

EARSeL



**8th EARSeL
Imaging Spectrometry Workshop**



**8 – 10 April 2013
Nantes, France**

March 2013
No. 93

NEWSLETTER



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Editorial

Dear members,

Another EARSeL event, the 9th EARSeL Workshop of the SIG “Forest Fires”, entitled “Quantifying the environmental impact of forest fires” will take place on 15 - 17 October 2013, at Coombe Abbey, Warwickshire, UK. Please do mark the important dates at your calendar, to submit your papers in time.

Other updates from EARSeL include the 32nd Symposium proceedings, new EARSeL memberships and national reports on remote sensing activities by our members. More particularly, the proceedings of the 32nd EARSeL Symposium are now available at the publications section via the EARSeL website. We also want to extend a warm welcome to six new EARSeL members since the 32nd EARSeL Symposium. As usual, at this time of year, the issue hosts some of the remote sensing activities of EARSeL members for the past year 2012. Therefore, four national reports from Belgium, Finland, France and Romania for the year 2012 have been included in this March issue.

You’ll also find in this issue a number of articles of organisations and events such as the European Urban Atlas, part of the local component of the GMES/Copernicus land monitoring services, an article on Global Land cover by the Group on Earth Observations as well as an article dedicated to the Biodiversity Multi-Source Monitoring System. Finally, a report on the training course on “Regional Experiments for Land-atmosphere Exchanges” (REFLEX) has also been included.

One more interesting article concerning the recent developments in Earth Observation satellites and sensors appears at the newly formed rubric “Science Article”, whereas EARSeL eProceedings have been enriched with four scientific papers focused on the natural environment.

The forthcoming EARSeL events are underway, starting with the 8th EARSeL Workshop on Imaging Spectroscopy in April and the 33rd EARSeL Symposium later in June, accompanied by the 4th EARSeL Workshop on Education and Training, the 6th EARSeL Workshop on Remote Sensing of the Coastal Zone and the 4th EARSeL Workshop on Cultural and Natural Heritage.

The last part of this issue includes a list of conferences, training courses and summer schools to attend in the near future.

Your feedback on the EARSeL Newsletter is critical to us. We will be pleased to hear your comments and suggestions. Moreover, you are more than welcome to contribute with a science article or a report for the forthcoming issues.

Enjoy reading this March issue!

The Editors

News from EARSeL

9th EARSeL Workshop on Forest Fires

'Quantifying the environmental impact of forest fires'

15 - 17 October 2013 Coombe Abbey, Warwickshire, UK

[More info](#)



European Association of
Remote Sensing Laboratories



University of
Leicester

Call for Papers

As we attempt to model the Earth System it is important that the impact of forest fires on the Earth System is fully understood and quantified. These impacts can be on climate, the biosphere, ecosystem functioning, society and livelihood. Fire disturbance has been identified by climate modellers as an Essential Climate Variable. Forest disturbance and the associated carbon flux needs to be measured and reported under the United Nations REDD+ programme. Furthermore, we have been very good at understanding the short term impacts of fire on forests, but less good at understanding the response of vegetation under different fire frequency and severity scenarios. The workshop will draw out the state of the art research being undertaken to identify and quantify these impacts.

All relevant institutions and interested individuals are invited to participate.

The deadline for submission of abstracts for the meeting is the **15 April 2013**.

All scientists, professionals and researchers involved or interested in the field of the Workshop are strongly encouraged to present papers according to the following topics:

- Existing and future orbital IS sensors
- Characterising the impact of fire severity and fire frequency across vegetation types
- Validation methods for burned area mapping
- Monitoring and modelling vegetation recovery after fire disturbance
- Scaling from regional to global burned area maps
- Mapping forest fires for REDD+ MRV
- Using active fire mapping and fire radiative energy to inform on fire severity and impact

Important Dates

- | | |
|---|----------------------|
| ➤ Abstract submission deadline | 15 April 2013 |
| ➤ Notification of acceptance | 31 May 2013 |
| ➤ Submission of Extended Illustrated Abstract (4 pages) | 15 July 2013 |
| ➤ Compulsory presenting author registration | 15 July 2013 |

Keynote Speakers

Moreover, the following keynote speakers have confirmed their presence at the workshop. These are:

- Dr. Guido van der Werf from VU University Amsterdam, The Netherlands who will talk on global fire emissions and potential fire-related climate mitigation options.
- Dr. Luigi Boschetti from the University of Idaho, USA who will talk about his research on global burned area mapping and validation (exact title TBC).
- Dr. Gareth Roberts from the University of Southampton, UK who will present a talk on quantifying wildfire fuel combustion using active fire observations.

Special Issue Opportunity

There is also a call for papers at a special issue on the topic of Quantifying the Environmental Impact of Forest Fires with Remote Sensing - Open Access Journal. The deadline for submission is 31 December 2013. More details can be found at:

http://www.mdpi.com/journal/remotesensing/special_issues/environmental_impact_of_forest_fires

In addition, EARSeL encourages the publishing of the full version of the manuscripts to the EARSeL eProceedings.

For more detailed information please visit the Workshop website at:

<http://www.earsel.org/SIG/FF/9th-workshop>.

Proceedings of the 32nd EARSeL Symposium, May 2012, Mykonos Island, Greece

The 32nd EARSeL Symposium entitled 'Advances in Geosciences' took place on 21-24 May 2012 in Mykonos Island, jointly organised by EARSeL and the Department of Planning and Regional Development of the University of Thessaly, under the auspices of the Hellenic Ministry of the Environment, Energy and Climate Change and the Municipality of Mykonos.

The **32nd EARSeL Symposium Proceedings** present the research contributions of over 130 participants, coming from 32 countries of 4 continents presented to the following 19 scientific sessions: Hydrology, Thermal Remote Sensing, Ocean and Climate Change, Disaster Monitoring and Response, Coastal Zones, Land Use/Land Cover, Forest Fires, Cultural and Natural Heritage, Developing Countries, Change Detection, Imaging Spectroscopy, Instruments and Methods, Radar Remote Sensing, 3D Remote Sensing, Education and Training, Land Ice and Snow, Urban Remote Sensing and Forestry and Natural Environment. A very special session, dedicated to Proba-V mission, has also been included at the Symposium.

The proceedings of the 32nd EARSeL Symposium, indexed with ISBN 978-960-88490-3-7, have been edited by Konstantinos Perakis and Athanasios Moysiadis, are available via the following link:

<http://www.earsel.org/symposia/2012-symposium-Mykonos/Proceedings/index.htm>

New EARSeL Members

We want to extend a warm welcome to the following members who've registered with EARSeL. We are looking forward to their active participation and contribution to the EARSeL activities, and in collaboration with other members in this long-established network of scientific research laboratories.

1. FUKAL - Photogrammetry-Remote Sensing and Geospatial Analysis Laboratory

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History: FUKAL (*Turkish acronym of* Photogrammetry-Remote Sensing and Geospatial Analysis Laboratory) is a multi-disciplined research laboratory with respect to photogrammetry, remote sensing and geospatial data evaluation. FUKAL was found as a Photogrammetry and Remote Sensing Laboratory in 1999 as a part of Department of Geomatics Engineering at Engineering Faculty of Bülent Ecevit University (*formerly* Zonguldak Karaelmas University), Zonguldak, Turkey. FUKAL received its latest name in 2011, extending the scope to geospatial information assessment.

Research Scope: The following are the primary research interests including optical, microwave and laser data:

1. Georeferencing accuracy assessment,
2. Image classification,
3. Geospatial information content analysis,
4. DEM generation and validation,
5. 3D modelling,
6. Microwave remote sensing,
7. Laser scanning,
8. Digital photogrammetric aerial cameras,
9. Imaging via unmanned aerial vehicles.

Projects: FUKAL has hosted and joined many national and international scientific projects supported by organisations such as ISPRS, TUBITAK, Jülich Research Center (Germany) and the host University. Especially, projects based on geospatial analysis of remote sensing optical and microwave data have considerable impact both nationally and internationally. The results are published in the leading national and international journals and scientific meetings.

Educational Activities: Because the Department of Geomatics Engineering supports under- and post-graduate education, the members and supporters of FUKAL are responsible for education related to photogrammetry, remote sensing and geographic information sciences. Many PhD and MSc theses are completed under FUKAL.

Organisational Activities: FUKAL recently hosted two educational courses "Mapping from Space" with the collaboration of Leibniz University Hannover and one national-wide Remote Sensing and Geographic Information Sciences Symposium (UZAL-CBS) inviting the EARSeL Chair and Secretary General as invited speakers, and many conferences inviting national and international leading scientists.

Opportunities: FUKAL has a wide range of optical, microwave, laser and geospatial data, plus several commercial and scientific software packages.

Cooperation: FUKAL has a continuous and strong cooperation with many national and international institutions, such as Leibniz University Hannover (Germany), ETH Zurich (Switzerland), Aristotle University of Thessaloniki (Greece), Istanbul Technical University and Yıldız Technical University (Turkey); as project-partnerships and ERASMUS agreements.

Please visit <http://jeodezi.beun.edu.tr/fukal> (in Turkish) for more information.

2. Norwegian Forest and Landscape Institute

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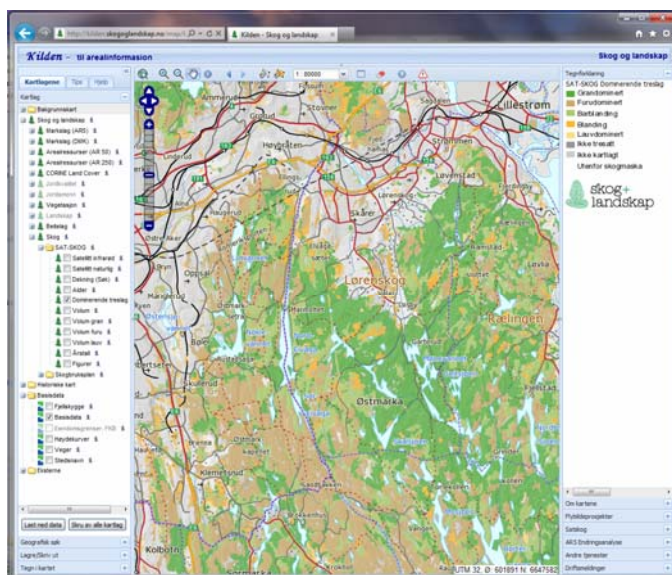
Norway

The Norwegian Forest and Landscape Institute is a public agency and research institute under the Ministry of Agriculture and Food. The institute is the mandated organization responsible for the implementation of national mapping and monitoring programs and resource inventories related to land cover, forestry, agriculture, landscape and the environment. The institute is also the leading Norwegian research institute regarding forestry, landscape and land monitoring. The Norwegian Forest and Landscape Institute is an advanced user of geographic information technology and a major contributor to the Norwegian geospatial data infrastructure. The institute has 220 employees (of these 70 are researchers) and an annual budget of approximately 30 mill EUR.



skog+
landskap

NORWEGIAN FOREST AND
LANDSCAPE INSTITUTE



Map of dominating tree species from Kilden, the institute's web-based map portal. The automatic interpretation is based on Landsat images and forest plot data from the NFI.

National wall-to-wall mapping programs:

- Soil mapping (all agricultural areas, scale 1:5,000)

- Vegetation mapping (mountain areas, scale 1:50,000)
- Land cover mapping
 - Below the tree line, scale 1:5,000
 - National coverage at scale 1:50,000

Operational area frame surveys:

- Land cover survey (based on LUCAS methodology)
- National forest inventory (NFI)
- Soil survey of agricultural land
- Landscape monitoring
- Cultural heritage site monitoring

Information systems:

- Spatial database (all data are kept in a seamless, integrated geospatial database). The database is made available to external users over the Internet (<http://kilden.skogoglandskap.no>).
- Geospatial data infrastructure. The institute is a major contributor to the Norwegian geospatial data infrastructure Norway Digital.
- GIS services. The institute supports GIS users in agriculture, forestry and area planning with data, advisory services and training.

International auditing:

- National centre for LULUCF monitoring (UN-IPCC and Kyoto Protocol)
- National Reference Centre for land cover analysis and monitoring (EEA/EIONET)

Remote sensing:

- Use of medium resolution optical satellite data to automatically map forest resources (volume by tree species, dominating tree species, and age) for all forest land in Norway.
- Use of medium resolution optical satellite data to automatically map alpine vegetation (five broad classes associated with vegetation cover and productivity) for all mountain areas in Norway.
- Use of air photos to manually map landscape features of monitoring plots, and soil and vegetation maps.

Research:

The Norwegian forest and landscape institute is the national research institute for forestry. The purpose of the research is to improve the economic contribution of forestry and landscape, strengthen the management and provide tools and knowledge to support sustainable development and use of forest and landscape resources. The institute also has research activities linked to landscape change and land monitoring.

In the field of remote sensing, research has lately been focused on the use of 3D techniques based on data from space-borne radar and aerial photography to improve the accuracy of timber volume estimations for wall-to-wall maps and small areas. Future research activities will also focus on forest change and damage detection based on bi-temporal image pairs and phenological time-series. This activity aims to exploit data from ESA's planned Sentinel 2 mission.

3. Pixalytics Ltd.

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4. CNES/DSC/CFT - Space Mission Feasibility Office

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5. Environmental Science Centre British Geological Survey

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6. GeoInformatics Research Group University of Helsinki - Department of Geosciences and Geography

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National Reports

Remote Sensing Activities in Belgium, 2012 Earth Observation Activities

Current Belgian EO Research Programme

The STEREO II programme

Launched in 2006, the STEREO II research programme “Support to Exploitation and Research on Earth Observation” (2006-2013) is a **national remote sensing programme** funded by the Belgian federal government and managed by the Federal Science Policy Office.

The thematic research priorities are:

- Global monitoring of vegetation and evolution of terrestrial ecosystems
- Management of the local and regional environment (coastal zones, inland water, soil, forests and biodiversity, agricultural areas, urban and peri-urban areas)
- Health and humanitarian aid
- Security and risk management

The programme funds both basic scientific research (large thematic projects, small innovation and spin-off projects) and applied research (development of products and services) carried out by partnerships between research organisations and private companies and/or public administrations. International partners can participate in the programme on the basis of shared cost.

The programme is now reaching its last phase and the year 2013 is dedicated to the evaluation of the results of the STEREO II programme and on the elaboration of the next Belgian remote sensing programme.

Facts and figures

STEREO II in mid-2011 that was:

55 projects

49 Belgian and Luxembourgian teams involved in a project

36 International teams involved in a project

110 International experts in a Steering committee of a project

385 International experts involved in the evaluation of a project submitted in the frame of a call for proposals

Hyperspectral Campaigns

In 2012, two main hyperspectral flight campaigns were organised with the APEX sensor.

- In June, France (for the STEREO II “SEASWIR” project), Germany, The Netherlands, Switzerland and Belgium (amongst other for the STEREO II “ESSENSE”, HEATHRECOVER” and “HYPERMIX” projects) were flown but the weather conditions and therefore the data acquired were not satisfactory in every case.

- The second campaign was organised in September with flights in Belgium and over the border between Poland and the Czech Republic.

Earth Observation HelpDesk

Continuous activities

The EODesk provides permanent support to Remote Sensing data users, first by ensuring the acquisition of satellite images needed for the research projects executed within the framework of Belgian science policy programmes and secondly by offering relevant and up-to-date information on remote sensing via the Belgian Earth Observation Platform <http://eo.belspo.be>. More than 400 people, mostly scientists, are registered with the mailing list which regularly informs them about the latest developments in the field of satellite Earth observation.

The EOedu website <http://eoedu.belspo.be> informs the public at large, teachers and students about the world of Remote Sensing. The 'Satellites' section provides access to an information sheet for a twenty of important satellites. This section has been completely updated and will be enriched in the near future. The satellite launch table has also been updated and provides an alphabetically or chronologically overview of the launch dates and activity periods for nearly 200 Earth observation satellites.

Teachers, students or other people interested in satellite imagery applications can subscribe to the EOedu Newsletter to follow some important events in the news as seen through the eyes of satellites (in French or Dutch only):

<http://eoedu.belspo.be/fr/mailling-index.htm>.

Specific activities

Exhibition Imaging the world's forests

This small travelling exhibition has been realized jointly by the Belgian Science Policy Office, the Flemish Institute for Technological Research (VITO) and the Earth and Life Institute from the Université catholique de Louvain on the occasion of the International Year of Forests 2011. It aims to show the public at large how satellite images can help to better manage and preserve the forests of our planet.

The exhibition has been shown in various locations across Belgium since September 2011 and is still running

A website is online since Oct 2011 <http://eoedu.belspo.be/forests>: it provides the public at large, teachers and students with more information about the link between forests and satellite imagery.

Exhibition Satellites and World Heritage sites, partners to understand climate change

This exhibition has been initially developed by UNESCO with the financial aid of the Flemish Government and thanks to generous contributions from a number of space partners: Belgian Science Policy, Planet Action (France), the European Space Agency (ESA) and the German Aerospace Center (DLR). A series of 25 panels shows satellites images of selected World Heritage sites. Through a series of remarkable examples, the exhibition highlights the specific climate change challenges facing selected World Heritage sites and demonstrates the use of satellite observation to assess the effects of Climate change on these sites.

Beginning of 2012, the exhibition has been adapted for the Belgian public by the Belgian Science Policy. New panels have been printed with texts in French, Dutch and English.

This initiative lies in the continuity of a very fruitful partnership between BELSPO and UNESCO to improve the monitoring and management, with space technologies, of the famous World Heritage sites. The website is: <http://eoedu.belspo.be/unesco>

Belgian Participation in EO Research Programmes

The PROBA-V programme

For almost 15 years, the VEGETATION 1 and 2 instruments on board of SPOT 4 and 5 have been monitoring the terrestrial surface on a daily basis.

The VEGETATION 2 instrument will likely cease its operation in the beginning of 2013, while the SENTINEL 3 satellites which are currently being built in view of the European GMES programme will not be operational in due time to contribute to the continuation of the availability of VEGETATION type data. It will take the launch of the second Sentinel-3 mission, scheduled for 2016, to truly provide comparable global coverage.

To redress the data gap and to fulfil all of the specifications of the VEGETATION user community who need the data for environmental and agricultural monitoring, Belgium decided to build a small satellite mission based on the successful PROBA expertise and using state of the art technology through ESA. This mission is called PROBA-V ("V" standing for Vegetation). It has been designated as a Third Party Mission supporting Europe's GMES initiative.

To fit within the available space and mass budget of PROBA meant shrinking the design down significantly: the original VEGETATION instrument was in fact larger and heavier than the entire Proba satellite.

PROBA-V's Vegetation instrument will offer a substantial improvement in data quality over its predecessors. In addition to 1 km-resolution data products, 300 m resolution imagery will be available as well, along with an additional 100 m resolution product available within its central nadir-looking telescope in four spectral channels (blue, red, near-infrared and mid-infrared). To be compatible with its predecessor Proba-V's 820-km polar orbit is Sun synchronised, giving a local 10:30 time on the ground for optimal illumination conditions and to enable observational comparisons. In short the mission can be summarized as "continuity with VEGETATION but better".

The data will be downlinked once per orbit to the Kiruna ground station in the Swedish Arctic. The raw data is relayed automatically to VITO, where it will be processed on a near-real time basis into one-day and ten-day products. These products will then be distributed via VITO and ESA's ESRIN Earth Observation centre in Italy.

The launch is scheduled for spring 2013.

The PROBA-V Preparatory programme

This programme was initiated by the Belgian Science Policy Office and supervised by an International User Committee (IUC).

Its main objectives were:

1. to get future users acquainted with these new data sets and their full characteristics and quality,
2. to prepare the full exploitation of Proba-V data sets with respect to the technical enhancements which are planned (spatial resolution in particular);

The programme ended mid 2012 and the results were presented at a dedicated session of EARSeL's 32nd Symposium which was held in Mykonos. They will also feature in a special issue of the *International Journal of Remote Sensing*, to be published in mid 2013.

For more information you can visit the following websites:

<http://probav-iuc.org> and <http://proba-v.vgt.vito.be>

Events Organised in 2012

- In May, **the 44th International Liege Colloquium on Ocean Dynamics** focussing on: "Remote sensing of colour, temperature and salinity – new challenges and opportunities" was organized by the University of Liège (Belgium). More information available on the website: <http://modb.oce.ulg.ac.be/?page=colloquium&year=2012>
- In the frame of **32nd EARSeL Symposium organised in Mykonos Island** (Greece) in May a complete and very successful session was dedicated to the PROBA-V preparatory programme. Website <http://www.earsel.org/symposia/2012-symposium-Mykonos>
- On September 4th 2012 **the 5th edition of BRUHYP** was organized in Bruges, Belgium by the Belgian Science Policy Office and the Flemish Institute for Technological Research (VITO). BRUHYP 2012 was fully dedicated to the first APEX campaigns organized in 2011. APEX (<http://www.apex-esa.org>) is an airborne imaging spectrometer developed under the PRODEX programme by a Swiss-Belgian consortium and was formally accepted by ESA at the end of 2010. Since then, APEX is being operated by VITO and RSL (University of Zürich). APEX features up to 532 spectral bands acquired in 1000 pixels across track with a FOV of 28°, resulting in ground pixel sizes of 1.5-2.5 m at typical flight levels of 3000-5000 m above target and was developed for simulation, calibration and validation of ESA satellite missions as well as for fostering hyperspectral imaging research in Europe. In 2011, the first scientific APEX campaigns were organized for users in Belgium, Germany, Italy, Luxemburg, the Netherlands, Spain and Switzerland.

At BRUHYP 2012, VITO and RSL presented details on the calibration of the APEX sensor and the processing software developed by RSL and VITO and implemented at the Central Data Processing Center at VITO, while researchers presented their scientific results of the APEX campaigns 2011.

About 75 researchers in airborne hyperspectral imaging from 10 different European countries gathered during this one-day workshop to discuss scientific results and exchange experience in airborne hyperspectral imaging.

BRUHYP 2012 presentations are available at http://eo.belspo.be/Directory/Resources/Presentations.aspx_
- The day after the BRUHYP conference, **the annual Belgian Earth Observation day** was organized in Bruges. The main goal of this event is to make professionals and researchers concerned by remote sensing aware of the projects realized in Belgium in the framework of the STEREO II programme and to offer the possibility for networking. BEODAY 2012 presentations are available at http://eo.belspo.be/Directory/Resources/Presentations.aspx_
- **The 3rd Workshop on Remote Sensing for Archaeology and Cultural Heritage Management** was successfully organized by Rudi Goossens in Gent in September 2012. More information about this meeting can be found on the following link: <http://www.earsel2012.ugent.be>

Events Scheduled in 2013

- May 22-23: **Probing Vegetation conference, Antwerp.**

SPOT VEGETATION turns 15 in May 2013. After a long and successful career as Europe's first truly operational system for global monitoring of vegetation, it is now nearing the end of its life cycle. The role of SPOT VEGETATION will be taken over by ESA's technologically advanced PROBA-V mission from the summer of 2013 onwards.

The *Probing Vegetation* conference wants to celebrate the operational and scientific achievements of SPOT VEGETATION and to look forward to the intriguing perspectives that will be offered to the user's community by PROBA-V.

Website: <http://www.probing-vegetation.vgt.vito.be>

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Remote Sensing Activities in Finland, 2012

Aalto University, Department of Radio Science and Engineering (RAD)

The RAD Space Technology Group participated over a period of several years in the development of European Space Agency's (ESA) SMOS satellite mission, which was launched in November 2009. During the nominal minimum three-year life time 2009-2012 of the mission, SMOS technical activities of RAD have concentrated on the monitoring and optimization of the performance of the SMOS reference radiometers, since RAD initially contributed substantially to the design of these radiometers in the early 2000's. Currently, the main areas of research are the long term temporal and thermal stability of these instruments.

Early data from SMOS revealed numerous man-made Radio Frequency Interference (RFI) sources within the protected 1.4 GHz band. RAD studies the detection, mitigation, and influence of these RFI to the scientific products of SMOS. Especially, the existence of RFI sources in Finland and their influence on SMOS data over study sites in southern and northern Finland is examined using satellite data from SMOS and airborne data from our HUT-2D interferometric radiometer. New methods are being developed to enhance soil moisture retrieval capabilities of SMOS by mitigating the effects of RFI.

In the frame of developing Soil Moisture retrieval algorithms especially for northern latitudes, RAD has used its HUT-2D airborne interferometric radiometer to study L-band emission from forests and bogs to determine their effect to soil moisture retrieval. Advances have been made in forest vegetation modeling. The performance of the SMOS soil moisture processor has been examined by modifying the model parameters according to airborne findings and comparing its output to Finnish soil moisture models and data from ground stations, provided by Finnish Meteorological Institute (FMI) and Finnish Environment Institute (SYKE), respectively.

Related to SMOS, RAD studies sea surface salinity retrieval and sea emission modeling. Especially, the influence of sea roughness is examined by means of a concept based on GNSS reflectometry and interferometry. Results from the airborne experiments, analysed in 2012, demonstrate the feasibility of the new technique for both altimetric and radiometric purposes.

A consortium led by the Finnish Meteorological Institute is developing an advanced high frequency (14-96 GHz) radar system for operation in various application areas. The RAD Space Technology Group is a consortium member along with the University of Helsinki, Harp Technologies Ltd., Vaisala, Eigenor Corporation, Aerial Oy, and Space Systems Finland. Current activities at Aalto University include power supply design and subsystem testing for the 14 GHz radar demonstrator.

Finnish Meteorological Institute, University of Helsinki, and Aalto University have conducted research on solid winter precipitation associated with the Global Precipitation Measurement satellite mission of NASA and JAXA. In Aalto University this work has focused on modeling the electromagnetic scattering and the microphysical properties of melting hydrometeors. One of the goals is to estimate radar signal attenuation, which deteriorates the quantitative precipitation estimate.

Development of an algorithm for tree height retrieval in the boreal forest zone from TanDEM-X interferometric imagery has been continued. Based on earlier work using airborne SAR images, X-band scattering center height was connected to forest height through the Random Volume over Ground model. Previously X-band was not considered to contain relevant forest information.

During the spring of 2012, a set of eight spaceborne TanDEM-X pairs, acquired during summer and autumn 2011 over southern Finland, were analysed in order to evaluate the potential tree height retrieval performance for this new space-borne instrument. The study showed that a single channel interferometric X-band image, when combined with accurate ground model, can give rather good forest height estimates. A Finnish nationwide LIDAR-based ground model was used as ancillary information in the project. Accuracy of the method for spaceborne images is not yet comparable to that for airborne SAR images.

In the next phase of this study, seasonal variability of the scattering center height inside the forest volume was studied. The study revealed that seasonal changes in foliage have indeed an influence on forest scattering center height. Variability was bigger for deciduous and mixed forests than for coniferous forest as presumed. These studies showed that X-band SAR images from spaceborne instruments can potentially be used for biomass mapping in areas where an accurate terrain model is available. However, seasonal variability in scattering center height should be taken into account.

The Aalto-1 Earth observing nanosatellite project was in 2012 in the detailed design phase. The team concentrated in developing the onboard computer, radio communication and electrical power system. Miniature spectral imager AASI key components have passed the environmental tests and the unit is in the final design phase. Additionally, the Aalto-2 satellite project was started. Aalto-2 is designed to be part of the European QB50 CubeSat constellation, scheduled for launch in 2015. The Aalto-2 main payload is an atmospheric measurement payload provided by the QB50 consortium.

VTT Technical Research Centre of Finland

A novel concept was developed for the mapping of forest resources of tropical forest using satellite data in project ReCover that is coordinated by VTT under the Framework Program 7 of the European Commission. The novelty comes from a combination of a sample of very high resolution satellite images with medium resolution wall-to-wall mapping in a statistical sampling framework. The approach developed makes it possible to obtain reliable information on mapping accuracy over the whole area of interest. Also forest biomass can be mapped with the same method. The method can be used to verify forest resources in the carbon trade process. Two articles about the method were accepted for publication in journal IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing.

Methods developed in the Framework Program 7 project Geoland 2 for forest cover and tree density estimation were applied in a commission project GMES Initial Operations. VTT is responsible for the mapping of Finland, Baltic countries and Island.

A concept to combine forest variable information, collected by cellular phones, with very high resolution satellite data, was developed. Forest data can be measured either directly in the field with the phones, or pictures that are taken with the cellphones are submitted to an analysis center and the forest variable values are extracted off-line. The field information from the phones is located with the phone GPS coordinates on satellite images. It can be used for the development of a model for satellite image analysis and for the assessment of the accuracy of the satellite maps. The satellite image interpretation results are further input to a system that produces forest management plans.

The research of radar data aimed at improving capabilities for automatic and semi-automatic processing of multi-polarization SAR imagery. A new method for radiometric inter-normalization of neighbouring scenes was developed for processing of fully polarimetric mosaics. The method allows performing further classification of whole SAR mosaics in one step, and makes it possible to effectively use training data spread all over the whole area of mosaiced imagery, as opposite to regular scene-by-scene classification that is traditionally used in fully polarimetric land cover mapping. The normalization technique and results were published in IEEE Geoscience and Remote Sensing Letters.

A modified robust method for boreal forest stem-volume retrieval was developed and tested at two study sites in Finland. Likewise previously reported techniques, it primarily relies on water cloud related semi-empirical boreal forest model, but stem-volume estimation utilizes inverted rather than forward version of the model. The method produces robust stem-volume estimates practically without such regular inversion artefacts as undefined or negative stem-volume. The method and results were reported in IEEE JSTARS.

Geological Survey of Finland (GTK)

GTK has developed an ordination based procedure to optimize class hierarchical levels of peatland site types from imaging spectroscopic data. GTK is involved in developing object based image analysis approaches of LiDAR DEMs for geomorphological interpretation. GTK has also participated in educational remote sensing projects in Africa.

Finnish Geodetic Institute

The Finnish Geodetic Institute coordinated jointly with the Institut Cartogràfic de Catalunya a European Spatial Data Research (EuroSDR) research project "Radiometric aspects of digital photogrammetric images" during 2008-2012. The project was a European-wide multi-site research project, where the participants represented stakeholders of photogrammetric data in National Mapping Agencies, software development and research. The project began with a review phase, which consisted of a literature review and a questionnaire to the stakeholders of photogrammetric data. The review indicated excellent radiometric potential of the novel imaging systems, but also revealed many shortcomings in the radiometric processing lines. The second phase was an empirical investigation, for which radiometrically controlled flight campaigns were carried out in Finland and in Spain using the Leica Geosystems ADS40 and Intergraph DMC large-format photogrammetric cameras. The investigations considered vicarious radiometric calibration and validation of sensors, spatial resolution assessment, radiometric processing of photogrammetric image blocks and practical applications. The results proved the stability and quality of evaluated imaging systems with respect to radiometry and optical system. The first new-generation methods for reflectance image production and equalization of photogrammetric image blocks provided promising results and were also functional from the productivity and usability points of view. For reflectance images, an accuracy of up to 5% was obtained without need of ground reference measurements. Application oriented results indicated that automatic interpretation methods will benefit from the optimal use of radiometrically accurate stereoscopic photogrammetric imagery. Many improvements are still

needed for the processing chains in order to obtain full advantage of the excellent radiometric potential of photogrammetric sensors. The results of the project are presented in several scientific research articles and in the EuroSDR final report. Based on the results, two EuroSDR Eduserv courses “Radiometric performance of Digital Photogrammetric Cameras and Laser Scanners” are organized in co-operation with Vienna University in spring 2012 and 2013.

The performance of various mobile laser scanning systems (MLS) was tested on an established test field. The test was connected to the European Spatial Data Research (EuroSDR) project “Mobile Mapping - Road Environment Mapping Using Mobile Laser Scanning”. Several commercial and research systems collected laser point cloud data on the same test field. The system comparisons focused on planimetric and elevation errors using a filtered digital elevation model, poles, and building corners as the reference objects. The results revealed the high quality of the point clouds generated by all of the tested systems under good GNSS conditions. With all professional systems properly calibrated, the elevation accuracy was better than 3.5 cm up to a range of 35 m. The best system achieved a planimetric accuracy of 2.5 cm over a range of 45 m. The planimetric errors increased as a function of range, but moderately so if the system was properly calibrated. The main focus on mobile laser scanning development in the near future should be on the improvement of the trajectory solution, especially under non-ideal conditions, using both improvements in hardware and software. Test fields are relatively easy to implement in built environments and they are feasible for verifying and comparing the performance of different systems and also for improving system calibration to achieve optimum quality.

University of Turku, Department of Geography and Geology

Change detection of the river channels has been mapped by the Fluvial Research Group with airborne and mobile laser scanning surveys in subarctic river environments. LS based surveys and change detection enable measurements of the point bar morphology including micro-scale forms (e.g. dunes and ripples) and their changes. Furthermore, these outcomes have been utilised as an input and reference data in hydraulic modelling.

Bathymetric model of the subarctic river reach Tana has been constructed based on Lyzenga algorithm using normal colour airphotos. To date, the approach has been used for tropical sea bathymetry and has not been utilised for subarctic river bathymetry prior to our study.

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Remote Sensing Activities in France, 2012: Earth Study and Observation

OVERARCHING INTRODUCTION: Funding and leveraging Earth Observation research and technology

The French national civilian space budget (including the national contribution to ESA budget, see hereunder) is managed by Cnes, the French Space Agency. Public research defining innovative space systems and/or using space derived data, products and services is funded at the national level mainly through the budget of the French Research Ministry and other national ancillary sources (including other so-called “technical” Ministries such as agriculture, etc. and contracts with specific public organizations and private sectors). The “Earth Observation from space” component of this budget is indeed impossible to determine. At European level, EC/ research FP plays a significant role – not only in terms of budget, but also in terms of networking and synergy building. It should also be underlined that the development of commercial applications of Earth Observation from space led to a significant development of targeted private research, including by SME’s in their own market niches.

Cnes develops most of its remote sensing programme in bilateral and multilateral cooperation, giving top priority to programmes developed within the ESA Convention framework. France has reaffirmed its proactive policy and intention to sustain its pivotal role in European space Earth Observation activities. France is and plans to remain ESA’s first contributor, strengthening national and European capacities in Remote Sensing space and ground systems, research and applications. Many examples will be found hereunder.

In the national scientific vision, our planet has to be understood, studied, observed and managed as an integrated Earth system – even when local scales are addressed. This is a major trend in international Earth Sciences organization. As an “upstream” Agency, Cnes fully shares such a vision, and enthusiastically supports such initiatives as CEOS and GEO which reflect it at international level. Following such a vision, there are no basic reasons to separate “traditional” remote sensing products like optical and microwave bidimensional observations from other space information systems related to land, ocean, atmosphere or some specific parameters as geomagnetism and gravity, even if these disciplines are addressed by other associations than EARSeL. So, the traditional yearly French report to EARSeL addresses the ongoing Earth Observation systems and their scientific results as a whole – with a specific emphasis to direct emerged lands observation, needless to say..

The Lisbon Treaty and on the technical side GMES (now Copernicus) and Galileo made the European Commission a major European actor of space activities in Europe, which is taken in due account by Cnes. In particular, a strong and clear EC-ESA management of GMES/Copernicus is perceived as a key point in EO development.

Since the beginning of the present millennium, the Cnes financial figures have been more or less similar from one year to another in spite of some budget shortages linked to European economic conditions. Cnes grants a national budget that exceeds some 200 million Euros (some 20 to 25% of its budget) to sustainable development programmes and to the Earth science sectors, which are directly relevant to Earth Observation space technologies.

The independent so-called CPS (Scientific Programme Committee) emits opinions and recommendations to better fit the Cnes programme as derived from Governmental guidelines and its analysis and derivation into programmes (taking into account user’s needs surveys, missions, technologies, ESA programme, international framework and policies, cost/benefit analysis, etc.) with top-level needs of scientific and researchers communities at large.

It should be underlined that some 7% of the CNES total budget is dedicated to leveraging the Ministerial and EC scientific research budgets in order to encourage the analysis and use of data and products derived from satellite measurements and monitoring. This figure applies to all relevant

disciplines (astronomy, etc) but there should not be significant percentage differences between disciplines when referred to its sectoral budget.

Some past key national institutional events of present key interest

On October 26, 2010, the French Government signed the so-called “*Contrat Etat- Cnes*”, an official document which defines policy guidelines for the period 2011-2015. Earth, Environment and climate science and applications are among top priorities. Without any kind of ranking, a few points should be highlighted for EARSeL members: follow-on and innovative oceanography missions (altimetry and ocean colour); GHG, water cycle, clouds and aerosols study and monitoring (with a specific emphasis on the role of vegetation in these cycles); contributing to ESA/UE GMES success stories.

At the institutional national level, Cnes and MEDDE (Ministry of Ecology, Sustainable Development, and Energy) are closely working together on various public interest issues in which EO could bring an undisputed added value. The value of EO derived products and services have been acknowledged for long by Ministry technical central services. The challenge is now to have them used at their full capacity by local staffs.

On the national scientific side, a report issued in 2010 by the French Academy of Sciences delivered overarching recommendations to strengthen already important cooperation between Cnes, the CNRS (National Scientific Research Centre) and Universities. In the EO domain, Cnes already signed Conventions with several research organizations, among which CNRS and IRD (Development Research Institute). The agreement with IRD includes many scientific activities making use Earth Observation data, products and services (including for instance a receiving station in French Guyana) which should enhance the use of EO derived data, products and services for developing countries.

The French Scientific Remote Sensing Programme (PNTS)

Coordinated by INSU¹, the **PNTS**² programme brings together a wide part of the Earth Observation scientific community in multiyear operations; the earth has to be analyzed as a system (see above). The PNTS aims at developing scientific methodologies, promoting the implementation of operational methods, assessing and assimilating space data in complex models, and promoting interdisciplinary studies. This programme allows funding:

- Exploratory studies for future instruments,
- Observed signal physics studies, including radiative transfer modelling,
- New processing methodologies for operating instruments and instruments about to be launched,
- Inter-comparison of satellite and exogenous measurements,
- Innovative use of space observation for a given thematic application.

The priorities for 2013 studies are:

- Methodological developments addressing uncertainties related to geophysical products derived from raw satellite observation data,
- Developments of inverse modelling using satellite data collected from complex environments,
- Development of methodologies to better use high temporal resolution observations;
- Development of methodologies addressing synergy between observations from different instruments in order to analyze underlying measurement physics;

¹ Institut National des Sciences de l'Univers

² Programme National pour la Télédétection Spatiale.

- Development of methodologies to jointly use data observed by space and by in situ observation systems
- Innovative studies to use observations derived from the Pleiades system.

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

An original initiative: Planet Action Foundation and programme

Planet Action is a non-profit initiative launched in June 2007 by Spot Image joined by ESRI as a co-founding partner. Other partners have also joined the initiative and the Planet Action Foundation has been set up. Planet Action and the UNESCO signed a cooperation agreement within the framework of the Open Initiative to support World Heritage sites.

Planet Action supports projects related to climate change issues by providing geographic information, Earth observation images and expertise to organizations (incl. NGOs), institutions and universities working towards combating climate change with local organizations. Since Planet Action’s launch in 2007, more than 600 projects have been submitted for imagery grants. In 2011 alone, more than 1000 Spot images were donated to nonprofits worldwide. Innovative results have already been got and are available on the web site www.planet-action.org.

High-resolution optical sector systems, European synergies and scientific preferential data policy

In this field, France runs both the civilian SPOT/Pleiades and military HELIOS systems: Maintaining complementarities between European programs and encouraging the scientific and operational use of Earth Observation data for institutional and private users – in particular through GMES, is a major guideline for the French Government

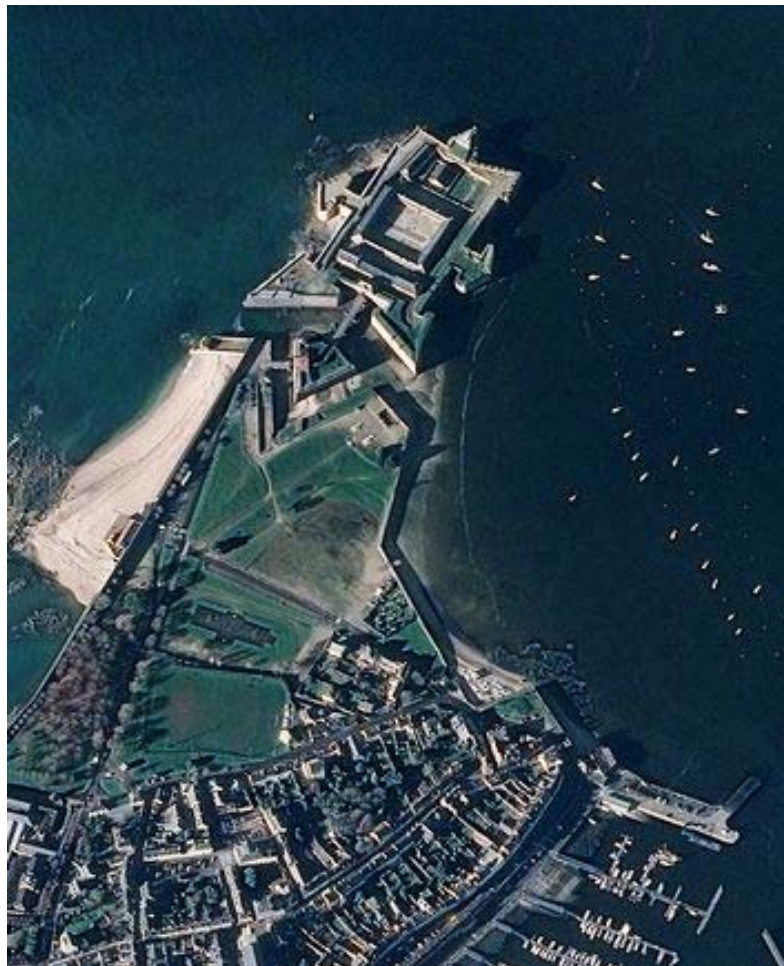
- The **HELIOS-2A** satellite has been operational since April 2005, while the **HELIOS-2B** satellite was launched in December 2009. Compared to HELIOS-I series, the second generation satellites feature sharper imagery, improved viewing field and access time to information, as well as an infrared capability for night imaging. The ground segment has been enhanced as well.
- The **SPOT³** constellation currently includes three satellites (SPOT 4, 5 and 6 – see hereunder). It has been decided to stop the SPOT-4 operations (and hence the products delivered by its HRVIR and VGT-1 instruments) and to de-orbit the satellite. Before that final event, a campaign dedicated to technological experiments and observations will be led. However, this will not jeopardize the SPOT family long term observing and archiving capacities as presented below.
- **The SPOT archive** includes now close to 30 million scenes. In order to complement its SPOT offer, SPOTIMAGE also distributes FORMOSAT-2 (2 metres in panchromatic and 8 metres in multispectral mode resolution, daily revisit) and KOMPSAT-2 (1 metres in panchromatic and 4 metres in multispectral mode resolution) images. A major decision about the SPOT archive products distribution is currently under discussion. The scenes observed more than 5 years before the order date could be released for free to non-commercial users. Such major applications as global change monitoring should take benefit from this facility.
- The **follow-on SPOT** series (SPOT-6 and SPOT-7) has been switched to private industry (ASTRIUM) in order to ensure a follow-on source of high resolution wide field Earth

³ Satellite Pour l’Observation de la Terre.

Observation products up to 2023. It is a constant policy for CNES to switch operational satellites to private industry or users public organizations (e.g. EUMETSAT) in order to focus its budget on innovation. It should be noted that such a privatization started significantly with the implementation of an operational stereoscopic sensor on SPOT-5. The development of this follow-on series takes advantage of synergies with the Pleiades satellites. **SPOT-6** was launched on September 8th, 2012.

The main observation features of SPOT-6 & 7 are:

- Field of view: 60 km
- Panchromatic band: 0.455 - 0.745 μm , 1.5m resolution
- 4 multispectral bands:
 - 'blue': 0.455 - 0.525 μm , 6m resolution
 - 'green': 0.530 μm - 0.590 μm , 6m resolution
 - 'red': 0.625 - 0.695 μm , 6m resolution
 - 'near infrared': 0.760 - 0.890 μm , 6m resolution



One of the first Pleiades-2 images. Constructed at a time when European countries were fighting against one another (EARSel could not exist at that time!): the Vauban Citadel in the Lorient harbour, France © CNES 2012, distribution Astrium services/SpotImage.

- The first **Pléiades-HR** satellite (Pleiades 1A) was launched on 16 December, 2011, and the second one (Pleiades 1B) on 1 December, 2012. Pleiades is designed to ensure an innovative generation of wide field observation satellites in panchromatic and multispectral bands. It will offer 0.5 m resolution products over a 20 km field of view, and a daily revisit capacity.

- It should be emphasized that **SPOT-6, SPOT-7, Pleiades 1A and Pleiades 1B** share (or will share) the same orbit with a 90° shift in order to ensure a maximal compatibility and in particular a maximal revisit capacity.
- Optical data from the SPOT series and Pleiades are available for European research users at subsidised prices through the ISIS programme run by CNES: www.isis-cnes.fr
- The **Kalideos** programme, set up by CNES as early as 2000, aims at developing remote sensing consistent reference databases for the scientific community. Four databases have been implemented to support the integration of satellite imagery in basic or applied research projects, targeting agronomic assimilation and modelling, tropical interdisciplinary studies, coastal zones and hydrologic and agricultural resources. They are aimed at research and development programmes focused on the development of new applications, or activities intended for demonstrating the potential of spatial data for a specific field, consistently with the implementation of the Copernicus (formerly GMES) initiative. Kalideos is quite active both in terms of updated data supply and scientific use.

“Vegetation” (low resolution, high receptivity optical system) and synergistic missions

The main propose of the VEGETATION mission and follow-on programme is a daily monitoring of vegetation status over the whole planet. In operational terms, the VEGETATION ground segment operated by VITO ensures a 10-day survey to deliver accurate products in which such perturbations as cloud coverage; directionality of observations and other artefacts are corrected as far as possible.

- **VEGETATION-1** was launched on-board SPOT-4 in 1998, followed by **VEGETATION-2** on board SPOT-5 in May 2002. The two instruments were operational up to this year. Data are processed and distributed by VITO, Belgium. This led Belgium to take the lead in that specific observation products range. End of 2008, a workshop evidenced the major role that VEGETATION and follow-on programmes played and will play, namely within the Copernicus (formerly GMES) framework. Since SPOT-4 is about to be deorbited, the programme is now entering a new phase.
- The continuity of the VEGETATION programme beyond SPOT-5 will be guaranteed by two satellites:
 - The **ESA SENTINEL-3** satellite is a part of the space component of the GMES initiative, providing global, frequent and near-real time ocean, ice and land monitoring; to be launched in 2013. The SENTINEL-3 mission addresses (1) ocean observation and altimetry, and (2) observations similar to the VEGETATION family, plus Earth surface temperature observation (SLSTR instrument).
 - The **PROBA-V** ESA satellite, with VITO as PI, is to be launched in April 2013. It should fill the gap (if any) between VEGETATION-2 (SPOT-5) and SENTINEL-3. VEGETATION-2 could be used to calibrate PROBA-V. The French Laboratory CESBIO⁴ is deeply involved in the preparatory programme of the International Users Committee (IUC). In particular, it studied how to best use jointly PROBA-V/SENTINEL-3, Venus, SENTINEL-2 data and products, which offer obvious complementarities in terms of spatial and temporal sampling (PRO-Fusion project, mainly led in 2011 with a final report in 2012).

This decision clearly breaks off the concept of simultaneous high and medium resolution observations as performed with SPOT-4 and 5, which does not appear as a critical requirement.

- France cooperates with Israel in the **Venus**⁵ research mission, dedicated mainly to vegetation and sustainable development applications. Venus prime objective is to monitor the fast vegetation changes during the growing season. Scheduled to be launched end 2013 (TBC), the Venus micro-satellite will cover every other day 50 to 100 representative sites of the main terrestrial and coastal ecosystems in 12 spectral bands, in the visible and near infra-red regions.
- CNES carried out the feasibility study of a micro satellite carrying out the so-called **MISTIGRI**⁶ mission. There is a clear need for high resolution images in the Thermal infrared to provide a way to detect irrigated fields, measure evapotranspiration and detect plant water stress. Models and algorithms have largely improved to yield very good results. However the only in-orbit satellites providing high resolution images in the thermal infrared domain (Landsat, Aster) do not provide them at the relevant frequent frequency and are long beyond their design lifetime. MISTIGRI should fulfil this need for high resolution and frequent coverage thermal infrared data for hydrological applications.

Optical and SAR remote sensing policy coherence at European level

- In the 80's, France, associated to Sweden and Belgium, took a *de facto* leadership in optical remote sensing in Europe – not to say in the world, taking great care to work within a coherent European framework at short, medium and long term – either through multilateral coordination or through the ESA programmes. An illustration is the VEGETATION – PROBA V – Sentinel-3 evolution.

Another key point is the present complementarity between three major components in moderate and high resolution optical remote sensing; the follow-on SPOT family has been transferred to the private sector. The Pleiades optical family and the Cosmo-Skymed SAR family are the two components of the ORFEO constellation. SPOT and Pleiades have been developed as complementary systems. The ESA Sentinel-2 satellite mission has been derived from some GMES service oriented requirements. Sentinel-2 is significantly different from SPOT and Pleiades/Skymed satellites. It is a moderate resolution superspectral 12-channel observation system, offering ground resolution in the 10-60 m range.

- In agreement with the above described political guidelines, France did not develop any SAR satellite family.

Before the launch of ERS-1, the French scientific community developed cutting-edge skills in SAR remote sensing, including interferometric techniques. So, the national scientific community was ready to take full advantage of ERS1 then ERS2 satellites (including the ERS1/ERS2 tandem archive), and then ENVISAT ASAR. In parallel, Italy developed Cosmo-Skymed as a part of the Orfeo dual constellation. The four planned satellites were launched from 2007 to 2010. Cosmo-Skymed offers X-band observations with resolutions ranging from 100m (SCANSAR mode) to 1m (Spotlight mode) Germany developed the TERRASAR-X satellite family as a public-private partnership, offering X-band observation at 1m resolution at best and a capacity to collect tandem images for DEM generation thanks to the second satellite launched in 2010, while the first one had been launched in 2008.

In order to fulfil some GMES (now Copernicus) requirements, ESA is developing the C-Band Sentinel-1 satellite. Sentinel-1 will ensure the continuity of ESA's heritage SAR systems on

⁵ Vegetation and Environment Monitoring New **Micro-Satellite**.

⁶ **Micro Satellite for Thermal InfraRed GRound Surface Imaging**

ERS-1, ERS-2 and Envisat. On its side, Canada – a former partner of the ERS programme which developed the RADARSAT-1 and 2 satellites – decided to build up the RADARSAT constellation and signed the related contract beginning of January 2013.

Miscellaneous (soil & oceans): SMOS and SWOT

- As reported in previous national reports, the **SMOS**⁷ satellite was successfully launched on Nov 02, 2009. It is a joint ESA (European Space Agency) / CNES (France) / CDTI (Spain) Earth Observation program. The SMOS satellite had been proposed by the French lab CESBIO and selected by ESA as the 2nd Earth Explorer Opportunity Mission.

The SMOS accuracy objective is of 4% for volumetric soil moisture, with three days revisit and a spatial sampling better than 50 km, and a 0, 01 – 0, 02% for ocean salinity for monthly mean at 200*200 km. Such monitoring is essential to better understand the water cycle.

The SMOS derived ocean salinity measurement was cross-checked with those derived from the NASA's AQUARIUS mission and from the ARGO international network of in-situ drifters. In October 2012, ESA stated that *"the mission is now approaching its objective of 0.1 psu (practical salinity unit) accuracy for a 10–30 day average, over an open ocean area of 200 km by 200 km"*.

It was also shown that SMOS could provide scientists with ancillary but precious results, such as reliable estimates of the surface wind speeds under intense storms. This was experimented for the hybrid Sandy storm end October, 2012, the largest Atlantic hurricane on record (ESA communication, Nov 09, 2012).

- The **SWOT**⁸ mission is a major technology break in space altimetry, bringing together conventional space altimetry and continental water resources monitoring and paving the way to key scientific and technological innovations.

SWOT is developed as a joint project between CNES, NASA and CSA.

The national scientific studies to define and streamline the SWOT developments are led through the TOSCA⁹ programme, associating CNES, the CLS company and major French laboratories: CNRM, LEGOS, IFREMER, LMD and LOCEAN.

Nadir altimetry delivers punctual measurements along profiles spaced by several tens/hundreds of km, thus preventing the study of small scale structures in oceanography, and forbidding the monitoring of most of the continental water bodies. It is thus necessary to develop new instruments able to overcome these limitations. This is the challenge of the SWOT mission and of the new concept of its sensor, the **KaRIN** instrument (Ka-band Radar INterferometer).

The SWOT mission objective is to measure water heights (and their space-time variations) of rivers, lakes and flooded zones as well as oceans. The interferometric altimetry will give access to a bi-dimensional image with a 50-100 m horizontal resolution. The KaRIN instrument includes two SAR antennas in Ka band at the end of 10 meters boom providing a ground track of 120 km large. SWOT satellite will cover the Earth, at least twice every 21 days. KaRIN is coupled to a nadir altimeter.

In oceanography, SWOT enables to accurately characterize meso- and sub-meso-scale circulations which play a major role in the energy transport in oceans. SWOT also gives access to

⁷ Soil Moisture and Ocean Salinity.

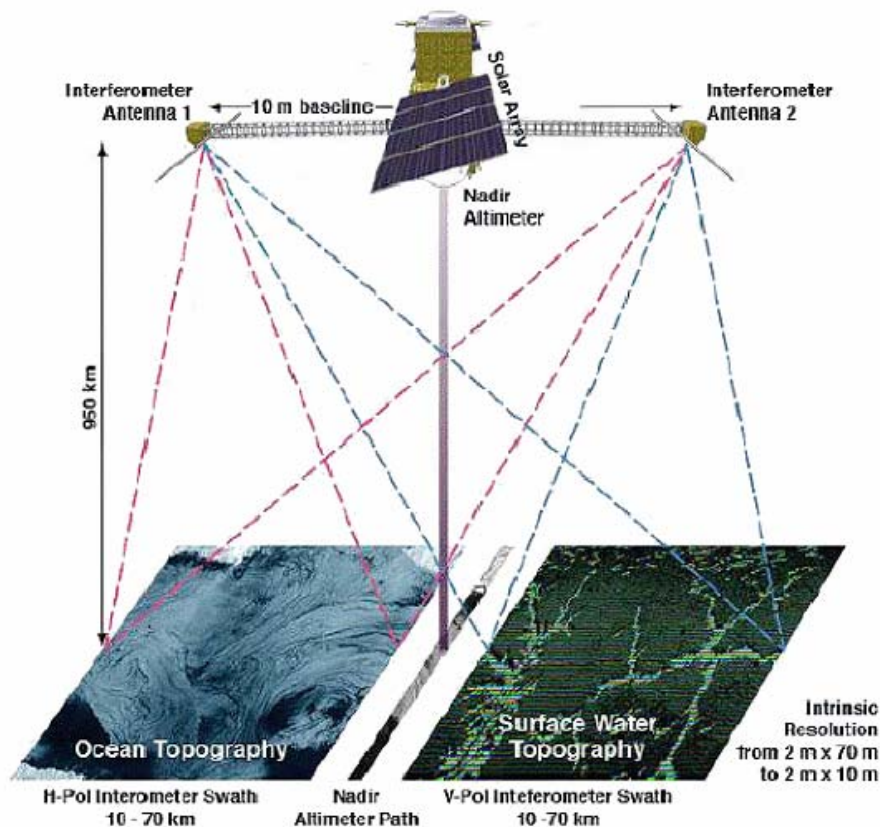
⁸ Surface Water and Ocean Topography

⁹ Comité « Terre solide, océan, surfaces continentales, atmosphère »

coastal circulation effects on marine life, ecosystems, water quality, transports and will enable a better modelling of ocean/atmosphere coupling.

In continental surfaces hydrology, SWOT will enable (a) to measure at large scale changes in water storage of the main humid areas, lakes and reservoirs, and (b) to improve the accuracy estimation of the main rivers flow. These new capabilities will enable monitoring the evolution of fresh water supply in the global change context, notably in the regions where few observations exist.

The SWOT phase A started in November 2012.



The key principles of the innovative SWOT mission, combining a two antennas interferometer (10m baseline) and a nadir altimeter.

Geodesy and 'Solid Earth'

- Operational since 1992, Doris¹⁰ is a highly accurate positioning system, both for tracking satellites and determining the absolute location of ground beacons. The Doris instruments can be easily carried on several satellites, so the number of instruments in space varies from year to year. They are or were implemented on board the SPOT series after SPOT-4, ENVISAT, the Pleiades series and the JASON series. Doris enables a 1-cm accuracy positioning and a few yearly mm for the motion of its 55 ground stations. Enhanced Doris instruments and ground segment are now available.
- Developed by France and the USA, the **ARGOS** system has been operational since 1978. This system allows accurately positioning any object equipped with Argos beacons and collecting any information that they transmit. ARGOS system is exploited worldwide by CLS, a

¹⁰ Doppler and Radio Positioning Integration by Satellite.

subsidiary of Cnes and Ifremer¹¹. The first third generation instrument was carried on board of METOP launched in 2006. Three more satellites (will) carry on ARGOS-3: (NOAA N' (2009), METOP B (2012), METOP C)

- **Geomagnetism:** In the recent past, France has cooperated with Denmark **ØRSTED**¹² mission (1999-2006). It will contribute to ESA's **SWARM** mission ('Opportunity mission' of the 'Earth Explorer' program), a constellation of three. The SWARM constellation is planned to be launched in April 15, 2013.

The scientific objective of the mission is to provide the best survey ever achieved of the geomagnetic field and its temporal evolution, in order to gain new insights into the Earth system by improving our understanding of the Earth's interior and Sun-Earth connections.

The French contribution to SWARM consists in supplying the absolute magnetometers (**ASM**: Absolute Scalar Magnetometer). In addition IPGP¹³ will carry out the scientific validation of the data generated by the ASM. The magnetometers developed by LETI¹⁴ are much more accurate than those from the previous ØRSTED and CHAMP missions.

- **Gravity:** During the past decade, France was involved in two dedicated gravity missions: the **CHAMP**¹⁵ mission with Germany (2000-2010) and the US **GRACE**¹⁶ twin satellites mission (launched in 2002 and still in operation).

The ESA's **GOCE**¹⁷ mission (ESA's 'Earth Explorer' programme) was successfully launched on March 17, 2009. Within more than three years, GOCE has gathered enough data to map Earth's gravity with unrivalled precision. Scientists now have access to the most accurate model of the 'geoid' ever produced.

- **TLE processes:** Following the scientific relevance of information delivered by the CNES **DEMETER**¹⁸ micro-satellite (2005-2010), scientists from the French LP2CE lab, in cooperation with US, Polish, Czech and Japanese colleagues designed the follow-on **TARANIS** mission, to study magnetosphere-ionosphere-atmosphere coupling via TLEs (Transient Luminous Events) processes. TARANIS has been approved by the Cnes Council.

Oceans

- The Franco-American **TOPEX-POSEIDON** ocean altimeter system stopped operating in 2005 after a successful 13-year mission. Launched in 2001, its successor, the **JASON-1** mini-satellite has enabled to study ocean dynamics and to determine sea level with 1-cm accuracy. The **JASON-2** satellite, launched in 2008, is a key component of the Ocean Surface Topography Mission (OSTM - EUMETSAT). Jason-2 is the continuation of the existing successful cooperation between the United States and Europe. The JASON story perfectly illustrates a progressive transfer of operational systems from research (CNES, NASA) to operational (NOAA, EUMETSAT) agencies. The follow-on TOPEX-POSEIDON, JASON-1 and JASON-2 series of satellites allow both long term oceanic altimetry monitoring and its near-real time forecast. The follow-on JASON-3 satellite is planned to be launched in April 2014.
- The **SARAL/AltiKa**¹⁹ project led in cooperation between France and India is dedicated to operational ocean altimetry. SARAL will embark AltiKa, an altimeter system delivering

¹¹ French Research Institute for Exploitation of the Sea

¹² Named after the Danish physicist.

¹³ Institut de Physique du Globe de Paris

¹⁴ Laboratoire d'Électronique et de Technologies de l'Information

¹⁵ **CHALLENGING** Mini-satellite Payload for Geophysical Research and Application

¹⁶ Gravity Recovery And Climate Experiment.

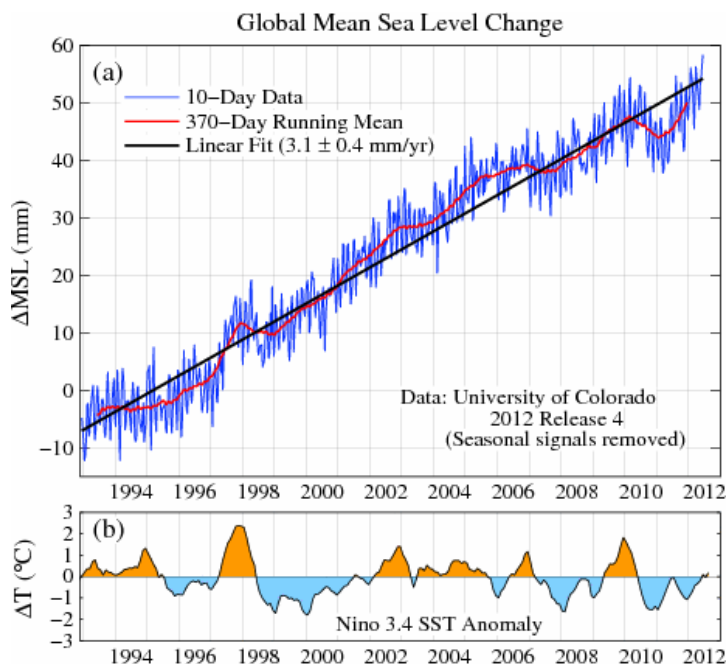
¹⁷ Gravity Field and Steady-State Ocean Circulation Explorer.

¹⁸ Detection of Electro-Magnetic Emission Transmitted from Earthquake Regions

¹⁹ Altimetry in Ka band

enhanced observations of ocean surface levels, currents, wave height and wind speed at sea surface thanks to measurements in Ka band – an innovative high frequency in altimetry technology. AltiKa is envisioned as a successor of RA-2 instrument on board ESA's satellite ENVISAT, which stopped its observations in 2012. On board SARAL, AltiKa will be complemented by ARGOS-3, DORIS, LRA. SARAL is planned to be launched on February 11, 2013.

- The AltiKa project is a key component of the French operational oceanography program development. It includes the deployment of in situ measurements (**CORIOLIS** project) and the implementation of an analysis and forecasting Center (Mercator Ocean). These two programmes are the French contribution to **GODAE** (Global Ocean Data Assimilation Experiment), the first international operational oceanography experiment. Various Applications of modelling/assimilation systems such as Mercator Ocean are in operation, giving preliminary answers to scientific key questions and contributing to the development of operational applications. Ocean altimetry is a key observation parameter of the system, while continuity of observations is a critical factor of its efficiency. Participation to the permanent observation system that will feed operational oceanography thus constitutes a major objective of AltiKa. In particular, SARAL/AltiKa will contribute to the definition and implementation of the Marine Core Service of the COPERNICUS (formerly GMES) program through the MyOcean2 project (in the continuity of the **MERSEA** project).
- The Chinese Space Agency (CNSA) and Cnes have decided to cooperate in building up the so-called **CFOSAT** mission. CFOSAT will monitor ocean waves and climatic state of sea surface state on a global and repetitive basis. CFOSAT is planned to be launched in 2015.



Global sea level change measured by TOPEX satellite (1992-2001), Jason-1 (2002-mid 2008) and Jason-2 (mid 2008-present). © University of Colorado, Boulder.

Meteorology, climate

France participates to geostationary and polar orbiting meteorological satellites through its involvement within ESA and EUMETSAT, plus some specific developments such as IASI on board METOP and the Megha-Tropiques satellite developed in cooperation with India.

Three **Meteosat Second Generation (MSG)**, developed with a strong French industry involvement were launched in 2002, 2005 and 2012. **MSG-4**, the last satellite of the series, is planned for launch around 2014.

Following the successful launch of the first **MSG-2**²⁰ satellite (2005) and the experimental **PUMA**²¹ exploitation programme, aimed at fostering the use of MSG data for non-meteorological applications in Africa, which ended in September 2005, the **AMESD**²² programme is considered as a Copernicus (formerly GMES) component to support African countries in better managing their natural resources by providing them with relevant environmental information. 111 stations were deployed as of June 2011 in 48 African Sub-Saharan countries in the framework of AMESD programme by Telespazio-France. The 111 stations comprise 57 AMESD stations, 50 PUMA-2010 stations, and the equipment of 4 African training centres.

The follow-on **Meteosat Third generation (MTG)** started through a Preparatory Programme beginning of 2008 upon a decision of the 63rd EUMETSAT Council. On 21 November 2012 the European Space Agency and EUMETSAT signed the agreement on MTG at the ESA Ministerial Council Planned for launch around 2015; MTG will provide a significant improvement over the capabilities of the current Meteosat satellites.

France took an important part in the development of the METOP23 programme, which is the space segment of the EUMETSAT Polar System (EPS) 24. METOP-A and B were launched in 2006 and on 17 September, 2012, while METOP satellite is planned to be launched around 2016 Therefore, the polar-orbiting satellites dedicated to operational meteorology are now equally shared between EUMETSAT and NOAA. The most innovative METOP payload is IASI25, 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. In 2012, CNES decided to develop a new generation instrument (IASI-NG).

Its performance objective is to improve the IASI demonstrated performances by a factor of 2

The Indian Space Research Organisation (ISRO) and CNES jointly developed the **MEGHA-TROPIQUES**²⁶ satellite, launched on October 12, 2011. Observations transmitted by MEGHA-TROPIQUES are expected to improve scientific knowledge on the water cycle contribution to the climate dynamic in the tropical atmosphere and on the processes linked to the tropical convection, especially regarding the ITCZ²⁷ region, where the atmosphere dynamics is particularly intense due to high solar incoming irradiance. MEGHA-TROPIQUES 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, already used in previous missions in cooperation with Russia.

²⁰ **Meteosat Second Generation.**

²¹ **Preparation to the Use of MSG in Africa.**

²² **African Monitoring of the Environment for Sustainable Development.**

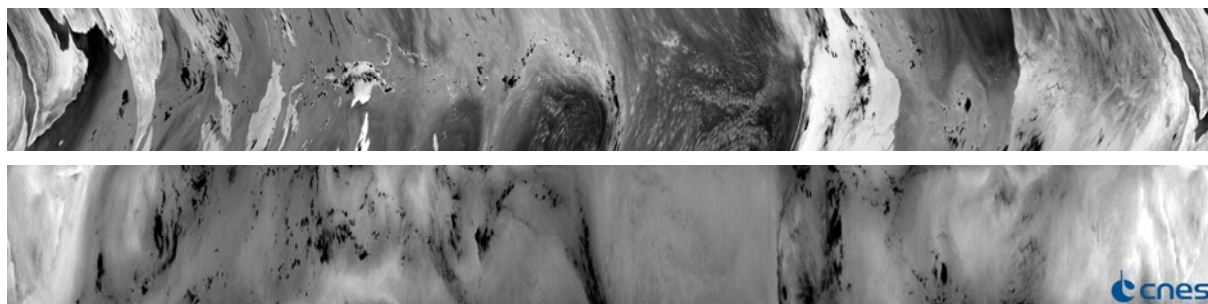
²³ **METEorological OPerational Satellite.**

²⁴ The EUMETSAT Polar System consists of the METOP spacecrafts and associated ground segment.

²⁵ **Infrared Atmospheric Sounding Interferometer.**

²⁶ "**Megha**" means cloud in Sanskrit and "**Tropiques**" means tropics in French.

²⁷ **Inter-Tropical Convergence Zone.**



MEGHA-TROPIQUES: Some of the very first images delivered by MADRAS (89V channel) and SAPHIR (channel 6) sensors- © ISRO & CNES.

Aerosols, clouds, radiative budget – The A-Train

Developed by the NASA, Cnes and CSA²⁸, the so-called **A-Train** is a series of satellites (the initial concept included Oco²⁹, Aqua, Cloudsat, Calipso, Parosol, Aura, Glory) on the same orbit, 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. Since the A-Train is a long term concept, the set of satellites which compose it changes with time. Some satellites leave it (e.g. PARASOL) while new ones join it.

CNES' **PARASOL**³⁰ micro-satellite carries on a **POLDER**³¹-like wide-field radiometer. Derived products were made available in 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). On 2 December 2009, PARASOL was manoeuvred out of the A-Train and dropped some 4 km below the other satellites by early January 2010 without stopping transmitting information, such giving access to a 7 years archive.

Managed by NASA in cooperation with France, the **CALIPSO**³² mission was launched in 2006. CALIPSO addresses important questions about the effects of clouds and aerosols (airborne particles) on the Earth climate change.

GHG monitoring: MERLIN

In 2009, The French and German scientific community, together with CNES and DLR, started a new cooperation in order to develop an innovative mission for climate change studies. The so-called **MERLIN** project was defined. Its objective is to accurately measure the CH₄ concentration in the atmosphere and its spatial-temporal variations. The CH₄ greenhouse impact is about 25 times greater than CO₂, and no significant sinks exist on Earth. So, monitoring CH₄ concentration in the atmosphere is of a paramount importance for carbon cycle studies, as well as climate change studies and definition of relevant environmental policies.

German will supply an innovative differential absorption lidar, while France will supply a new platform meeting the mission needs. A joint phase B is to be led in 2013.

French scientific community major involvements in future ESA Earth Explorer Core Missions

Within the framework of the second call for **Earth Explorer Opportunity Missions** (2005), following pre-phase A studies, ESA selected the following missions for Phase A studies in March 2009:

²⁸ Canadian Space Agency.

²⁹ The launch of **OCO** failed.

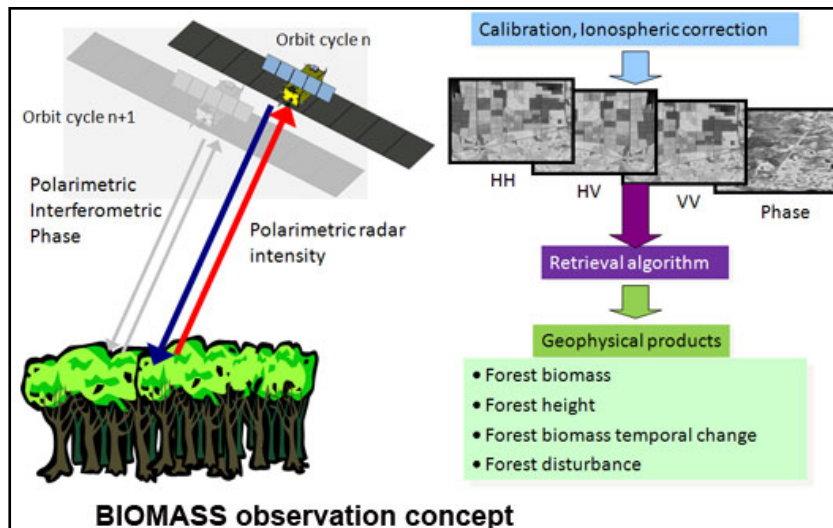
³⁰ Polarisation and Anisotropy of Reflectances for Atmospheric Sciences coupled with Observations from a Lidar

³¹ POLarisation and Directionality of the Earth's Reflectances.

³² Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations.

BIOMASS, CoReH2O and PREMIER. France is deeply involved in these proposals, especially in the first one.

BIOMASS aims at delineating forests and quantifying forest biomass using a 50 m spatial resolution, 25 days revisit time P-band SAR offering repeat-pass interferometer. Coordinated by CESBIO (France), BIOMASS is the first mission fully dedicated to forest monitoring with scientists in the “driving seat”.



The BIOMASS observation concept. © CESBIO

COPERNICUS (formerly GMES) core services

From its very beginning, France strongly supported **GMES**³³ - now **Copernicus** - as a user driven initiative making use of reliable operational information sources, both from space and in situ monitoring. ESA was involved in GMES through the **GSE**³⁴ scheme, a suite of Earth Observation-based precursor services. France was engaged in 11 of the 12 initial GSE projects. Now, Copernicus is developing “core services”. France is providing operational products in two of them (described below) and also involved in the development of rapid mapping services for civil security users:

- **COPERNICUS Land Core Service:** The main objective of the **Geoland2** project is to support decision makers in mitigating the threats of global change impacts by effective adaptation strategies and counter measures by provide them with accurate, up-to-date and reliable information on the changing conditions of our natural resources through a frequent and area-wide monitoring of the environment.

The Land Services provide cross-border harmonised geo-information at global to local scales in a time- and cost-effective manner. These monitoring services have been defined, developed and implemented within a series of projects funded by the European Commission (Geoland, BOSS4GMES) and the European Space Agency (GSE Land, GSE Forest Monitoring).

Building upon their results, Geoland2 aims to organise a qualified production network, to build, validate and demonstrate operational processing lines and to set-up a user driven product quality assurance process.

The Geoland-2 project started in September, 2008.

- **COPERNICUS Marine Core Service.** The main objective of the **MyOcean2** project is to deliver and operate a rigorous, robust and sustainable Ocean Monitoring and Forecasting system of the GMES Marine Service (OMF/GMS) to users for all marine applications: maritime safety,

³³ Global Monitoring for Environment and Security.

³⁴ GMES Service Elements.

marine resources, marine and coastal environment and climate, seasonal and weather forecasting.

In the period from April 2012 to September 2014, MyOcean2 will ensure a controlled continuation and extension of the services and systems already implemented in MyOcean, a previous FP7-funded project (April 2009 - March 2012) that has advanced the pre-operational marine service capabilities by conducting the necessary research and development.

To enable the move to full operations as of 2014, MyOcean2 is targeting the prototype operations, and developing the necessary management and coordination environment to provide GMES users with continuous access to the GMES service products, as well as the interfaces necessary to benefit from independent R&D activities.

Cnes developed a dedicated programme to facilitate the operational use of GMES at a national level.

‘Thematic Data Centers’

The French programme of ‘thematic data centres’ is a major initiative meant to provide scientists with relevant products and information. It also can make scientific results available to downstream users, such as technical services of policy and decision makers or service providers. A working group has been established at the beginning of 2012 to propose a roadmap for the evolution of the network of thematic data centres in France. This report and roadmap will be available in June 2013.

- The **PTSC**³⁵ (Land Data Centre) was formally created through an agreement signed by seven French organizations on December 6, 2012. Its objective is to support environmental research to make the best and widest use of Earth Observation products. Its key objectives are: anthropic and climate pressures on ecosystems and territories; observing, quantifying and modelling water and carbon cycles; monitor societal evolutions and related activities; better understand the dynamics of biodiversity. The network will supply the national scientific community with quality controlled data, products, methods and services related to Earth surface observation from space, from the ecosystem and territories to the planet scales. These information sets will cover large areas and wide time scales. It is planned to serve over 400 laboratories and 100 doctoral schools, but also public actors of territories management, public institutes and services, services and territorial institutions.
- The **ETHER** Data Centre manages and valorises data related to atmospheric chemistry. Although dedicated primarily to scientists, it can bring valuable information to operational services, policy makers and general public.
- The **ICARE**³⁶ Thematic Competence Network is a partnership dedicated to aerosols, clouds, radiation and the water cycle. Among others, it distributes atmospheric products derived from the A-TRAIN (in particular PARASOL, see above), but also from archives of past missions (ScaRaB, TRMM, Polder)

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³⁵ Pôle Thématique Surfaces Continentales.

³⁶ Interactions Clouds Aerosols Radiations Etc

Remote Sensing Activities in Romania, 2012

The Remote Sensing & GIS Laboratory, inside the National Meteorological Administration (NMA), is one of the leading Romanian providers in remote sensing products and services for environment monitoring and applications. The remote sensing activities are concentrated in following strategic application areas: disaster management, snow, drought, new satellites and water resources. Remotely sensed information is integrated in Geographical Information Systems (GIS) for further evaluation and stored in geo enabled databases to support information management.

Flooding remains the most widely distributed natural hazard in Europe, leading to significant economic and social impact. Various processing techniques (classification, georeferencing, filtering, and photointerpretation) are used to combine the optical and radar images and map the flooded areas. The entire work-flow is fully optimized and usually we obtain the final product in 1 – 2 hours after the image was acquired by the satellite sensor.

One of our research activity focuses on snow water content estimations for the mains hydrographic basins involving remote sensing techniques together with GIS information and data recorded by weather stations. These estimations resulted from snow water reserves calculated by altitude level and vegetation cover. Calculating snow water reserves at their maximum levels and at several times of the melt season is particularly important to forecasting and water management services as well as for the exploitation of storage lakes. It was also considered the setting up of an efficient system to get, analyze and display information that is useful in snow water resource forecasting and management, helping managers and decision takers.

Participation in European cooperation projects

- *FP7 CRYOLand Project:* Since 1 February 2011, the National Meteorological Administration has been participating together with another nine institutions and private companies from Europe in the CRYOLand Project, financed by the European Commission within the framework of FP7. This project is mainly aimed at setting up an operational GMES service to provide the whole European territory with quantitative measurements of snow/ice-covered areas, snow water content etc. Its main objective is the development of a sustained, standard and validated service focused on several parameters related to snow/ice, obtained from satellite data. CRYOLand approaches a socio-economical topic of special relevance to the European citizens, namely the very accurate monitoring of snow/ice-covered areas, glaciers and frozen lakes. The service to be developed will improve the management of economical and ecological activities related to snow and ice throughout Europe.

- *EU Grant Project: Drought Mitigation in the Mures Basin's Vulnerable Areas:* The MIDMURES project is aimed to test dedicated technologies, techniques and practices focused on drought mitigation. There are some priorities: pluvial and surface water conservation, alternative spraying, and efficient water saving and low-water-consuming crops. The MIDMURES objectives were:
 - Decreased water supply in agriculture and drought forecasts in the Mures basin pilot area obtained by combining several technical approaches;
 - Runs of climatic scenarios based on regional climatic models and agrometeorological models, in order to optimize the structure of crops;
 - Analyses of the modifications in land use classes through time;
 - Monitoring the vegetation condition in crops using satellite images.

- *PROBA-V Preparatory Program, Project “Testing PROBA_V and VEGETATION data for agricultural applications in Bulgaria and Romania”*: The project main aimed was the evaluation of the quality of PROBA-V mission and its consistency with VEGETATION 1 & 2 by comparing and validating SPOT VEGETATION and simulated PROBA-V data, in order to estimate the vegetation condition.

- *LIFE Program, Project CLEANWATER “Integrated system to protect and analyze the condition and evolution of waters threatened by nitrogen pollution”*: The project main goal was to create a decision instrument to be used in the sustained management of water resources in a hydrographic basin, based on mathematical modeling in order to determine the nutrient balance from surface and ground water resources using some predefined trends and scenarios of the evolution of human activities on the background of climate change. This project works out a GIS-based support system to determine nitrates-vulnerable areas in order to elaborate strategies for sustainable use of water resources in a hydrographic basin, given the climate change conditions in Romania. By this integrated information system, every area potentially vulnerable to nitrate pollution can be detected together with the steps to be taken for protecting the water resources and keeping them in good ecological condition.

Participation in National funded R&D projects

- *Project PN-II-PT-PCCA GEODIM (Platform for Geo-information Support of Disaster Management)*; The main goal of the GEODIM project is to develop a downstream emergency response service for contributing to current disaster and risk management approach based on Earth observation data. The project objectives are:
 - Targeting information products being agreed by the user community and defined based on current technology and EO data based on users' requirements;
 - Ensuring the continuity and improvement evolution of the previous national project SIGUR (Satellite Based Emergency Response Service) developed by the same core partners;
 - Acting as an interface with the existing emergency response complementary services: SIGUR, EMS, International Charter for Space and Major Disasters, UN-SPIDER, and strengthening the expertise of the Romanian RSO (Regional Support Office) in UN-SPIDER;
 - Validating and qualifying the pre-operational performance and considering its further commercial exploitation.

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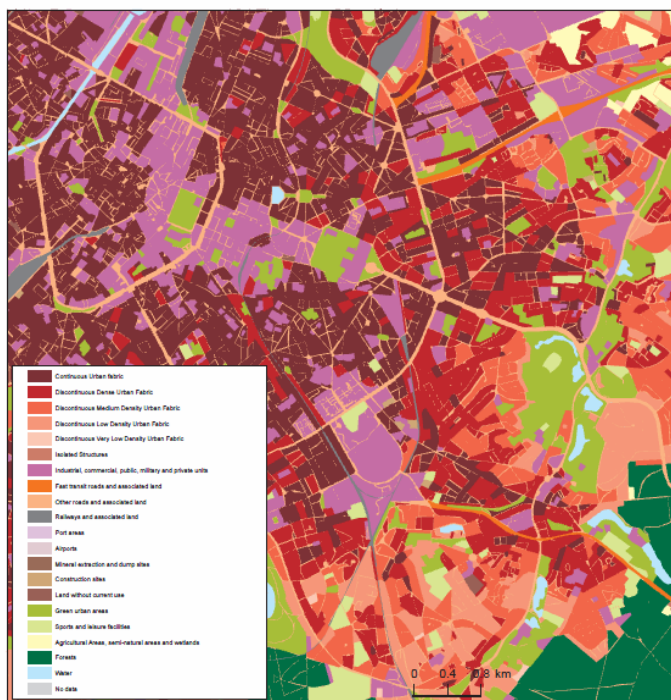
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News from Other Organisations

GMES/Copernicus Urban Atlas - Call for Tender

The European Urban Atlas is part of the local component of the GMES/Copernicus land monitoring services, a joint initiative of the European Commission Directorate-General for Regional Policy and the Directorate-General for Enterprise and Industry with the support of the European Space Agency and the European Environment Agency. Urban Atlas provides reliable, inter-comparable, high-resolution land cover / land use maps for 305 Larger Urban Zones (more than 100.000 inhabitants as defined by the Urban Audit) for the reference year 2006. The GIS data can be downloaded together with a map for each urban area covered and a report with the metadata. Urban Atlas is not as detailed as local LC/LU information managed by the cities themselves, but has the advantage of providing for the first time a comparison basis between cities, using a single harmonized and coherent nomenclature. The Urban Audit, a data collection of indicators on cities and their surroundings, showed that although a wide variety of socio-economic data is available for cities, inter-comparable land use data did not exist. To facilitate more evidence-based policy-making, the European Urban Atlas was specifically designed to compare land cover land use patterns amongst major European cities, and hence underpinning Community regional policies and funding. It uses images from satellites to create reliable and comparable high-resolution maps of urban land in a cost-efficient manner.

The Urban Atlas has a legend designed to capture urban land cover and land use, including low density urban fabric, and a resolution that is 100 times higher than CORINE land cover. The maps of the Hague and Torino show how Urban Atlas brings cities and urban fringes into focus thanks to its superior resolution. The higher resolution in combination with the street network allows for a wide range of additional analyses such as proximity to green space or train stations. The Urban Atlas provides a far more accurate picture of urban sprawl in the fringe of urban zones. The results of the first Urban Atlas are available via <http://www.eea.europa.eu/data-and-maps/data/urban-atlas>.



Urban Atlas Product for Brussels,
(Mapping Guide for a European Urban Atlas, © European Union, 2011).

The call for tender for the Urban Atlas aims at the delivery of an update of the Urban Atlas 2006 land use/cover maps of major European urban agglomerations towards the reference year 2012. It is meanwhile closed, and the evaluation is on-going, meaning that the contract should be signed a few weeks later, and that the actual work should be starting in spring this year. The work consists of the serial production of land cover/use change and updates some maps of larger urban zones (LUZ) where changes in the circumscription occurred as compared to the Urban Atlas 2006 delineation of LUZs, and extended with a list of additional LUZ. The work shall be based on the Urban Atlas 2006 datasets and the Very High Resolution (VHR) satellite images of the reference year 2012 (+/-1) that are made available by the EC through the ESA GMES data warehouse (DWH). The output of the work shall be under the form of GIS compatible vector maps of the urban agglomerations.

More particularly, the call for tender for Urban Atlas addresses following tasks:

- A revision of the UA 2006 (mainly adaptation of LUZ delineations and minor nomenclature changes)
- A change detection 2006-2012 for all the LUZs that were covered in UA2006;
- An update to the 2012 reference year also for all the LUZs covered in UA2006;
- An extension of the LUZs for 2012, towards: Croatia (joining the EU mid 2013), major cities of EFTA countries, other EU cities larger than 50 000 inhabitants.

The area that will be covered by UA 2012 will be extended to 430 000 km² more, compared to the UA2006 covered approximately 585 000 km².

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Group on Earth Observations: Covering the users' needs in Global Land cover data, tools, services and capacity building

By Georgios Sarantakos (GEO Secretariat)

Abstract: What if there was an online system that every user could access for free national, regional and global land cover-related datasets and products at 30 m resolution? And what if this online system provided a free service to create these products, where the user could choose the classification of these products according to his/her needs? And what if these resulted products were validated by all means, including among else more than 100,000 validation points from crowd-sourcing, a network of in-situ validation data and a group of experts around the globe that is interested in using this products? What if this network was increased over the years and filled the gap regions though trainings and capacity building activities? The Global Land Cover community teams up under the umbrella of the Group on Earth Observations (GEO) to turn these “what ifs” into reality. EARSeL Global Land Cover is playing a key role at this effort.

Introduction

Over the last few years, more and more sectors rely on remote sensing products. This trend has been enhanced by the opening of the access to Landsat data in 2008 and the Rio International Conventions in 2002³⁷. The former resulted in explosive data-distribution growth³⁸, while the later raised the need for tools and products for the measurement and visualization of status and trends of global environmental issues, such as climate change, biodiversity and desertification respectively, and their implications. These products should also be able to support the policy makers to take informed decisions for national, regional and global issues.

Global Land Cover community

The Global Land Cover community is expected to lead this new era. According to a recent report, prepared by the USA satellite community on behalf of the Group on Earth Observations³⁹, the Global Land Cover is among the top5 most critical earth observation parameters required for the monitoring of environmental and human wellbeing issues such as forest carbon, biodiversity and ecosystem services, energy and food security, sustainability impacts, health etc.

While there are several global maps, the most of them have resulted from different methodologies and serve different needs by using different classifications. Therefore, there is not always consensus among these products. Also, they are not always able to address the needs of the increasing number and multidisciplinary of experts and policy makers in terms of classification and temporal and spatial resolution. This is mainly because they are static products and they do not always capture the dynamic nature of the environment i.e. they illustrate status and not trends.

³⁷ UNFCCC (United Nations Convention on Climate Change), UNCBD (United Nations Convention on Biological Diversity) and UNCCD (United Nations Convention on Combating Desertification)

³⁸ Daily average of scenes jumps from 53 per day to 5776 per day

³⁹ Group on Earth Observations. Task US-09-01a: Critical Earth Observation Priorities. Critical Earth Observation Priorities (Second Edition). 2012. Available at <<http://sbageotask.larc.nasa.gov>>.

GEO Global Land Cover task

In order to tackle this issue the Global Land Cover community⁴⁰ combined its efforts under the umbrella of the Group on Earth Observations (GEO) and its Global Land Cover task. EARSel through its Land Use and Land Cover Special Interest Group, represented by its co-chairman Dr. Ioannis Manakos, plays an important role to this effort. In addition, GEO bridge the gaps between the Global Land Cover community and the users, i.e. policy makers and experts.

For instance, the development of the 30m resolution thematic maps is conducted in collaboration with the GEO biodiversity and ecosystems community. The added value of this collaboration lies on the fact that this biodiversity community develops the Global Wetlands Observation System in partnership with *inter alia* Ramsar Convention, and therefore represents the main users of these products. At the same time, the biodiversity community will be of great support for the validation of these products.

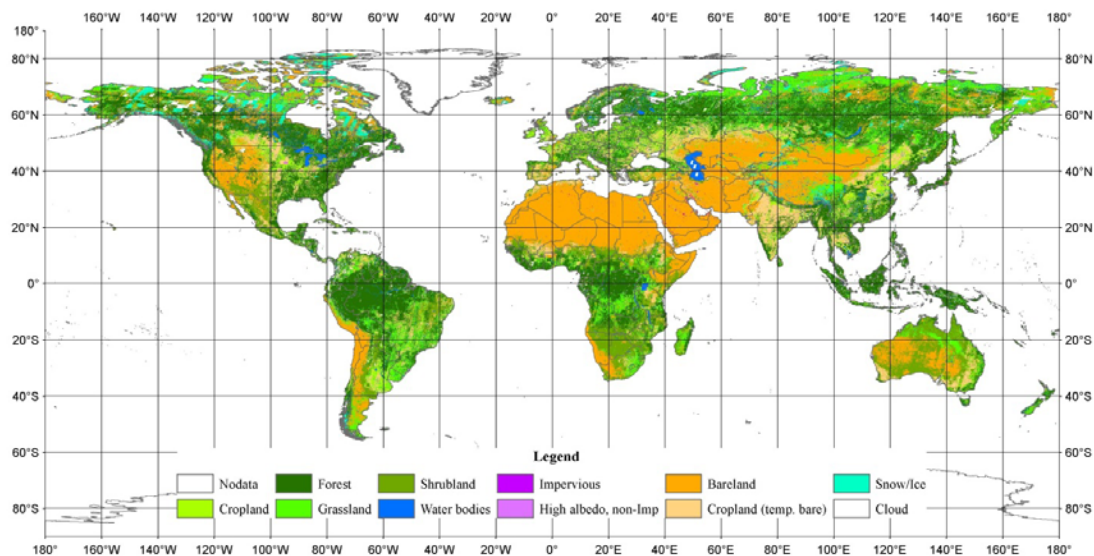


Figure 1: Global Land Cover product developed by the support of the Ministry of Science and Technology, and Tsinghua University of China.⁴¹

The GEO Global Land Cover task is organized in 3 components:

1. Global Land Cover Datasets and Service. For the development of datasets and ready-to-use products.

This team addresses operational issues related to global land cover/change, including data processing, product generation, updating, and service; with special emphasis on the use of fine resolution data. Also, it develops a global moderate-resolution (<50m) land-cover monitoring system focused on the delivery of: (i) a global geospatial database of land-cover types and associated attributes; (ii) frequent (up to annual) updating of the database by capturing land conversions and ecosystem disturbances; (iii) periodic global land-cover maps, statistics, and analyses; and (iv) land-cover products at the global scale (e.g. assessments of carbon storage or habitat conditions). Furthermore, a web portal is under development connecting all major global land cover websites to (i) form a single access point and (ii) coordinate and facilitate data sharing (images, samples, etc.) and accuracy assessment of products (in collaboration with C3)

⁴⁰ The GEO Global Land Cover task is led by Canada (Ryerson University), China (NSDI, Central South University, Tsinghua University), GTOS (GOCF-GOLD), EARSel, EEA, ESA, Spain (IGN-CNIG, Spain), Sweden (KTH), Japan (KEIO University) and USA (USGS).

⁴¹ Peng Gong et al, 2013. Finer resolution observation and monitoring of global land cover: first mapping results from Landsat TM and ETM+ data. International Journal of Remote Sensing.

The added value of this consortium under GEO lies on the facts that

- a) it will enhance and continue providing access to, historical land-cover relevant imagery and global high-resolution coverage obtained through international acquisitions coordination. Support retrospective processing of historical satellite data archives for land-cover mapping and change analyses (e.g. GLOBCOVER and MODIS land-cover).
- b) build international consensus and generate products driven by requirements for land-cover as an Essential Climate Variable by ensuring coordinated operations of existing and new moderate resolution (<50m) satellites for land-cover mapping and monitoring, in particular the European GMES Sentinels, US Landsat, and China's resource satellites.

2. Global Land Cover Validation and User Engagement: Validation of the datasets and products of the Component 1 and engagement of experts and policy makers.

This team will outline reliable and accepted methods for the validation, including includes data collection, sampling design, observation analysis, and accuracy assessment, of global land cover datasets at all spatial resolutions. Also, it supports existing initiatives for a sustained reference data collection network in view of the application of standardized validation protocols, such as a universal validation site sampling design.

Also, this component team tests approaches for augmenting existing global validation data with regional and national data; analyzes and harmonizes available land cover validation databases for integration and wider use, and advocates for the development of the Land Cover Classification System (LCCS). Furthermore, it facilitates the exchange and management of validation data and explore new ways of capturing (ground truth) reference information (e.g. crowd sourcing, citizen science), as well as visualizing and distributing spatial data for validation. This may include new global public information services for collecting and sharing environmental data.

3. Global Land Cover Methodology and Capacity Building/Outreach. Development of capacities for the use of the validated data produced by the Components 1 and 2.

The team will understand the facts and processes of land cover in different regions, such as urban/rural areas, pasture land, costal zones, and model the impact/influence global/local changes. Also, it will raise awareness about global land cover products, and services and demonstrate the relevance of (global) land cover products to national strategic development planning, For specific countries, it will improve national capacity a) to produce regional and national land cover products by growing the size and expertise of land cover groups around the world, and b) to provide feedback (up-to-date, homogenized and coordinated information) to fine tune global land cover products and guarantee good-quality monitoring.

This effort requires the development of methods, recommendations for mapping specifications, land cover standards, e.g. legends and definitions, and a coordinated web portal linking existing national and regional land cover data and resources (including training and e-learning material); due to be developed in collaboration with C1. Also, cutting-edge technological issues related to global land cover/change, such as utilization of new sensor data, longer and denser time-series data, and SAR data e.g. ERS-1/2, ENVISAT, Sentinel-1, will be addressed.

The upcoming GEO Global Land Cover meetings are:

- the *3rd International Workshop on High Resolution Global Land Cover (GLC) Mapping* to be held on April 27-28, 2013, in Beijing, China
- the *2013 GEO Global Land Cover meeting* to be held on 18th April, 2013 in the Netherlands

GEO and GEOSS



The Group on Earth Observations (GEO), established in 2002, is coordinating efforts to build a Global Earth Observation System of Systems (GEOSS) with a vision of a world where decisions and actions are informed by coordinated, comprehensive and sustained Earth observations. For this purpose, GEO fosters the coordinated and sustained access to Earth observations and their use for the global environment and human wellbeing.

GEO's Members include 88 governments and the European Commission plus 64 intergovernmental, international, and regional organizations. GEO is organized around nine Societal Benefit Areas (SBAs, Annex I), including biodiversity, ecosystems, agriculture, climate, health, water and also five cross-cutting areas, such as land cover, forests, and oceans. Interactions among these areas help them address complex environmental issues in a cost efficient and effective way. Recognizing the specific national and regional environmental needs, GEO has established national and regional GEOSS, such as AfriGEOSS, Pacific GEOSS, US-GEO and EuroGEOSS, in support of its global activities.

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Biodiversity Multi-Source Monitoring System: From Space to Species

NATURA 2000 sites which have been designated for protecting biodiversity and ecosystems are still threatened by human activities, such as logging, mining, poaching, agricultural intensification, contamination, infrastructure development for tourism and spillage of wastes. The cumulative effect of such activities through time can eventually lead to habitat loss, degradation and fragmentation. In the past, such changes have rarely been monitored effectively or routinely.

Long-term baseline data of land covers and habitats as well as new automatic, standardized, rapid and cost-effective monitoring techniques are a key issue for conservation managers. Additionally, there is an emergent need for methods for assessing the significance of measured land cover changes and evaluating trends, along with modelling techniques for evaluating the combined impact that different drivers affecting soils and/or vegetation may have on biodiversity.

The recent provision of very high spatial resolution (< 4 m) remotely sensed data and automatic classification techniques has provided a unique opportunity for periodic and automated mapping of land surfaces and habitats and their changes over time. Whilst such monitoring may be undertaken

externally, this capability will benefit local and regional authorities by providing timely information on pressures and impacts, allowing them to take appropriate action. The data and techniques will also contribute to national and international reporting requirements.

BIO_SOS (BIOdiversity Multi-Source MOnitoring System: From Space to Species; www.biosos.eu) addresses topic SPACE.2010.1.1-04 "Stimulating the development of GMES services in specific areas" with application to biodiversity. The main objective of BIO-SOS is the development of a knowledge-based pre-operational ecological modelling system suitable for effective and timely multi-annual monitoring of NATURA 2000 sites and their surrounding areas particularly exposed to different and combined type of pressures. Very high resolution remotely sensed data (i.e., QuickBird, WorldView2) along with on-site data are used for classification and evaluation of land cover and habitat maps, respectively. Ontologies and semantic network are used to formally represent the expert knowledge.

The proposed system, named *EO Data for Habitat Monitoring* (EODHaM), is compliant with on-going GEOSS, GMES and INSPIRE initiatives. Areas in three Mediterranean and two Western Europe Countries are under investigation. To extrapolate from European test cases, extending the application domain of the methods, additional areas are being considered in two tropical countries (i.e., Brazil and India). In those areas, the Natura 2000 system does not exist, but the availability of advanced monitoring systems is particularly important for Biodiversity conservation.

Habitat maps, which are at the base of biodiversity indicators extraction, can be obtained by interpreting land cover maps of sufficient detail, with these often generated with EO-derived products and ancillary data. The BIO_SOS classification system has adopted the Food and Agriculture (FAO) Land Cover Classification System (LCCS) scheme and taxonomy for class identification because of its more generic approach. The scheme is also more suitable than CORINE as the land cover categories can be more readily translated to habitat categories, which better describe (semi)-natural systems (Tomaselli et al. 2012). Once mapped, a key component is to translate the land cover classes to habitat categories, as these are often needed for conservation efforts.

The use of General Habitat Categories (GHCs) was highlighted as a means of consistently and efficiently defining habitats in the previous BioHab and Ebone projects (Bunce et al., 2008, 2011). GHCs were proposed as they provided an exhaustive typology of habitat types that can be found in any terrestrial landscape around the globe, from natural ecosystems to urban areas, and from sparsely vegetated areas to multi-layered tropical forests (Bunce et al. 2011). GHCs also hold a close relation to other habitat classifications and particularly the Habitats Directive Annex I classification, which is of central importance for international reporting and Natura 2000 management (Bunce et al. 2012). Finally, as they describe landscapes in terms of habitat mosaics, the GHC mapping and recording methodology was also effective in describing and predicting the distribution of species and biodiversity, thereby contributing to the assessment of international sets of indicators while at the same time supporting the local management of endangered species and priority habitats.

Once generated, these maps can be updated over time to detect change, thereby supporting management options (either strategic or operational) and reporting of obligations under the Habitat Directive for management of Natura 2000 sites. *BIO_SOS* is also focusing on the development of a modelling framework for pressure analysis and threat assessment in different protected areas (Mairota et al., 2012, Harini et al. 2012) with the aim to evaluate their impacts on habitats. Quantitative landscape pattern analysis framework was developed to produce composite, site/scale specific indicator set for monitoring and buffer area identification, while protocols were defined for comparative habitat and landscape modelling across sites to relate biodiversity to habitat quality, linking in-situ and EO data.

BIO_SOS has made progress steps towards developing:

- Novel pre-operational automatic high spatial resolution (HR), very high spatial resolution (VHR) and hyper-spectral resolution EO data understanding techniques for land cover/use (LC/LU) map and LC/LU change map generation as an *improvement of GMES core services*;
- New GMES *down-stream* services based on ecological modelling, at habitat and landscape level, to combine EO and *in-situ* data and provide HR and VHR habitat maps, their changes and adequate indicators of biodiversity
- *Quantitative landscape pattern analysis* (QLPA) framework to produce composite, site/scale specific indicator set for monitoring and Natura 2000 buffer area identification;
- Ecological niche modelling (ENM) to evaluate the importance of GHCs as environmental variables to explain the distribution of the target species better than LC/LU.
- *Threat analysis* framework to use EO data to extract pressure trends through direct detection or monitoring of impacts on landscapes, land cover/habitat types, communities and species.
- BIO_SOS metadata geoportal.

The key benefits of the EODHAM system are:

- The use of the LCCS provides a standardized framework for LC/LU classification that is globally recognised.
- The LCCS and subsequent GHC classes differ when change (e.g., in height, cover, frequency of inundation) occurs, and hence can be used for monitoring.
- For end users, the building blocks of the system can be generated as background and the final LCCS categories then easily defined with reference to the LCCS components.
- The approach is applicable to any area across a range of scales and, in the absence of some components from EO data, other information (e.g., thematic layers) can be included.
- The EODHaM classification and the range of indices used in its generation can also be used as input to species distribution models, thereby supporting the long-term monitoring of indicator species, which can potentially be mapped from EO data.

The products and systems generated by the BIO_SOS project will be made available for policy decision making and planning (e.g., scenario building) and, more specifically, for evaluating the consequences of changes within Natura 2000 sites and their surroundings. EODHaM is compliant with on-going GEOSS, GMES and INSPIRE initiatives and its outputs will be used for:

- Following up impact of existing and new policy.
- Defining a buffer area for each Natura 2000 site and preventing habitat fragmentation in its surrounding area. When regional authorities elaborate and approve a plan for a protected area, a buffer zone needs to be defined around the protected area where rules different from the ones to be adopted within the site have to be defined. When they enter in negotiation with local authorities and local people, they need to support their decision with scientific evidence of the impacts that such rules may have on the areas and the importance of the buffer zone;

- The use of BIO_SOS results is not limited to the management of Natura 2000 sites but to the integration of the sustainable management of the regional Natura 2000 network within the ordinary planning system.
- Innovative planning activity at a local level must try to modifying a static municipal planning system into a dynamic planning system. That means that indicators are needed to establish whether the goals associated with the approved municipal plan were met during the implementation phase. Such indicators should provide a dynamic monitoring of the different planning processes and an evaluation of the effectiveness of the policies implemented.
- Outside Europe as well, in mega-diverse countries such as Brazil and India, the operational flexibility that is required given the diversity of environments, habitats, species and threats is supported by the BIO-SOS project in that the approach is multi-resolution and multi-scale for mapping out the land cover. EODHaM system would enable managers to understand the pressure issues in multiple ecological and human environments.

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Report of the REFLEX training course, 18 – 28 July, 2012, Albacete-Barrax, Spain

The training course on "Regional Experiments For Land-atmosphere EXchanges" (**REFLEX**), organized by the Faculty of Geo-Information Science and Earth Observation of the University of Twente (UT-ITC) was held from July 18th to 28th 2012 at Albacete-Barrax, Spain. The REFLEX training course was a collaboration between FP7 EUFAR, COST ACTION ES0903 EUROSPEC and ESA.

The main objective of the REFLEX training course was to teach early-stage researchers and university lecturers how to organize and conduct an airborne field campaign with hyperspectral imaging sensors that supports their research in the framework of multi-scale ("leaf to ecosystem") land-atmosphere exchanges. An airborne campaign as part of the training course (funded by EUFAR) was carried out with the INTA C-212-200 RS aircraft equipped with two hyperspectral sensors (AHS and casi1500i) in a well recognized ground reference agricultural site ("Las Tiesas" experimental farm, Barrax, Spain). In addition, participants were trained in ground measurements (organized by EUROSPEC) in coincidence with the aircraft overpasses, with a proper ground measurement strategy and procedures designed by the participants.

Data acquisition during the REFLEX training course ranged from satellite acquisition (CHRIS-PROBA, MSG-SEVIRI), airborne acquisition (casi1500i, AHS), atmospheric measurements (soundings, ground atmospheric observations), ground radiometric measurements (near-ground spectroscopy, solar range radiometric measurements, thermal infrared radiometric measurements), surface energy budget measurements (flux tower measurements, Large Aperture Scintillometer measurements, Thermo dynamic measurements), ground biophysical measurements (LAI, Leaf Angle Distribution measurements, fluorescence measurements, soil moisture measurements) to meteorological measurements and is described in the REFLEX 2012 Data Acquisition Report, December 2012, ed. Wim Timmermans.

The airborne images were processed on-site and distributed to the participants to allow them to have a first look at the potential of the acquired information. The final processed data set, including ground and airborne measurements, was made available to the participants for analysis.

REFLEX presentations and scientific working group reports are available at the EUFAR website (www.eufar.net) for registered EUFAR members.

Scientific results of the REFLEX campaign will be published in a special issue on "Land-atmosphere exchanges of water, energy and carbon fluxes" in the journal "Acta Geophysica".

Twenty early-stage researchers and university lecturers from 9 different European member states and New-Zealand (selected from 102 applications) funded by EUFAR and EUROSPEC participated in the REFLEX training course.

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Angel Barba, Javier Banzo, Juan Sánchez, Crew from Spanish Air Force 47 Group

Remo Bianchi, Malcolm Davidson (ESA)



REFLEX group picture



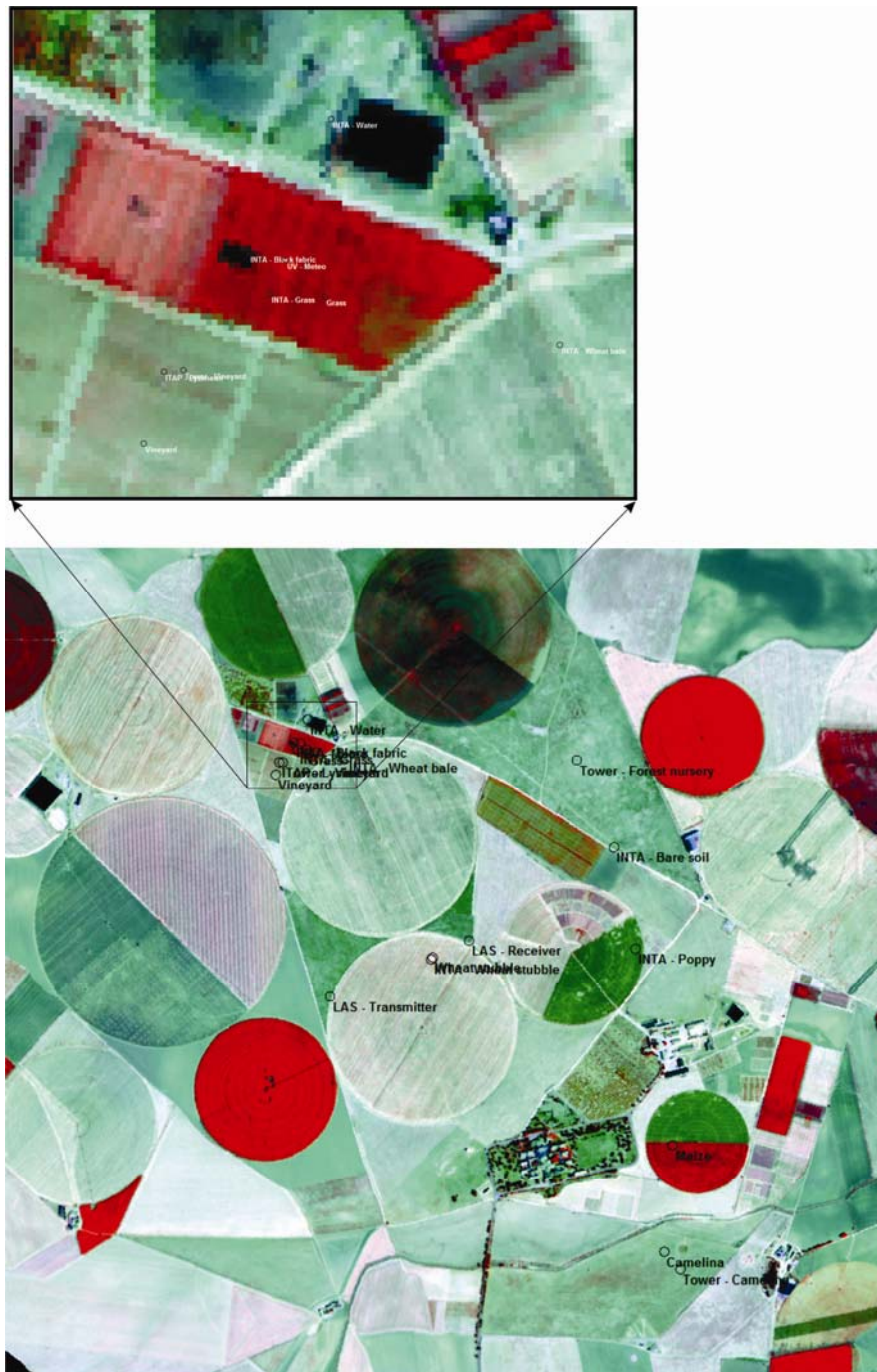
REFLEX theoretical session on field spectroscopy presented by Dr. Alasdair MacArthur



CIR mosaic from images acquired by AHS on July 25th 2012 of “Las Tiesas” test site, Barrax, Albacete, Spain



True colour mosaic from images acquired by CASI on July 25th 2012 of “Las Tiesas” test site, Barrax, Albacete, Spain



False color composite AHS image acquired on 25th July 2012 of “Las Tiesas” test site, Barrax, Albacete, Spain with an overview of the REFLEX main ground observation locations. Zoom on the grassland site central in the area, where a high concentration of ground observations took place.

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Science Article

Satellites & Sensors

This article reports on recent developments in Earth Observing satellites and sensors.

Meteosat-10

Europe's latest geostationary weather satellite, launched on 5 July, delivered its first image from its SEVIRI (Spinning Enhanced Visible and Infrared Imager) sensor on 13 August. The satellite is the third in a series of four satellites introduced in 2002. After the successful completion of in-orbit testing, on 12 December the MSG-3 satellite was declared ready to support the Meteosat operational services and renamed to Meteosat-10. Meteosat-10 is scheduled to become the prime operational satellite on 21 January after moving from 3.4° West to 0° East. Meteosat-9 will move to 9.5° East, and Meteosat-8 will move from 9.5° East to 3.5° East to become the backup for Meteosat-10. SEVIRI delivers weather coverage over Europe and Africa. It scans Earth's surface and atmosphere every 15 minutes in 12 different wavelengths. SEVIRI has a best resolution of 1 kilometre in the visible bands, and 3 kilometres in the infrared.

The last of the series, MSG-4, is planned for launch in 2015.

Meanwhile, the European Space Agency and EUMETSAT have signed the agreement on the Meteosat Third Generation weather satellite system. The agreement determines the principles of cooperation between the two agencies when establishing the various components of the Meteosat Third Generation (MTG) system.

Kanopus-V-1 & BelKA-2

On 22 July, Roskosmos launched a Soyuz-FG/Fregat into polar orbit with a cluster of five small satellites. Kanopus-Vulkan-1 and BelKA-2 are Earth imaging satellites built by VNIIEK (VNIIEK), the former for Roskosmos and the latter for the Belarussian Academy of Sciences. The satellites carry 2-meter-resolution cameras.

Kanopus-V (a.k.a Canopus-B) was designed for real-time monitoring of natural and man-made disasters and other emergency situations. It is an imaging satellite with a resolution of about 2.1 meter and a swath of 20 kilometre panchromatic, and a resolution of 10.5 meter and a swath of 41 kilometre of the 4-band multispectral camera. Resulting images would be used for cartography, agricultural planning and similar applications. VNIIEK advertised Kanopus-V as a complement to a larger Meteor-M spacecraft, which was built by the same company for large-scale observations of the Earth. A second satellite, Kanopus-V-2, will be constructed starting 2013.

Under an agreement with the Belarussian government, VNIIEK built a virtual copy of the Kanopus-V satellite, known as BKA, BelKA-2, or the Belarussian spacecraft. It was meant to be a replacement for the original Belarussian Earth-watching satellite, BelKA, which was lost in the botched launch of the Dnepr rocket in 2006. At the end of November 2012, Russian officials reported that they had been transferring control over to their colleagues in Belarus.

SPOT-6

On 9 September SPOT-6 was launched by an Indian PSLV rocket. It reached its final orbit on 22 September. In the mean time, its improved sensors have already been recording images.

Resolution is 1.5 metre panchromatic and 6 metre multispectral with a swath width of 60 metre at nadir. The architecture is similar to that of the Pleiades satellites (see below).

SPOT-7 is due to launch early in 2014. SPOT-6 and SPOT-7 will be placed in the same orbit as the Pleiades satellites. Revisit time of SPOT-6 and SPOT-7 together is one day.

Metop-B

Metop-B was launched on 17 September. This is the second satellite in a series of three polar-orbiting meteorological satellites operated by EUMETSAT.

The European Metop and American NOAA satellites carry a set of identical sensors: AVHRR/3 and the ATOVS suite consisting of AMSU-A, HIRS/4 and MHS. NOAA provides most of the joint instruments on board the satellites and EUMETSAT has developed and provides NOAA with the Microwave Humidity Sounder (MHS). In addition, the Metop satellites carry a set of European sensors, IASI, ASCAT, GOME-2 and GRAS, aimed at improving atmospheric soundings, as well as measuring atmospheric ozone and near-surface wind vectors over the ocean.

The satellites are launched in five to six year intervals. The first Metop-A was launched in 2006. The third Metop-C satellite is scheduled for launch in 2017. With a satellite lifetime of more than 5 year the series is designed to provide continuity in satellite weather information.

Miranda/VRSS-1

China launched a CAST-2000 class remote sensing satellite on 29 September. The satellite, 'Venezuela Yaogan Weixing yi hao' (Venezuela Remote Sensing Satellite 1) was purchased by Venezuela and is named 'Miranda' after the independence leader 'Generalissimo' Francisco de Miranda (1750-1816).

The satellite carries two high-resolution cameras and two medium resolution cameras. The high resolution cameras have a spatial resolution of 2.5 metre panchromatic and 10 metre multispectral. The medium resolution cameras have a spatial resolution of 16 metre. The satellite is designed to operate for a minimum of five years.

Envisat

On 11 October ESA denied the accusation that it had used the remaining fuel to continue Envisat's mission instead of putting it in a disposal orbit. ESA said that "Envisat was planned and designed in 1987–1990, a time when space debris was not considered to be a serious problem and before the existence of mitigation guidelines, established by the UN in 2007 and adopted the next year by ESA for all of its projects."

In 2010, ESA manoeuvred Envisat into a lower orbit, which allowed it to continue its observation. The fact that ESA extended the operational lifetime and did not put more effort into reserving fuel to prevent Envisat from becoming space debris in a low earth orbit has been severely criticized. Because of its huge size, Envisat is widely seen as a serious collision threat in this populated orbit.

For future satellite missions, ESA is investigating ways to deorbit used satellites in a controlled manner.

Huanjing-1C

China plans to launch eleven Huanjing satellites for disaster and environmental monitoring ('huanjing' is Chinese for 'environment'). Together, the satellites will be capable of multispectral (visible and infrared) and synthetic aperture radar imaging. The first two satellites, Huanjing-1A and Huanjing-1B, were launched on 6 September 2008.

Huanjing-1C was launched on 16 November 2012 on a Long March-2C rocket from the Taiyuan Satellite Launch Center. It is the first civilian Chinese remote sensing satellite to use a Synthetic Aperture Radar as imaging instrument. This particular S-band SAR was manufactured in Russia by NPO Mashinostroyenia. The SAR operates at 3.13 GHz (S-band) corresponding to a wavelength of 9.6 cm, and has a spatial resolution of 20 meters with a swath width of 100 km.

Yaogan-16A, B & C

Busy China launched another set of remote sensing satellites last year on 25 November. Yaogan (in full Yaogan Weixing, 'Remote Sensing Satellite') refers to a series of Chinese reconnaissance satellites launched in the early 21st century. This mission is similar to the Yaogan-9 mission, with three satellites flying in formation. Being similar to Yaogan-9, the triplet comprises an optical surveillance satellite, a synthetic aperture radar (SAR) satellite, and one that is possibly a signal intelligence satellite.

Pleiades-1B

Pleiades-1B was launched on 2 December. The satellite is a very-high-resolution dual-use satellite designed to provide optical imaging coverage for French and European defence ministries, institutions and civil users. It joins its twin, Pleiades-1A, which was launched on 17 December 2011. The panchromatic sensor has a resolution of 70 cm, whereas the 4-band multispectral sensor has a resolution of 2 metre. Swath width is 20 kilometre. It recorded its first images on 18 January.

Göktürk-2

On 18 December, Göktürk-2 was launched in China by a Long March 2D rocket. Göktürk is an optical reconnaissance satellite for the Turkish Defence Ministry. The satellite was built by the Turkish Aerospace Inc. and the TUBITAK research council. Its mission will have a dual civil and military purpose. This is the second Earth-observation satellite designed and manufactured in Turkey, following RASAT, which was launched in Russia on 17 August 2011. The satellite offers high-resolution images of 2.5 meter resolution panchromatic, and 10 metre (VNIR) and 20 metre (SWIR) multispectral. Swath width is 20 kilometre.

Landsat 8

Fourteen years after Landsat 7, Landsat 8 was finally launched on 11 February. Currently, the spacecraft is tested, its sensor devices are being slowly out-gassed and cooled. The first images are expected any time now. Operational production of image data is expected to start three months after launch.

The satellite carries two new pushbroom imaging devices, the Operational Land Imager (OLI) and the Thermal Infrared Sensor (TIRS). The OLI instrument provides 15-metre panchromatic and 30-metre multi-spectral spatial resolutions along a 185 km wide swath with a 16-day repeat cycle. In addition to the bands of the previous Landsats, OLI will have two new spectral bands, one in the deep blue for coastal applications and aerosols, and one shortwave-infrared band for cirrus cloud detection. Furthermore, Landsat 8 will deliver two thermal bands with a 100-meter resolution, covering the same area as the OLI sensor. With a 12-bit radiometric resolution the performance from OLI and the TIRS instrument will be substantially better than any of the previous Landsat sensors flown.

Earlier this year Landsat 5 was decommissioned after almost 29 years of loyal service. Its longevity earned it an official place in the Guinness Book of World Records as the longest operating Earth observation satellite. The workhorse Landsat 5 singlehandedly saved the Landsat program. The launch of Landsat 8 was long overdue as Landsat 6 failed to reach orbit in 1993 (now presumed taking pictures of the ocean floor), and Landsat 7 is already 14 years old, running out of fuel, and half blind due to a failing scan mirror correction device.

Upcoming launches

Date	Satellite
April	GeoEye-2
May	CBERS-3
May	DMSP F-19
June	Resurs P-1

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EARSeL eProceedings



New Publications in Vol. 11(2), 2012

Comparative analysis of crop maps for chosen test areas on the territory of Bulgaria and Romania using simulated Proba-V and Spot vegetation data

Eugenia Roumenina, Lachezar Filchev, Vassil Vassilev, Petar Dimitrov, Georgi Jelev, Gheorghe Stancalie, Elena Savin, and Denis Mihailescu

Abstract

Read full paper online: <http://www.eproceedings.org>

The operational capabilities of low-resolution satellite instruments, such as SPOT VEGETATION, MODIS, and NOAA AVHRR, make real-time and near-real time Earth Observation (EO) data indispensable for monitoring world vegetation resources. The data continuity of the SPOT VEGETATION mission is to be ensured by PROBA-V (âVegetationâ). The present study aims to reveal the potentialities of the PROBA-V mission and its advantages as compared to SPOT VEGETATION based on a comparison of accuracy assessments of crop identification maps. The scope of the study is achieved by using unsupervised ISODATA and supervised Maximum Likelihood Classification (MLC) algorithms on single-date PROBA-V simulated data and SPOT VEGETATION images, and a comparison of classification accuracies. The results show that single-date PROBA-V simulated images provide better crop map classifications than SPOT VEGETATION images with a 15 to 22% higher overall accuracy, and Kappa statistics of 0.31 to 0.33 higher for the Zhiten test area (Bulgaria) and the Fundulea test area (Romania), respectively. It was also established that single-date PROBA-V simulated data can serve as a basis for reliable crop identification of winter crops with high users and producer's accuracy.

New Publications in Vol. 12(1), 2013

Characterising fire hazard from temporal sequences of thermal infrared MODIS measurements

Carmine Maffei, Silvia Alfieri, and Massimo Menenti

Abstract

Read full paper online: <http://www.eproceedings.org>

The objective of the present research was the characterisation of fire hazard using temporal sequences of land surface temperature (*LST*) derived from Terra-MODIS measurements. The investigation was based on a complete sequence of MODIS *LST* data from 2000 to 2006 on Campania (Italy) and on a data set of fires officially recorded in the area in the same period.

Missing and/or cloudy *LST* data were reconstructed by means of the HANTS (Harmonic ANalysis of Time Series) algorithm applied to annual sequences of daily observations. The coefficients of the Fourier analysis were then assessed against spatial patterns of fire occurrence. The HANTS algorithm was also used on the complete *LST* data set to construct daily reference temperature maps against which to evaluate temperature anomalies and cumulated temperature anomalies.

Results show that fires tend to occur in areas characterised by specific values of several Fourier coefficients with high significance, and to avoid the other areas. The amplitude of the second harmonic is the only Fourier coefficient dictating mean fire size. The mean fire size and the proportion of large fires correlate with both daily and cumulated thermal anomalies. However, the dynamic range of the predictions from cumulated anomalies is much larger, and thus maps of the latter are more effective in predicting fire hazard.

A multitemporal and non-parametric approach for assessing the impacts of drought on vegetation greenness: A case study for Latin America

Hugo Carrão, Guadalupe Sepulcre, Stephanie Horion, and Paulo Barbosa

Abstract

Read full paper online: <http://www.eproceedings.org>

This study evaluates the relationship between the frequency and duration of meteorological droughts and the subsequent temporal changes on the quantity of actively photosynthesizing biomass (greenness) estimated from satellite imagery on rainfed croplands in Latin America. An innovative non-parametric and non-supervised approach, based on the Fisher-Jenks optimal classification algorithm, is used to identify multi-scale meteorological droughts on the basis of empirical cumulative distributions of 1, 3, 6, and 12-monthly precipitation totals. As input data for the classifier, we use the gridded GPCP Full Data Reanalysis precipitation time-series product, which ranges from January 1901 to December 2010 and is interpolated at the spatial resolution of 1° (decimal degree, DD). Vegetation greenness composites are derived from 10-daily SPOT-VEGETATION images at the spatial resolution of 1/112° DD for the period between 1998 and 2010.

The time-series analysis of vegetation greenness is performed during the growing season with a non-parametric method, namely the seasonal Relative Greenness (*RG*) of spatially accumulated *fAPAR*. The Global Land Cover map of 2000 and the GlobCover maps of 2005/2006 and 2009 are used as reference data to select study cases only on geographic areas that did not undergo land cover changes during the analysis period. The multi-scale information is integrated at the lowest spatial resolution available, i.e. 1° DD, and the impacts of meteorological drought episodes on seasonal greenness of rainfed crops are assessed at the regional scale. Final results suggest that the agricultural cycle at the regional scale is more correlated with long-standing and uninterrupted small timescale drought conditions that occur prior to vegetation growing season than with isolated and short long-term timescale drought events.

Canopy structure effect on SAR image texture versus forest biomass relationships

Isabelle Champion, Jean Pierre Da Costa, Adrien Godineau, Ludovic Villard, Pascale Dubois-Fernandez, and Tuy Le Toan

Abstract

Read full paper online: <http://www.eproceedings.org>

Quantifying forest biomass is of crucial importance for estimating carbon fluxes on the regional and global scale in climate change studies. Significant relationships have already been established between radar mean intensity and forest biomass, but these relationships show a reduced sensitivity to biomass variations for mature stands (about 80 t/ha and more). On the contrary, recent studies have shown that image texture is significantly related to biomass even for mature stands for a temperate, monospecific, even-aged forest the biomass of which is 140 t/ha at its highest point.

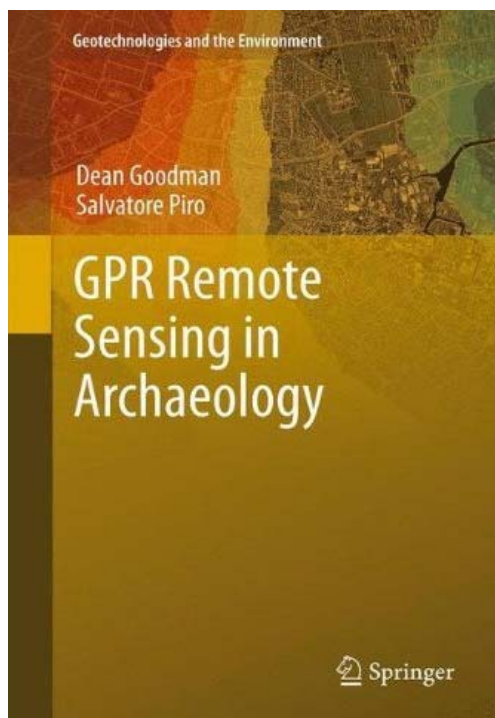
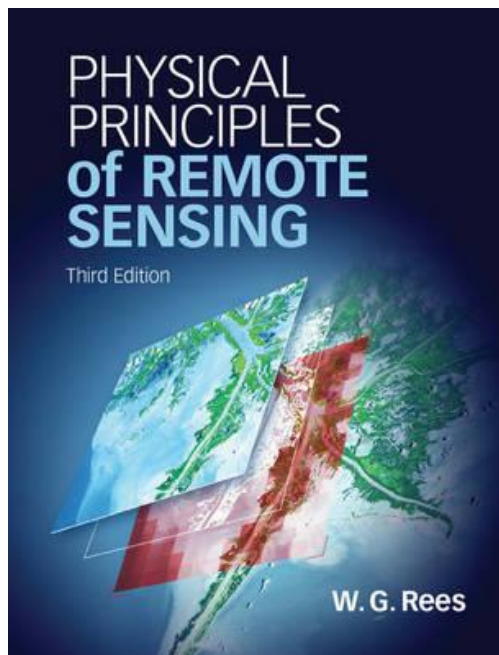
The present paper aims at extending these observations to tropical forests which represent a large terrestrial biomass pool with values higher than 450 t/ha. Radar images were acquired during the TropiSAR experiment in 2009, which took place over a tropical rain forest located in French Guiana at P band and cross-polarization with the use of SETHI ONERA airborne instrument. Three sets of treatments applied to 15 forest stands provided biomass values from 268 to 466 t/ha where permanent zones of 6.25 ha each were mapped and regularly measured.

Homogeneous patches were selected inside each of the 15 experimental stands. Statistical features were then derived for each patch: a) from grey level statistics; b) from the statistics of pixel pairs on the basis of the gray level co-occurrence matrix. It is shown that linear relationships between texture features and forest biomass are heavily influenced by stand structure and the local topography and soil of the experimental stands. But, when stands are separated on two structural groups using texture descriptors, texture/biomass regressions reveal to be very significant.

Book Releases

Physical Principles of Remote Sensing (Third edition) is available from Cambridge University Press written by W. G. Rees.

Fully updated and containing significant new material on photography, laser profiling and image processing, the third edition of this popular textbook covers a broad range of remote sensing applications and techniques. It focuses on physical principles, giving students a deeper understanding of remote sensing systems and their possibilities, while remaining accessible to those with less mathematical training by providing a step-by-step approach to quantitative topics. Boxed examples, additional photos and numerous colour images engage students and show them how the theory relates to the many real-world applications. Chapter summaries, review questions and additional problems allow students to check their understanding of key concepts and practise handling real data for themselves. Supplementary online material includes links to freely available software, animations, computer programs, colour images and other web-based resources of interest.



GPR Remote Sensing in Archaeology written by Dean Goodman and Salvatore Piro was published by Springer.

The book provides a complete description of the processes needed to take raw GPR data all the way to the construction of subsurface images. The book includes an introduction to the “theory” of GPR by using a simulator that shows how radar profiles across simple model structures look and provides many examples so that the complexity of radar signatures can be understood. It continues with a review of the necessary radargram signal processes needed along with examples. The most comprehensive methodology to construct subsurface images from either coarsely spaced data using interpolation or from dense data from multi-channel equipment and 3D volume generation is presented, advanced imaging solutions such as overlay analysis are introduced, and numerous worldwide site case histories are shown. The authors present their studies in a way that most technical and non-technical users of the equipment will find essentials for implementing in their own subsurface investigations.

Forthcoming EARSeL Conferences

8th EARSeL Workshop on Imaging Spectroscopy

At La Cité Nantes Events Center
8 - 10 April 2013, Nantes, France

[More info](#)



EARSeL's Special Interest Group on Imaging Spectroscopy is a forum whose aim is to encourage international discussions among specialists working with this innovative Earth Observation technology. The forum was founded by EARSeL at the University of Zurich in 1999, led by RSL, who conducted the first workshop. Since then, five more very successful workshops were held at ITC Enschede, the Netherlands (2001), DLR Herrsching, Germany (2003), the University of Warsaw, Warsaw, Poland (2005), VITO, Brugge, Belgium (2007), Tel Aviv, Israël (2009) and University of Edinburgh, U.K. (2011). The next workshop will take place in Nantes, France, from April 8th to 10th 2013. We invite you to mark your calendar for this important meeting.

The meeting will cover all themes related to imaging spectroscopy. As several spaceborne missions are scheduled for the near future, this workshop is particularly important and will provide a unique opportunity to discuss recent developments in imaging and related spectroscopic methods for environmental research, learn about recent developments in imaging science and thematic / environmental applications at ground, airborne and spaceborne levels, exploring the integration of spatial and temporal coverage afforded by imaging instruments with the high spectral resolution data obtained for every pixel, discuss ground-based spectroscopic techniques, such as field spectroscopy and related hyperspectral sensing methods, learn and discuss how these methods can address key environmental issues and new areas of environmental science.

All scientists, professionals and researchers involved or interested in the field of the workshop are strongly encouraged to participate at the Workshop, which will cover the following topics:

- Existing and future orbital IS sensors
- Existing and future airborne IS sensors
- Image processing methods and tools
- New analytical techniques
- Calibration and validation
- Application to terrestrial ecosystems
- Coastal and marine ecosystems
- Inland waters
- Urban environment
- Geology and soils

- Risk management
- Climate change
- Commercial applications

For more detailed information please visit the Workshop website at:
<http://www.sciences.univ-nantes.fr/lpgnantes>.

33rd EARSeL Symposium, 2013

“Towards Horizon 2020: Earth Observation and Social Perspectives”

3-6 June 2013 Matera, Italy

[More info](#)



The 33rd EARSeL Symposium entitled “Towards Horizon 2020: Earth Observation and social perspectives” will be held in Matera, Italy from 3 to 6 June 2013. All scientists, professionals and researchers involved or interested in the field of the Symposium are strongly encouraged to present their research papers.

All scientists, professionals and researchers involved or interested in the field of the workshop are strongly encouraged to participate at the Symposium, which will cover the following topics:

- EO for improving Smart City management
- Monitoring and protecting biodiversity
- Support of regenerative energy production and transport
- Improving climate observations
- Improving agriculture, water and fisheries management
- Supporting disaster management

Other topics that will be covered are the following:

- Scientific applications of remote sensing, emerging methods and technologies
- Capacity building for organisations and authorities involved in environmental monitoring and protection
- Remote sensing for archaeology

- Land use and land cover, degradation and desertification
- Urban remote sensing
- Open ocean remote sensing
- Natural and man-made disasters
- Forestry and forest fires
- Remote sensing and its associated support to the understanding of climate change
- Hydrological applications: water management, underground water sources, land ice and snow
- 3D remote sensing, Radar, Lidar, Thermal Remote Sensing
- New instruments and methods, including ground truth

For more detailed information, please visit the Symposium website at:

<http://www.earsel.org/symposia/2013-symposium-Matera>.

4th EARSel Workshop on Education and Training

4 June 2013 Matera, Italy

[More info](#)

Organised by the “Remote Sensing in Education and Training” EARSel SIG



The 4th Workshop on Education and Training will be held in the framework of the 33rd EARSel Symposium on 4 June 2013 in Matera, Italy. All scientists, professionals and researchers involved or interested in the field of the Workshop are strongly encouraged to participate at the Workshop.

Presentations on the current use of Earth Observation as a support tool for education, training and capacity building, with emphasis on the following topics:

- Earth Observation for kids
- Earth Observation and its associated use to support science education in schools, high schools and universities
- Environmental science as a tool in cooperative learning and teaching, in enquiry-based learning and in other educational practices for tomorrow's schools
- Earth Observation and its use as educational support in areas like biology, chemistry, geography, physics and mathematics curricula in the classroom but also in continuous individual learning
- Training activities in GMES, with a focus on the environment, climate change and natural disasters, in GEOSS, and other international programmes

- Earth Observation and its use for public outreach of Environmental Sciences and Global Change

All relevant institutions and interested individuals are invited to participate. In particular the workshop is also addressing

- **the Global Environment and Security (GMES)** programme of the European Commission and the European Space Agency.

The success of GMES services and information products, especially in the fields of environment, climate change and natural disasters depends on specific training activities which include remote sensing for Earth Observation as a core element. Moreover, the workshop will focus on the planned foundation of

- **the International Remote Sensing Academy (IRSA),**

initiated by EARSel and proposed to international remote sensing organisations in early 2012. The goal will be to discuss the strategic framework of the Academy. The concept of IRSA has been published in [Issue 91 of the EARSel Newsletter](#).

For more detailed information, please visit the Workshop website at:

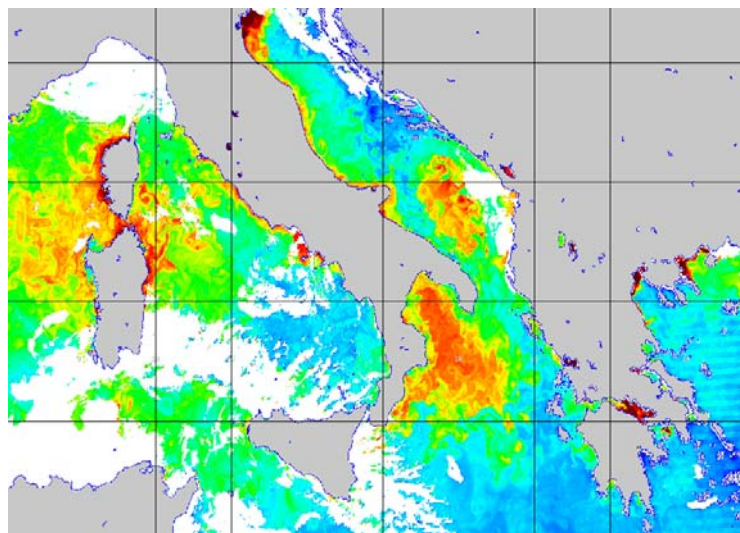
<http://www.earsel.org/SIG/ET/4th-workshop>.

6th EARSel Workshop on Remote Sensing of the Coastal Zone

6-7 June 2013 Matera, Italy

[More info](#)

Organised by the "Remote Sensing of the Coastal Zone" EARSel SIG



The 6th Workshop on Remote Sensing of the Coastal Zone will be held in the framework of the 33rd EARSel Symposium on 6-7 June 2013 in Matera, Italy. All scientists, professionals and researchers involved or interested in the field of the Workshop are strongly encouraged to participate at the Workshop. The Workshop will provide an interdisciplinary forum for presentations and discussions on our current state of knowledge on remote sensing of the coastal zone environment in terms of algorithm accuracy, time series analysis of environmental indices based on remote sensing data and new technologies.

Considering this general framework and future challenges for the coastal zone remote sensing community, the 6th Workshop represents an ideal opportunity for discussing these themes and tracing the route for forthcoming projects and collaborations. Themes proposed for discussions are:

- changing terrestrial run-off into coastal waters
- escalation of extreme coastal events: floods, storms, high tides
- hydrology and water budget evolution of rivers and lakes
- temperature variations in inland and coastal waters
- phytoplankton biomass and Phytoplankton Functional Types (PFTs)
- impact of varying physical forcing on morph dynamics and ecosystems
- new developments of habitats, biodiversity and alien invaders
- fluxes and fate of seawater constituents, including pollutants and sediments
- role of Coastal Zone Management in adapting to climate change

and their investigation with **Remote Sensing**:

- active and passive methods in all spectral ranges, sensor combinations
- satellite, airborne and ground-based methods including ground truth
- modeling of radiative transfer, image processing and related aspects
- interaction of physical, biological and chemical conditions and processes
- Ocean Colour Remote Sensing for Coastal and Inland Waters

For more detailed information, please visit the Workshop website at:

<http://www.earsel.org/SIG/CZ/6th-workshop>.

4th EARSel Workshop on Cultural and Natural Heritage

6-7 June 2013 Matera, Italy

[More info](#)

Organised by the “Remote Sensing for Archaeology, Cultural and natural Heritage (ReSeArCH)”

EARSel SIG



The 4th Workshop on Cultural and Natural Heritage will be held in the framework of the 33rd EARSeL Symposium on 6-7 June 2013 in Matera, Italy. All scientists, professionals and researchers involved or interested in the field of the Workshop are strongly encouraged to participate at the Workshop.

The cultural and practical interconnections between Environment, Culture and Territory are the framework of this event. The scientific committee selected some priority themes related to:

- **fields of application** such as the use of remote sensing for risk management and cultural and natural heritage, interconnection between environmental, climatic changes and dynamics of human frequentation, the aware fruition of material and immaterial witnesses of ancient civilizations
- **methodologies** such as development of ad hoc semiautomatic and automatic approach for extracting cultural information, integration and fusion of passive and active remotely sensed data, remote sensing and geospatial analysis for preventive archaeology, palaeoenvironmental investigation and risk management
- **co-operation strategies** for the creation of a permanent platform for data and knowledge sharing.

In particularly, the 4th workshop focuses on the following topics:

- From aerial photos to declassified satellite images: the study of landscape over time by means of historical data sources
- From visual data interpretation to semiautomatic and automatic procedures in an archaeological perspective
- Remote Sensing, GIS and Geospatial analysis for the risk monitoring and management of cultural resources
- Integration of space/air borne and ground remote sensing in archaeogeophysics
- The "LiDAR revolution"
- SAR applications for Archaeology and palaeoenvironmental studies
- Interactions between the environment and human civilizations in the past: which approach using remote sensing?
- Geographic information and Earth Observation technologies for the protection and management of cultural resources in emerging countries of Asia, Africa and Latin America
- Low cost technologies
- From remote sensing to virtual reconstruction: the study of human past

For more detailed information, please visit the Workshop website at:

<http://www.earsel.org/SIG/NCH/4th-workshop>.

9th EARSeL Workshop on Forest Fires

'Quantifying the environmental impact of forest fires'

15 - 17 October 2013 Coombe Abbey, Warwickshire, UK

[More info](#)



European Association of
Remote Sensing Laboratories



University of
Leicester

Call for Papers

The 9th Workshop on Forest Fires entitled 'Quantifying the environmental impact of forest fires' will be held on 15-17 October 2013 in Coombe Abbey, Warwickshire, UK. All scientists, professionals and researchers involved or interested in the field of the Workshop are strongly encouraged to present their research papers.

Authors are requested to submit their abstracts by **15 April 2013**.

For more detailed information regarding the topics of the Workshop, important dates as well as the registration process, please refer to the "**News from EARSeL**" section of this issue and to the Workshop website at: <http://www.earsel.org/SIG/FF/9th-workshop>.

Other Conferences



5-7 March, 2013: 17th ISU Annual International Symposium.
Strasbourg, France.



11-13 March, 2013: RSPSoc Wavelength Conference.
Glasgow, United Kingdom.



18-20 March, 2013: 3rd EOS Topical Meeting on Blue Photonics - Optics in the Sea.
Texel, The Netherlands.



8-10 April, 2013: First International Conference on Remote Sensing and Geo-information of Environment.
Pafos, Cyprus.



22-26 April, 2013: 35th International Symposium on Remote Sensing of Environment (ISRSE35).
Beijing, China.



12-15 May, 2013: 6th International Workshop on Information Fusion and Geographic Information Systems: Environmental and Urban Challenges (IF & GIS' 2013).
St. Petersburg, Russia.



13-16 May, 2013: Geospatial World Forum.
Rotterdam, The Netherlands.



30 May - 1 June, 2013: 8th International Symposium on Spatial Data Quality.
Hong Kong, China.



12-14 June, 2013: 6th International Conference on Recent Advances in Space Technologies (RAST 2013).
Istanbul, Turkey.



17-21 June, 2013: 13th Conference on Electromagnetic and Light Scattering.
Lille, France.



25-27 June, 2013: MultiTemp 2013 - 7th International Workshop on the Analysis of Multi-temporal Remote Sensing Images.
Banff, Alberta, Canada.



25-28 June, 2013: Workshop on Hyperspectral Image and Signal Processing (WHISPERS).
Gainesville, Florida, USA.



2-5 July, 2013: GI_Forum 2013.
Salzburg, Austria.



21-26 July, 2013: [IEEE International Geoscience and Remote Sensing Symposium](#).
Melbourne, Australia.



26-29 August, 2013: [8th International Symposium on Digital Earth 2013 \(ISDE 2013\)](#).
Kuching, Sarawak, Malaysia.



9-10 September, 2013: [Workshop on UAV-based Remote Sensing Methods for Monitoring Vegetation](#).
Cologne, Germany.

Summer Schools and Advanced Courses



5th International Summer School on Radar

12-19 July 2013, Fraunhofer Institute for High Frequency Physics and Radar Techniques FHR, Germany

Deadline for application: **18 March 2013**



Summer School Alpbach 2013, Space Weather: Science, Missions and Systems

16-25 July 2013, Aeronautics and Space Agency of FFG and the European Space Agency (ESA), Alpbach/Tyrol - Austria

Deadline for application: **31 March 2013**



Assessment of the Effect of Climate Change on Agro-ecological Systems Using Optical and SAR Remote Sensing and GIS

10 June 2013 – three weeks, ITC Faculty of Geo-Information Science and Earth Observation, University of Twente, The Netherlands

Deadline for application: **25 April 2013**



8th International Symposium on Digital Earth 2013 (ISDE 2013) – Summer School

19-24 August 2013, Faculty of Computer Science & Information Technology, University Malaysia Sarawak, Kuching, Malaysia.

Deadline for application: **31 May 2013**

Back Cover – ¹ Château des Ducs de Bretagne in Nantes, entrance, ^{2,3} The Nantes.

Credits: ¹ Pierre Lindenbaum, ² Jean-Dominique Billaud, ³ Jibi44

Source: ¹ <http://commons.wikimedia.org/wiki/File:ChateauDesDucsDeBretagne20090906.jpeg>,

² http://commons.wikimedia.org/wiki/File:Ile_de_Nantes.JPG,

³ Google Earth.



**8th EARSeL
Imaging Spectrometry Workshop**



**8 – 10 April 2013
Nantes, France**

EARSeL Sponsoring Agencies:



Council of Europe



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