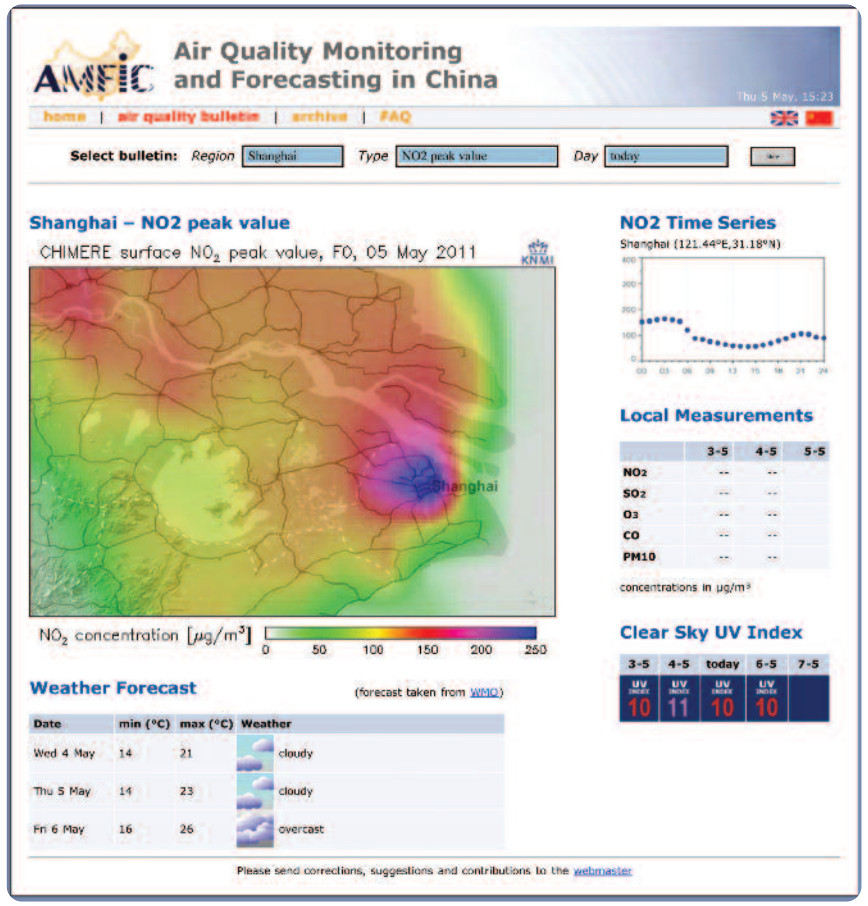
Air quality Monitoring and Forecasting In China (AMFIC)

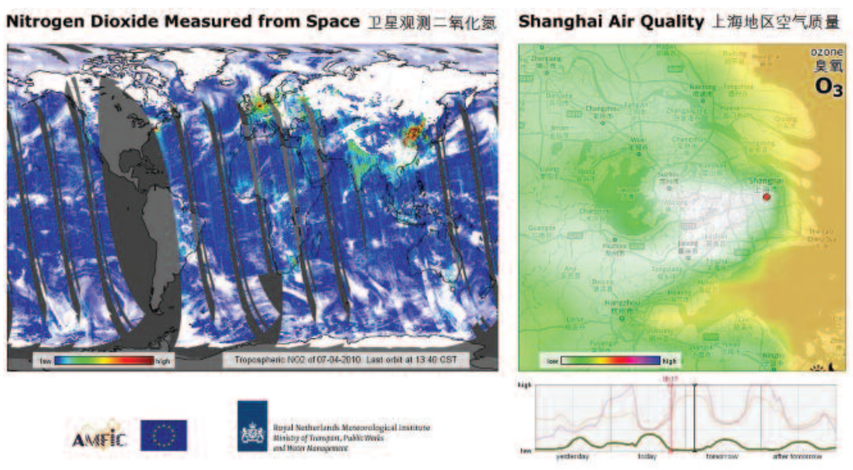
The AMFIC project addresses atmospheric environmental monitoring over China. The aim is to develop an integrated information system for monitoring and forecasting tropospheric pollutants over China. The system uses satellite and in situ air quality measurements and modelling to generate consistent air quality information over China. The data cover the recent years and the actual situation including an air quality forecast for several days ahead. Measured air pollutants are ozone, nitrogen dioxide, sulphur dioxide, formaldehyde, glyoxal, carbon monoxide, methane, and aerosol/particular matter. Overpass files have been generated for satellite data at the relevant locations (70 ground stations). These overpass files have been used in many validation activities world-wide and in China in particular.

Air quality during the World Expo 2010 in Shanghai

AMFIC joined the World Expo in Shanghai with an air quality station at the Dutch pavilion. It showed on one panel the latest OMI satellite observations of nitrogen dioxide, an important air pollutant that contributes to smog and particulate matter. On the other panel the surface concentrations of three air pollutants were shown for the Shanghai area: nitrogen dioxide, ozone, and fine particles. The concentrations were calculated with the regional model CHIMERE using regional emission data and meteorological data. By using the meteorological forecast, it simulated the hourly evolution of air quality in the coming days. The AMFIC project was invited by the EU to give a presentation on their results at the "Embrace Space" event on the World Expo.



AMFIC on-line interface can be used to provide regional air quality forecasts in China



AMFIC air quality station at the World expo 2010 at Shanghai

ID: 5311

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

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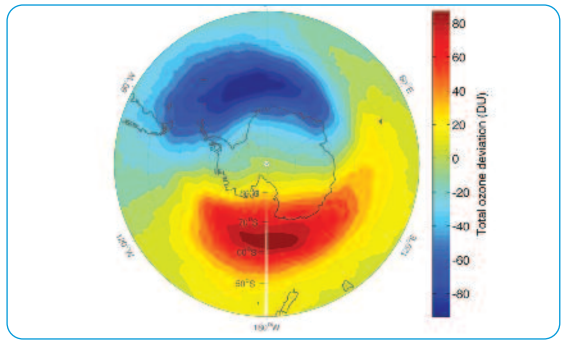
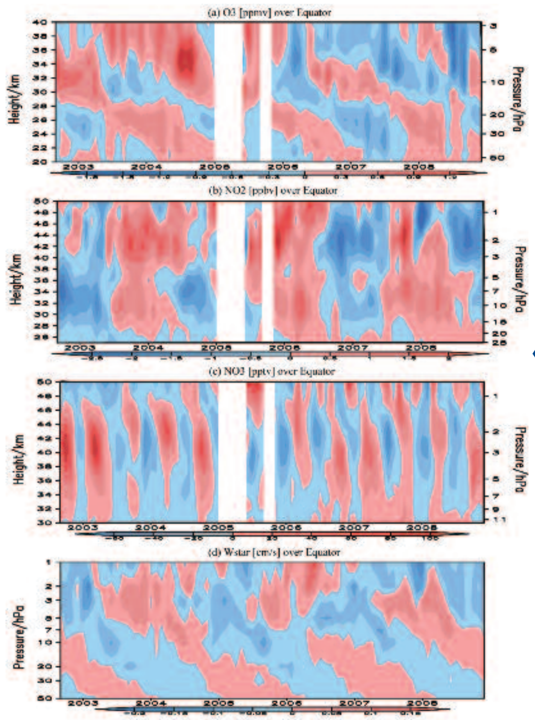
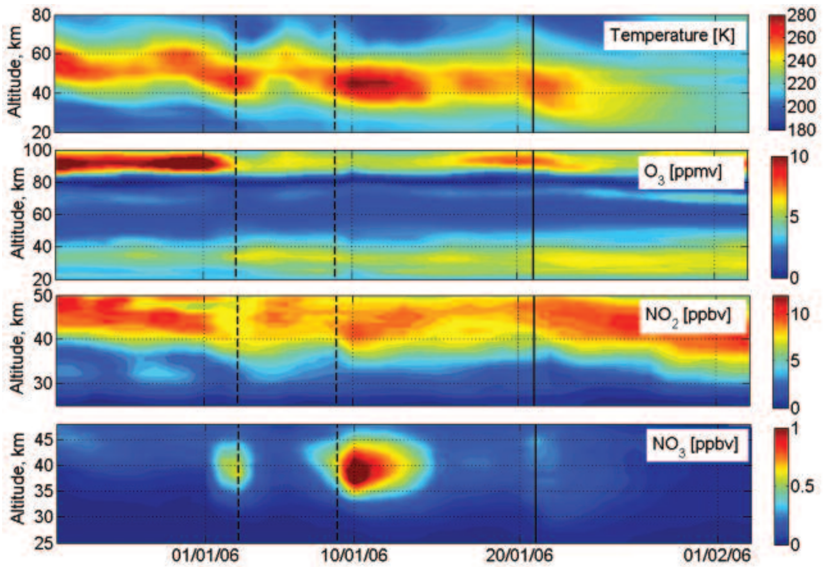


Deviation from the zonal mean of OMI total ozone - 10/2008



Time-vertical sections for the interannual anomalies of (a) O3, (b) NO_2, (c) NO_3 from GOMOS observations and (d) w-star (vertical velocity of residual circulation) calculated from ECMWF data during 2002-2008. The time series of O3 and NO2 represent the QBO (Quasi-Biennial Oscillation) characteristic and the time series of NO_3 represent the SAO (Semi-annual Oscillation) pattern distribution. The QBO-pattern of w-star illustrates the effects of dynamical transports



MLS observations of temperature and GOMOS observations of ozone, NO_2 and NO_3 in the middle atmosphere during sudden stratospheric warming (SSW) in January 2006. Black dashed and solid lines indicate onsets of minor and major SSW, respectively

The aim of the EGOMO project is to study natural variation in the middle atmosphere using satellite data and modelling tools. Data are coming from four presently active satellite instruments: GOMOS and MIPAS on ENVISAT, OSIRIS on Odin and OMI on EOS-Aura. We are also making use of several middle atmosphere chemistry-transport models to analyse satellite data.

We have constructed climatologies and time series for O_3, NO_2 and NO_3 using GOMOS and OSIRIS measurements. Using measurements from the SAGE II instrument the ozone time series has been extended to years 1987-2010. Time series have been analysed by fitting trends, annual and semi-annual harmonics as well as solar and quasi-biennial oscillation (QBO) proxies.

The QBO and semi-annual oscillation (SAO) characteristics of O_3, NO_2, and NO_3 were analyzed using GOMOS observations. The dynamical transport was found to be the principal factor controlling the QBO pattern of O_3. The QBO signals of O_3 originate in the middle stratosphere and propagate downward along with the anomalies of the vertical residual circulation over the equator. We found the NO_2 QBO pattern was deep and stationary over the equator. The interannual anomalies of NO3 displayed an apparent SAO pattern in the tropical upper stratosphere.

The response of the middle-atmosphere trace gases during several sudden stratospheric warmings in 2003-2008 was investigated using measurements from GOMOS and MLS. Significant changes were observed in the chemical composition of the stratosphere and mesosphere. These results have been compared with the modelling from FinROSE with a good agreement in the stratosphere.

ID: 5291

The project team with the mobile wind Lidar, Qingdao in May 2010.

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

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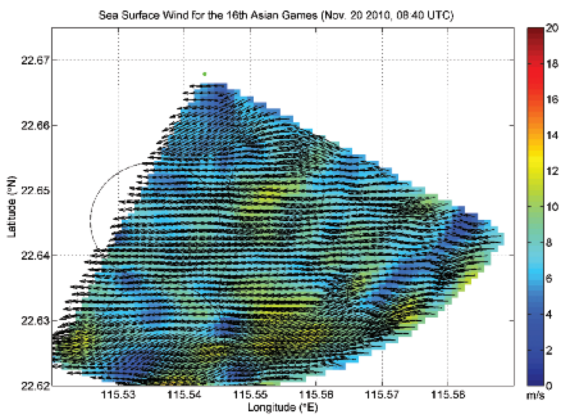
The global observation of atmospheric wind profiles remains to be the highest priority need for weather forecast. ESA decided to implement the Atmospheric Dynamics Mission ADM-Aeolus to demonstrate the potential of the Doppler lidar technology for global wind profiling in order to improve the quality of the numerical weather prediction. ADM-Aeolus will carry the first wind lidar in space and launch is scheduled for end 2013.

An airborne prototype of the lidar instrument on ADM-Aeolus was developed by DLR (Deutsches Zentrum für Luft- und Raumfahrt) and deployed during several field campaigns on the DLR Falcon aircraft. In 2009 the instrument calibration concept and retrieval of high wind speeds was validated with flights over Iceland, Greenland and the North Atlantic Ocean (see bottom of page photos).

In 2010, Dr. Oliver Reitebuch and Mr. Benjamin Witschas of DLR, the European DRAGON-2 partners visited Ocean Remote Sensing Institute, Ocean University of China (ORSI/OUC) for discussing recent results and the future validation plan for ADM-Aeolus (see top of page photo). The mobile Doppler lidar developed by ORSI/OUC was applied during the 8th WMO International Radiosonde Comparison in Yangjiang, China for continuously wind profile and cloud measurements. The mobile lidar performed sea surface wind measurements in November 2010 during the 16th Asian Games in Guangzhou, China, over the sailing competition areas and uploaded the data to the local meteorological station every 10 min (a scan is shown in the figure).



Sea surface winds during 16th Asian Games 2010 in Guangzhou, China (color indicates wind speed and arrow shows the wind direction)

DLR Falcon aircraft in Kangerlussuaq, Greenland for pre-launch tests of the ADM-Aeolus calibration

East coast of Greenland from DLR Falcon aircraft during ADM-Aeolus pre-launch tests

ID: 5252

SOIL MOISTURE AND OCEAN SALINITY (SMOS) CAL/VAL IN CHINA

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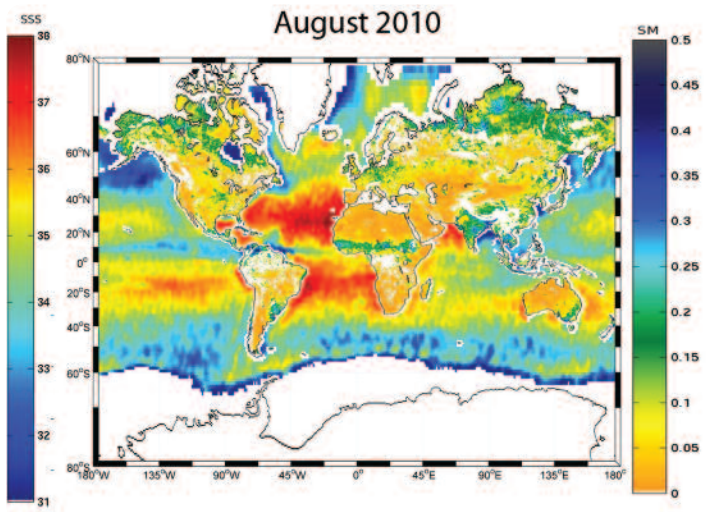
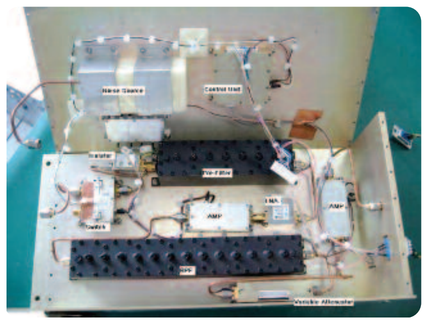
LeTAK radiometer in operation, Taklamakan desert test site, China



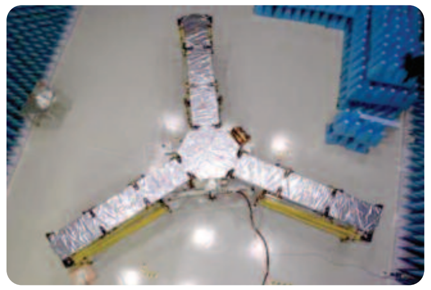
Global mean monthly (Aug. 2010) ocean sea surface salinity and soil moisture derived from SMOS observations. Credits: CESBIO, IFREMER, CATDS

A sightview at centre of the Taklamakan desert which is taken by Yann Kerr when both PIs were visiting the site.



Inside of LeTAK

Artists impression of SMOS satellite in space with MIRAS antennas deployed in Y formation



Testing of SMOS MIRAS antennas in anechoic chamber (prior to launch)

SMOS is the second Earth Explorer opportunity mission (ESA led with CNES and CDTI) which was selected in 1999, initiated in 2000 and launched in 2009. It uses a new technique (2D interferometry) to provide global measurements from space of key variables (soil moisture and sea surface salinity) for the first time (figure shows global mean parameters for August 2010). The average resolution of SMOS is about 43 Km with global coverage while a given point of the surface can be seen with several angles and maximum time (equator) between two acquisitions is 3 days.

SMOS has suffered from Radio frequency interferences (RFI) severely over Europe-Asia even though it is operated in passive mode in protected band preserved for astronomy observation (no active transmission from satellite to ground). The consequence is data quality declines sharply and has no obvious measure to solve it unless RFI sources are mitigated. The project has paid great efforts to monitor and coordinate RFI mitigation in China.

A radiometer for observing L-band Emission from Taklamakan desert (LeTak radiometer) has been constructed (shown top of the page). The radiometer is designed to conduct a ground measurement of brightness temperature in centre of Taklamakan desert in purpose of giving a reference point for vicarious calibration of SMOS. LeTak is operated with a central frequency of 1.4135GHz, 19MHz bandwidth (3dB), 3dB noise figure while about 15 degree antenna beamwidth. LeTak is in test near Beijing right now.

CAL/VAL activities should be based on fully understanding of satellite data, reliable measurement instruments and then a reasonable plan. This project will continue to focus on these three aspects as well as RFI mitigation issues.

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Beijing Digital View Technology Co. Ltd.	China
Beijing Information Resources Management Centre	China
Beijing Seismological Bureau	China
BIRA-IASB	Belgium
BOOST-Technologies	France
Bureau of International Cooperation, Chinese Academy of Sciences (CAS)	China
Cambridge Environmental Research Consultants	United Kingdom
Capital Normal University	China
CEMAGREF, Maison de la Télédétection	France
Center for Applications of Spatial Information Technolgies and Public Health	China
Center for Earth Observation and Digital Earth, Chinese Academy of Sciences (CAS)	China
Center for Space Sciences and Application Research, Chinese Academy of Sciences (CAS)	China
Centre for Computing Geology, UMR CNRS SISYPHE	France
Centre for Terrestrial Carbon Dynamics (CTCD), University of Sheffield	United Kingdom
Centre National de la Recherche Scientifique (CNRS)	France
CESBIO (Centre d'Etudes Spatiales de la Biosphère)	France
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China University of Geoscience	China
Chinese University of Hong Kong (CUHK)	China
Chinese Academy of Meteorological Sciences (CAMS/CMA)	China
Chinese Academy of Surveying and Mapping	China
Chinese University of Science and Technology, School of Life Sciences	China
CLS	France
CNES French Space Agency - Directorate of Strategy and Programs	France
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CNR-IBIMET	Italy
CNR-IREA	Italy
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Finnish Meteorological Institute	Finland
Finnish Meteorological Institute, Arctic Research Centre	Finland
Finnish Meteorological Institute, Climate Change Unit	Finland
Finnish Meteorological Institute, Earth Observation Unit	Finland
First Institute of Oceanography (FIO), State Oceanic Administration (SOA)	China
Flemish Institute for Technological Research (VITO)	Belgium
Foundation for Research and Technology - Hellas Institute of Applied and Computational Mathematics, Regional Analysis Division	Greece
Freie Universität Berlin	Germany
FutureWater	Netherlands
Gamma Remote Sensing Research and Consulting AG	Switzerland
General Foundation of the University of Valladolid, Remote Sensing Laboratory	Spain
GeoForschungsZentrum Potsdam, Remote Sensing Section	Germany
Geoinformatics Division Department of Urban Planning and Environment, Royal Institute of Technology	Sweden
German Aerospace Center (DLR)	Germany
German Aerospace Centre, DLR, Microwave and Radar Institute (DLR-HR)	Germany

DRAGON 2 PARTNERS

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GRTR/LSIIT, ULP	France
GuangXi Forest Resources Monitoring Center, GuangXi Forestry Survey and Design Institute	China
Harbin Institute of Technology, Shenzhen	China
Hellas Institute of Applied and Computational Mathematics, Foundation for Research and Technology-Regional Analysis Division	Greece
IFREMER	France
INRIA	France
Institut fuer Weltraumwissenschaften, Freie Universitaet Berlin	Germany
Institut für Geographie	Germany
Institute of Agriculture Modernization, Jiangsu Academy of Agriculture Sciences	China
Institute of Atmospheric Physics, Chinese Academy of Sciences (CAS)	China
Institute of Atmospheric Physics, DLR	Germany
Institute of Crustal Dynamics, China Earthquake Administration (CEA)	China
Institute of Disaster Management, Beijing Normal University (BNU)	China
Institute of Electronics and Telecommunications of Rennes - University of Rennes 1	France
Institute of Electronics, Chinese Academy of Sciences (CAS) (IECAS)	China
Institute of Environmental Physics (IUP), University of Bremen	Germany
Institute of Geodesy and Geophysics, Chinese Academy of Sciences (CAS)	China
Institute of Geographical Sciences and Natural Resource Research, Chinese Academy Sciences	China
Institute of Geology, Beijing China Earthquake Administration (CEA)	China
Institute of Geophysics, China Earthquake Administration (CEA)	China
Institute of Meteorological Sciences	China
Institute of Remote Sensing and GIS, Peking University	China
Institute of Remote Sensing Applications, Chinese Academy of Sciences (CAS) (IRSA/CAS)	China
Institute of Remote Sensing/Environmental Physics (IFE/IUP), University of Bremen	Germany
Institute of Resource Technology, Beijing Normal University (BNU)	China
Institute of Tibetan Plateau Research, Chinese Academy of Sciences (CAS)	China
Institute of Water Resources and Hydropower, Ministry of Water Resources	China
International Crane Foundation (ICF)	China
KNMI	Netherlands
Laboratory of Information Engineering in Surveying, Wuhan University	China
Laboratoire de Détection et de Géophysique, Commissariat à l'Energie Atomique	France
Laboratoire de Géologie, Ecole Normale Supérieure	France
Laboratoire de Tectonique, Institut de Physique du Globe de Paris	France
Laboratoire des Sciences de l'Image de l'Informatique et de la Télédétection (LSIIT); Université Louis Pasteur (ULP)/CNR-ISAFoM	France/Italy
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 (WHU)	China
Meteorological Data Analysis and Collection, National Climate Data Center	China
Ministry of Science and Technology	China
Mullard Space Science Lab, Dept. of Space and Climate Physics, University College London	United Kingdom
Nanjing Institute of Geography and Limnology, Chinese Academy of Sciences (CAS)	China
Nansen Environmental and Remote Sensing Center	Norway
Nansen-Zhu International Research Center, IAP/CAS	China
National Aerospace Laboratory (NLR)	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
National Observatory of Athens, University of Athens	Greece
National Remote Sensing Center of China, MOST	China
National Satellite Meteorological Centre, China Meteorological Administration (CMA)	China
National Satellite Ocean Application Service	China
Ocean Remote Sensing Consulting	Germany
Ocean Remote Sensing Institute (ORSI), Ocean University of China	China
Potsdam Institute for Climate Research	Germany
Remote Sensing Group Department of Electronics, University of Pavia	Italy
Remote Sensing Laboratory of INIA	Spain
Remote Sensing Technology Application Center, Ministry of Water Resources	China
Remote Sensing Unit National Centre for Earthquake Monitoring, National Institute of Geophysics and Volcanology	Italy
Research Institute of Forest Resource Information Techniques, Chinese Academy of Forestry	China
Resource Ecology Group, Centre for Ecosystem Studies, Wageningen University	Netherlands
School of Geodesy and Geomatics, Wuhan University	China
School of Geo-Sciences, University of Edinburgh	United Kingdom
School of Life Sciences-SLS, University of Science and Technology of China	China
SCSIO	China
Second Institute of Oceanography, State Oceanic Administration	China
SERTIT, University of Strasbourg	France
Shanghai Institute of Geology Survey	China
Spatial Information Research Center	China
State Key Lab of Remote Sensing Science, Institute of Remote Sensing Applications, Chinese Academy of Sciences (CAS), Beijing Normal University/Ecosystem Science Department of Environmental Science, Policy and Management, University of California	China/USA

State Key Laboratory of Earthquake Dynamics, Institute of Geology, China Earthquake Administration (CEA)	China
State Key Laboratory of Estuarine and Coastal Research, East China Normal University	China
State Key Laboratory of Hydrology-Water Resources and Hydraulic Engineering, Hohai University	China
State key Laboratory of Lakes and Environment Studies of the Nanjing Institute of Geography and Limnology, NIGLAS	China
State Key Laboratory of Satellite Ocean Environment Dynamics, Second Institute of Oceanography	China
Technical University Eindhoven	Netherlands
Terradue S.r.l	Italy
The Global Fire Monitoring Center (GFMC), Max Planck Institute for Chemistry, Freiburg University	Germany
TUDelft	Netherlands
UK Met Office	United Kingdom
Universitat de Valencia	Spain
Université Paul Sabatier - Toulouse III Centre d'Etudes Spatiales de la Biosphere - CESBIO	France
University of East Anglia, University Campus	United Kingdom
University of Newcastle, University Campus	United Kingdom
University of Pavia	Italy
University of Plymouth	United Kingdom
University of Valladolid, Remote Sensing Laboratory	Spain
VITO - Remote Sensing and Earth Observation Process	Belgium