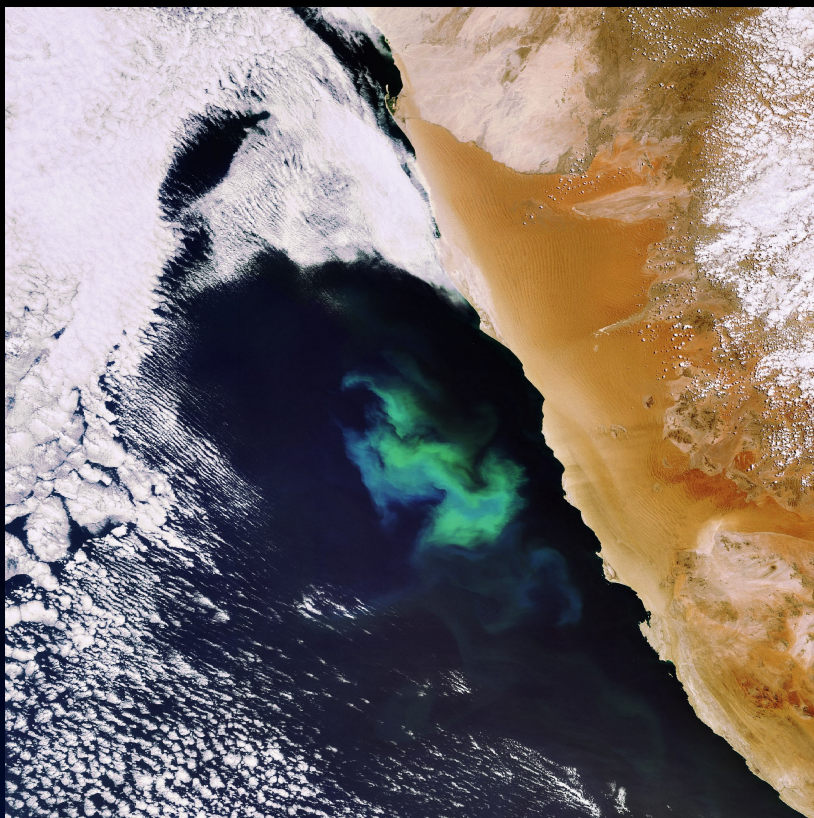


EARSel



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March 2008
No 73



European Association of Remote Sensing Laboratories

Front Cover – Envisat captures vibrant aquamarine-coloured swirls of a plankton bloom decorating the waters of the South Atlantic Ocean just off the shores of the Republic of Namibia. Plankton play a similar role to terrestrial ‘green’ plants in the photosynthetic process and are credited with removing as much carbon dioxide from the atmosphere as their earthbound counterparts, making it important to monitor and model plankton into calculations of future climate change. Image acquired on 6 November 2007 by the MERIS (Medium Resolution Imaging Spectrometer) instrument aboard ESA’s Envisat satellite.
Source: ESA Image Gallery.

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1. EDITORIAL

Dear members,

It is with great regret that we announce the grave news of the passing away of Professor Mike Barnsley of the Swansea University. The European and global remote sensing community is mourning the loss of a great scientist, and mentor to many remote sensing enthusiasts. A full obituary can be found in the News section of this newsletter.

This spring, the "History" of the EARSel organisation is expected to become available. At the moment of writing, the book is being printed and it is very possible that by the time you read this editorial, it will already be available. The book is expected to be very informative for the newer members, about the ambitions and achievements of EARSel.

As with every March issue, you can find the annual reports for 2007, for many of the countries with members in the EARSel organisation. In addition to the usual news and future events, two feature articles can be found in this issue. The first article is about the GMOSS project, which is part of GMES, and was concluded in February 2008. The article contains interesting information about the objectives, work plan and achievements of the network. The second article is regarding the A-Train and two of its six satellites: PARASOL and CALIPSO.

We hope that 2008 started with the best omens for you, both scientifically and personally. We are looking forward to seeing you in Istanbul for the 28th EARSel Annual Symposium.

Sincerely,

The Editorial Team

2. NEWS FROM MEMBERS

2.1 CROATIA 2007 REPORT

Remote sensing and GIS activities in Croatia in 2007 were carried out mostly within institutions and firms that are members of the Scientific Council for remote sensing of the Croatian Academy of Sciences and Arts (CASA). The activities may be ordered according to the topics of interest, i.e. to the Working Groups, and, in addition, to the preparations for the First International Conference on Remote Sensing Techniques in Disaster Management and Emergency Response in the Mediterranean Region.

The description of major activities of particular Working Groups follows:

Photography, General Interpretation and GIS Working Group

The company GEOFOTO from Zagreb carried out photogrammetric photographing using new digital aerial cameras (Veycel UltracamX-Pan, RGB, and NIR). In addition, the official state bases have been transformed into a new referential system.

There was a follow-up of the cyclic aerial photographing of the Croatian territory (Central Croatia), and, in this context, of designing topographic maps (HOK5, TK25, TK50, TK250) and the topological processing of the topographic data base. The work on the military geo-information system (VoGIS) has been initiated. For archaeological research purposes, pilot photographing from a balloon was performed using a Sony digital camera.

Geology and Geophysics Working Group

Aerial photographs were successfully used for designing the following geological maps: basic geological map of the Republic of Croatia (scale 1:50,000); basic geological map for engineer-geology (scale 1:100,000); structural and geo-morphological map (scale 1:100,000). Diverse satellite images for the whole territory of the Republic of Croatia were acquired. Satellite images were used for the purposes of the exploration of various natural resources: In oil and gas exploration, for defining the optimal parameters for recording the 3D seismic). For particular individual areas of exploitation, a digital elevation model was designed.

The firm GEOSAT from Zagreb continued, together with ECOINA, the mineral exploration in Kurdistan, Iraq. In this

exploration, the ASTER and QuickBird satellite images were successfully used. Those images were digitally processed and transformed into cartographic projections; hence, image maps (colour composites) could be designed in the co-ordination system and in the following scales: 1:25,000 and 1:5,000. The images were used for field orientation purposes, and for entering geological and geophysical data with their accurate location. The images were furthermore used for geological mapping: dividing littoral units (rock discrimination) and registering tectonic elements.

Vegetation, Forestry and Agriculture Working Group

The analysis of satellite images relevant for the area of Eastern Croatia (Slavonia) in the vegetation period between 1998 and 2006 was concluded. The acquired data will be very helpful in establishing a system for monitoring the forest status via satellite images of wide temporal resolution. Following a two-year research, maps of habitats and land covers for the nature parks of Lonjsko Polje and Učka have been finalised. Research regarding the status of forest damage has been continued, placing the focus upon the problem issue of fir dry-out (*Abies alba* Mill). For the purposes of this exploration, infrared aerial photographs were successfully used.

The hyper-spectral line scanner (Im Spectar V9) was used for recording the major tree species (fir, oak, beech, spruce et al.), the aim of which had been to obtain the initial reflection status of particular species.

Oceanography Working Group

Automatic oceanographic and meteorological buoys have been installed in the open sea area; thereby, a better coverage by oceanographic and meteorological data of high temporal resolution in real time may be achieved. Such testing has proven particularly useful during cloud, when satellite data on sea temperature are unavailable.

The data on air temperature and atmospheric pressure, as well as on wind direction and velocity, are received via communication satellite, which is registered at the meteorological station located at the "Marko Polo" ship.

Spatial Planning and Environmental Protection Working Group

The work on the STIRP project, engaged in the protection of the Adriatic Sea, the surface waters, the coast and the islands, has been initiated. For the wider Zagreb area, annual aerial photographing aimed at environmental protection and monitoring has been introduced. The data thus acquired are used for the purposes of spatial planning as well.

Hydrometeorology Working Group

Since Croatia is a full member of EUMETSAT, it is entitled to use the satellite data relevant for monitoring seas and oceans. There was a continuance related to the EUMeTrain project, within which the e-learning materials for satellite meteorology and its application are developed and made available on the internet. The activities in the fields of nowcasting and of warnings related to dangerous weather manifestations have, since 2007, become based mainly upon the satellite (optical and radar) images and the products directly deriving from the satellite images.

Archaeology and Historical Heritage Working Group

Remote sensing activities have been carried out in several scientific projects, as well as in scientific archaeological investigation and in the presentation of the achieved results in science journals, exhibitions and museums. Various aerial photographs were used in the following projects:

The Genesis and Continuance of the Croatian Material Culture; The Mediaeval Archaeological Heritage of Croatia in the European Context (5th-17th centuries). These projects comprise particular individual late-antiquity, early mediaeval, late mediaeval and modern-history monuments. Thereby, of special interest are the littoral and insular zones of Istria and Dalmatia.

In conclusion to this report, I would like to point out that in 2007, intense preparations were carried out in relation to the organisation of the First International Conference on Remote Sensing Techniques in Disaster Management and Emergency Response in the Mediterranean Region, which is planned to be held in Zadar, Croatia in 2008.

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2.2 FINLAND 2007 REPORT**General**

The national space strategy for 2005-2007 emphasised increasing the utilisation of satellite technology, positioning, and remote sensing in commercial activities. Participation in major European space programmes and strong research groups are considered vital to achieve these goals. Preparations for a new middle-term national space strategy, to be issued in 2008, have been initiated. Annual public funding of space activities is presently approximately 50 M€. TEKES, Finnish Funding Agency for Technology and Innovation (supporting R&D for commercial and operational activities), and the Academy of Finland (supporting basic research) are the main public funding sources for remote sensing research along with the European Space Agency, European Union and EUMETSAT. Finland's contribution to ESA's remote sensing programmes is 5 M€ and that to EUMETSAT is 3.7 M€. The national Remote Sensing Symposium 2007 had 100 attendees.

Helsinki University of Technology, Laboratory of Space Technology (TKK/LST¹)

The test campaigns of the reference radiometers of ESA's SMOS satellite were completed in 2006, but the development of their calibration procedures continued throughout 2007. The calibration procedures were updated based on new analyses and payload level characterisation and thermal vacuum test results. The use of the reference radiometers as part of the interferometer array - their additional function besides working as a reference for the instrument calibration - was consolidated.

Airborne measurements with the recently completed L-band (1.4 GHz) aperture synthesis radiometer HUT-2D were conducted in April and August 2007 over the Baltic Sea and various land sites in Finland. These data are used to develop and validate SMOS soil moisture and sea surface salinity algorithms. The HUT-2D data acquisitions were funded by the ESA coSMOS-OS project.

TKK/LST coordinates the ESA-funded MERIS-Lakes project (January 2007 through mid-2008). The objective of the project is to develop a processor that derives water quality information from ENVISAT/MERIS

¹ <http://www.space.tkk.fi>

data. In order to validate the processor, two field campaigns were conducted in 2007 at Lakes Vesijärvi and Päijänne. Turbidity time-series were determined using MODIS data in the Catch-Lake project. A preliminary version of software (Matlab GUI) for processing data measured with portable spectrometers (ASD-ProJr and HH) was developed in the Marcoast project.

A boreal snow-covered area (SCA) estimation method, which employs RADARSAT-1 ScanSAR HH-polarization data, was further developed within the SnowCLIM project with regard to operational usability and estimation accuracy for hydrological forecasting purposes. TKK/LST participated in the ESA-funded Polar View project aiming for the development of a snow water equivalent (SWE) algorithm for Eurasia. The algorithm employs space-borne microwave radiometer data, weather station measurements and assimilation methods. TKK/LST is developing snow mapping algorithms for the EUMETSAT-funded H-SAF project. Final products include snow type mapping (no snow, wet snow and dry snow) and snow water equivalent map over Europe. Snow type mapping is based on microwave radiometer data together with optical data. SWE mapping employs an algorithm similar to that developed in the PolarView project.

POL-ICE (Multi-Polarisation SAR for Operational Sea Ice Monitoring, 2005-2007) was part of the joint Finnish-Canadian remote sensing programme. The main objective was to apply dual-polarisation SAR data from ENVISAT ASAR and RADARSAT-2 for improving operational sea ice monitoring. TKK/LST coordinated the Finnish project, determined the incidence angle dependence of backscattering coefficients in SAR images and investigated statistical relationships between SAR data and 3-D laser ice surface topography data.

A Matlab-based simulator was developed for modelling ASIRAS and Cryosat multi-looked echoes for snow covered first-year ice. The simulator enables development of distance tracker algorithms for the ASIRAS and Cryosat data and investigation of the contribution of various scattering sources to the multi-looked echo including sea ice surface and snow volume.

The goal of the NewSAR project was to develop readiness for new generation polarimetric spaceborne SAR applications and evaluate new possibilities of polarimetric

and interferometric techniques in various applications in Finland. TKK/LST was responsible for polarimetric interferometric application evaluation for boreal forest mapping, calibration validation and multi-temporal data utilization.

VTT Technical Research Centre of Finland²

Image analysis method development at VTT has focused on one hand on the super high resolution optical imagery and on the other hand on the most modern synthetic aperture radar (SAR) data. The third major item in the research agenda is combination of multi-source data.

A new image segmentation method Pyramidas was completed. The method and software offer a flexible tool for the delineation of homogeneous regions from satellite or airborne digital data. The Pyramidas method is combined with the Probability tool that estimates forest or other parameter values as continuous variables.

Processing chains including image orthorectification and topographic normalization was developed for the PaISAR polarimetric radar data. Also, forest parameter estimation, land cover mapping and change detection methods were developed using the polarimetric imagery. Use of the fully polarimetric data improved the land cover mapping performance by 5 percentage units in comparison to the combined co-polarized and cross-polarized amplitude data.

Forest change mapping 1993-2003 for the entire French Guiana of approximately 90 000 square kilometres was completed using ERS-1 and ENVISAT radar data. The mapping was validated with a visually interpreted sample of 16 000 observations from optical satellite imagery. The project is part of the GMES service element project Forest Monitoring for ESA and it is conducted in cooperation with the French National Forest Inventory IFN.

In the multi-source domain methods to combine airborne laser scanning data, aerial images and SPOT satellite image were developed. An automatic method to detect the phenological (seasonal) stage from ground-based web cameras was created. A project started to combine data from ground based radars with radar satellite imagery for winter navigation of ships.

² <http://www.vtt.fi>

University of Turku, Laboratory of Computer Cartography (UTU/LCC³)

The UTU-LCC facilities have been largely utilized in 2007 both by remote sensing and geoinformatics courses and research projects. International projects of biogeographical research in Western Amazon have continued and a project of sustainable landscapes in Zanzibar has utilized multiple spatial data sources and produced in its final phase maps of land cover and biotope patterns and their changes in addition to carrying out PGIS campaigns, too. In Finland, the EXTREFLOOD project plays an important role for national flood hazard mapping and risk assessment. A new project of coastal geography research, COASTER, was launched to make inventories, multi-source spatial analysis and modelling of littoral dynamic processes and shoreline morphology in the coastal environment in south-western Finland.

University of Joensuu, Faculty of Forest sciences (UJF⁴)

The UJF research team focussed during 2007 on airborne laser scanning (ALS) and high resolution data fusion. The team completed several forest inventory related studies, which concern estimation of characteristics of tree size distribution of stand and single trees. A few activities are related to optical medium resolution satellite data processing, e.g. super-resolution and image calibration.

In the case of ALS based forest inventory determination of tree species has been of primary interest. To identify tree species, a combination of ALS and aerial photographs was applied. In addition, ALS data based alpha shape metrics were used for tree species recognition. Research efforts were also done to characterize rare nature objects, such as large aspens and herb-rich forests, and to develop a pre-harvest measurement system of a marked stand based on single tree detection and ALS data. International co-operation related to ALS has been most active with University of Life Sciences of Norway.

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2.3 FRANCE 2007 REPORT

Funding and supporting Earth Observation research and technology

CNES, the French Space Agency, develops most of its remote sensing programme in bilateral and multilateral cooperation, as presented hereunder. A priority is given to programmes developed within the ESA Convention. CNES is a major financial provider of the European Space Agency.

In the 2000s, the CNES financial figures are about the same from one year to another one. CNES grants some 20 to 25% of its budget to sustainable development programmes and to the science sector (which are directly relevant to remote sensing).

The French national budget for Earth Observation (Including dual programmes) exceeds some 200 million euros.

France has reaffirmed its proactive policy and intention to sustain its pivotal role in European space, materialised by an annual contribution of 685 million euros to ESA programmes until 2010. This annual contribution includes some 90 million euros specifically devoted to Earth Observation.

French Scientific Remote Sensing Programme (PNTS)

The PNTS⁵ programme associates a wide part of the Earth Observation scientific community in operations lasting several years. It aims at developing methodologies designed to prepare the use of satellite data by scientists, promoting the implementation of operational methods, assessing and assimilating space data in complex models, and promoting interdisciplinary studies. To ensure follow-on to the 2002-2006 period, a call for proposals has been launched to define the PNTS 2008 programme. It allows funding:

- Exploratory studies for future instruments,
- Measure physics studies,
- New processing methodologies for exiting instruments,
- Inter-comparison of satellite and exogenous measurements,
- Innovative use of space observation for a given thematic application.

³ <http://utu-lcc.utu.fi>

⁴ <http://www.joensuu.fi/metsatdk>

⁵ Programme National pour la Télédétection Spatiale.

The priorities are:

- Studies about physics measurement, among which modelling of interaction between electromagnetic waves and atmosphere, oceans and emerged lands;
- Preparation of future missions using active or passive sensors in the solar, infrared and microwave spectral domains;
- Methodological developments using innovative concepts or new capacities offered by recent and future space systems;
- Methodological developments to validate signal modelling and their validity domain,
- Development of new mathematical methods for interpretation, classification and inversion based upon innovative approaches easy to transfer or generalize,
- Development and validation of signal processing techniques paving the way to new applications
- Analysis of relationship between space scales, variables integration, upscaling and downscaling, and spatial analysis methods;
- Methodologies for long temporal series of satellite data taking into account related artefacts.

Using products delivered by 'thematic competence networks' is highly encouraged. Conversely, developed methods and algorithms should contribute to improve the quality and relevance of such products (see hereunder)

High-resolution optical sector systems and scientific preferential data policy

In this field, France runs both the civilian SPOT and military HELIOS systems:

- The **HELIOS-2A**⁶ satellite has been operational since April 2005. It features sharper imagery, improved viewing field and access time to information, as well as an infrared capability for night imaging. Its ground segment has been enhanced as well.
- The **SPOT**⁷ constellation currently includes three satellites (2, 4, and 5). End 2007, the related archive includes more than 16 million scenes (including more than 110 million km² of stereoscopic coverage by the HRS instrument). More than 35.000 scenes were produced by SPOT IMAGE in 2006.

⁶ HELIOS, sun-synchronous satellites, are named after the Sun God in Greek mythology, supposed to see everything.

⁷ Satellite Pour l'Observation de la Terre.

- As follow-on to SPOT, CNES has associated with Italy to implement the **ORFEO**⁸ programme that will consist of several small compact satellites. This dual-use (military and civilian) programme includes a high resolution optical instrument developed by France (Pléiades-HR), and an X-band radar element (3-12 cm wavelength) developed by Italy (Cosmo-Skymed). The first Cosmo-Skymed was launched in 2007. The first **Pléiades-HR** satellite should be launched at the very beginning of 2010, the second one in March 2010. Pléiades will ensure the continuity and enhancement of wide field observations after SPOT-5, in panchromatic and multispectral bands. Pleiades will offer a 0.7 m resolution within a 20 km field of view, and a daily revisit capacity.
- The **ISIS**⁹ programme (CNES) that grants the European scientific community an easier access to SPOT space imagery through preferential rates is reserved for French users. Since 1 February 2005, European researchers can access the new **OASIS**¹⁰ programme, which allows the scientific community of 32 countries to use SPOT products for free. In addition the ESA-led **TPM** programme allowed a free access to SPOT-4 products archive and programming for so-called "Category-1" ESA-labelled users and for the GMES/GSE projects.

Vegetation

- Two **VEGETATION** instruments are currently flying onboard SPOT-4 and -5. They offer long-term (beyond 10 years), medium resolution (1.1 km) and wide field (2,200 km) observations, with a typical daily revisit period. VEGETATION is designed for both operational and scientific aims. It is much used within the scope of the Millennium Ecosystem Assessment.
- France cooperates with Israel in the **Venus**¹¹ research mission, dedicated to Earth Observation (especially vegetation and sustainable development applications). Scheduled to be operational in 2010, the Venus micro-satellite will cover every other day 50 to 100 representative sites of the main terrestrial

⁸ Optical and Radar Federated Earth Observation.

⁹ Incitation à l'utilisation Scientifique des Images Spot.

¹⁰ Optimising Access to SPOT Infrastructure for Science.

¹¹ Vegetation and Environment Monitoring New Micro-Satellite.

and coastal ecosystems in 12 spectral bands, in the visible and near infra-red regions. PI's for related scientific studies were selected.

Geodesy and 'Solid Earth'

Five **Doris**¹² instruments are currently flying (SPOT-2, SPOT-4, SPOT-5, ENVISAT, JASON). In its latest configuration, Doris enables a 1-cm accuracy positioning and a few yearly mm for the motion of its 55 ground stations. Enhanced Doris instruments are planned to be used in future missions such as Pléiades, Jason-2 and AltiKa. The Doris tracking network is being modernised using third-generation antennas and improved beacon monumentation.

Developed by France and the USA, the **ARGOS** system has been operational since 1978. This system allows to determine the accurate position of any object equipped with Argos beacons and to collect any information transmitted by them. This unique system is exploited worldwide by CLS, a subsidiary of CNES and Ifremer¹³. The first third generation instrument was carried on board of METOP (see hereunder) launched in 2006.

Geomagnetism: France has been cooperating with Denmark in the still operational **OERSTED**¹⁴ mission and will contribute to ESA's **SWARM** mission, scheduled for launch in 2009.

Gravity: France collaborates with the three main dedicated gravity missions of the decade, i.e.: currently with Germany for **CHAMP**¹⁵ and with the US **GRACE**¹⁶ mission, and with ESA's **GOCE**¹⁷ mission to be launched in 2008.

Study of electromagnetic and ionosphere disturbances: Scientific results of CNES DEMETER¹⁸ micro-satellite have been acquired since 2005 and confirm the relevance of the high quality data obtained. These disturbances are believed to be correlated with Earth crust phenomena.

¹² **D**oppler and **R**adio Positioning Integration by **S**atellite.

¹³ French Research Institute for Exploitation of the Sea

¹⁴ Named after the Danish physicist.

¹⁵ **C**hallenging **M**ini-satellite **P**ayload for **G**eophysical Research and Application.

¹⁶ **G**ravity **R**ecovery **A**nd **C**limate Experiment.

¹⁷ **G**ravity Field and Steady-State **O**cean **C**irculation Explorer.

¹⁸ **D**etection of **E**lectro-**M**agnetic **E**mission **T**ransmitted from **E**arthquake **R**egions.

Oceans

- The Franco-American **TOPEX-POSEIDON** system stopped operating in 2005 after a successful 13-year mission. Its successor, the **JASON-1** mini-satellite has enabled to study ocean dynamics and to determine sea level with 1-cm accuracy. The future **JASON-2** satellite, to be launched in 2008, will be a key component of the Ocean Surface Topography Mission (EUMETSAT). This illustrates a progressive transfer of operational systems from research agencies to operational agencies.
- A new ocean observation programme, the operational ocean altimetry **ALTIKA**¹⁹ mission (2010) will be carried out in cooperation with ISRO (Indian Space Research Organisation). It will allow enhanced observations of ocean surface levels, currents, wave height and wind speed at sea surface.
- Now running for 10 years, the French **MERCATOR** project for operational oceanography (real-time assimilation of global data in complex high resolution models) is part of the French involvement in the **MYOCEAN** European Integrated Project (a core component of GMES), which in turn contributes to the **GODAE**²⁰ global experiment.

Meteorology, climate

Following the successful launch of the EUMETSAT **MSG-2**²¹ satellite (2005) developed with a strong the French industry involvement, and the experimental **PUMA**²² exploitation programme, aimed at fostering the use of MSG data for non-meteorological applications in Africa, which ended in September 2005, the **AMESD**²³ programme started. It is considered as a GMES component to help African countries to better manage their natural resources by providing them with relevant environmental information.

France took an important part in the development of the **METOP**²⁴ programme, which is the space segment of the EUMETSAT Polar System (EPS)²⁵. Among

¹⁹ **A**ltimetry in **K**a-band.

²⁰ **G**lobal **O**cean **D**ata **A**ssimilation **E**xperiment.

²¹ **M**eteorosol **S**econd **G**eneration.

²² **P**reparation to the **U**se of **M**SG in **A**frica.

²³ **A**frican **M**onitoring of the **E**nvironment for **S**ustainable **D**evelopment.

²⁴ **M**ETEorological **O**PERational Satellite.

²⁵ The EUMETSAT Polar System consists of the METOP spacecrafts and associated ground segment.

the three polar orbiting satellites to be launched at five-year intervals, the first one was launched in 2006. So, the polar-orbiting satellites dedicated to operational meteorology are now equally shared between EUMETSAT and NOAA. The most innovative METOP payload is **IASI**²⁶, a new-generation Fourier Transform Michelson interferometer developed by CNES that currently provides atmospheric infrared emission spectra of unprecedented accuracy (temperature and humidity profiles accurate to 1°C and 10% respectively, with a vertical resolution of 1 kilometre). It also allows retrieving such trace gases as O₃, CH₄, CO at global scale. It also includes an infrared imaging sensor that allows co-registration with the AVHRR instrument of the payload.

The Indian Space Research Organisation (ISRO) and CNES are developing together the **MEGHA-TROPIQUES**²⁷ satellite planned to be launched in 2009. Megha-Tropiques is expected to provide valuable data for climate research, especially regarding the ITCZ²⁸. It carries on three instruments: MADRAS, a microwave imaging sensor to study rainfall and cloud properties, SAPHIR, a 6-channel microwave radiometer to determine water vapour vertical profile and horizontal distribution and SCARAB, a radiometer to measure top of atmosphere radiative flux.

Aerosols, clouds, radiative budget – The A-Train

CNES' **PARASOL**²⁹ micro-satellite carries a **POLDER**³⁰-like wide-field radiometer. Derived products are currently available to users since April 2005. They include unique information and results about the marine and terrestrial aerosols. They are distributed by CNES and by the ICARE 'Thematic Competence Network' (see below).

Managed by NASA in cooperation with France, the **CALIPSO**³¹ mission was launched in 2006. CALIPSO will allow answering important questions about the effects of clouds and aerosols (airborne particles) on the Earth climate change.

²⁶ Infrared Atmospheric Sounding Interferometer.

²⁷ "Megha" means cloud in Sanskrit and "Tropiques" means tropics in French.

²⁸ Inter-Tropical Convergence Zone.

²⁹ Polarisation and Anisotropy of Reflectances for Atmospheric Sciences coupled with Observations from a Lidar.

³⁰ POLarisation and Directionality of the Earth's Reflectances).

³¹ Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations.

CALIPSO and **PARASOL** are two components of the series of six satellites that make the so-called **A-Train** (Oco, Aqua, Cloudsat, Calipso, Parasol, and Aura) - which CALIPSO joined in 2006. Developed by the NASA, CNES and CSA³², the A-Train is a series of satellites crossing the equator at about 13:30. A-Train is a unique observatory of the integrated Earth system and specially the atmosphere that they sound both horizontally and vertically from about the same location at the same time.

Selection of proposals for assessment studies for the next ESA Earth Explorer Core Missions

In May 2006, ESA informed the national delegations that the ESAC recommended the following studies for pre-phase A studies: BIOMASS, TRAQ, PREMIER, FLEX, A-SCOPE, CoReH20. France is deeply involved in these proposals, and namely in the two first ones.

BIOMASS aims at delineating forests and quantifying forest biomass using a high resolution P-band (alternatively L-band) SAR working in two modes and offering repeat-pass interferometry.

TRAQ aims at estimating the troposphere composition and air quality. It will also allow studying atmospheric chemical processes. **TRAQ** is based upon a new synergistic sensor concept. The SIFTI instrument is a static Fourier Transform spectrometer allowing a proper vertical sampling of the troposphere.

The related Phases A are planned to be completed in 2009.

'Thematic competence networks'

The French programme of 'thematic competence networks' is a major initiative meant to provide scientists with relevant products and information, while saving as much time and manpower as possible regarding data handling and pre-processing irrelevant to their scope of research.

- The **POSTEL**³³ "Land Surfaces" Thematic centre (biogeophysical geocoded information) is a competence network associating several national research laboratories and a service unit, fulfilling a developing and an operating function. Actually, this service unit takes advantage of projects developed under France, EC

³² Canadian Space Agency.

³³ Pôle d'Observation des Surfaces Terrestres aux Echelles Grandes.

and ESA funding. So, it is expected to supersede the national level by becoming a part of the GMES Land Monitoring Core Service. POSTEL was described in EARSeL Newsletter 65, March 2006, pp 49-50.

- The **ETHER** Thematic Competence Network manages and valorises data related to atmospheric chemistry.
- The **ICARE**³⁴ Thematic Competence Network is a partnership dedicated to aerosols, clouds, radiation and the water cycle. Among others, it distributes atmospheric products derived from PARASOL (see above).

Environment and security:

From its very beginning, France has been strongly supporting the **GMES**³⁵ initiative, aimed at designing and establishing by 2008 a European capacity to provide and use operational services for Global Monitoring of Environment and Security. ESA was involved in GMES through the **GSE**³⁶ scheme that is a suite of Earth Observation-based precursor services. Out of the 12 initial GSE projects³⁷, France was engaged in 11 and leading 3 of them. The potential future role of MERCATOR and POSTEL initiatives are quoted below.

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2.4 GERMANY 2007 REPORT

1. German Space Agency (Dr. Gerald Braun), DLR, Bonn

The German Space Agency coordinates the distribution of the space related budget from the Federal Ministry of Economics and Technology (BMWi). Apart from the contribution to European space programmes there are a series of R&D projects funded through the space agency.

³⁴ Interactions Clouds Aerosols Radiations Etc.

³⁵ Global Monitoring for Environment and Security.

³⁶ GMES Service Elements.

³⁷ These 12 projects cover the following areas: ground motion hazards, operational ice monitoring, polar monitoring, crop monitoring, urban mapping services, forest monitoring, water management, forest fire and flood management risk information, coastal zone management, ocean surveillance, atmospheric composition, humanitarian aid.

DeMARINE is going to be launched as one of the German "interfacing projects" besides DeCOVER and DeSECURE related to the GMES Fast Track Services. The focus of the project is divided into the marine environmental and the marine security aspects. The regional interests will be mostly the Baltic and the North Sea with some extend into the Northern Atlantic. The environmental topics deal with coastal protection, oil spill etc; the security topics will be research on vessel security, traffic security etc. Both topics will use optical and Radar remote sensing data to modify, optimise or develop methods and products. Starting by mid 2008 DeMARINE is designed for project cycle of 3 years and will be supported from the R&D budget with 3 million  , which allows the participation of research institutions, universities, industry and SMEs as well.

DeSECURE is the second joint project in this cluster. The objective is the optimization and medium term stabilization of the German Crisis Reaction Capacities. The project consortium is composed of SMEs, research institutes and users:

- DLR
- Definiens AG
- GAF AG
- Infoterra GmbH
- Pro DV Software AG
- RapidEye AG
- Technical University Berlin
- Technical University Munich

The Main objectives are:

- Improving operational provision of satellite based crisis information
- Strengthening the methodological-technical rapid mapping capacities in Germany
- Integration of German satellites in the rapid mapping chain: RapidEye, TerraSAR-X

The users are the Federal Crisis Centre of the Department of Foreign Affairs, the Common Communication Centre in the Federal Office of Civil Protection and Disaster Assistance and the Monitoring and Information Centre of the European Commission.

The project has been started in April 2007 for a 3 years period with a public cost contribution of 2.5 million  .

DeCOVER has been launched in July 2005 as the first joint project with the focus on the service needs of federal and regional

German authorities to report on land use, land cover, environment and regional infrastructure for several European, Federal and regional Schemes like CLC, habitat type monitoring, change layers for mapping, other directives etc. The approach is strictly user oriented in view of future synergy effects for several governmental financing obligations by applying new optical and Radar remote sensing methods in combination with thematic interoperability issues. The project consortium is composed of SMEs, research institutes and industry:

- EFTAS GmbH
- Definiens AG
- Delphi IMM GmbH
- GAF AG
- GDS GmbH
- Infoterra GmbH
- Jena Optronics GmbH
- RapidEye AG
- RSS GmbH
- University of Hanover

The Main objectives are:

- Improving operational provision of satellite based land cover information
- Strengthening the methodological-technical environmental mapping synergies in Germany
- Integration of German satellites in the land use and environmental mapping chain: RapidEye, TerraSAR-X

The core users are the Federal Agency for Environment, Federal Agency for Nature Conservation and the Federal Agency for Cartography and Geodesy. Besides these there is a registered user community of over 80 federal and regional departments, agencies and regional councils.

The project has been started in July 2005 for a 3 years period with a public cost contribution of 3.5 million €. The funding of further 3 million € has been earmarked for another 3 year phase starting in July 2008.

AO Synergy between RapidEye and TerraSAR-X. This announcement of opportunity has been launched in late 2007 with the objective to promote further R&D activities between the two new German satellite systems, that is between optical and Radar remote sensing data. The start of projects is foreseen for the middle of 2008. The space agency has selected from 56 applications 9 proposals for funding in the next two to three years with a total amount of 2 million €.

2. Standard Guideline Imaging Spectroscopy (Dr. Christian Fischer), DLR/VDI

Scientists from science and industry as well as from well known consulting companies in Germany have started to develop an official Guideline for Airborne Imaging Spectroscopy to facilitate the acceptance of hyper spectral imagery. Therefore the general principles of current sensor technologies and their relevant physical parameters, combined with the basics and principles of aerial flight campaigns in collecting and processing data and quality aspects of the imagery itself are described. The aim is to develop an essential document that provides general principles and information of the quality of hyper spectral imagery and derived products for data suppliers and users alike.

This activity is supported by the Centre of Competence for Optical Technologies (KfOT) funded by the Ministry of Education and Research (BMBF) and hosted by the German Engineers Association (VDI). The VDI is the largest technical-scientific Association in Germany and also an international leading organisation. It fosters offices in Berlin and Brussels. VDI guidelines serve as a strategic and economic instrument due to the fact that legislation refers since 1985 to VDI guidelines to ease governmental regulations. These guidelines are often a first step to further adoption within the German Industrial Standardisation Institute (DIN) and then in CEN and ISO.

3. CORINE Land Cover in Germany

The realization of CLC 2006 in Germany has been initiated in November 2007 by the Federal Agency for Environment (UBA) with support of the German Remote Sensing Centre (DFD) within the DLR. During the Kick-Off Meeting in Oberpfaffenhofen there were the experienced value adding companies from the CLC 2000 exercise and the Federal Agency for Cartography (BKG) and Geodesy involved to discuss different approaches for doing a change detection without a complete mapping of the new situation, decreasing the minimum mapping unit at the same time and allowing besides synergy with other projects also the derivation of a new land use status.

DLR and BKG are testing the possibility to update the CLC data set from the national cartographic data model which itself will have to be transformed to the CLC nomenclature and partially updated by satellite data first.

Currently there are four test sheets in preparation to achieve comparative results for the decision in spring 2008 which method will be chosen to do the whole of Germany in 2008 and 2009.

4. German Industry Standardization Institute (DIN)

Since a couple of years a working group is active to prepare a series of standards on the quality of products in photogrammetry and remote sensing (Requirements for the quality of land use classifications). Currently the standards no. 5 (future DIN 18740-5) and no. 6 (future DIN 18740-6) are under preparation. Chairman of the working group is **Prof. Ralf Reulke**, Humboldt University Berlin.

The current state of progress is that the standard on land use classification will be submitted in 2008 for final review while the standard of data fusion will slip into the year 2009. Compared to the state of work in the ISO technical committee TC211 there is currently no similar work which may result into the development of a model standard for later adoption in CEN and ISO.

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2.5 ITALY 2007 REPORT

Italy hosted the 27th EARSeL Symposium, *GeoInformation in Europe* reflecting the broadening scope and deeper integration of diverse technologies towards the better management of European resources and recognition of the need to develop ways to foster and strengthen these developments through various European initiatives including GeoInformation, INSPIRE, Galileo, GMES, GEOSS, etc.

A range of workshops were proposed in conjunction with the Symposium:

- *Tools and Techniques for the Analysis of Time Series Image Data* focused on the emerging area of analysis in remote sensing to do with changes over time

- *Remote Sensing of the Coastal Zone, from Inland to Marine Waters*, with a dedicated excursion on the Garda Lake in Sirmione, Italy.

- *GMES (Global Monitoring for Environment and Security)* addressing a main issue in our professional life and medium-term plans: *What role for European research - and among others remote sensing research - in the GSE ?*

- *Geologic Hazards in Mountainous Areas* with an excursion to the Dolomites

The Symposium also included a collaboration with ISPRS Commission VIII, Remote Sensing Applications and Policies, the Working Group 2 : 'Natural Hazards and Human Health'.

The 27th EARSeL international Symposium was the occasion to present a spectacular exhibition of images from satellite, whose title was: *"Between light and shadow, beyond the rainbow, the Earth from the Space."*

The exhibition included 30 images from Space. Providing a perspective, which underline a planet not so well known in its synoptic view. These images mainly had an artistic value and were very fascinating for the general public.

For students, a *Didactic Interactive Laboratory for Remote Sensing* was organised, in combination with the show of satellite images and aimed to gradually introduce them to the complexity of the Remote Sensing system.

The hosting structure was the EURAC Convention Centre, a structure which also included the Institute for Applied Remote Sensing of EURAC Research, formally instituted in September 2006.

Italian Space Agency (ASI)

Giovanni Fabrizio Bignami, was appointed as President of the Italian Space Agency in April 2007.

GFB was instrumental in developing gamma-ray astronomy as a new space-age discipline. His work was essential in discovering a population of gamma-ray sources in our Galaxy, as well as in discovering the first extragalactic gamma-ray source. His research on the identification and understanding of Geminga as the first of a new class of gamma-ray neutron stars remains a template for today's workers in the field.

More recent work in X- and gamma-ray astronomy has yielded a new measure of an isolated neutron star magnetic field and other interesting properties of neutron stars, as well as the first evidence for asymmetry of

the galactic antimatter distribution and its possible explanation.

2003-2006 Director of the Centre d'Etude Spatiale des Rayonnements, CNRS/UPS, Toulouse, France

2006: Officier de la Legion d'Honneur de la Republique Française

The most spectacular moments have been the launches of three national satellites, AGILE and Cosmo Sky-Med 1 and 2. Credit goes to the scientific and technological teams (from ASI, the industry and the scientific community). In particular, are now available the first astronomical images of AGILE and the first images from Cosmo-SkyMed.

COSMO-SkyMed doubles

A second satellite was launched from the Vandenberg (US) base. On Sunday morning (December 9, 2007) at 3.30 Italian time, a Boeing Delta II rocket launched the second satellite of the earth observation constellation, COSMO-SkyMed, from Vandenberg US air force base.

The Italian COSMO-SkyMed system, the first dual-use global earth observation constellation, will entail the launch of four radar satellites that can "see" in all weather and light conditions. The system comprises four radar satellites for dual use (civil/government, military and commercial) and is designed to monitor and survey the entire globe for civil protection (environmental risk management), strategic (defence and national security), and scientific and commercial purposes. It will be particularly useful for applications in environmental risk management, emergencies, defence and national security and will thus be able to provide assessments of situations on a global scale. Development of the whole system requires total investment of around EUR 1 billion.

Since its launch into orbit in June 2007, the COSMO-SkyMed 1 satellite has successfully completed all the test phases, and to date, has already captured 4,000 images, corresponding, in its various operational configurations, to an overall area of approximately 6,900,000 sq km. In this four-month period, COSMO-SkyMed 1 has confirmed the high quality of its operational performance and capacity, providing detailed images of, for example, the sites of natural and environmental disasters, such as the Bolzano landslide, the wreck of the Russian

oil tanker Volganef-139 in the Black Sea and the recent cyclone in Bangladesh. With the launch of the second satellite of the system today, COSMO-SkyMed's capacity to capture and produce images of the Earth will be doubled to 900 a day. The satellites will be able to provide daily mapping data on around 1.5 million sq km. Even more important is the improvement that will be obtained in the frequency with which it will be possible to observe the same site. With two satellites in operation, the time taken to revisit the same point on the globe will be reduced to less than 45 hours. When the entire constellation is in orbit and fully operational, this frequency will fall to 6/8 hours, opening the way to new applications and services relating to environmental monitoring, security and risk management.

COSMO-SkyMed will be integrated with two French optical satellites (Helios II) and, thanks to an agreement between the Italian Space Agency (ASI) and its Argentine counterpart (CONAE), will then work in conjunction with the two Argentine Saocom satellites to create the Siasge programme. The COSMO-SkyMed system is one of the "building blocks" for the European GMES (Global Monitoring for Environmental Security) programme. The third satellite will also be launched from the Vandenberg air force base, California, in summer 2008.

COSMO-SkyMed is a programme created through an agreement between the Italian Space Agency and the Italian Defence Ministry, developed by Thales Alenia Space, prime contractor and manager of the entire system. Telespazio is responsible for building the civil and military ground segments.

Associations

The Federation of the Scientific Societies for the Geographic and Environmental Information (ASITA).

The ASITA federation is based, since 1997, on the collaboration of four Scientific Associations concerning with different aspects of Geomatics:

SIFET - Società Italiana di Topografia e Fotogrammetria, representing Italy in ISPRS (International Society for Photogrammetry and Remote Sensing)

AIC - Associazione Italiana di Cartografia representing Italy in ICA (International Cartography Association)

AIT - Italian Remote Sensing Association, since 1996 Associate Member of ISPRS,

AM/FM/GIS Italia - Automated Mapping/ Facilities Management/ Geographic Information System/Italia, representing Italy in (European Umbrella for Geographical Information).

The 11th National Conference was held in Turin, 6-9 November 2007. About 1.300 registered at the Conference, 400 papers were published in the Proceedings, and more than 60 exhibitors presented their technical solutions in the field of the Geographic Information.

The list of the several activities promoted by ASITA are reported in the Web site: www.asita.it

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2.6 NETHERLANDS 2007 REPORT

Introduction

This report is split into a general part I which contains information on activities in remote sensing at the National level in the Netherlands and a member specific part II that contains information from the individual members.

Earth observation in NL (Part I)

NL role in earth observation has been carved out by over the last 15 years of support and guidance by the Netherlands Remote Sensing Board (BCRS) through its User Support programme. BCRS is no longer, but through the National Science Foundation (delegated to the SRON bureau external research) support for earth observation research as well as operational services is given.

There are two budget lines for funding of operational and application oriented use of earth observation and for science support. The National User Support Programme NUSP³⁸ is executed by the Netherlands Agency for Aerospace Programmes (NIVR) and the Space Research Organization of the Netherlands (SRON). The NUSP is financed from the national space budget. The NUSP subsidy arrangement contributes to the

development of new applications and policy-supporting research, institutional use and use by private companies.

The Science support programme is issued by the Netherlands Research Council (NWO) under the life- and earth sciences initiative and executed by SRON³⁹. Another budget line, the field of planetary geosciences has also been revived in the Netherlands. Recently a platform for planetary research in the Netherlands was established: the 'National Platform voor Planetenonderzoek (NPP)'. This platform brings together scientists and industry and serves as a support to ESA's planetary geosciences missions. Mrs. Dr. Tanja Zegers of ESA and Utrecht University is chairing this platform. See <http://www.planetenonderzoek.nl/> (only in Dutch)

Since 23 October 2003 there is one professional organization covering the field of geo-information science namely 'Geo-information Netherlands – GIN'⁴⁰. GIN has 3500 members and covers a wide range of professional fields in the arena of geo-information science at academic but also at a polytechnic and practitioners level. Of the six sections, two deal with remote sensing aspects namely the section on earth observation chaired by Prof. Vosselman of ITC. During 2006 one-day workshops/symposia were organized by the section earth observation on digital cameras on 11 December 2006. In addition, GIN organizes each year a one day GIN symposium and a three day GIN conference and exhibition (former Geodesia congress). GIN also has an email newsletter, a bulletin (Geo-Info) and a website (www.geo-info.nl). The Netherlands (formally the GIN section earth observation) hosts the ISPRS technical commission VII on thematic processing, modelling and analysis of remote sensed data under presidency of Professor John van Genderen of ITC.

Earth Observation in NL (Part II)

The Netherlands has 14 members of EARSeL throughout 2007 namely:

1. Department of Geoinformation and ICT (AGI), RWS
2. Synoptics, Integrated Remote Sensing and GIS Applications
3. Netherlands Institute for Sea Research (NIOZ)
4. Royal Netherlands Meteorological Institute (KNMI)

³⁸ <http://www.ao-go.nivr.nl/>

³⁹ <http://www.sron.nl/>

⁴⁰ <http://www.geo-info.nl>

5. ALTERRA
 6. National Aerospace Laboratory NLR
 7. TNO-Physics & Electronics Laboratory
 8. Laboratory of Geo-Information Science and Remote Sensing (Wageningen University)
 9. International Institute for Geo-Information Science and earth observation (ITC)
 10. Department of Physical Geography, Utrecht University
 11. ARGOSS
 12. P. Geerders Consultancy
 13. Terralimaging B.V.
 14. Landscape and Environmental Research Group, University of Amsterdam
- This is the same number as in 2006.

Laboratory of Geo-Information Science and Remote Sensing (Wageningen University)

Representative: Dr. Jan Clevers

This report is a combined effort of the Wageningen University and Research Centre (Department CGI) and Alterra.

The Centre for Geo-Information (CGI) is a joint undertaking of the laboratory of Geo-Information Science and Remote Sensing⁴¹ of Wageningen University and the department of Geo-Information⁴² of Alterra.

One of the specialist themes concerns Remote Sensing (RS) or Earth Observation (EO). This theme deals with the acquisition and analysis of spatial data through geoinformation and RS techniques. The theme deals with image processing techniques (e.g., classification, segmentation, aggregation, change detection, data fusion, data mining, neural networks, wavelets), physical parameter estimations (atmospheric correction, BRDF, estimating vegetation parameters such as LAI, fAPAR, coverage, albedo, emissivity, plant and soil temperatures, soil moisture, and the synergy VIS/SWIR-TIR-MW) and data assimilation (coupled numerical modelling of complex water-soil-vegetation-atmosphere systems by assimilation of satellite observations).

CGI is member of the Hyperspectral Imaging Network (HYPER-I-NET), which is a four-year (2007-2010) FP6 Marie Curie Research Training Network designed to build an interdisciplinary European research community focusing on hyperspectral

imaging activities⁴³. CGI also contributes to Hyperspectral Remote Sensing in Europe specific Support Actions (HYRESSA), aiming at an improved access to hyperspectral data across Europe⁴⁴.

Some specific on-going remote sensing activities concern:

- Mapping and monitoring land cover and land use in the Netherlands; recently the fifth version of the national land use of the Netherlands (LGN5) has been produced. An update of the Corine land cover data base of the Netherlands also has been realized.
- Assimilation of remote sensing data in regional crop growth models on crop yield forecasting has been applied to improve operational systems, such as the MARS-OP project coordinated by the European Joint Research Centre, Ispra, Italy.
- Assessment of the impact of global change on biodiversity and ecosystems by using advanced modelling approaches and remote sensing data is performed within the FP6 Ecochange project⁴⁵.
- Energy balance modelling and irrigation performance monitoring was performed for pilot projects in Ukraine, Morocco and China to map drought based on satellite imagery to improve operational water management.

During the last ISPRS conference (July 2004) in Istanbul, Turkey, Prof. Dr. Michael Schaepman (Wageningen University - CGI) was appointed the new chairman of the working group VII/1 on fundamental physics and modelling in remote sensing. Under the lead of the president of the ISPRS Commission VII, Prof. Dr. John van Genderen from ITC in the Netherlands, Michael Schaepman will jointly with his co-chair Prof. Dr. Shunlin Liang (Univ. of Maryland, USA) and secretary Dr. Mathias Kneubuehler (Univ. of Zurich, Switzerland) strengthen the importance of quantitative remote sensing using physical based approaches in the user community. During 2007 this working group organized ISPMRS'07, the 10th International Symposium on Physical Measurements and Spectral Signatures in Remote Sensing in Davos (Switzerland), March 12-14, 2007⁴⁶. In addition, CGI is increasingly contributing to GEO and GEOSS through its activities.

⁴¹ <http://www.geo-informatie.nl/>

⁴² <http://www.alterra.wur.nl/UK/research/Specialisation+Geo-information/>

⁴³ <http://hyperinet.multimediacampus.it/>

⁴⁴ <http://www.hyressa.net>

⁴⁵ <http://www.ecochange-project.eu>

⁴⁶ <http://www.ispmrs07.org/>

International Institute for Geo-information Science and Earth Observation (ITC)

Representative: Prof. Freek van der Meer

Networks and partnerships

ITC plays a pivotal role in international networks and initiatives. During the last five years ITC has concentrated on setting up joint education educational programmes at technician, PM and MSc level in partnership with local universities and institutes in various regions in the world. These are instruments to contribute to building organisational capacity in less developed countries focusing on issues of relevance (droughts in Sub Saharan Africa, tsunamis in SE Asia, floods in China etc.) to the region and embedded in local infrastructures. The joint education partnerships are no isolated bilateral agreements between ITC and one partner, but they are part of a larger network in which ITC participates: the GI-Net. GI-Net stands for Geo-Information Network for Education and Training". The main aim of the network is to promote the use of spatial information and earth observation through capacity building and institutional development. More details can be found at <http://www.gi-net.org/>.

ITC participates in an EU Erasmus Mundus programme on Environmental Modelling with the Universities of Lund, Southampton and Warsaw as partners. Through this programme so far 34 (6 in 2004 and 28 in 2005) MScs graduated and presently over 30 students are attending the programme intending to graduate in March 2008. This programme offers EU-funded scholarships to exceptional non-EU students. In 2007 ITC won the competition for the EU's new Erasmus Mundus External Cooperation Window which offers more than 1,300 scholarships to Russia, Central Asia, Iran, Iraq and Yemen for purposes of studying, training or carrying out research abroad in the academic year of 2007-2008. The scholarships are targeted at undergraduate, master's, doctorate and post-doctoral levels, as well as at the exchange of academic staff for teaching, training and research purposes.

On 4th April 2005, the United Nations University (UNU) and ITC entered into an agreement, appointing ITC as an Associated Institution of the UNU. ITC has two programmes with UNU embedded in an ITC – UNU School namely one on Capacity Building for Disaster Geo-Information Management (DGIM) and one on Land Administration Studies. See also: <http://www.itc.nl/unu/>.

ITC also plays an active role in the Global Earth Observation System of Systems (GEOSS) initiative as the institute has a leading role in the Capacity Building Working Group of GEOSS (lead in tasks CB-06-01 and CB-06-03). In the framework of GEO Netcast ITC has a MSG facility for data storage and distribution. On 1-2 November 2007 ITC organized and hosted a Executive Seminar on the recognition of cross border capacity building in earth observation⁴⁷. This was a joint initiative of ITC, GEO Secretariat and ISPRS TC VI WG VI/1 and VI/3.

ITC hosts the ISPRS technical commission VII on thematic processing, modelling and analysis of remote sensed data under presidency of Professor John van Genderen of ITC. In the framework of this several workshops were held in 2007. Amongst these a workshop at ITC from 15-17 June 2007 on "Spatial Data Quality", which is the premier international symposium of ISPRS's working group II-7 - Quality of Spatio-Temporal data and models - for international leading scientists and young researchers to share experiences in this field. See also: <http://www.itc.nl/issdq2007/>

Research programme

ITC has revised its research programme after having gone through an external research review. Focus of ITC's research is on the use of geoinformation and earth observation, themes addressed are:

- Biodiversity in fragmenting landscapes
- Carbon cycle and climate change
- Disaster management
- Earth systems science
- Food security and environmental sustainability
- Informed multilevel governance of urban regions
- Land administration for informed governance
- Managing water scarcity
- Spatial data infrastructure technology
- Spatio-temporal data integration and visualization
- Stochastic methods for image mining and data quality
- Sustainable urban-regional dynamics
- Topographic mapping
- Water cycle and climate

New remote sensing equipment

⁴⁷http://intranet.itc.nl/support/com/documents/Leaflet_GEO_2007.pdf

ITC has a geochemistry/water/vegetation laboratory with ICP MS equipment. We have geophysical equipment for resistivity and various other methods and a spectrometer pool consisting of a ASD fieldspec, GER 3700, PIMA and two Licor's. In 2007 ITC expanded its remote sensing spectroscopy pool with two world class thermal infrared spectrometers. To support our analytical laboratory, we bought a Fourier Transform Infrared (FT-IR) interferometer: the BRUKER FTIR of the VERTEX series. This instrument measures the SWIR up to TIR windows. At the moment of writing this report, the instrument's integrating sphere is added to the configuration which allows to measure soil and rock samples as well as man made materials. The present setup has a drift casing which allows to measure very small quantities of material. The second instrument is a thermal field camera. The FTIR and thermal camera allow to measure the TIR window and thus to calibrate thermal bands of ASTER, MODIS and Sebas as well as future TIR sensors (ARES). TIR spectroscopy also has an advantage over NIR-SWIR spectroscopy that you can look at principal absorption rather than overtones.

Projects

ITC participates in several ESA projects amongst these the Tiger (Africa) and Dragon (China) initiatives which are pivotal in ITC's Capacity Building programme both on site in Africa and China. ITC also organized a large field campaign for ESA: the Eagle campaign.

Department of Physical Geography, Utrecht University

Representative: Prof. Steven de Jong, Dr. Elisabeth Addink

PhD theses work at Utrecht University:

In 2007 four remote sensing - GIS related PhD theses were successfully completed and defended. These four PhD projects were:

1. Laser Altimetry to Survey Hydraulic Roughness within River Banks by Menno Straatsma
2. Imaging Spectroscopy of Salt-Affected Soils: model-based integrated method by Jamshid Farifteh, together with ITC.
3. Simulating floods: on the application of a 2D-hydraulic model for flood hazard and risk

assessment by Dinand Alkema, together with ITC.

4. Beach Watch, the effect of daily morphodynamics on seasonal beach evolution by Susanne Quartel.

All PhD theses of Utrecht University are published in the book series 'Netherlands Geographical Studies' (NGS) and can be acquired via www.geography.nl. ITC PhD theses are available via www.itc.nl.

Examples of ongoing remote sensing projects of the Utrecht group 2007 were:

Rainfall interception mapping using hyperspectral remote sensing.

A method was developed to quantitatively estimate rainfall interception by vegetation from hyperspectral remote sensing, very useful for water balance and erosion studies. Rainfall interception by vegetation is an important factor in the water balance and should be an important factor in models simulating processes such as evaporation, surface runoff and crop growth. In practice, however, it is difficult to make quantitative assessments of the spatial and temporal distribution of rainfall interception loss at for instance the stand level or catchment level, and next to make these values available as model input. In this paper we present a novel method using airborne hyperspectral earth observation images (HyMap) to estimate local quantitative values of rainfall interception loss. Spectral mixture analysis yield the fractional vegetation cover per pixel while spectral vegetation indices yield the vegetation canopy storage via leaf area index estimates. The method is illustrated for a part of the Payne catchment in southern France. Figure 1 below shows the various steps used in the method from the original HyMap image (A), to the computed Leaf Area Index (B), the bare soil/vegetation fraction and the computed rainfall interception for a given rainfall event of 30 mm. The innovative method is published as:

De Jong S.M. & V.G. Jetten, 2007, Estimating Spatial Patterns of Rainfall Interception from Remotely Sensed Vegetation Indices and Spectral Mixture Analysis. International Journal of Geographical Information Science, Special Issue, Vol.21, pp.529-545.

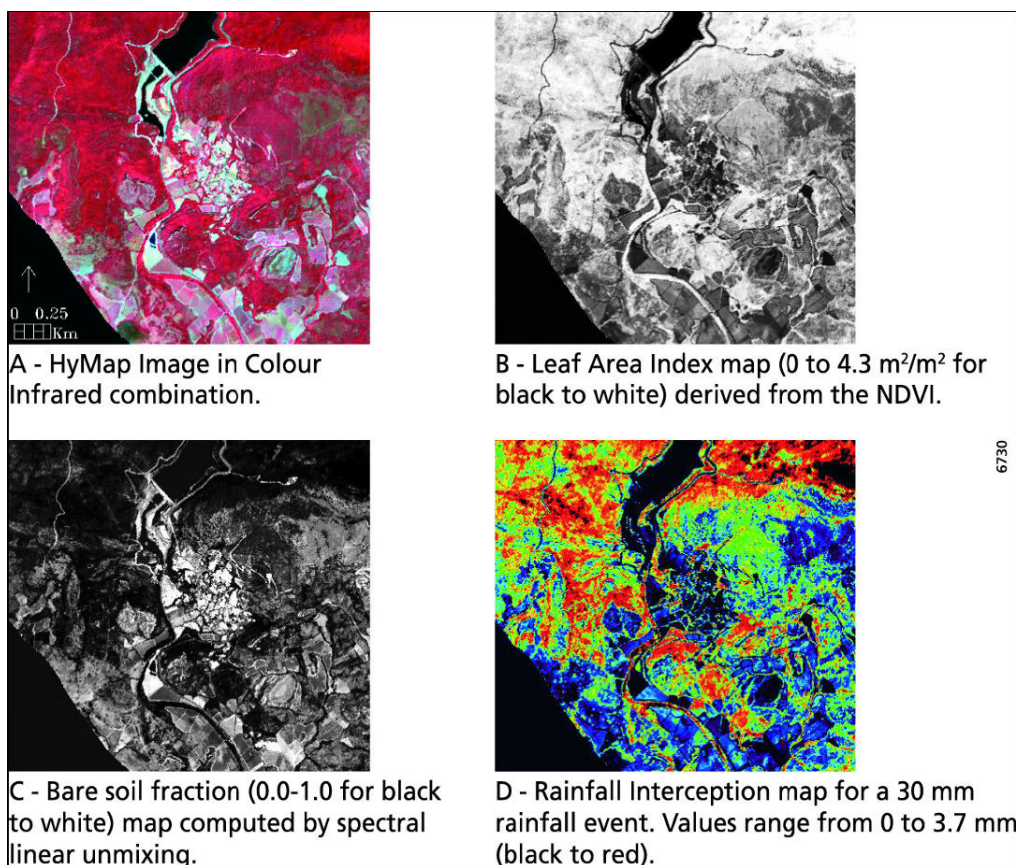


Figure 1. Images and derived maps used in the canopy storage capacity estimation a) HyMap Image in Colour Infrared combination; b) leaf area index map (0 to 4.3 m²/m² for black to white) derived from NDVI; c) Bare soil fraction (0.0-1.0 for black to white) map; d) Rainfall interception map for a 30 mm rainfall event. Values range from 0 to 3.7 mm (black to red).

Object-oriented image analysis for spatial ecological modelling

A project funded by the Netherlands Research Organisation (NWO) and carried out by Ms Dr Addink. The project investigates the possibilities of quantitative mapping of structural forest parameters such as Leaf Area Index, aboveground biomass, chlorophyll content and moisture contents of Mediterranean forests. An important issue is the comparison of per pixel approaches of hyperspectral image analysis versus the object-based analysis. The study area of this project is also the Peyne area near Montpellier in southern France. Results indicate that object-based approaches indeed yield better results than per-pixel methods. One important papers of this study is published as:

Addink, E.A., De Jong, S.M. and Pebesma, E.J., 2007, The importance of scale in object-based mapping of vegetation parameters with hyperspectral imagery. *Photogrammetric Engineering & Remote Sensing* 73(8), pp.905-912.

P. Geerders Consultancy

Representative: Paul Geerders

Again in 2007, P. Geerders Consultancy has been involved in remote sensing related activities in Latin America. These activities included individual and institutional consultancy projects and training events, mainly in Colombia, Panama and Cuba.

The operational application of remote sensing in the region still falls behind the requirement and the potential. The causes are insufficient information on capabilities, and lack of sufficient funds especially for satellite imagery.

In the region, an increasing interest can be noted in small, remote controlled platforms for aerial surveys and monitoring of the environment. These platforms already have proven their impressive capabilities, equivalent and often superior to satellite observations.

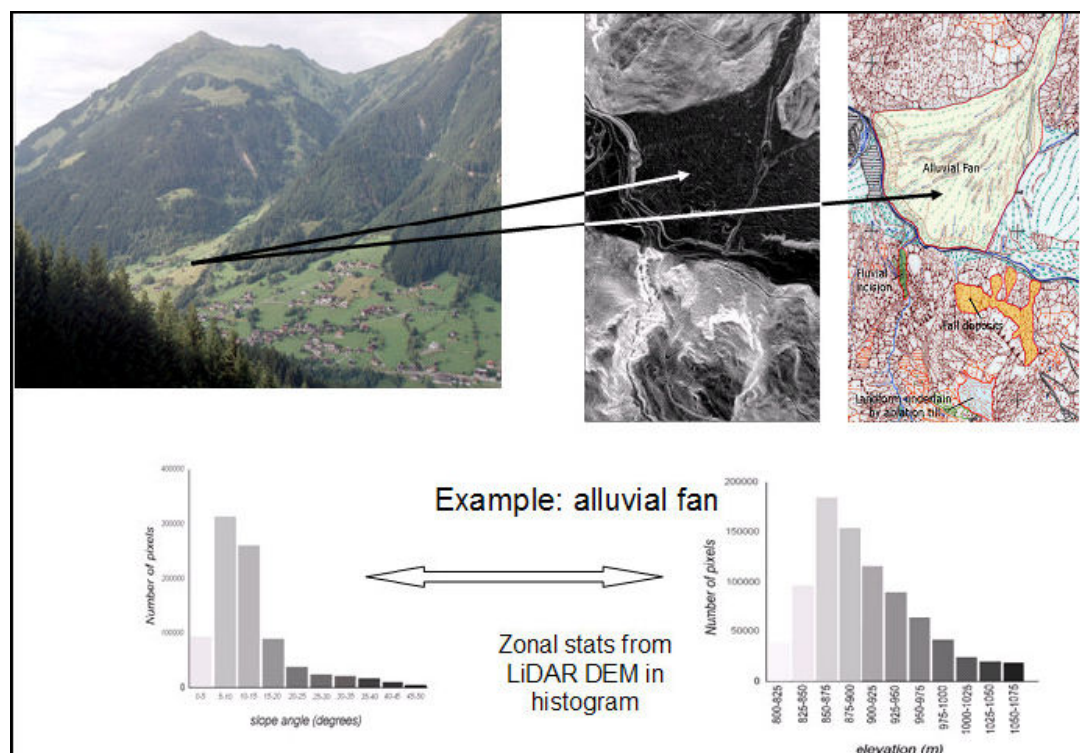


Figure 2. Example of an alluvial fan in the field, on a slope raster, a geomorphological map and as zonal statistics in frequency histograms based on altitude and slope angle derived from laser altimetry data.

Operational applications in the region, such as management of resources and environment, require remote sensing data to be merged with data from in-situ observations and numerical models to achieve the required quality and continuity. However, most European activities in this field focus only on satellite data as a unique source of data.

The region needs successful and widely promoted pilot and demonstration projects to achieve the necessary capacity building of local experts, and develop and implement the required local technical infrastructure as a basis for future operational applications of remote sensing technology.

Landscape and Environmental Research Group, University of Amsterdam

Representative: Dr. Harry Seijmonsbergen

In alpine geomorphology progress has been made to automate the process of geomorphological mapping using laser altimetry datasets. Especially zonal statistical analysis of objects defined by expert based segmentation seems a promising methodology to automate the process of geomorphological mapping (Figure 2). A further step is to use additional thematic data and

derived parameters to optimize and automate this process. Other activities related to LIDAR data are the calculation of biomass parameters in sloping alpine forests using normalized crown indices and Shannon Evenness Indices for forest stands in the Montafon area, western Austria. Furthermore, research is underway to simulate channel incision over time by combining vector and raster based models using long and cross sectional profiles derived from laser altimetry data. Geo-conservation of landscapes based on LIDAR integration has been started this year in cooperation with inatura – the nature museum in Dornbirn, Austria. Further information on LIDAR related research at the UvA can be provided by A.C.Seijmonsbergen@science.uva.nl.

The Avian Alert feasibility study is conducted by Computational GeoEcology at the University of Amsterdam and will be completed towards the end of 2007. During this step different user communities will have an opportunity to help formulate the requirements of potential sustainable systems using remote sensing technology. Migration ecology research is one of the key pillars in this process. Understanding the migratory behaviour of birds and how this is linked to dynamic processes in the environment is essential for improving flight

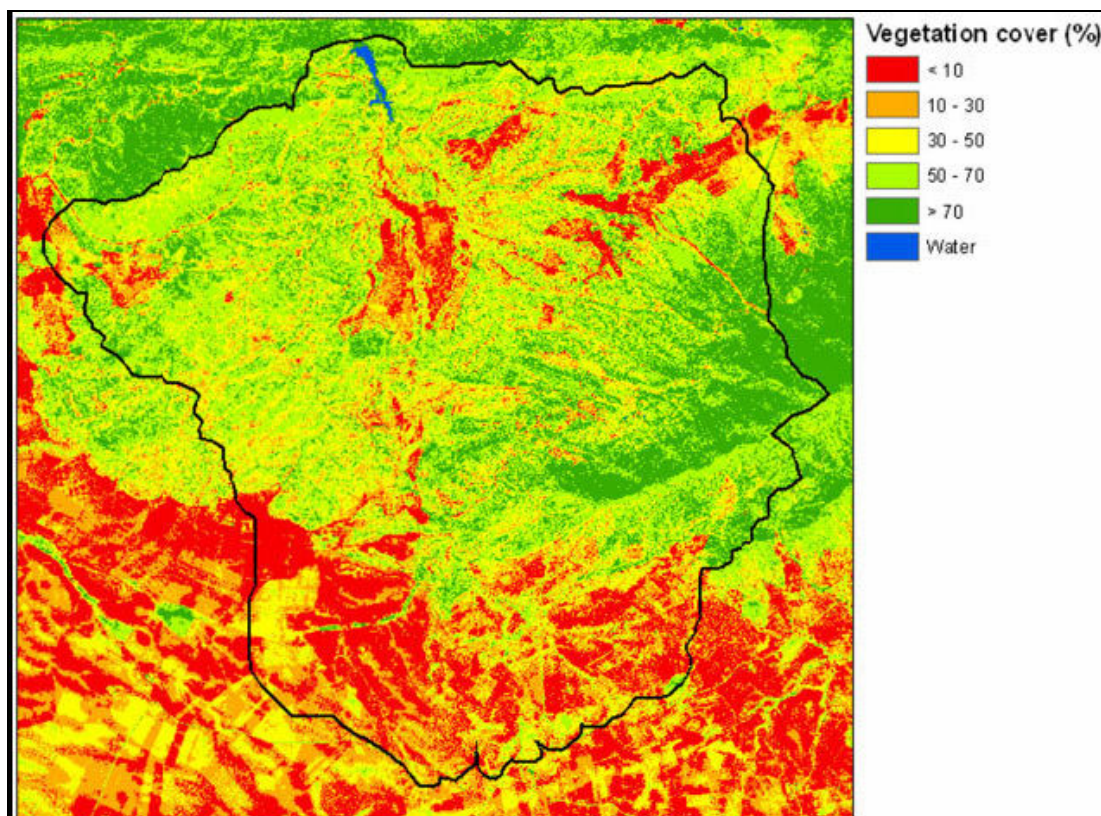


Figure 3. Quickbird satellite image of the RECONDES study site in Spain showing modelled vegetation cover percentage

safety during migration, monitoring and mitigating the spread of avian borne diseases, and conservation of migratory species and their habitats.

In May 2007, ESA and the University of Amsterdam hosted the "Avian Alert: Solutions Through Synergy" workshop at ESTEC in The Netherlands. The aim of the workshop was to identify the requirements of different international user communities in need of information on bird mobility. The user communities represented during this workshop were: Flight Safety, Migration ecology and conservation, and Avian borne disease and human health.

The FlySafe project has been selected to demonstrate the added value of integrating different existing space and non-space systems across national borders to further improve military flight safety by reducing the risk of bird-aircraft collisions. The primary long term objectives of this project is to stimulate and support the development of an European and later international bird warning system available through Internet technology for pilots, air traffic controllers

and flight planners to improve flight safety. The current project includes partners and observers from the Belgium, France, Germany, The Netherlands and Switzerland from military aviation, academic and national institutes and industry. The systems that will be used to collect data on bird migration and bird movements in Belgium, the Netherlands, Germany and France include long range military radars and short range local radar systems, meteorological Doppler radars, and satellite tracking of individual birds. Each of these data sources are complementary to some extent. All of these information sources will be integrated into the virtual laboratory for bird migration. Different aspects of bird migration will also be modelled in order to provide predictions and forecasts of migration at different scales in space and time. Information on these projects can be provided by Judy Shamoun-Baranes, (J.Z.Shamoun.Baranes@uva.nl).

In the Recondes project, research is in progress focussing on the multi-scale interactions between soil, vegetation and erosion in the context of agricultural land

abandonment in the Mediterranean (<http://www.port.ac.uk/research/recondes>). The main objective of is to understand and quantify relations between soil, vegetation and erosion after agricultural land abandonment at multiple scales. These relations will be used in a catchment scale runoff-erosion model based on connectivity of the landscape. Furthermore, the study will deliver measures for the mitigation of erosion after land abandonment, with a focus on bioengineering techniques. The major objective of EU project RECONDES is to produce practical guidelines on the conditions for use of vegetation in areas vulnerable to desertification, taking into account spatial variability in geomorphological and human-driven processes related to degradation and desertification.

On the plot scale terrestrial photos are taken using a digital camera mounted on a hand held balloon to study vegetation patterns on a very detailed cell size. Linked to land use change pattern analysis based on multi-temporal aerial photograph analysis sources and sinks for surface discharge could be detected and used in modelling. Upscaling was done using Quickbird imagery (Figure 3). More information on the project can be provided by J.P.Lesschen@uva.nl

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3. NEWS ITEMS

3.1 OBITUARY FOR MICHAEL J. BARNSELY

It is with great regret that we announce the passing away of Professor Michael Barnsley, of the University of Swansea, on the 6th of December 2007.

Prof. Barnsley completed his undergraduate and post-graduate studies in the University of Reading. His PhD was examining the effects and implications of off-nadir viewing sensors, on the study of vegetation, and he has been an advocate of the merits of the applications of off-nadir bidirectional reflectance distribution function on vegetation, ever since.

He joined the Department of Geography of the University of Swansea in 1995, as a Research Professor of Remote Sensing and GIS, ascending to the position of Head of Department in 2002 and Head of the School of Environment in 2005. In January last year, he was appointed to the post of Pro Vice Chancellor at Swansea. Between 2003 and 2005 he was also the first Director of the Climate and Land-Surface Systems Interaction Centre (CLASSIC), one of the



Natural Environment Research Council's (NERC) six Centres of Excellence in Earth Observation.

He was an inspiration to his students and colleagues and had the ability to achieve results efficiently and effectively. Without a doubt, the UK, European and global remote sensing community has lost one of its champions.

We would like to express our condolences to Prof. Barnsley's family, colleagues and all that suffer from his loss.

3.2 SWEDEN MEMBERS ELECT NEW REPRESENTATIVE

The Swedish EARSel members have all voted in favour of the nominated candidate Professor Yifang Ban as the new country representative.

Professor Yifang Ban holds the same chair as the former ISPRS president Kennert Torlegård had at the Royal Institute of Technology in Stockholm. The Swedish EARSel members that voted in favour of Professor Ban were Prof. Bengt Lundén (Stockholm University), Dr. Leif Eriksson (Chalmers University of Technology), Prof. Hakan Olsson (Swedish University of Agricultural Sciences) and Mr. Erik Willén, Head of Metria Mljöanalys.

3.3 UN-SPIDER UPDATES

United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER)

The Secretary-General of the United Nations appointed **Ms. Mazlan Othman (Malaysia)** as Director of the Office for Outer Space Affairs (OOSA), a post she held already from 1999 to 2002, and she took up her new post last 12 December 2007. After leaving OOSA in July 2002, Ms. Othman joined the National Space Agency of Malaysia as Director General. Ms. Othman was elected Chairman of the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space (COPUOS)⁴⁸.

The **United Nations General Assembly** during its last session of the main part of the current 62nd Session endorsed the work plan for 2007 of the **United Nations Platform for Space- Based Information for Disaster Management and Emergency Response (UN-SPIDER)**, along with the platform programme for the biennium 2007-2009 and the plan of work for the period 2008-2009.

At the same session the United Nations General Assembly also endorsed the draft resolution on the **International cooperation in the peaceful uses of outer space** which, among other decisions, urges all countries, in particular those with major space capabilities, to contribute actively to the goal of preventing an arms race in outer space, agrees that Bolivia and Switzerland become members of the **Committee on the Peaceful Uses of Outer Space**, and endorses the Committee's Space Debris Mitigation Guidelines⁴⁹.

The **International Disaster and Risk Conference - IDRC Davos 2008** will be held in Davos, Switzerland from August 25th to August 29th, 2008⁵⁰. Conference Motto: "Public-private partnership – Key for integral risk management and climate change adaptation". IDRC Davos 2008 is expected to bring together over 1.300 interested individuals, policy makers, risk managers, scientists and other risk experts from politics, governments, science, the private and civil sector, NGOs, etc. to focus on the array of

risks facing society today and on effective strategies to manage and reduce these risks and disasters. The conference will continue the dialogue between the different risk areas and their stakeholders, but also serve as a bridge between science, risk governance, technology perspectives, problem solving and capacity building.

UN responds to record number of emergencies in the Americas in 2007. The United Nations sent a record number of disaster assessment teams to emergencies in the Americas in 2007, offering a potential glimpse at the future of climate change. Nine of the 14 teams dispatched this year by the U.N. went to Central and South America, the highest number in history, including the first ever to Mexico, according to the U.N. Office for the Coordination of Humanitarian Affairs, known as OCHA. Previously the highest number of missions to the region was the eight sent in 1998 after Hurricanes Mitch and Georges devastated the region.

3.4 NEW RADAR SATELLITE TECHNIQUE SHEDS LIGHT ON OCEAN CURRENT DYNAMICS

Ocean surface currents have long been the focus of research due to the role they play in weather, climate and transportation of pollutants, yet essential aspects of these currents remain unknown.

By employing a new technique – based on the same principle as police speed-measuring radar guns – to satellite radar data, scientists can now obtain information necessary to understand better the strength and variability of surface current regimes and their relevance for climate change.

Scientists at the SeaSAR 2008 workshop held this week in ESRIN, ESA's European Centre for Earth Observation in Frascati, Italy, demonstrated how this new method on data from the Advanced Synthetic Aperture Radar (ASAR) instrument aboard ESA's Envisat, enabled measurements of the speed of the moving ocean surface.

Synthetic Aperture Radar (SAR) instruments, such as ASAR, record microwave radar backscatter in order to identify roughness patterns, which are linked to varying surface winds, waves and currents of the ocean surface. However, interpreting radar images to identify and quantify surface currents had proven very difficult.

⁴⁸<http://www.unoosa.org/oosa/en/unspider/docs.html>

⁴⁹<http://www.un.org/News/Press/docs/2007/ga10684.doc.htm>

⁵⁰<http://www.irdc.info>

By using the new information embedded in the radar signal – the Doppler shift of the electromagnetic waves reflected from the water surface – Dr Bertrand Chapron of the French Research Institute for Exploitation of the Sea (IFREMER), Dr Johnny Johannessen of Norway's Nansen Environmental and Remote Sensing Centre (NERSC) and Dr Fabrice Collard of France's BOOST Technologies were able to determine how surface winds and currents contribute to the Doppler shift.

The Doppler shift occurs due to changing relative velocities, experienced in everyday life in the way the pitch of a siren on a passing ambulance goes up as it approaches, then goes down as the vehicle recedes away.

The shift is introduced by the relative motion between the satellite platform, the rotation of the Earth and the velocity of the particular facets of the sea surface from which the SAR signal scatters back to orbit. The initial two values are well known – particularly for Envisat, with its very stable satellite orbit and attitude – and can be simply subtracted to extract sea surface velocity information.

Chapron first demonstrated the concept in 2005 with initial tests carried out over the Gulf Stream. Although the results were promising, repeat acquisitions and careful validation were not possible. However, based on these conclusions ESA upgraded its ASAR ground segment in July 2007 to systematically process and disseminate a Doppler grid product, a regularly spaced collection of individual Doppler information, for all Wide Swath acquired images.

The Doppler grid, embedded in ESA standard products, is now regularly tested on a number of so-called super-sites, including regions of the Gulf Stream and the greater Agulhas Current, both among the strongest western boundary currents of the world's oceans.

"These measurements are very useful for advancing the understanding of surface current dynamics and mesoscale variability, as well as for determining surface drift, important for oil dispersion and pollution transport and for wave-current interaction, probably influencing the existence of extreme waves," Johannessen said.

"The method at this very high resolution could also complement the use of additional information sources to improve 3-D ocean models. Its use for sensor synergy with

radiometry, spectrometry and altimetry is very promising," Chapron added.

The ground segment upgrade is also allowing the scientists to examine the anticipated Doppler shift signal of the river outflow at the mouth of the Amazon delta to monitor river runoff and improve our understanding of hydrological processes.

Chapron and Collard also presented their Near Real Time global swell wave observations to the workshop, attended by 150 participants from 25 countries. Using standard processed SAR ESA wave mode products, the team produces three hourly animations every morning for the Atlantic, Pacific and Indian Oceans and makes them available online.

Tracking swell waves from space is very important because they are generally preceded by calm water, making it impossible to detect their arrival from shore. Envisat's Wave Mode acquires 10 by 5 km small images, or 'imageettes', of the sea surface every 100 km along the satellite orbit. These small images, which depict the wave groups, are then mathematically transformed into wave energy and direction, called ocean-wave spectra.

ESA has provided SAR data to some 500 oceanography projects since 1998 and remains committed to providing continuity to its SAR missions. As part of its Global Monitoring for Environment and Security (GMES) programme, the agency will launch the Sentinels – the first series of operational satellites responding to the Earth Observation needs of GMES, a joint initiative of the European Commission and ESA.

Sentinel-1, expected to be launched in 2011, will ensure the continuity of C-band SAR data with ESA's ERS-2 and Envisat satellites. Important applications driving the mission concept include marine-vessel detection, oil spill mapping and sea ice mapping. With these new findings, Sentinel-1 is expected to provide additional information, such as consistent wind, wave and current products.

Source: ESA website

3.5 NASA TSUNAMI RESEARCH MAKES WAVES IN SCIENCE COMMUNITY

PASADENA, Calif. – A wave of new NASA research on tsunamis has yielded an innovative method to improve existing tsunami warning systems, and a potentially groundbreaking new theory on the source of the December 2004 Indian Ocean tsunami.

In one study, published last fall in *Geophysical Research Letters*, researcher Y. Tony Song of NASA's Jet Propulsion Laboratory, Pasadena, Calif., demonstrated that real-time data from NASA's network of global positioning system (GPS) stations can detect ground motions preceding tsunamis and reliably estimate a tsunami's destructive potential within minutes, well before it reaches coastal areas. The method could lead to development of more reliable global tsunami warning systems, saving lives and reducing false alarms.

Conventional tsunami warning systems rely on estimates of an earthquake's magnitude to determine whether a large tsunami will be generated. Earthquake magnitude is not always a reliable indicator of tsunami potential, however. The 2004 Indian Ocean quake generated a huge tsunami, while the 2005 Nias (Indonesia) quake did not, even though both had almost the same magnitude from initial estimates. Between 2005 and 2007, five false tsunami alarms were issued worldwide. Such alarms have negative societal and economic effects.

Song's method estimates the energy an undersea earthquake transfers to the ocean to generate a tsunami by using data from coastal GPS stations near the epicentre. With these data, ocean floor displacements caused by the earthquake can be inferred. Tsunamis typically originate at undersea boundaries of tectonic plates near the edges of continents.

"Tsunamis can travel as fast as jet planes, so rapid assessment following quakes is vital to mitigate their hazard," said Ichiro Fukumori, a JPL oceanographer not involved in the study. "Song and his colleagues have demonstrated that GPS technology can help improve both the speed and accuracy of such analyses."

Song's method works as follows: an earthquake's epicentre is located using seismometer data. GPS displacement data from stations near the epicenter are then

gathered to derive seafloor motions. Based upon these data, local topography data and new theoretical developments, a new "tsunami scale" measurement from one to 10 is generated, much like the Richter Scale used for earthquakes. Song proposes using the scale to make a distinction between earthquakes capable of generating destructive tsunamis from those unlikely to do so.

To demonstrate his methodology on real earthquake-tsunamis, Song examined three historical tsunamis with well-documented ground motion measurements and tsunami observations: Alaska in 1964; the Indian Ocean in 2004; and Nias Island, Indonesia in 2005. His method successfully replicated all three. The data compared favorably with conventional seismic solutions that usually take hours or days to calculate.

Song said many coastal GPS stations are already in operation, measuring ground motions near earthquake faults in real time once every few seconds. "A coastal GPS network established and combined with the existing International GPS Service global sites could provide a more reliable global tsunami warning system than those available today," he said.

The theory behind the GPS study was published in the December 20 issue of *Ocean Modelling*. Song and his team from JPL; the California Institute of Technology, Pasadena, Calif.; University of California, Santa Barbara; and Ohio State University, Columbus, Ohio, theorized most of the height and energy generated by the 2004 Indian Ocean tsunami resulted from horizontal, not vertical, faulting motions. The study uses a 3D earthquake-tsunami model based on seismograph and GPS data to explain how the fault's horizontal motions might be the major cause of the tsunami's genesis.

Scientists have long believed tsunamis form from vertical deformation of seafloor during undersea earthquakes. However, seismograph and GPS data show such deformation from the 2004 Sumatra earthquake was too small to generate the powerful tsunami that ensued. Song's team found horizontal forces were responsible for two-thirds of the tsunami's height, as observed by three satellites (NASA's Jason, the U.S. Navy's Geosat follow-on and the European Space Agency's Environmental Satellite), and generated five times more energy than the earthquake's vertical displacements. The horizontal forces also

best explain the way the tsunami spread out across the Indian Ocean. The same mechanism was also found to explain the data observed from the 2005 Nias earthquake and tsunami.

Co-author C.K. Shum of Ohio State University said the study suggests horizontal faulting motions play a much more important role in tsunami generation than previously believed. "If this is found to be true for other tsunamis, we may have to revise some early views on how tsunamis are formed and where mega tsunamis are likely to happen in the future," he said.

Source: JPL website

3.6 TWO YEARS IN SPACE FOR GALILEO SATELLITE

On 28th of December, it was two years since GIOVE-A - the first Galileo satellite - was launched by a Soyuz rocket from Baikonur, in Kazakhstan. This satellite demonstrates the progress Europe has made in setting up its own navigation system.

Since January 2006, Galileo signals have been broadcast by GIOVE-A, and received all around the globe. At ESA's research and technology centre in the Netherlands, a laboratory is checking both the instruments on board the spacecraft that generate the signals and the receivers on the ground. This testing and calibration has allowed the specialists to confirm the success of the mission, which is a good sign for the rest of the programme.

The next step is well under way, with GIOVE-B - the second experimental satellite - finishing its preparations for launch in ESA's test facilities. This second Galileo satellite will embark the most accurate atomic clock ever flown in space, which will contribute to the quality of the performance of the Galileo system.

After GIOVE-B, the validation in orbit will be completed with the launch of four further satellites - the minimum required to obtain a satellite navigation position measurement. These satellites are currently being built at locations across Europe, for launch from the end of 2009.

To reach operational status, Galileo needs a constellation of 30 satellites and an associated network of ground stations spread all around the globe. This phase has just been confirmed with the decisions taken

by the European Union, which has agreed on a financing package of € 3.4 billion Euros and proposed to entrust ESA with the full deployment of Galileo by 2013.

While waiting for Galileo, another positioning system is in its pre-operational phase in Europe. EGNOS, the European Geostationary Navigation Overlay System, is a network of ground stations that improves GPS signals and retransmits them via geostationary satellites. EGNOS allows position determination accurate to within two metres. Originally designed to improve air traffic safety, EGNOS is accessible to all and paves the way for Galileo.

With these steps, the European Commission and ESA are progressively setting up a civilian system able to offer guidance and help worldwide.

Source: ESA website

3.7 NASA SATELLITES HELP LIFT CLOUD OF UNCERTAINTY ON CLIMATE CHANGE

SAN FRANCISCO—New findings from NASA's CloudSat and other spacecraft in NASA's "A-Train" constellation of five Earth observing satellites offer important insights into this year's record reduction of Arctic sea ice, global rainfall patterns and the effects of pollution on clouds.

The investigations are giving scientists a greater understanding of factors influencing Earth's present climate and an important foundation for better understanding long-term climate change.

Speaking at the fall meeting of the American Geophysical Union in San Francisco, Graeme Stephens, CloudSat principal investigator and professor of atmospheric science at Colorado State University, Fort Collins, Colo., outlined results of several recent studies currently in peer review.

In one study, a team led by Jennifer Kay at the National Centre for Atmospheric Research, Boulder, Colo., examined the influence of polar clouds on 2007's record low extent of Arctic sea ice. Using data from CloudSat and NASA's Cloud-Aerosol LIDAR and Infrared Pathfinder Satellite Observation satellite, they found the total cloud cover over the western Arctic, where most of the ice loss occurred, was 16 percent less over the 2007 melt season than in 2006. The resulting clearer skies in 2007 heated the Arctic

surface enough to warm ocean waters by 2.4 degrees Celsius (four degrees Fahrenheit) or enough to melt 0.3 meters (one foot) of sea ice. Anomalous clouds, in addition to other weather factors, helped melt ice that had already thinned due to sustained warming in recent years.

The results highlight the importance of weather pattern variability to a warming Arctic environment. "As Arctic sea ice thins, its extent is more sensitive to year-to-year variability in weather and cloud patterns," said Kay. "Our data show that clearer skies this summer allowed more of the sun's energy to melt the vulnerably thin sea ice and heat the ocean surface."

A separate CloudSat study led by John Haynes at Colorado State University found it rains more often and in greater amounts over Earth's oceans than previously estimated. The team found that, on average, 13 percent of clouds over Earth's oceans produce rain that reaches the surface. The difference in total rainfall amount estimates was greatest during winter, when large storms produced much more rainfall than previously estimated.

"These results suggest there is considerably more water falling from our skies, at least over Earth's oceans, than we previously thought," said Haynes. "The implications of these results are substantial and are still being examined, and suggest it may be necessary to reassess climate model estimates of Earth's water cycle intensity. By improving our understanding of present rainfall patterns, scientists can also improve climate model projections of how rainfall will increase or decrease in the future around the world."

CloudSat is providing some of the first, most direct observations of where rainfall occurs on a near-global basis, allowing scientists to see, for the first time, what fraction of Earth's clouds precipitate. It surveys ocean regions where measurements did not previously exist - regions where the United Nations' Intergovernmental Panel on Climate Change suggests the greatest changes are occurring. It complements NASA's Tropical Rainfall Measuring Mission and offers a test bed for its planned Global Precipitation Measurement mission.

In another study, Colorado State University student Matt Lebsock and Stephens found the first global evidence that pollution of clouds by aerosols - small particles suspended in the atmosphere - is indeed

making clouds brighter and more reflective, reducing the amount of sunlight available to warm the surface. These indirect aerosol effects are not well understood and create major uncertainties in climate models. The team combined data from CloudSat with the Advanced Microwave Scanning Radiometer-Earth Observing System and Moderate Resolution Imaging Spectroradiometer instruments on NASA's Aqua satellite.

Scientists had previously believed that aerosols indirectly altered sunlight reflected by clouds by altering the sizes of cloud particles. The new observations also show that aerosols might allow clouds to grow deeper, increasing the amount of sunlight reflected from them even more than previously thought.

The Afternoon, or "A-Train" satellite constellation presently consists of five satellites flying in formation around the globe. Each satellite within the A-Train has unique measurement capabilities that greatly complement each other. The combined set of measurements is providing new insights into the global distribution and evolution of clouds that will lead to improvements in weather forecasting and climate prediction.

Source: NASA Earth Observatory website

3.8 ENVISAT CAPTURES SOUTH KOREA'S CRUDE OIL LEAK

Crude oil from the wrecked 146 000-ton tanker, Hebei Spirit, was seen polluting the sea off South Korea by Envisat (see back cover).

More than 10 000 tons of oil from the tanker was reported to have leaked into the sea since colliding with another vessel on Friday 7 December 2007. The South Korean government had declared the coastal regions, located southwest of Seoul, where oil was washing onto their beaches disaster areas.

This image was acquired by the Advanced Synthetic Aperture Radar (ASAR) aboard ESA's Envisat, while operating in its wide-swath mode covering an area approximately 400 km by 400 km.

The presence of oil on the sea surface damps down smaller wind generated waves. It is these waves that reflect the radar signal back in the direction of the source. When they are damped, the reflected power measured by the radar is reduced, causing

oil slicks to be seen as dark areas on an otherwise brighter sea.

ASAR, like other space-based radar systems, essentially provide its own source of illumination and operates at longer wavelengths than optical sensors. This enables it to observe the Earth's surface at night and through thick cloud cover.

Source ESA website

3.9 SATELLITE DATA TO DELIVER 'STATE-OF-THE-ART' AIR QUALITY INFORMATION

The European Environment Agency has finalised an agreement with an ESA-led consortium to provide unparalleled information on air pollution, which contributes to the premature deaths of hundreds of thousands of Europeans annually.

Under the agreement, the European Environment Agency (EEA) will use a service, which combines and processes satellite data with surface measurements from 29 European countries to deliver accurate information on air quality daily, to support the implementation of European air-quality policies.

"Sophisticated processing and satellite data from ESA will combine to deliver state-of-the-art information on air quality. This will allow EEA to get the most from ground-based measurements collected through its networks," EEA Project Manager Tim Haigh said.

"I am excited about the opportunity that this service creates to help us provide timely information on Europe's environment at an unprecedented level."

The 'Integrated Air Quality Platform for Europe' service, part of the ESA GMES (Global Monitoring for the Environment and Security) PROMOTE (PROtocol MONiToring for the GMES Service Element) project, was developed to provide end-users information about air quality and is currently providing forecasts for up to 72 hours at a resolution of 50 km.

The service includes data on ozone, nitrogen dioxide and particulate matter (the sum of all particles suspended in air, including dust, smoke, pollen, etc.). Exposure to these pollutants can cause adverse health effects such as decreased lung function, increased respiratory symptoms and allergic

responses, according to the World Health Organisation.

The service applies an ensemble approach by combining three different and thoroughly validated air-quality models: MOCAGE (Meteo-France), EURAD (RIU), and CHIMERE (INERIS). These models combine in-situ and satellite data using different data assimilation techniques in order to generate consistent information about air quality.

The Service Level Agreement (SLA) was signed between EEA and the French National Institute for Industrial Environment and Risks (INERIS) and the German Space Agency (DLR).

"A median model ensemble provides air quality forecasts and analyses that are superior to any single model simulation, combining the strengths of different models, and allows [for the] representation of the range of variability of the model responses that is a part of their inherent uncertainty," Laurence Rouil from INERIS said. "Therefore, decision makers and regulatory-purpose applications will benefit from this PROMOTE service."

In addition to supporting air quality policies, the service offers the wider public the ability to protect better their health by avoiding exposure and taking measures to reduce air pollution.

PROMOTE and GMES

PROMOTE is an ESA project that seeks to develop beneficial operational services for organisations and citizens that will use atmospheric data to address the concerns of both policymakers and individuals. The PROMOTE consortium is made up of more than 30 partners from 11 countries.

GMES – a joint initiative of the European Commission and ESA – responds to Europe's needs for geo-spatial information services by bringing together the capacity of Europe to collect and manage data and information on the environment and civil security, for the benefit of European citizens.

The GMES Service Element (GSE) prepares user organisations in Europe and worldwide for GMES by enabling them to receive and evaluate information services derived from existing Earth Observation satellites since 2002.

Source: ESA website

4. FEATURE ARTICLES

GMOSS: A NETWORK OF EXCELLENCE PROMOTING E.O. FOR SECURITY AND STABILITY

Vinciane Lacroix¹, Hans-Joachim Lotz-Iwen², Peter Zeil³ and Martino Pesaresi⁴

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ABSTRACT

GMOSS is a network of excellence in the Aeronautics and Space priority of the 6th Framework Programme of the European Union lasting from 2004 to 2008. Being part of the GMES programme, GMOSS aims to “integrate Europe’s civil security research so as to acquire and nourish the autonomous knowledge and expertise base Europe needs if it is to develop and maintain an effective capacity for global monitoring using satellite earth observation”. The objective is, starting from a joint programme, to establish links between researchers and their organisations that will sustain beyond the projects lifetime while identifying the gaps to be addressed by future research projects such as benchmarking of services, analysis of security scenarios, early warning indicators and reliable vulnerability assessment methodologies.

In this paper, the specificities of the network of excellence, its precise objectives, work plan, and achievements will be presented. The activities will be first described for the three supporting pillars of GMOSS: the first one dealing with security concepts, the second devoted to some selected security applications, and the third one concerning generic tools and methods more specifically designed for security applications. The horizontal work packages, aiming at the facilitation of partnership integration, will then be presented. In this respect, we focus on three activities that are considered as the core element of GMOSS: the setting up of common test cases, the participation of the network in a real-time exercise and the creation of an overall “benchmarking”

concept. Last but not least, the training activities that have contributed to capacity building for EU and non-EU institutions are summarized, together with the outreach measures taken, and the Gender Action programme established.

INTRODUCTION: THE GMES CONTEXT

More and more, citizens require their governments to make evidence-based policy decisions about the environment, including better predictions of natural disasters, epidemics, the impact of energy choices, and variations in the climate. Today there is much evidence that these issues should be addressed at a global scale, in a worldwide perspective.

Several initiatives have been made to assist governments in these tasks. In particular, the intergovernmental Group on Earth Observations (GEO) established in 2005, including 68 member countries, the European Commission, and 46 participating organizations, is leading a worldwide programme to build a Global Earth Observation System of Systems (GEOSS) over the next 10 years (see <http://www.earthobservations.org/>).

GEOSS will work with and build upon existing national, regional, and international systems to provide comprehensive, coordinated Earth observations from thousands of instruments worldwide, transforming the data they collect into vital information for society. GEOSS is an ambitious programme of information for ecological security and durable development intended for mankind. It principally foresees the monitoring and understanding of nature,

the extent of disasters due to human activities, the impact of global warming, desertification, erosion and deforestation.

While the worldwide programme GEOSS seems more focused on environment related issues, the “Global Monitoring of Environment and Security” (GMES) programme, as its name suggests, also addresses the security aspect. The GMES initiative, developed by the European Space Agency and the European Union in 1998, thus seven years before the creation of GEO, is to establish a coherent, operational, long-term and user-dedicated information system that meets the specific needs for policy making and research in several fields such as environment, agriculture, regional development, security, and transport. The GMES initiative aims at supporting Europe's leading role in the monitoring of the global environment and provides support to policy makers in the fields of hazards and crisis management⁵¹ GMES has been a key item of the Aeronautics and Space priority in the Community's Sixth Research Framework Programme (2002 – 2006) and will remain so in the Seventh one (2007-2011). GMES will be built up gradually: it starts with a pilot phase which targets the availability of a first set of operational GMES services by 2008 followed by the development of an extended range of services which meet user requirements⁵² [8].

In its environment dimension, GMES has adopted the priority areas of the 6th Environmental Action Program: climate change, biodiversity, environment and health and sustainable use of resources. In the security dimension, GMES focuses on conflict prevention and crisis management: civil protecting, humanitarian aid and the EU Common Foreign and Security Policy (see Global Monitoring for Environment and Security Final Report of the GMES Initial Period 2001-2003). These two dimensions are related in the sense that environmental problems may generate conflicts between nations and endanger security of individuals.

GMES consists of four main components: the space component, the in-situ component, the data harmonization and standardization component, and the user oriented services. The European Union makes use of various tools such as Integrated Projects, Networks of Excellence (NoE), Strategic Targeted Research Projects and Specific Support

Actions in order to address the various aspects of the four GMES components. The NoE has been introduced as a tool for the 6th framework programme. It is specific in the sense that its programme is updated every year and that it aims at the integration of the partners rather than on the creation of products.

In this context, the NoE GMOSS, lasting from 2004 to 2008, has been created in order to address the Security aspect of GMES. GMOSS is aiming at integrating Europe's civil security research so as to acquire and nourish the autonomous knowledge and expertise base Europe needs if it is to develop and maintain an effective capacity for global monitoring using satellite earth observation. The objective of the network is to get a critical mass of resources and experts in order to reinforce the scientific and technologic excellence for the benefit of the individual on the one hand, and a socio-economic stability on the other hand. The purpose is, starting from a joint programme, to establish links between researchers and their organizations that will sustain beyond the projects lifetime while identifying the gaps to be addressed by future research projects such as benchmarking of services, analysis of security scenarios, early warning indicators and reliable vulnerability assessment methodologies.

In the following, we outline the objectives of the network, its work package structures (WP) and the involved partners. The various results will then be presented. The last section is devoted to the recent activities and to future perspectives.

GMOSS OVERVIEW

The specific objectives of GMOSS are the following:

- Share expertise and knowledge within the network
- Assess the current methods, algorithms and software required for the automatic (or semi-automatic) image interpretation and visualization of security applications
- Provide best practices concerning the specific science and technology for treaty monitoring protecting from the proliferation of weapons of mass destruction, the estimation of population and their dynamics at a global scale, the

⁵¹ <http://www.esa.int/>

⁵² <http://www.gmes.info/>



Duration March 2004 - February 2008
Contractors 22 (starting with 24 partners)
Coordination DLR

13 Associated Partners

- FH Hof (D)
- ITC , Enschede (NL)
- IMAA, Tito la Scala (I)
- TAAS, Salzburg (A)
- CMJ, Université Toulouse (F)
- Definiens AG, Munich (D)
- LAMP, Sassari (I)
- University Salamanca (E)
- University Wien (A)
- BICC, Bonn (D)
- University Pavia (I)
- European Academy (I)
- SERTIT (F)

Figure 1 GMOSS partners

infrastructures and borders monitoring, and the rapid damage assessment

- Finally, propose EO means and methods for the analysis and the understanding of threats on the civil society, in order to incite reactions adapted to the crisis evolution and to prevent conflicts.

The network GMOSS, coordinated by DLR, involves 22 Institutions and 13 associated partners as shown in Figure 1.

The core of the network is made of three research pillars, represented in Figure 2. On the left, the security concepts, in the middle, the applications and on the right the generic tools more specifically designed for security. At each side of the core one can find the horizontal WPs that aim at a better partner integration, and the training and outreach activities.

SECURITY CONCEPTS

The report of the European security strategy [1] mentions terrorism, proliferation of weapons of Mass destruction, regional

conflicts, state failure, and organized crime as the threats on our civil society.

The partners of the WP "Issues and Priorities" agreed on a classification and ranking of key threats and risks and the possibility to deal with these issues using Earth Observation. They identified the geographic localization of these key threats and risks by drawing on ESS and getting greater specificity by using UN/OSCE activities and NATO peacekeeping missions as indicators of areas of risk. This work has then been used by the "Scenario Analysis" Work package, and for the specification of the some test cases on which all partners could work. This is how test cases located in Iraq, Iran, Zimbabwe and Kashmir have been identified by the network.

The WP "Responding to crisis" proposed to the network a real-time exercise simulating a nuclear accident. The goal of this exercise was to assess the workflow, identify gaps and shortcomings and improve effectiveness and methodology of the whole network while addressing a specific security problem. The three teams composed of GMOSS partners with

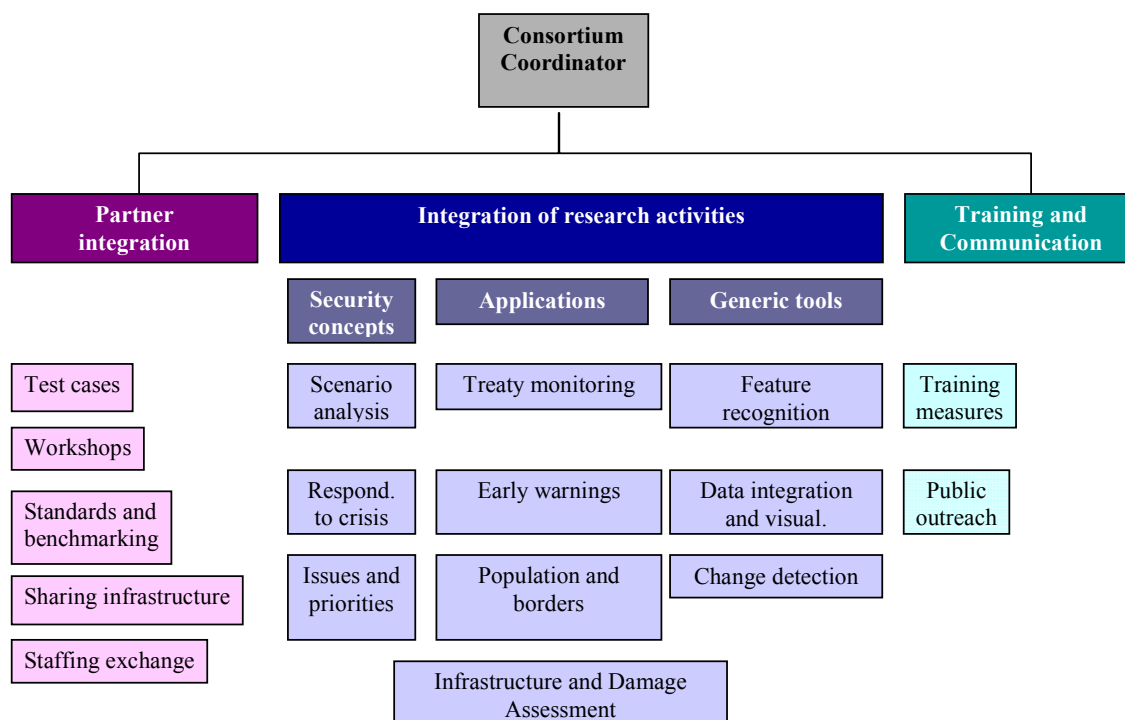


Figure 2 GMOSS working structure.

complementary experience, were asked, to produce, a list of products within 36 hours. The operational base of each team was located at three different GMOSS institutions, gathering the most important task forces of the teams which were observed by some researchers, while some other partners were working remotely. The end users seemed to be very pleased by the results produced by the teams. This exercise on the one hand showed how partners from different cultural and technical background could integrate and use new methods answering some end-user needs, and on the other hand convinced the GMOSS partners that indeed games may be interesting tools for integration, analysis and training, as recommended by the WP "Scenario Analysis".

APPLICATIONS

The applications considered by GMOSS are Treaty monitoring, early warnings, damage assessment, population, infrastructure and border monitoring. The "Treaty monitoring" WP focused on nonproliferation of nuclear weapon treaties and on the verification of nuclear sites ([6], [7],[3]). The systematic development of keys for the nuclear fuel cycle [9], brought up thanks to image

processing methods, is the core of their research and has been used to study the Esfahan test site. This site monitored by the International Atomic Energy Agency (IAEA) is Iran's largest nuclear research centre and represents a key infrastructure of the Iranian nuclear programme. In particular, the estimation of building height thanks to stereoscopic satellite data combined with semi-automatic segmentation enable to establish the role of the buildings in the site.

The detection of rapid changes and hostile events in near real-time is of concern for any security system. The WP "Early warning" is using a unique and robust technique characterized by a high temporal and a low spatial resolution (MSG/SEVIRI: 15 minutes and 3 km) in order to identify hot spots, would they be from a natural origin such as a volcano, or criminal, as pipelines attacks. These hot spots are then used as indicators in conflict zones; they may also be used to analyze the scenario of the attacks.

The WP "population and border monitoring" is summarized as deriving indicators for the presence and characteristics of populations. It is done by using VHRS, medium resolution, night-time and possible UAV images in combination with various algorithms. These techniques have been

used in the test case of Zimbabwe and Iraq ([5], [10]). The applications are focused on detection of dwellings in refugee camps, damage assessment in settlements in mountainous rural areas of Kashmir [4] and man-made infrastructures at the border of India and Pakistan.

The WP "monitoring infrastructure and damage assessment" worked on cases caused by natural as well as human origin. Indeed, the analysis of satellite images on the one hand enabled to estimate the damages in Kashmir and in Iran after the earthquakes of 2005, and the Tsunami at Sumatra in 2004 [2], and on the other hand to study the military operations in Iraq, the Ryongchon explosion in 2004 in North Korea, and the conflict in Darfur.

Finally, Swisspeace made its early warning forecasting tool "reporters" available⁵³.

METHODS

A feature catalogue for security applications has been produced by the WP Feature extraction. A processing chain, valid for any image processing application, is completing their contribution. The latter involves pre-processing, optimization, segmentation, classification, and object detection, each module being discussed and compared inside the network. Moreover, the partners of this WP have proposed to share several toolboxes for this processing chain.

The WP Data visualization and integration has defined a Common Operational Picture and analyzed data mining, data access and visualization, and user interfaces, including webGIS applications. The team is also evaluating common tools such as Google Earth and Virtual Explorer in order to build a prototype of a virtual globe based search engine

Another catalog has been produced by the "Change Detection" WP. The latter lists the methods, sensors, resolution, etc., better suited for specific security applications. Several methods have been shared among the network and tested in particular on the Esfahan test case. In this example, volume detection computed from very high stereo pairs enable to hypothesize the building up of buried infrastructures.

HORIZONTAL ACTIVITIES

The network has organized many workshops. Initially, these workshops were gathering partners involved in the same work package, in order to learn about each others expertise and share technical details. By and by several common themes have been proposed to gather partners involved in different workpackages. For example, partners of the feature recognition WP, Change detection WP and infrastructure and damage assessment WP met at a Tsunami workshop.

The reviewers of the Network of Excellence GMOSS also suggested the use of common test cases on which partners could use and compare their tools, thus leading to the creation of a new work package "Test cases". In Iraq, the security problem is related to the pipeline network that is subject to many attacks. In Iran, the main concern is to provide proven evidence on the existence or development of weapons for mass destruction and in particular nuclear weapons. Zimbabwe on the other hand is an example of monitoring an internal conflict by assessing the scale of destruction in urban settlements and by providing evidence on a government resettlement programme; damage assessment and support to humanitarian action is the main focus in Kashmir.

Most applications assume data pre-processing: atmospheric corrections, data registration between similar or different modalities, and ortho rectification. Now the working conditions in security applications are often sub optimal, as no ground control points are available, and viewing angle may be far from nadir thus introducing large deformation in hilly areas. The first task assigned to the benchmarking activity of the standard and benchmarking work package is to analyse and compare existing tools in a zone where ground control points are available, and to set up a concept of benchmarking task.

In the work package "sharing infrastructure", a tool has also been proposed by a partner for data management. Thanks to this tool partners have access to all meta data related to data available inside the network.

⁵³ <http://fastserver.unibe.ch>

TRAINING AND OUTREACH ACTIVITIES

Outreach has been performed through various means. GMOSS has a web site⁵⁴ which will be maintained by the Joint Research Centre after the life of GMOSS. Quite a number of joint publications have been produced by the network and the publication of a book is foreseen in 2008. GMOSS has also been presented at several conferences and international events. Finally, the network has a specific gender action programme. "Gender Actions", recommended by the EU, aim not only to encourage women activities in Sciences, especially in managing positions but also to consider the impact of the phenomena analyzed by the IP, NoE or SGE on female populations or their specific role in the considered domain. In this context, GMOSS organized a workshop where the gender dimension of security has been addressed through a multidisciplinary approach.

As far as training is concerned, GMOSS is organizing every year a summer school for young researchers and future decision makers. The schools provide a spectrum composed of lectures on political context and technology, practical exercises in the form of lab-sessions and near real-time assignments, interactive working groups and panel discussions with users. The topics covered so far are 'Rapid Information Extraction' (2005), 'Monitoring for Human Security - People, Homes and Infrastructure' (2006) and 'Early Warning and Monitoring of Agreements' (to be held in Madrid from Sept. 2-9 2007). Training courses devoted to specific techniques are also organized on a regular basis. The training coordinator of GMOSS, Z_GIS, also provides an e-Learning platform for security research.

GMOSS is also part of GMES, and thus has specific links with the several projects such as LINES, TANGO, RESPOND, PREVIEW, etc. Other potential end-users are also contacted: UNOCHA, UNOOSA, and OCDE, IAEA, FAO, ESA and NATO. The various ministries of Research, Technology, Foreign Affairs and Defence have been involved as potential end-users at various stages.

ACTUAL AND FUTURE GMOSS PLAN

For its last year of existence, the network is planning to concentrate its activities around horizontal activities such as test case

studies, scenario analysis, and its common repository containing data, publications, tools and methods.

As far as outreach activities are concerned, the network will use its last year in order to strengthen its links with GMES and potentials end-users, to publish a book in which each WP will have a contribution and finally continue its training activities.

The network will survive after its term in the FP6 programme, thanks to its common repository, fed by all partners on a regular basis and maintained by JRC. No collective effort will be made in order to continue the network experience as such, mainly because of the administrative burden and the lack of funding devoted to common scientific research activities. Nevertheless, several cells involving GMOSS partners have been created and will apply for the FTP7 programme, in order to build on the developments produced thanks to the NoE. Some partners have also signed some bilateral agreements at their management level, insuring future collaborations.

Finally, the JRC has proposed to organize a series of security conferences, open to the whole community, thus proving an excellent opportunity for the researchers to meet at these events and exchange results or prepare future collaborations.

CONCLUSIONS

The GMOSS experience has been quite interesting so far. It enabled many European partners to set up a common research programme, to jointly identify problems and challenges encountered by EO in dealing with existing and emerging threats to our civil society, and to compare their approaches and respective methods. Although at the scientific level all partners seem quite satisfied with the collaborations and exchanges brought to light by a long list of joint publications, the common activities such as the real-time exercise, and training seminars, the administrative burden and the lack of funding for realizing the joint work is damping the partners enthusiasm.

GLOSSARY OF TERMS

GEO Group on Earth Observations
GEOSS Global Earth Observation System of Systems
GMES Global Monitoring of Environment and Security

⁵⁴ <http://gmooss.jrc.it/>

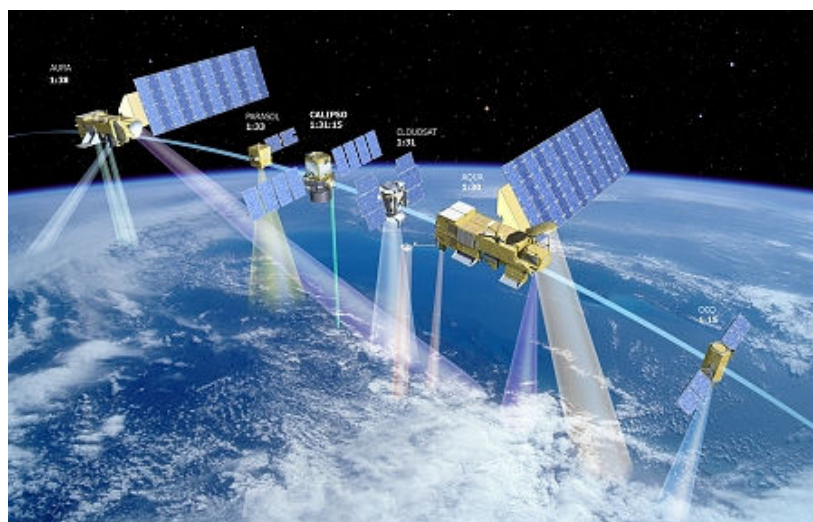
GMOSS Global Monitoring for Security and Stability
 IAEA International Atomic Energy Agency
 IP Integrated Projects
 JRC Joint Research Centre
 MSG/SEVIRI: Meteosat Second Generation
 Spinning Enhanced Visible and Infra-red Imager
 NoE Network of excellence
 UAV unmanned aerial vehicle
 VHSR Very High Spatial Resolution
 WP Workpackage
 Z_GIS Centre for GeoInformatics at Salzburg University

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- 4 Laneve at al. Development of automatic techniques for refugee camps using very high spatial resolution (vhsr) satellite imagery. In IGARSS Conference, Denver, Colorado, 31 July-4 August 2006.
- 5 Lang at al. Beyond sensors and algorithms: an information delivery approach for population estimation in African refugee camps. In 6th African Association of Remote Sensing of the Environment Conference (AARSE), Cairo, Egypt, Oct 30-Nov 2 2006.
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- 8 Communication from the European Commission to the Council and European Parliament - "Towards a European Space Policy", COM(2001)718 final, 07 December 2001.
- 9 Jasani. Identification of key features of nuclear reactors for interpretation of images from remote sensing satellites. Journal of Nuclear Material Management, WWII(3): 28-36, 2004.
- 10 Scheiderbauer and Ehrlich. Population density estimations for disaster management, case study rural Zimbabwe. In Geo-information for Disaster Management, Delft, The Netherlands, March 21-23, 2005

PARASOL AND CALIPSO: WHEN FRANCE AND EUROPE TAKE THE A-TRAIN

G rard BEGNI, CNES ; Didier RENAUT, CNES ; Yves M. TOURRE, M dias-France



Artist's view of the A-Train constellation.   CNES.

THE A-TRAIN CONSTELLATION

For jazz music lovers, 'Take the A-Train' is a standard recorded by Ella Fitzgerald and Duke Ellington in 1941 (words & music: Billy Strayhorn and the Delta Rhythm Blues):

*You must take the A-train
To go to Sugar Hill 'way up in Harlem.
.../...*

*If you miss the A-train
You'll find you've missed the quickest way to
Harlem.*

For space scientists, engineers and decision makers, **the A-Train** ('A' which stands for Aqua) is a unique ensemble of six satellites (AQUA, AURA, CLOUDSAT, CALIPSO, PARASOL, and OCO). Five are now in operation while OCO will join the 'train' in 2008. It is mainly a US initiative, with a significant French contribution. Located on the same orbit, the satellites cross the equator within a few minutes of one another at ~ 1:30 pm local time. This 'train' equivalent to an extraordinary space laboratory mainly dedicated to studies on climatic impacts from clouds and aerosols is a unique technical approach that will simultaneously use all the clouds and aerosols observational techniques currently available, ranging from passive radiometry to LIDAR, and active radar sounding. Thus, by combining this special set of observations, scientists should get a better understanding of parameters associated with the 'climate system', its variability and change. Moreover the 'A-

Train' will help addressing the main following issues:

- What are key aerosols types and how do observations match global emission and transfer models?
- How do aerosols contribute to the Earth radiation budget and climate variability and changes?
- How does cloud layering affect the Earth radiation budget?
- What is the vertical distribution of cloud water/ice in clouds' systems?
- What is the role of polar stratospheric clouds in ozone depletion and what are the linkages with the Arctic vortex?

It should be understood that developing the Earth Observation from Space in a continuous approach implies **considering Planet Earth as a Global System** and hence monitoring in quasi real-time most of its components (including hydrosphere, cryosphere and atmosphere). Consequently, the idea of 'Earth Remote Sensing' should evolve towards an integrated approach. This is the reason why EARSel cannot ignore such approach – even if its focus and contribution remains upon observing emerged surfaces. The 'A-Train' – and its European involvement - is probably the most striking example to be presented in the EARSel newsletter.

The 'A-Train' includes six satellites (by ascending orbit ordering) as follows:

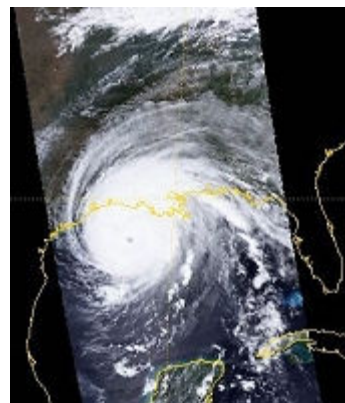
1. AURA (NASA), launched July 15, 2004.
2. PARASOL (CNES), launched December 18, 2004
3. CALIPSO (NASA/CNES/IPSL), launched April 28, 2006
4. CLOUDSAT (NASA/CSA), launched along with CALIPSO
5. AQUA (NASA), launched May 4, 2002
6. OCO (NASA), to be launched during 2008.

The 'A-Train' data distribution systems in Europe are implemented step by step at national and European levels, include the French 'thematic units' ICARE and POSTEL.

PARASOL

PARASOL stands for 'Polarisation and Anisotropy of Reflectances for Atmospheric Sciences coupled with Observations from a LIDAR' (the LIDAR is on-board of CALIPSO, see hereafter). It aims at characterizing the radiative properties of clouds and aerosols by maximizing the complementarity of micro-satellites (the second of the MYRIADE series developed by CNES) with the other instruments of the 'A-Train' (e.g. CERES and MODIS on-board of AQUA, CALIPSO LIDAR and CLOUDSAT radar). It is equipped with a POLDER (POLarization and Directionality of the Earth's Reflectance) wide field imaging radiometer designed with the contribution of the 'Laboratoire d'Optique Atmosphérique' (CNRS-USTL) of Lille (France). POLDER measures the direction and polarisation of light reflected by the Earth-atmosphere system in seven narrow spectral bands (i.e., from 0.443 to 1.020 μm wavelengths). This is to improve our understanding of the radiative and microphysical properties of clouds and aerosols. It also gives a unique access to some features of the ground surface reflectance through its directional and polarization properties. POLDER has already flown on board of the ADEOS Japanese mission. Thus archiving and technical know-how on data processing are already available on hands. Second generation algorithms have been designed, which dramatically improve the range and quality of some derived information (e.g. extracting small aerosol over land, refining the clouds phase function). Reprocessing of former POLDER/ADEOS data will be performed.

PARASOL was launched on December 18, 2004 and transmitted its first images on January 7, 2005. It joined the 'A-Train' in March, 2005.



Rita Cyclone observed by PARASOL, September 23, 2005, © CNES.

Detailed information and product samples can be found at:

<http://smc.cnes.fr/PARASOL/index.htm>

CALIPSO

A joint venture between NASA, CNES and CNRS/IPSL, CALIPSO (Cloud Aerosol LIDAR Infrared Pathfinder Satellite Observations) is designed to bring **accurate information about the 3-dimensional properties of aerosols, clouds, and related issues of atmospheric physics**, especially regarding the impact of clouds and aerosols on the Earth radiative budget. CALIPSO should therefore allow significant progress in evaluating major uncertainties limiting our understanding of the functioning of the Climate System. The CALIPSO mission main goal is to improve our knowledge of related physical processes through a spatio-temporal monitoring of various key parameters. This is well described in many research programmes from the WCRP (World Climate Research Programme of WMO) and more specifically in projects from GEWEX (Global Energy and Water Cycle Experiment) or CLIVAR (CLimate VARIability and predictability).

The CALIPSO mission is born from the space scientific workshop organised by CNES, the French Space Agency, in 1999. It is led in cooperation with NASA and IPSL ('Institut Pierre Simon Laplace' in Paris), a federation of laboratories from CNRS (National Centre for Scientific Research, France). It was selected by NASA in the framework of its Earth System Science Pathfinder (ESSP) programme. Understanding the earth radiative budget involves measuring fluxes not only on top of the atmosphere and at Earth surface, but also their vertical distribution and profiling. Three-dimensional numerical models taking



Artist's view of the CALIPSO satellite.
© CNES.

into account multi-layer clouds parameterization are essential to analyze global-scale processes for climate forecasting purposes. Integrating an appropriate physical representation of the atmospheric processes and of those coupling atmosphere, ocean and biosphere is a prerequisite for realistic analyses. The 'A-Train' is designed for such a mission, with CALIPSO bringing an invaluable contribution.

The CALIPSO mission is performed using **three co-axial instruments** on board of a mini-satellite making use of the PROTEUS platform (a joint venture between CNES and Alcatel Alenia Space). The 'key' instrument is a two-channel (0.532 and 1.064 μm) LIDAR equipped with a 1-m diameter telescope (NASA), which provides the basic vertical sounding information. The second instrument is a wide field single-channel (0.645 μm) camera that provides spatial high resolution images over a 60-km width on the LIDAR spot (NASA/Ball Aerospace). The third one is a three-channel (8.7 μm , 10.5 μm and 12 μm) thermal Infrared Imager Radiometer that will supply a continuous 64-km-wide coverage following the satellite's tracks and centred on the LIDAR spot (CNES/SODERN).

Detailed information and product samples can be found at:

<http://smc.cnes.fr/CALIPSO/index.htm>

DATA DISTRIBUTION IN FRANCE AND EUROPE

Level 1 processed data of the data delivered by the 'A-Train' is basically performed by NASA and CNES.

Higher level data and products are available in France through the so-called '**thematic**

units', a concept developed by CNES and CNRS in the late 90s.

The atmospheric data derived from the 'A-Train' will be evaluated within the **ICARE** Clouds-Aerosols-Radiation Thematic Unit, which is the result of a partnership between CNES, CNRS, the University of Lille, and the 'Nord-Pas de Calais' Region in France. ICARE was initiated in 2003 to provide various services to support the research community in fields related to atmospheric physics: aerosols, clouds, radiation, water cycle, and their interactions. Its first objective is the production and distribution of remote sensing products derived from Earth observation missions from CNES and NASA. One of its main components is the Development and Processing Centre (CGTD) from University of Lille. CGTD develops science algorithms and codes, building on expertise from a number of scientific partnerships, and distributes products to the users' community at large.

In a similar way, the Earth surface products derived from PARASOL will be distributed by the **POSTEL** thematic unit. Located at MEDIAS-France, POSTEL associates R&D and services to describe the soil and vegetation coverage from Earth Observation satellite data, at regional and global scales. It is supported by Météo-France, IRD, INRA, CNRS and CNES. Its mission is to process remotely sensed images into spatialized indicators describing with details soil and vegetation properties. These indicators, called "biogeophysical variables", describe for example the vegetal cover fraction, burnt areas, the soil moisture content, the albedo (reflecting power of surfaces), the surface temperature, and so forth. Specialized Centres are responsible for the release of biogeophysical products, the development of appropriate algorithms, and validation procedures. The Service Centre is responsible for designing operational processing channels, production and dissemination of algorithms, as well as of the interface between producers and user's community at large. The POSTEL thematic unit was already described by Marc Leroy in the 65th EARSeL newsletter, pp. 49-50.

ICARE and POSTEL are intended to be key components of the **GMES Services** respectively dedicated to observation of the Atmosphere and Land Surfaces. As such ICARE and POSTEL will become the backbone of the **European Environmental Policy Structures**.

5. FUTURE EVENTS

5.1 CONFERENCES AND SYMPOSIA

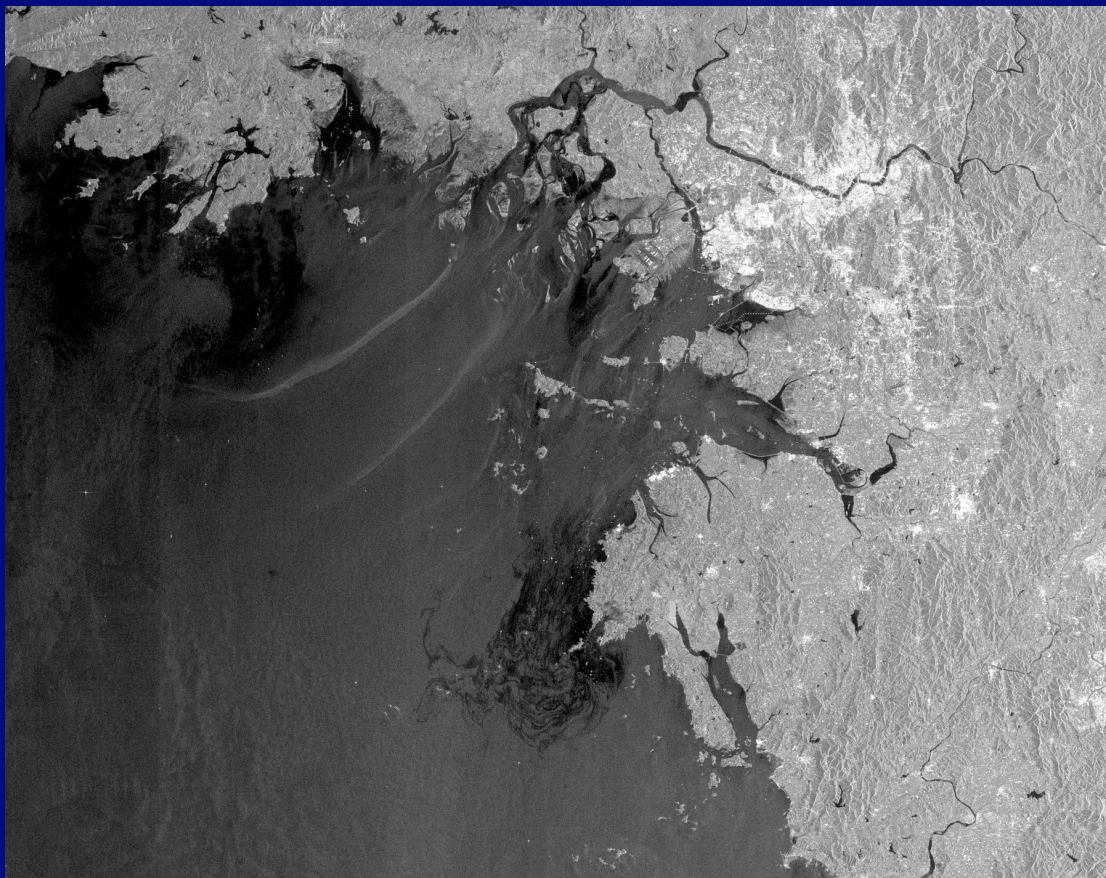
- | | |
|------------------|--|
| 13 – 18 | European Geosciences Union General Assembly 2008 |
| April | Vienna, Austria |
| 2008 | http://meetings.copernicus.org/egu2008/ |
| 22 – 25 | Toulouse Space Show (European Navigation Conference – Global Navigation Satellite Systems (ENC-GNSS) and European Frequency and Time Forum (EFTF)) |
| April | Toulouse, France |
| 2008 | http://www.toulousspaceshow.eu/ |
| 27 - 30 | 2008 International Congress on Image and Signal Processing (CISP2008) |
| May | Sanya, Hainan, China |
| 2008 | http://210.37.44.250/index.html |
| End of | Interdisciplinary workshop "From images to 3D animation" |
| May | CNES, Toulouse, France |
| 2008 | More info: Jean-Marc.Delvit@cnes.fr |
| 2 – 7 | 28 th EARSel Symposium "Remote Sensing for a Changing Europe" |
| June | Istanbul, Turkey |
| 2008 | http://www.earsel28.itu.edu.tr/ |
| 4 – 7 | 4th Workshop of the EARSel Special Interest Group on Developing Countries |
| June | GISDECO 8, 8th workshop of the GIS in Developing Countries network |
| 2008 | Istanbul, Turkey |
| | http://www.earsel-dc.uni-hannover.de/ |
| 4 – 7 | 3rd Workshop of the EARSel SIG on Geological Applications: "Seismic Hazards". |
| June | Istanbul, Turkey |
| 2008 | http://www.itc.nl/personal/siggeo/ |
| 6 June | 1st Workshop Earth Observation: "From Research to Teaching in Schools and Universities" |
| 2008 | Istanbul, Turkey |
| | http://las.physik.uni-oldenburg.de/SIG-ET/1st-workshop/ |
| 23 – 27 | GGEO2008: International Symposium on Gravity, Geoid and Earth Observation |
| June | Chania, Crete, Greece |
| 2008 | http://www.geomatlab.tuc.gr/content/view/54/84/lang,en/ |
| 13 – 20 | 37 th COSPAR Scientific Assembly |
| July | Montreal, Canada |
| 2008 | http://www.cospar2008.org/ |
| 17 – 19 | Forest Fires 2008 |
| September | Toledo, Spain |
| 2008 | http://www.wessex.ac.uk/conferences/2008/fires08/index.html |

- 22 - 24 September 2008** First International Conference on Remote Sensing techniques in Disaster Management and Emergency Response in the Mediterranean Region.
Zadar, Croatia
<http://www.earsel.geosat.hr>
- 22 - 26 September 2008** 2nd MERIS/(A)ATSR User Workshop
ESA/ESRIN Frascati (Rome), Italy
http://earth.esa.int/meris_aatsr_2008/
- 1 - 4 October 2008** 1st Workshop Earth Observation: "Advances in Remote Sensing for Archaeology and Cultural Heritage Management"
Rome, Italy
<http://www.ibam.cnr.it/earsel/workshop/Workshop.htm>
- 6 - 8 October 2008** 10th International Workshop on Signal Processing for Space Communications (SPSC 2008)
Rhodes Island, Greece
<http://www.congrex.nl/08c07/>
- 12 - 14 November 2008** Digital Earth Summit on Geoinformatics: Tools for Global Change Research
Wissenschaftspark Albert Einstein, Potsdam, Germany
http://www.isde-summit-2008.org/front_content.php
- 16 - 19 March 2009** EARSel 6TH SIG Imaging Spectroscopy Workshop: "IMAGING SPECTROSCOPY: An Innovative Tool for Scientific and Commercial Environmental Applications"
Ramat Aviv, Tel-Aviv, Israel
<http://www.earsel6th.tau.ac.il/>

5.2 SUMMER SCHOOLS AND TRAINING COURSES

- 24 June - 4 July 2008** ENEREGION - Summer School 2008 on "Regional Potentials for Renewable Energy Generation"
Salzburg, Austria
http://www.edu-zgis.net/index.php?option=com_content&task=view&id=40&Itemid=37
- 26 June - 1 July 2008** LBS Summer School 2008 on "Mobile and Location Based Services"
Salzburg, Austria
http://www.edu-zgis.net/index.php?option=com_content&task=view&id=55&Itemid=38
- 14 - 25 April 2008** 2nd EUFAR Summer School on Airborne Cloud and Aerosol Science (ACAS)
Utrecht, The Netherlands
<http://www.eufar.net/ET>
- 9 - 14 May 2008** 3D Modelling in Archaeology and Cultural Heritage
Monte Verita, Ascona, Switzerland
<http://www.3darchaeology.org/>

Back Cover – Crude oil from the wrecked Hebei Spirit tanker is seen polluting the sea off South Korea in this image acquired on 11 December 2007 by Envisat's Advanced Synthetic Aperture Radar (ASAR) instrument. Source: ESA.



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