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Front Cover – Central picture: Geoeye satellite images of Haiti before and after the earthquake.

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CONTENTS

1. EDITORIAL

Dear members,

We welcome new and existing readers. We are delighted to announce the expansion of the EARSeL family by two members. These are the **School of Geo-Sciences, University of Edinburgh,** and the **Institute of Oceanology, Bulgarian Academy of Sciences, Varna.**

As it is customary, the March issue of the newsletter brings you the reports of activities from each national representative of EARSeL.

We are certain the readers will find particularly interesting these national reports which contain an abundance of news and give evidence of the numerous activities in the field of remote sensing around Europe.

In addition to the national reports, you also have a feature article focused on the use and potential of ground remote sensing by Raffaele Persico and Francesco Soldovieri from the Italian National Council.

We would like to highlight that the 30th EARSeL Symposium is coming and it will be full of very interesting presentations. We hope we will see you in Paris to enjoy and share this important event!

We welcome suggestions, comments, and feedback in order to serve the Association the best way possible.

We wish you a happy Easter break.

Sincerely,
The Editorial team

2.NEWS FROM EARSeL

2.1 AUSTRIA 2009 REPORT

The report summarizes Austrian remote sensing activities considering highlights from the perspective of the Aeronautics and Space Agency (ALR), research institutions and value adding companies. Furthermore trans-institutional initiatives and activities are described.

CONTRIBUTION OF ALR (AERONAUTICS AND SPACE AGENCY)

The Austrian Research Promotion Agency (FFG) is the national funding institution for applied industrial research in Austria. Within FFG, the Aeronautics and Space Agency (ALR) acts as the central contact point for the coordination of space-related activities in Austria. One of the responsibilities of FFG/ALR is the management of the national funding programme ASAP (Austrian Space Applications Programme), a bottom-up programme targeted to space science, space technology development and the application of space-based technology. The share of funded application projects has been steadily increased since the start of the programme in 2002.
In the last call of ASAP a distinct funding line with an allocated budget was built up in response to the European GMES activities (*Aktionslinie GMES in Österreich*). The aim of this funding line is twofold: 1) to support Austrian actors in companies and research institutions, which are actively involved in ESA and EU GMES projects and 2) to prepare the user uptake of upcoming GMES services in Austria.
After the evaluation of a variety of proposals, the successful projects were kicked-off in the reporting period. The range of selected activities (some of them are described below in more detail) comprises a national monitoring concept for land use and land cover in Austria (LISA, Land Information System Austria), the development of global soil moisture services with the focus on water hazards applications, the development of integrated services for emergency response on local and regional level, the preparation of monitoring services related to snow cover and glaciers and the role definition of a region (the Vienna capital region) both as a provider of GMES data and as a user of GMES services. Besides these thematically focused topics, projects on the improvement and development of innovative methods for the analysis of multi-source, multi-scale and multi-temporal remote sensing data are funded equally in the *Aktionslinie GMES in Österreich*.

Dr. Thomas Geist (FFG/ALR)

REPORT ON RESEARCH INSTITUTIONS AND VALUE ADDING COMPANIES

Geoville

GeoVille Group is a private sector enterprise located in Austria and Luxembourg. GeoVille “start its services where Google Earth ends”. We are dedicated to provide cutting edge spatial data in the following fields: Land cover and land use mapping; Urban and regional planning; Spatial planning; Forestry; Infrastructure; Cartography and mapping. Working with GIS and EO data is GeoVille’s daily business. In this field, we offer an impressively wide range of services and we certainly are the perfect partner for anyone involved in remote sensing and GIS projects.

The project highlights of GeoVille Group in 2009 were the following:

- Kick-off of the **Land Information System Austria** (LISA) (http://www.landinformationsystem.at)
- Execution of 4 **World Bank projects** in Senegal, Vietnam, Honduras and WB internal, in the field of natural hazard risks and climate change adaption studies
- Development of an **EO based population locator (PopLoc) product** for the European Space Agency
- Establishment of a **framework contract with the EEA** for the provision of geographic data.
- Setup of a **new production facility** in Innsbruck, Austria (http://geoville.com/contact/)

Institute of Digital Image Processing, Forschungsgesellschaft Joanneum Research mbH

As "a partner in innovation" for business enterprises and political decision-makers, the institute focuses on applied research and development in key technologies in the field of remote sensing. The Institute deals with the development of algorithms and software packages for the processing and analysis of remote sensing image data from active and passive sensors as well as from airborne and spaceborne systems. The highlights in 2009 can be summarized as follows:

- Partner in several EC funded GMES projects (G-Mosaik, SAFER, LIMES, GEOLAND II, GNU) and biomass / carbon mapping (CEUBIOM, CarbonEUROPE)
- Partner in ESA GSE Forest extention on REDD
- Coordination of EC project PROVISG on Planetary Robot Vision
- Construction of a prototype airborne remote sensing platform (optical and thermal) for rapid mapping applications
- Algorithm and software development for processing of and information extraction from TerraSAR-X images within the commercial service segment as well as in national and international research projects.

Institute of Remote Sensing and Photogrammetry, Graz University of Technology

The work of the Institute is focused on the application of various remote sensing techniques in the field of geosciences. This includes airborne (laserscanner data, airborne scanner data and aerial photos) and spaceborne remotely sensed data as well as terrestrial data (e.g. digital cameras and terrestrial laserscanners). Major applications are high mountain cartography, hazard mapping, glacier monitoring, land use mapping and forest monitoring. Highlights of the year 2009 are:

- Completion of a prototype airborne remote sensing platform (optical and thermal) for rapid mapping applications together with Joanneum Research
- Network on glacial and periglacial alpine environments within ALP-CHANGE - Project

EOX

EOX IT Services GmbH (www.eox.at) is a young, innovative Austrian company providing spatial observation information technology solutions. EOX develops geospatial information infrastructures with special emphasis on satellite Earth Observation systems and next generation applications. Highlights in 2009 have been a number of European Space Agency contracts in the Heterogeneous Mission Accessibility programme establishing online download mechanisms for orthorectified imagery from GMES satellites. EOX has also contributed to the engineering of the logistics infrastructure within important European and national GMES Land Monitoring service projects (geoland2, SOSI, LISA).

Austrian Institute of Technologies, Seibersdorf

The team of Dr. Klaus Steinnocher was involved in national (LISA, GMSM) and international (geoland2) research activities. Mag. Christoph Aubrecht, researcher at the AIT - Austrian Institute of Technology, received the Talents Sponsorship Award 2009 for Science, awarded by the Federal State of Upper Austria, for his outstanding research activities in the fields of remote sensing and geoinformation science. In summer 2009 he was a visiting scientist at NOAA-NGDC, supported by a scholarship from University Corporation for Atmospheric Research.

Institute of Photogrammetry and Remote Sensing, Vienna University of Technology

The Institute of Photogrammetry and Remote Sensing of the Vienna University of Technology was involved in several ESA and EUMETSAT projects dealing with the retrieval of soil moisture from scatterometer and SAR measurements. TU Wien also coordinates the ESA DUE project PER-

MAFROST
(http://www.ipf.tuwien.ac.at/permafrost/)
that started in 2009.

Centre for Geoinformatics" (Z_GIS) at University of Salzburg

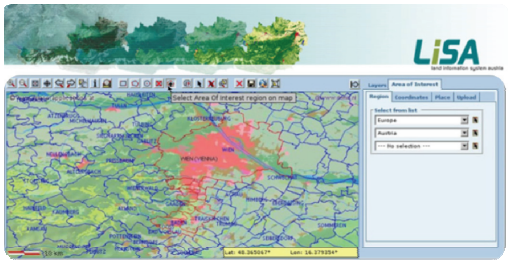
The Centre for Geoinformatics" (Z_GIS) at University of Salzburg is a well established centre of competence in GIScience, active in research & development, continuing education and industry cooperation. With the competence being built from basic and applied research primarily funded through international programmes. Z_GIS Research conducts R&D projects in various dimensions, time- and volume-wise, and with various funding sources and partner constellations. Selected Remotes Sensing relevant research projects 2009 are:

- MOVE 8 (Methods for the Improvement of Vulnerability Assessment in Europe)
  http://www.move-fp7.eu
- SAFER (Services and Applications For Emergency Response)
  http://www.emergencyresponse.eu
- G-MOSAIC (GMES Services for Management of Operations, Situation Awareness and Intelligence for regional Crises
  http://www.gmes-gmosaic.eu
- ENERGEO (Earth Observation for monitoring and assessment of the environmental impact of energy use)
- LIMES (Land-sea Integrated Monitoring for European Security)
  http://www.fp6-limes.eu
- BRAHMATWINN (Twinning European and South Asian River basins to enhance capacity and implement adaptive integrated)
  http://www.brahmatwinn.uni-jena.de
- ESA (Earthwatch ProgrammeResponse ISVG (Response Independent Service Validation Group)
  http://www.respond-int.org
- UN SPIDER (United Nations Platform for Space-based Information for Disaster Management and Emergency Response)

AUSTRIAN KEY STAKEHOLDERS INITIATE LAND INFORMATION SYSTEM AUSTRIA (LISA)

In order to overcome the shortcomings of existing LC/LU data sets for regional, national as well as European management and reporting requirements, the project Land Information System Austria (LISA) was initiated by Austrian stakeholders. The objective of LISA is to achieve a consensus on a new Austrian land information and monitoring system and demonstrate its benefits offering improved spatial and thematic content. The project is funded by the Austrian Space Application Program (ASAP), and was successfully kicked off on June 15th in Vienna at the Austrian Institute of Technology.

Since establishment of the user specified data catalogue, design of the data model, technical verification by the scientific committee and delivery of the relevant geodata by the province and the state departments, the production of the first LISA prototypes has started on schedule in January 2010. For more information on the Land Information System Austria and the first LISA datamodel please refer to www.landinformationsystem.at



LISA GeoPortal and example of LISA prototype

2.2 BELGIUM 2009 REPORT

CURRENT BELGIAN EO RESEARCH PROGRAMMES

1. THE STEREO PROGRAMME

STEREO II

Launched in 2006, the STEREO II research programme "Support to Exploitation and Research on Earth Observation" (25.85 M€, 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.

Following the three first calls for proposals, 9 projects are now finished and 23 projects are ongoing. Information on these projects and on projects in Earth observation previously funded by the Belgian science policy can be found on the following webpage:
http://eo.belspo.be/Directory/Projects.aspx
A fourth call for proposals, worth 1 790 000 € and aimed at small innovation and spin-off projects and at the development of products and services was launched in September 2009. The selected projects are scheduled to start in June 2010.
For more information contact the programme administrators (vdab@belspo.be and schy@belspo.be).

2. Earth Observation HelpDesk

Continuous activities

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 240 people, mostly scientists, are registered to 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 » continues to inform the public at large, teachers and students about the world of Remote Sensing. The « Links » section which lists by subject a selection of interesting sites, has been updated. In the « Satellites » section, the launch table has also been updated. It provides an alphabetically, chronologically or by country overview of the launch dates and activity periods for nearly 200 Earth observation satellites. By clicking on the name of a satellite, the visitor is redirected to the corresponding page on the Belgian Earth Observation Platform:

http://eoedu.belspo.be/en/launch-index.htm.

Specific activities

At the end of 2008, the Belgian Science Policy (EODesk) and the UCL-Geomatics have collaborated to produce a poster series covering the entire Earth to celebrate the 10 years of the SPOT VEGETATION programme. The poster images are made from a composite of all daily images recorded for ten years by the VEGETATION instruments onboard satellite SPOT-4 and SPOT-5.
On each of the 6 continental posters, 5 specific themes or main processes experienced in the last 10 years are underlined through very visual insets. These themes can now be explored more thoroughly through the website entitled "10 years of Imaging the Earth, SPOT VEGETATION", which offers a lot of information, pictures and links ; This website is available in English, French and Dutch : http://eoedu.belspo.be/vgt10.
The posters were distributed to teachers in Belgium and were presented at the 2nd EARSeL Workshop on Education and Training in Chania, Crete in June 2009.

Beside the translation of some modules of the SEOS project, the EODesk was also involved in the development of the French and English versions of the CDRom « COSMAS, the Space Reporter - an Educational Tool for Secondary Schools », an initiative of the University of Ghent.

BELGIAN PARTICIPATION IN EO RESEARCH PROGRAMMES

1. Belgian participation in ORFEO

Belgium committed 28.2 M€ for the 2004-2009 period to support the French Earth Observation programme "Pléiades" and the accompanyingg French-Italian preparatory programme ORFEO (Optical and Radar Federated Earth Observation). In the frame of this preparatory programme, Belgian experts were integrated in some thematic groups and in another side 6 Belgian methodological projects conducted by PhD or post-doctoral researchers have been funded. To get more details on these projects, visit our website: (http://eo.belspo.be/Directory/ProgrammeDetail.aspx?progId=8).

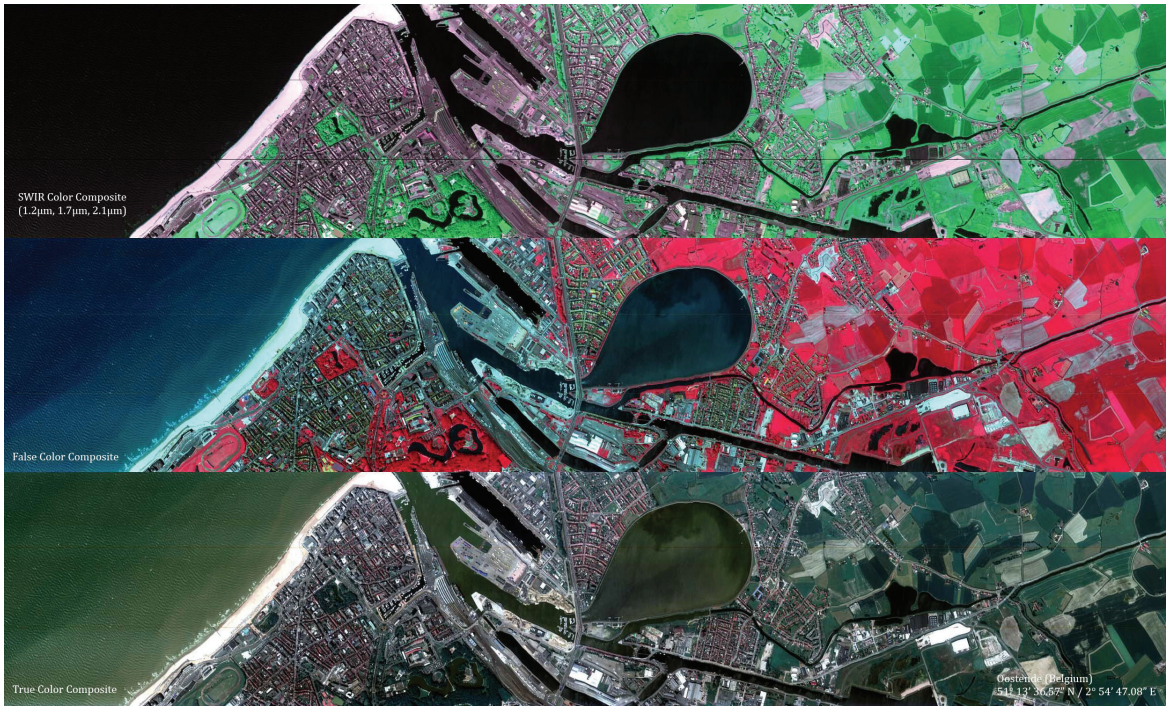
A first Belgian ORFEO workshop was held organized on 12 February 2008 and all the Belgian projects were presented during this event.
The results of the Belgian methodological research projects will also be presented during a workshop organised in Brussels on March 04 2010.

2. Belgian participation in the European project: SEOS

The educative project SEOS (Science Education through Earth Observation for High Schools) is implemented by universities, organisations (including ESA, Earsel and UNESCO) and high schools from all over Europe. This initiave aims at developping 15 internet-based eLearning tutorials integrating satellite Earth observation into the science curricula in the last degree of high school.
The first module, entitled « A World of Images » is a visual invitation to discover the entire project. The module has been tested in several European high schools. Teacher and pupils gave very enthusiastic feedback and their comments were used to improve the content of some pages and the navigation inside the module. This introductive module was developed by the Belgian Science Policy Office and is freely available online.
The Belgian Science Policy Office also contributed to the development of other educative modules and to the translations of the modules in French and Dutch.
The final version of the modules will be available also in other European languages in 2010.
The website of the project is www.seos-project.eu.

3. The SPOT VEGETATION programme

Since 1978, Belgium is a member of the SPOT programme led by France. In 1998, the VEGETATION programme, fruit of a collaboration between various European partners: Belgium, France, Italy, Sweden and the European Commission was grafted onto the SPOT programme. The VEGETATION programme consists of two observation instruments in orbit, as well as ground infrastructures. The two instruments are aboard the SPOT4 and SPOT5 satellites. With a swath of 2.200 km and a daily orbit, the instruments allows to observe each day almost the entire surface of the globe and its vegetation cover. After 10 years, the users of the data are very numerous and the applications of the products delivered are paramount in the field of agriculture and of forest study for example. One



of the most important contributions of Belgium is the funding and the hosting of the image processing centre (CTIV) at VITO in Mol (Belgium) which processes, distributes and archives the data products since the beginning of the programme. In April 2009 to ensure the continuity of the CTIV, the Belgian minister of the science policy has signed a contract which garantees the financing of the image processing centre until 2014. All these information and many others can be found on the website of the programme:(http://www.spot-vegetation.com/).

HYPERSPECTRAL REMOTE SENSING

1. Hyperspectral campaigns

In the framework of the STEREOII programme, the Belgian Science Policy finances hyperspectral flight campaigns. During the summer 2009 two campaigns were organized, one over the Belgian coast and another over the lake Constance in Switzerland. The images acquired are used in the frame of two STEREOII projects (BELCOLOUR-2 en MICAS).

2. Hyperspectral activities in VITO

In VITO, the Flemish Institute for Technological Research, hyperspectral research focuses on pre-processing algorithms, the development of classification techniques for nature conservation and coastal studies and on algorithmic research for inland and coastal water quality retrieval. In 2009 inland and coastal water research focused on adjacency corrections (Belcolour project, SR/00/104) and the development of APEX specific water quality algorithms (MICAS project, SR/00/122). For the MICAS project an APEX flight campaign was organized in June 2009 over the Scheldt estuary in Belgium and lake Constance in Switzerland. Coastal research continued in the framework of the INSHORE project (SR/00/125). the INSHORE project brings together know-how and expertise from both the airborne and seaborne realm to produce spatially integrated maps of the morphosedimentary environment. Finally in the HABISTAT project (SR/00/103) habitat quantity and quality is being mapped. The Habistat project approach is to breakdown habitats into classes that can be mapped based on hyperspectral characteristics, and to subsequently reclassify these land cover classifications to habitat maps.

3. APEX

After two test flights in 2008, some necessary reworks and upgrades were performed to the APEX imaging spectrometer. In June 2009 the APEX sensor was again mounted on a DLR Do-228 aircraft for experimental flights in the framework of the ongoing acceptance procedure. The data are under evaluation and the first APEX flight opportunities and data will be available to the scientific community, research institutions and commercial users as of 2010. Website: (http://www.apex-esa.org/)

Some quicklook imagery of the June 2009 flights acquired above Oostende (B) are shown in figure 1 above.

Events organized in Belgium in 2009
The annual Belgian Earth Observation day organised by the Belgian Science Policy Office took place in Maaseik on the 28 April 2009. The focus was put on the results of the STEREO II projects that are already finished. This meeting was also the opportunity to invite two keynote speakers, Dr. Uwe Rascher from the Institute of Phytosphere Research, Research Centre Jülich in Deutchland and Dr. Alan Blackburn , Department of Geography, Lancaster University, United Kingdom.
The presentations given during this event are on the website: (http://eo.belspo.be/Directory/Resources/Presentations.aspx)

Following the successful series of past conferences, InterCarto InterGIS 15 aims at bringing together international state-of-the-art research and exploring topics and research findings across a wide range of fields of cartography, GIS and also remote sensing. This year, the first part of the conference was held in city of Perm, Russia and the second part in the city of Ghent, Belgium between the 3 and the 6 July 2009. For more information, see the website: (http://intercartogis.org/).

The European Association for Spectral Imaging (EASIM) has organized the EASIM-09, the second general conference in spectral imaging the 3 and 4 March 09 in the Walloon Agricultural Research Centre in Gembloux. A half day was dedicated to the remote sensing applications. All the informations are available on the website : (http://www.cra.wallonie.be/pubtech/easim2009/index.php?page=).

Events scheduled in Belgium in 2010
The annual Belgian Earth Observation day organised by the Belgian Science Policy Office will take place in May 2010. Like previous years this meeting will be the opportunity to make professionals and researchers concerned with remote sensing aware of the projects realized in Belgium in the framework of the STEREO II programme and to offer the possibility for networking. An invited international speaker will open the morning session with a presentation.

March 4, 2010 an ORFEO (Optical and Radar Federated Earth Observation) workshop will be organised in the Royal Military Academy in Brussels. The main goal of the seminar is to present to the Belgian remote sensing community and to the members of CNES the results of the six projects realized in Belgium in the framework of the ORFEO support programme.

After the successful events of OBIA 2006 in Salzburg, Austria and GEOBIA 2008 in Calgary, Canada, the conference about the GEOgraphic Object-Based Image Analysis will be held in Ghent between the 29th of June and the 2nd of July. For more information, visit the website : http://geobia.ugent.be/

The second EARSeL “Joint workshops” (Urban, 3D, Developing Countries and Thermal) will take place in Ghent, Belgium, from 22□24 September 2010.

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http://eo.belspo.be

2.3 CROATIA 2009 REPORT

Remote Sensing Activities in Croatia in 2009
The activities, performed in the field of remote sensing in Croatia in 2009, have been carried out mostly in sections (working groups) consisting of specialists from the related institutions. The sections are members of the Scientific Council for Remote Sensing of the Croatian Academy of Sciences and Arts.
The description of major activities of particular Sections follows:

Photography, General Interpretation and GIS Section
In 2009, the entire territory of the Republic of Croatia has been completely photographed by the digital photogrammetric camera (Ultra CamX) under the Land Parcel Identification System (LPIS) Project. The aerial triangulation and digital orthophoto in the scale of 1:5,000 have been produced. The initial vectorization of the agricultural land performed by photographic interpretation has continued on the new orthophoto maps (LPIS Project).

The State Geodetic Administration has established CROPOS, State network of reference stations, for the purpose of enabling the positional determination of objects and phenomena in real time, with the accuracy of 2 cm horizontally and 4 cm vertically, throughout the territory of the Republic of Croatia. The system is composed of 30 referential GNSS stations that are 70 km apart. The stations collect the data obtained by satellite measurements that are corrected and forwarded to the users in the field. The system has significantly improved the accuracy of the elements of external orientation when photographing with a digital aerial photogrammetric camera.

The Faculty of Geodesy, Chair for Photogrammetry and Remote Sensing, of the University of Zagreb, works on a complex project entitled « Multi-Sensor Airborne Reconnaissance and Control in Extraordinary Situations and Environmental Protection» by using a multi-sensor platform for concrete tasks. The multi-sensor and hyperspectral airborne reconnaissance and control advanced system is in synergy with the deployment of decision support system under undetermined conditions and has been used in the Deployment of Decision Support System for Mine Suspected Area Reduction in Bosnia and Herzegovina (Project financed by the State Department). As part of the first project, multispectral and hyperspectral photographs were taken in mine suspected areas in the municipalities of Bilje, Drniš and Gospić.

Geology and Geophysics Section

The INA-Naftaplin oil company has continually used the remote sensing methods as part of various geological and geophysical research activities. Relevant satellite images are used for structural and tectonic research, determination of routes for locating geophysical measurements, etc.

In the Croatian Geological Survey, the remote sensing have been applied during the basic scientific research programme of producing geological maps, especially on the following projects: Base geological maps of Republic of Croatia in the scale of 1: 50,000; Basic technical geological maps of Republic of Croatia at a scale of 1: 100,000; Structural and geomorphologic maps of Republic of Croatia at a scale of 1: 100,000 and Tectonic maps at a scale of 1: 300 000.

Vegetation, Forestry and Agriculture Section

The work on the Colour Infra-Red Aerial Photography Analysis and Interpretation Project continues with the objective of determining the ever growing incidence of damage to forest stands in order to be able to take as effective measures as possible to protect the tree dieback. The present research has questioned the close connection between the growing incidence of tree dieback and the impact of various characteristics of the habitat and forest stand (altitude, exposure, slant, soil, structure etc.) as well as abiotic and biotic factors (Douglas-fir toussock moth, powdery mildew and mistletoe) but the real causes are still as yet unknown.

The IR aerial photographic interpretation has determined the health condition of the beech-fir forests in the Velebit mountains. It has also yielded the data on the forest damage distribution. Based on the research conducted, it may be deduced that the degree of damage of the inventoried forests is between low and average damage. The degree of damage of the fir trees amounts to 61.96%, and of the beech trees only 6.56%. It has thus been confirmed that the beech is the least damaged type of tree.

The health of the forest stands is also affected by geomorphological factors (terrain orientation, slant and altitude) which are planned to be further researched in the upcoming period with the help of the DTM.

Furthermore, it is planned next year to probe the option of applying artificial neural networks for the purpose of remote sensing and, in particular, forest management.

Based on the past experiences, it may be concluded that the histograms of second order may serve to assess the density of forest stands. Histograms of normal stand density have the greatest width around the main diagonal as well as lower degree of occurrences in the right part of the diagonal but also the widest spread of the „bars“. The histograms of second order for the forest stands whose density is less than normal may be divided into two groups. The histograms of the first subgroup are more similar to the histograms of the forest stands of normal density but the width of the main diagonal is smaller while the smaller bars are significantly more present. The histograms of the second sub-group have a wider main diagonal

and bigger bars than the histograms of poor density.
The procedure for the operational application of artificial neural networks in assessing the forest stand parameters (volume, number of trees, basal area, relative density and age of forest stand) will include the IKONOS images of high resolution. The present research encompassing the artificial intelligence procedure in forest management on satellite imagery, a high degree of automation has been achieved that cancels the subjectivity of classical analysis and photointerpretation. The results of the research have been presented at three national events and one international event, and published in specialized magazines.

Oceanography Section
Last year, this section has established a great number of scientific contacts with the specialists from various countries, in particular, with the specialists from Russia, Poland and USA. External specialists have held several interesting lectures at the Institute for Oceanography and Fishing in Split on the topic of using the SAR satellite images in detecting of oil spills in the sea. Furthermore, a seminar was held on the topic of "Coastal Area Spectroscopy" with the participation of specialists of various expertly profiles (forestry specialists, building contractors, oceanographers). Apart from the lectures, practical research was conducted by performing the measurements with the optical profiler and hyperspectral scanner (ASD Fildspec®3 VNIR) in the Kaštele Bay. The measurements were accompanied by other *in-situ* research.

Oceanography Section
Last year, this working group has established a great number of scientific contacts with the specialists from various countries, in particular, with the specialists from Russia, Poland and USA. External specialists have held several interesting lectures at the Institute for Oceanography and Fishing in Split on the topic of using the SAR satellite imagery in detecting oil spills in the sea. Furthermore, a seminar was held on the topic of "Coastal Area Spectroscopy" with the participation of specialists of various profiles (forestry specialists, building contractors, oceanographers). Apart from the lectures, practical research was conducted by performing the measurements with the optical profiler and hyperspectral scanner (ASD Fildspec®3 VNIR) in the Kaštele Bay. The measurements were accompanied by other in-situ research.

Spatial Planning and Environmental Protection Section
New digital ortophoto maps in colour and the scale of 1:5,000 have been produced for the territory of the Republic of Croatia. Their division has been regulated according to the new division for the Croatian Base Map (*Hrvatska osnovna karta-HOK*) and the new mapping projection of the Republic of Croatia. The maps may be obtained at the State Geodetic Administration. Since the content of the maps is up-to-date (photographed in 2008 and 2009), they are fit to be used in spatial planning.

Hydrometeorology Section
The Meteorological and Hydrological Service of Croatia has participated for the last five years in the international project *EUMeTrain* together with the meteorological institutes from Austria, Germany, Finland, the Netherlands and Portugal. The project involves the activities of developing learning materials through computers, on the topic of interpreting satellite images and their connectedness with other meteorological data. The first phase of the project was completed last year, and starting from 2010 the project work will continue for the next five years. Last year, for the purpose of maintaining the satellite manual (SATMANU), a group of experts from Meteorological and Hydrological Service has compiled new materials and has revised the existing ones for the two concept models of synoptic systems. A study has also been developed on *meteorological tsunami* on the island of Mali Lošinj. The material is available on the Internet, and adjusted for interactive learning
(http://www.zamg.ac.at/eumetrain/).
Within the project, several trainings were organized through the Internet on the topic of *analyses and fog forecasts; analyses and forecasts of convective cloud development*. The next training will be organized in 2010 on the topic of „*snow*".
The Meteorological and Hydrological Service experts have actively participated on the SATelliteREPort *(SATREP*) project, within the EUMETNET programme for the development of satellite reports for the

whole of Europe. The basis for a satellite report is a satellite image of clouds in combination with fields of meteorological parameters used to classify the cloud structures on the satellite images into the meteorological concept models. The concept models used in the classification are based on the SATMANU manual. The Meteorological and Hydrological Service experts are also involved in the development and maintenance of this manual.
The representatives of Meteorological and Hydrological Service, as *the Croatian delegation*, participated in 2009 in several meetings of EUMETSAT delegation bodies. The discussions in the meetings involved the topics of current issues related to the maintenance of geostationary and polar satellites in the orbit and the plans for the next period. The representatives of Meteorological and Hydrological Service participated in the EUMETSAT Annual Satellite Conference held in Bath, Great Britain. The discussions covered the possibilities of forecasting the *meteorological tsunamis in the Adriatic* with the help from satellite monitoring. A scientific paper was published on the topic of satellite meteorology and the application of satellite data.
Strelec Mahović, N. & Zeiner, B. (2009) Application of Meteosat SEVIRI channel difference 0.6 μm – 1.6 μm in convective cells detection. Atmospheric Research 93 (2009), 270-276.

Archaeology and Historical Heritage Section

The experts from this working group are not only involved in field researching, but they also participate in expert and scientific conferences where they present the results of their researches. Therefore, last year at the International Aerial Archaeology Conference (AARG- 2009, Ljubljana, Slovenia), they presented several papers.
Ilikić, M: Aerial photography in underwater archaeology (lecture)
Šiljeg, B: Remote Sensing on the Croatian coast (poster)
Tkalčec, T: Medieval Hillforts and Moated Sites in North-Western Croatia- Aerial Archaeology and Archaeological Reconnaissance (poster)
Drnić, I: Excavations along the C5 (poster).
At the scientific conference of *Molve – people, village and environment in the long run* (Molve, 2009) the lecture was given by:
Šiljeg, B: Aerial Archaeology of Molve Surroundings

Apart from being Working group members, we would like to mention the work on collecting and editing papers from the First International Conference on Remote Sensing Techniques in Disaster Management and Emergency Response in the Mediterranean Region, held in Zadar, 22-24 September 2008, as well as publishing the Proceedings from the Conference (editor: Marinko Oluić).
This report was prepared in the Sections sessions by: I. Landek i A. Krtalić; I. Hećimović; R. Pernar; M. Morović; J. Pleško; N. Strelec Mahović; B. Šiljag. The text synthesis and revision was completed by Marinko Oluić.

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2.4 CZECH 2009 REPORT

There are three EARSeL members in the Czech Republic - two departments of universities and one institute.

THE FOREST MANAGEMENT INSTITUTE

The Institute is a large institute covering forest inventory and forest data collection in the country. The Institute has a specialized remote sensing laboratory focused on development and implementation of modern techniques of monitoring of forest ecosystems combined with studying forest structure and dynamics.
The Institute goal is to apply *in situ* data as a reference data (training sets) for remote sensing image data analysis. Effective geospatial data collection helps to support the early warning system. The Institute activities are heading to the strategic target of the GMES program.
Monitoring of the forest environment by remote sensing tools provides objective information for determination of land characteristics, allows land potential control, and land changes. The main research themes of the Institute are:

- Selection and testing of new data sources in the forest management
- Selection and testing of reference training areas
- Evaluation of collection of the forest stand and tree characteristics from remote sensing data

- Support for evaluation of disaccords between cadastral maps, forest management maps and real state
- Support for the reforestation subsidy control (EAFRD)
- Updating and improvement of the forest transport network
- Monitoring of the fragmentation of land and forest units and its influence on biodiversity
- Mapping of forest stand boundaries

The Forest Institute remote sensing laboratory processed a Pilot project of the National Forest Inventory. Combination of data measured in the inventory areas network with aerial and satellite image data forms a base of national inventories in most advanced European countries. The Czech Republic will focus mainly on:

- Forest versus non-forest areas classification. Using automated image processing of VHR satellite data and orthophotographs, forest boundary vector lines will be determined in the object image analysis
- Land stratification before *in-situ* data collection, post-stratification after *in-situ* data collection, where stratification allows to split statistically non-homogeneous data set by clustering of more or less homogeneous clusters, The "strata" can form multi-resolution image segmentation based on close spectral, textural, shape or contextual characteristics
- Realistic improvement of the National Land Inventorization (NLI) for geographically small areas – assessment of state quantities out of NIL areas. It will be necessary to test and evaluate potential approaches on a base of concrete measurements and digital data and areas.
- Thematic map creations in the form of remote sensing data aggregation with the NLI database where a successful solution is equivalent to a quality and volume of the reference *in-situ* data

A complex methodology and software application was formed for photogrammetrical stratification of inventorized areas of NLI. In the case of the FOREST class, certain forest stand characteristics are studied, as forest phase, type of mixture forest, etc. Detailed evaluation will be performed of the pilot project.

Methodology of automated classification into FORESTx NON-FORESTx Uncertain classes was successfully verified on TM/ETM+ Landsat data. Output of the object classification will be used as an input for stratification and percentage of the forest land cover. SPOT and IRS data will be tested and advantage of the automated method compared to a forest boundary manual vectorization made from aerial orthophotographs will be evaluated.

A uniform historical satellite data from the data format point view will be performed from existing Landsat MSS, TM, ETM+ (over since 1984), SPOT 5 from 2007, individual scenes from different sensors which were used for methodology of a forest health state (IRS, Aster, QuickBird, EO-1 ALI, Hyperion) and aerial photographs. The archive data will be transformed to the same data format, coordinate system and equipped with metadata catalogue.

DEPARTMENT OF GEOINFORMATICS, FACULTY OF SCIENCE, CHARLES UNIVERSITY

The second member of the EARSeL is the Department of Geoinformatics of the Faculty of Science at the Charles University. Activity of the members of the department is oriented on two tasks – education and research. The research is concentrated in following projects:

1. **Telecommunications Advanced Networks for GMES Operations (TANGO).**

It is an EC FP 6 project whose main activity is application of EO data and web-GIS solutions for Security demonstration. The project is performed in co-operation with project partners: EADS ASTRIUM (leader) and 23 partners from research and industry. Its duration is 2006-2009 http://www.teladnetgo.eu/

2. **Demonstration of ESA environments in support to FLOod Risk Earth Observation monitoring (FLOREO)**

The project is financed by PECS ESA project. The department co-operates with two other organizations and is processed within the 2008-2010 period. The goal of the project is to define a method for detection of a snow cover monitored from EN-

VISAT ASAR and optical data (NOAA, MSG). http://www.floreo.cz/

3. GEO Network for Capacity Building (GEONetCab)

The project s performed in the framework of EC FP 7 in co-operation with ITC (leader) and 7 partners from education and research institutions. The project is proposed for the 2009 (November) – 2011 period.

The goal of the project is to create conditions for the improvement and increase of the GEO capacity building activities and framework, with a special emphasize on developing countries, new EU member states (and EU neighbouring states) and climate monitoring. It will serve a bigger goal of improved effectiveness and efficiency of GEO capacity building for application in the GEO societal benefit areas.

4. Suburbanization and Urban Sprawl

The project is financed by the Ministry of Environment of the Czech Republic

Its duration is a period of the 2007-2011 years. The project is focused on mapping of urban areas in Prague hinterland from high resolution EO data using OBIA.

Remote Sensing Laboratory of the Czech Technical University in Prague

The activity of the Laboratory is also split into two spheres – research projects and education.

The research is based on present projects. One is supported by the Czech Grant Agency and the project with duration 2008 -2010 Interferometric determination of subsidences caused by undermining by permanent scatters and phase unwrapping correction within interferometrical blocks. The project led to co-operation with a large mining company which enabled the Laboratory to build 11 corner reflectors in the mining area in the northern Bohemia. The reflectors are located in an undermined area, close to open brown coal mines and in surrounding stable places. The project is financially supported by the Principal Investigator project in the framework of which ERS and Envisat data are delivered.

The second project Modelling of urban areas to lower negative influences of human activities as a COST project is financed by the Czech Ministry of Education focused on determination of development of towns within last 40 years. The development is characterized by statistical data related to town land use classes for 70 towns in the Czech Republic in 10 years´ periods since 1970. The data are implemented into the temporal spatial data analysis using satellite and aerial image data.

The Laboratory has an active role in education of GIS, remote sensing and image processing for all university educational levels.

Education of both universities:

Department of Geoinformatics, Faculty of Science, Charles University and ***Remote Sensing Laboratory*** of the Czech Technical University in Prague were hosting the course in cooperation with the Czech Space Office: ESA Land Training, 28 June -3 July 2009 (http://earth.esa.int/landtraining09/.)

2.5 FRANCE 2009 REPORT

EARTH STUDY AND OBSERVATION IN FRANCE IN 2009

Introduction: Funding and supporting Earth Observation research and technology

CNES, the French Space Agency, develops most of its remote sensing programme in bilateral and multilateral cooperation, giving top priority to programmes developed within the ESA Convention. France has reaffirmed its proactive policy and intention to sustain its pivotal role in European space, materialised by an annual contribution of 685 million euros to ESA programmes until 2010. including some 90 million euros for Earth Observation. France is and plans to remain ESA's first contributor

In the 2000's, the CNES financial figures are more or less similar from one year to another one. 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.

French Scientific Remote Sensing Programme (PNTS)

The PNTS[1] programme associates a wide part of the Earth Observation scientific community in multiyear operations. It aims at developing scientific methodologies, promoting the implementation of operational methods, assessing and assimilating space data in complex models, and promoting interdisciplinary studies. The PNTS 2008 programme allows funding:

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

The priorities are:

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

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

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 since. More recently, 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. **Planet Action** is supporting now more than 200 projects around the world and has already achieved results.

High-resolution optical sector systems and scientific preferential data policy

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

- The **HELIOS-2A** satellite has been operational since April 2005, while the **HELIOS-2B** satellite has just be launched in December 2009. Compared to HELIOS-I series, these 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 **SPOT**[2] constellation currently includes now two satellites (4, and 5). SPOT 2 ceased commercial operations on June 30, 2009 and was deorbited one month later. The SPOT archive includes now over 20 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.

[1] **P**rogramme **N**ational pour la **T**élédétection **S**patiale.

[2] **S**atellite **P**our l'**O**bservation de la **T**erre.

- The first **Pléiades-HR** satellite is to be launched end 2010, and the second one mid 2011. Pléiades will ensure the continuity and enhancement of wide field observations after SPOT-5, in panchromatic and multispectral bands. Pleiades will offer 0.5m resolution products over a 20 km field of view, and a daily revisit capacity. Pleiades and the Italian COSMO-SKYMED satellites are the components of the joint ORFEO system. In parallel, an ORFEO preparatory program was launched as soon as 2003. Among others, the so-called 'ORFEO toolbox (OTB)' high resolution image processing algorithms was developed and is distributed as an open source library.
- The **e-CORCE** concept is under advanced consideration in CNES, which is looking for sponsors to develop a microsat flexible imaging constellation concept to provide Internet (and other) users with high-resolution, low-cost, frequently refreshed imagery of the entire Earth. The so-called 'Blue Planet' operating consortium is now under completion.
- The **ISIS**[3] programme (CNES) grants the European scientific community an easier access to SPOT space imagery at preferential rates.
- The **Kalideos** programme, set up by CNES during year 2000, aims at developing remote sensing reference databases for the scientific community. In the frame of this programme, three databases have been implemented to support the integration of satellite imagery in basic or applied research projects (agriculture, coastal zones, and multipurpose on 'Ile de la Réunion'). 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 GMES initiative.
- The ESA-led **TPM** programme allowed a free access to SPOT 1 to 4 products archive and programming for so-called "Category-1" ESA-labelled users and for the GMES/GSE projects.
- The **SPIRIT** (SPOT 5 stereoscopic survey of Polar Ice: Reference Images and Topographies) programme was launched in 2007 by CNES, SPOT Image and LEGOS as scientific leader within the framework of the International Polar Year, in order to improve the knowledge of the topography of Polar Regions. The SPIRIT programme included (1) the collection of SPOT 5 stereoscopic data of more than 2.5 million km² over key polar ice cap and glacier areas and (2) free-of-charge delivery to the IPY scientific community of 40m digital terrain models (DTM) within an absolute horizontal precision of 30m rms.

Vegetation (low resolution, high receptivity optical system)

- **VEGETATION-1** was launched onboard SPOT-4 in 1998, followed by **VEGETATION-2** on board SPOT-5 in May 2002. Data are processed and distributed by VITO, Belgium. End 2008, a workshop evidenced the major role that the system played and has to play, namely within the context of GMES.
- The continuity of the VEGETATION programme beyond SPOT-5 will be guaranteed by two satellites:
  - The **SENTINEL-3** satellite proposed by ESA as part of the space component of the GMES initiative, to be launched in 2013,
  - The **POBA-V** small Belgium satellite, to be launched in 2011-2012 should fill the gap (if any) between VEGETATION-2 (SPOT-5) and SENTINEL-3
- France cooperates with Israel in the **Venμs**[4] research mission, dedicated mainly to vegetation and sustainable development applications. Scheduled to be operational in 2012, the Venμs 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

[3] **I**ncitation à l'utilisation **S**cientifique des **I**mages **SPOT**.

[4] **V**egetation and **E**nvironment Monitoring **N**ew **Micro**-**S**atellite.

visible and near infra-red regions. PI's for related scientific studies have been selected.

Miscellaneous (soil & oceans): SMOS
The **SMOS**[5] satellite was successfully launched on Nov.2, 2009. It is a joint ESA (European Space Agency) / CNES (France) / CDTI (Spain) Earth Observation program. The SMOS satellite has been proposed by the French lab CESBIO (Centre for the Study of the Biosphere from Space, the Director of which, Dr Yann Kerr, is the Lead Investigator). It has been selected by ESA as the 2nd Earth Explorer Opportunity Mission.

The SMOS payload a L-Band (1.4 GHz) 2D passive interferometric radiometer with a Y-shaped 3 arms synthetic aperture antenna. The primary objective of the SMOS mission is the global observation of soil moisture and ocean salinity, two important parameters needed for accurate modelling of weather and climate. The SMOS accuracy objective is of 4% for soil moisture on 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.

These key parameters will allow scientists to have a dramatic improvement in their understanding of the Earth water cycle. Improving scientific understanding of several specific issues can also be targeted, such as among others ocean circulation dynamics, vegetation dynamics, desertification phenomena. So, SMOS addresses critical issues for most regions, among which the Mediterranean basin.

GEODESY AND 'SOLID EARTH'

Five **DORIS**[6] instruments are currently flying (spot-4, spot-5, envisat, jason-1, jason-2). in its latest configuration, DORIS enables a 1-cm accuracy positioning and a few yearly mm for the motion of its 55 ground stations. enhanced DORIS instruments are planned to be used in future missions such as PLÉIADES and ALTIKA. the DORIS tracking network is being modernised too.

Developed by France and the USA, the **ARGOS** system has been operational since 1978. This system allows to determine the accurate position of any object equipped with Argos beacons and to collect any information transmitted by them. This unique system is exploited worldwide by CLS, a subsidiary of CNES and Ifremer[7]. The first third generation instrument was carried on board of METOP (see hereunder) launched in 2006.

Geomagnetism: France has been cooperating with Denmark **OERSTED**[8] mission (1999-2006) and will contribute to ESA's **SWARM** mission ('living planet' programme), scheduled for launch in 2010.

Gravity: France collaborates with the three main dedicated gravity missions of the decade, i.e.: currently with Germany for **CHAMP**[9] and with the US **GRACE**[10] mission, and with ESA's **GOCE**[11] mission successfully launched on March 17, 2009 (ESA's 'Earth Explorer' programme).

Study of electromagnetic and ionosphere disturbances: Scientific results of CNES DEMETER[12] micro-satellite have been acquired since 2005 and confirm the relevance of the high quality data obtained. These disturbances are believed to be correlated with Earth crust phenomena. Interesting phenomena were recorded 7 days before the Samoa earthquake, September 29, 2009.

Oceans

- The Franco-American **TOPEX-POSEIDON** ocean altimeter system stopped operating in 2005 after a successful 13-year mission. Its successor, the **JASON-1** mini-satellite has enabled to study ocean dynamics and to determine sea level with 1-cm accuracy. **JASON-2** satellite, launched in 2008, is a key component of the Ocean Surface Topography Mission (EUMETSAT). Jason-2 is the continuation of the existing successful cooperation between the United States and Europe. It is a global endeavour. Responsibilities for satellite development and launch are shared between CNES and NASA. EUMETSAT and

[5] Soil Moisture and Ocean Salinity.
[6] **DO**ppler and **R**adio Positioning **I**ntegration by **S**atellite.
[7] French Research Institute for Exploitation of the Sea
[8] Named after the Danish physicist.
[9] **CHA**llenging **M**ini-satellite **P**ayload for Geophysical Research and Application.
[10] **G**ravity **R**ecovery **A**nd **C**limate **E**xperiment.
[11] **G**ravity Field and Steady-State **O**cean **C**irculation **E**xplorer.
[12] **D**etection of **E**lectro-**M**agnetic **E**mission **T**ransmitted from **E**arthquake **R**egions.

NOAA are responsible for satellite operations. Data processing is carried out by CNES, EUMETSAT and NOAA, with EUMETSAT acting as an interface for near real-time product distribution to European users. This perfectly illustrates a progressive transfer of operational systems from research agencies to operational agencies. The follow-on TOPEX-POSEIDON, JASON-1 and JASON-2 series of satellites allow both long term follow-on of oceanic altimetry and its near-real time forecast.

- A new ocean observation programme, the operational ocean altimetry **ALTIKA**[13] mission (tentative launch: end 2010) will be carried out in cooperation with ISRO (Indian Space Research Organisation). It will allow enhanced observations of ocean surface levels, currents, wave height and wind speed at sea surface.
- Now running for 10 years, the French **MERCATOR** project for operational oceanography (real-time assimilation of global data in complex high resolution models) is part of the French involvement in the **MYOCEAN** European Integrated Project (a core component of GMES), which in turn contributes to the **GODAE**[14] global experiment.

Meteorology, climate

Following the successful launch of the EUMETSAT MSG-2[15] satellite (2005) developed with a strong French industry involvement, and the experimental PUMA[16] exploitation programme, aimed at fostering the use of MSG data for non-meteorological applications in Africa, which ended in September 2005, the AMESD[17] programme is considered as a GMES component to help African countries to better manage their natural resources by providing them with relevant environmental information.

The last two Meteosat Second Generation (MSG) series are readied to launch as from 2011, while the Meteosat Third generation (MTG) Preparatory Programme was started at the beginning of 2008 according to a decision of the 63rd EUMETSAT Council.

France took an important part in the development of the METOP[18] programme, which is the space segment of the EUMETSAT Polar System (EPS)[19]. Among the three polar orbiting satellites to be launched at five-year intervals, the first one was launched in 2006. So, the polar-orbiting satellites dedicated to operational meteorology are now equally shared between EUMETSAT and NOAA. The most innovative METOP payload is IASI[20], 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 O_3, CH_4, CO at global scale.

The Indian Space Research Organisation (ISRO) and CNES are developing together the **MEGHA-TROPIQUES**[21] satellite planned to be launched in 2010. Megha-Tropiques is expected to provide valuable data for climate research, especially regarding the ITCZ[22]. It carries on three instruments : MADRAS, a microwave imaging sensor to study rainfall and cloud properties, SAPHIR, a 6-channel microwave radiometer to determine water vapour vertical profile and horizontal distribution and SCARAB , a radiometer to measure top of atmosphere radiative flux.

Aerosols, clouds, radiative budget – The A-Train

CNES' **PARASOL**[23] micro-satellite carries a **POLDER**[24]-like wide-field radiometer. Derived products have currently been available to users since April 2005. They include unique information and results about the marine and terrestrial aerosols. They are distributed by CNES and by the

[13] **Alti**metry in **Ka**-band.
[14] **G**lobal **O**cean **D**ata **A**ssimilation **E**xperiment.
[15] **M**eteosat **S**econd **G**eneration.
[16] **P**reparation to the **U**se of **M**SG in **A**frica.
[17] **A**frican **M**onitoring of the **E**nvironment for **S**ustainable **D**evelopment.
[18] **MET**eorological **OP**erational Satellite.
[19] The **E**UMETSAT **P**olar **S**ystem consists of the METOP spacecrafts and associated ground segment.
[20] **I**nfrared **A**tmospheric **S**ounding **I**nterferometer.
[21] "**Megha**" means cloud in Sanskrit and "**Tropiques**" means tropics in French.
[22] **I**nter-**T**ropical **C**onvergence **Z**one.
[23] **P**olarisation and **A**nisotropy of **R**eflectances for **A**tmospheric **S**ciences coupled with **O**bservations from a **L**idar.
[24] **POL**arisation and **D**irectionality of the **E**arth's **R**eflectances).

ICARE 'Thematic Competence Network' (see below).

Managed by NASA in cooperation with France, the **CALIPSO**[25] mission was launched in 2006. CALIPSO brings answering important questions about the effects of clouds and aerosols (airborne particles) on the Earth climate change.

CALIPSO and PARASOL are two components of the series of seven satellites that make the so-called **A-Train** (Oco[26], Aqua, Cloudsat, Calipso, Parasol, Aura, Glory) - which CALIPSO joined in 2006. Developed by NASA, CNES and CSA[27], the A-Train is a series of satellites crossing the equator at about 13:30. A-Train is a unique observatory of the integrated Earth system and specially the atmosphere that they sound both horizontally and vertically from about the same location at the same time.

Selection of proposals for the next ESA Earth Explorer Core Missions

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

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

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

The related Phases A under completion.

Environment and security:
From its very beginning, France has been strongly supporting the **GMES**[28] initiative. ESA was involved in GMES through the **GSE**[29] scheme that is a suite of Earth Observation-based precursor services. France was engaged

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2.6 GERMANY 2009 REPORT

1. Creation of a New Technical Profession: The Geomatician

Berlin, on January 13, 2010 the joint expert group finished the draft regulation on the reformation of the professions in Geoinformation Technology. The expert group was selected one year ago by the Federal Institute for Professional Education (BIBB) and was composed of administration, industries and professional associations representing the employer's side and representatives of the service union for the worker's side. The new regulation will soon be released officially by the Federal Ministry of Economy and Technology in conjunction with the Federal Ministry of Interior and the Federal Ministry of Education and Research to be in force before the 1st of August 2010.

The need for the reformation arose from a steadily decreasing number of vocational training contracts in Germany for surveying technicians and for cartographers together with remarkable discrepancies of new technical developments not yet reflected in the existing training regulations like geo-data infrastructure, GPS, remote sensing, photogrammetry, web-mapping etc.

The new regulation will guarantee in one group two technical professions to be learnt through three year vocational training employment according to the German formula of "dual training", meaning 3,5 days per week in a company or administration and 1,5 days per week in a vocational school. The final diploma will certify a nationaly acknowledged professional level which will guarantee to future employers skilled young people with a sound theoretical basis combined with practical experience.

One of the new regulated professions will be the surveying technician who will work with data banks, GPS techniques, CAD and visualisation methods in the modern surveying environment. An additional spe-

[25] **C**loud-**A**erosol **L**idar and **I**nfrared **P**athfinder **S**atellite **O**bservations.
[26] The launch of **OCO** failed.
[27] Canadian **S**pace **A**gency.
[28] **G**lobal **M**onitoring for **E**nvironment and **S**ecurity.
[29] GMES Service Elements.

cialisation can be achieved in land management or in the sphere of the mining industry having specific 3D-requirements and a different legal framework.

The new profession, called the Geomatician, will for the first time involve remote sensing and photogrammetric techniques together with geomatics and digital cartography a certified professional profile. In Germany the photogrammetric operator has never reached the status of a certified profession. But now there is the unique possibility to include GPS, remote sensing, photogrammetry, digital mapping, GIS-design, web-mapping and further developments in one actual certified technical profession with the ability to meet the challenges of the future.

Knowledge and ability profiling the profession are:

1. Legal and administrative regulations and industrial standards
2. Fundamentals of geo information technology
3. Specific procedures of geo-data management (including remote sensing)
   - 3.1 Capturing and acquisition of geo data
   - 3.2 Treatment, qualification and visualisation of data
   - 3.3 Interpreting, combining, linking and evaluating of data
4. Information- and communication-systems of geomatics
   - 4.1 Exploitation of information- and communication-systems
   - 4.2 Employment of data bank systems
   - 4.3 Application of automatic procedures
   - 4.4 Set-up, conception and application of geoinformation systems and geo-data infrastructure
5. Holistic procedures of geo-data management
6. Processing of contracts and marketing
   - 6.1 Scheduling and realization of contracts
   - 6.2 Realization of marketing and public relation activities

The final examination after three years of vocational training consists of two practical proofs of work, written and oral examination, also including scientific and mathematical fundamentals of Geoinformation technology, environment, health and security issues of the work and quality management.

Training places and employment will be provided in the public service departments and industries of the Geoinformation branch, for instance in the administration services of cadastre and Geoinformation, with service providers of cartography and editing companies and in remote sensing laboratories.

2. Scientific Programme Started to Support German EnMAP-Project

In 2009 the German Aero-Space Centre DLR started a series of announcements of opportunities to support the future data evaluation from the EnMAP satellite designed by the Geo Research Centre at Potsdam (GFZ). In this year the call for proposals open to universities will start and in the next years calls for R&D proposals open also to industries.

3. Celebration of 100 years German Society for Remote Sensing, Photogrammetry and Geoinformation (DGPF) in March 2009 in Jena

A successful annual conference was held in Jena with nearly 400 participants. Publication of a paper by Professor Jörg Albertz on 100 years history of the society is printed in the official journal PFG issue 6/2009 in German language. Single copies could be requested from the office of the DGPF: Dr. Klaus-Ulrich Komp, EFTAS, Oststrasse 2-18, 48145 Muenster, Germany.

Klaus-Ulrich Komp

2.7 ITALY 2009 REPORT

This document briefly describes some Italian initiatives at national and international level in 2009 that can be of interest for the EARSeL community.
They include:

- Springer's publication of the Book 'Basics of Geomatics' by Mario A. Gomarasca
- full operational Centre of Applied Research ITHACA (Information Technology for Humanitarian Assistance, Cooperation and Action), and
- three remote sensing receiving stations set up in the past by Italian EARSeL members.

Basics of Geomatics
Author:Mario A. Gomarasca
2009, 656 p. 300 illus., 50 in colour.
ISBN: 978-1-4020-9013-4
http://www.springer.com/earth+sciences/book/978-1-4020-9013-4

This volume presents a comprehensive and complete treatment. In a systematic way the complex topics and techniques are covered that can be assembled under Geospatial Information namely, Geodesy, Cartography, Photogrammetry, Remote Sensing, Informatics, Acquisition Systems, Global Positioning Systems, Digital Image Processing, Geographic Information Systems, Decision Support Systems, and WebGIS. It describes in detail and at an accessible level - too much maths has been avoided - the state of current knowledge. Per chapter summaries, resuming in boxes and detailed bibliography has been included.
As such, it will serve as a working tool not only to geoscientists and geographers but also to engineers, architects, computer scientists, urban planners, specialists in GIS, remote sensing, forestry, agricultural science, soil science geometry, environmental scientists and managers.
The book is organized in 10 chapters:
Geomatics, 2. Elements of cartography, 3. Elements of photogrammetry, 4. Elements of remote sensing, 5. Elements of informatics, 6. Acquisition systems, 7. Satellite positioning systems, 8. Digital image processing, 9. Elements of geographical information systems, 10. Land use/land cover classification systems.
An Online version is also available.

ITHACA - *Information Technology for Humanitarian Assistance, Cooperation and Action*
Reference: Piero Boccardo, Polytechnique of Turin, Italy
piero.boccardo@polito.it

ITHACA (Information Technology for Humanitarian Assistance, Cooperation and Action) is a non-profit association, envisaged as a centre of applied research developing products and services in support of emergency management.
Through its partnership with the UN World Food Programme (WFP) - the world's largest operational humanitarian agency - ITHACA is dedicated to scientific research, delivering methodologies, analytical services and technical tools which improve the capacity of WFP and the wider International community in humanitarian early warning, early impact assessment and other related topics.
Concerning the early-warning activities, ITHACA developed and implemented an alert system based on near real-time rainfall data processing. The main goal of the tool, operational with a nearly global coverage, is to detect extreme meteorological events monitoring actual precipitation rates acquired by a satellite platform, by means of a comparison with rainfall thresholds derived by the analysis of historical flood events occurred on the field.
In the field of early-impact and damage assessment, the main objective of the ITHACA activities is to provide georeferenced information (mainly in the form of map products) derived by satellite imagery analysis (both optical and radar sensors), highlighting the affected areas, the affected population and, potentially, the damages to the main infrastructures.
Since the beginning of the activity (January 2007), ITHACA was activated in occasion of more than 50 events, most of them related with flood caused by intense precipitations, cyclones, hurricanes, etc. More than 200 rapid mapping products were delivered. The same approach can be used to correctly identify the reference water bodies coverage or to produce scenarios based on historical events.
The main outputs of the ongoing project are delivered trough ad-hoc web-GIS applications tailored to the end users needs.

Receiving stations

Remote Sensing Laboratory for Environmental Hazard Monitoring
Università degli Studi di Salerno
http://reslehm.unisa.it/

The Remote Sensing Laboratory of Salerno university has a receiving station set up for direct downstream of Earth Observation satellite data in L, S and X band. In particular, the receiving station is composed of 2 antennae (one X band tracking antenna and one L-S band tracking one), that allows the acquisition of data from satellites such as:
NOAA (AVHRR, (A)TOVS), OrbView-2 (SeaWiFS), FY-1C&D (MVISR) - in L band;
Coriolis-WindSAT - in S band;
EOS-Terra, EOS-Aqua (MODIS), ed IRS-P4 (OCM) - in X band.
The system is completed by two receiving devices: an XR-100 for the X band and an SR-100 for L-S band

TELEGIS Laboratory
Department of Earth Science
Università degli Studi di Cagliari
http://telegis.unica.it/progetto/antenna/

The ANTENNA Project, coordinated by TeleGis Laboratory at Cagliari University, has permitted the installation of a receiving station set up for MODIS data and product acquisition, as well as for NOAA series satellite data in HRPT format.
The antenna system is located at the Laboratory for Physics of the Atmosphere, Department of Physics, University City of Monserrato (Cagliari, Sardinia).

EURAC research
Remote Sensing Unit
http://www.eurac.edu/Org/AlpineEnvironment/RemoteSensing/addinfo_recstat_intro

The Institute for Applied Remote Sensing of EURAC has inaugurated in November 13th, 2009 its own receiving station that allows for direct access to Earth observation data.
The acquisition system allows for the reception and the demodulation of data from Earth Observation satellites in low orbit (LEO - Low Elevation Orbit) that are currently in operation or are foreseen in the medium-term. This is achieved through a parabolic antenna mounted on an antenna mast, which is located on the Corno del Renon (2230 m) and run by the Civil Protection in Bozen, Italy.
The system is able to support the acquisition of data received from optical as well as radar sensors of different EO satellite missions. It is flexible, modular, scalable and upgradeable, so that it can be easily updated for the reception of data from other current or future satellite missions, without modification of the system's structure.
The data is transferred to the European Academy of Bozen for processing through a radio-relay.
For its position the receiving station is strategic for pan-European acquisition.

Mario A. Gomarasca,
gomarasca.m@irea.cnr.it

2.8 NETHERLANDS 2009 REPORT

Activities of earth observation in the Netherlands in the Year 2009

Introduction
This report is split into a general part I which contains information on activities in remote sensing at the National level in the Netherlands and a member specific part II that contains information from the individual members. The latter information was gathered by the Netherlands Delegate to EARSeL (Freek van der Meer) who approached all of the members and asked them for a status report on activities in their organization on remote sensing relevant to the EARSeL community. The replies received are listed in the Part II of

this report. They have been inserted as provided by the contact person of the institute involved. No editing has been done on the various contributions. Content is at the discretion of the member organization.
Earth observation in NL; Part I "general"
report by Dr. Rolf de Groot (Netherlands Space Office) and Prof Freek van der Meer (ITC)

The Netherlands role in Earth Observation has been carved out over the last 20 years with the support and guidance of organisations such as the Netherlands Remote Sensing Board (BCRS), the Netherlands Agency for Aerospace Programmes (NIVR), the Netherlands Institute for Space Research SRON and the Netherlands Organisation for Scientific Research NWO. These organisations have stimulated Earth Observation through different User Support Programmes, both for fundamental as well as application oriented research.

Since July 1st 2009, all these functions have been combined into one new organisation, The Netherlands Space Office (NSO). NSO is acting as the Space Agency for the Netherlands. NSO is supervised by a steering committee of involved ministries (Economic Affairs, Science and Education, and Transport, Public Works and Water Management) and NWO. The mission of NSO is to promote and stimulate the space activities in the Netherlands in a national and international context.

For Earth Observation, NSO currently has a budget line for fundamental research. This programme (User Support Space Research) is a collaboration with the Earth- and Life Sciences Council of NWO. Supported research themes include Atmospheric research (chemistry, dynamics, radiation balance, climate and air quality), Water (oceanography, processes in open oceans, coastal and inland waters, cryosphere research) and solid earth (gravitational field, geodynamics, magnetic field) (http://www.spaceoffice.nl). In addition, NSO is developing a new programme for funding of operational and application oriented use of earth observation, which will be operational in 2011.

Another budget line, the field of planetary geosciences, has also been revived in the Netherlands. Recently a platform for planetary research in the Netherlands was established: the 'National Platform voor Planeetonderzoek (NPP)'. This platform brings together scientists and industry and serves as a support to ESA's planetary geosciences missions. Dr. Wim van Westrenen of the Free University Amsterdam is chairing this platform. See http://www.planeetonderzoek.nl/ (only in Dutch). Funding for planetary research is available through the NSO programme User Support Space Research.

In the Netherlands there is one professional organization covering the field of geoinformation science namely 'Geoinformation Netherlands – GIN (www.geo-info.nl)'. GIN has 3500 members and covers a wide range of professional fields in the arena of geoinformation science at academic but also at a polytechnic and practitioners level. GIN organizes each year a two day symposium (in Dutch) and publishes an email newsletter and a bulletin (Geo-Info) and (of course) a website: www.geo-info.nl. The Netherlands (formally the GIN section earth observation) hosted the ISPRS technical commission VII on thematic processing, modelling and analysis of remote sensed data under presidency of Professor John van Genderen of ITC which had its final symposium in Beijing in 2008. The coming four years, the Netherlands hosts commission 6: Education and Outreach chaired by ITC's Rector Prof. Martien Molenaar (http://www.isprs.org/technical_commissions/tc_6.aspx).

Earth observation in NL; Part II "corporate"
The Netherlands has the following member laboratories:
Rijkswaterstaat Data en ICT Dienst (DiD)
Department of Geo-information and ICT
Netherlands Institute for Sea Research
Royal Netherlands Meteorological Institute (KNMI) Meteorology and Climatology
National Aerospace Laboratory
TNO-Physics & Electronics
Centre for Geo-Information Wageningen UR
International Institute for Geo-Information Science and Earth Observation (ITC)
Department of Physical Geography Utrecht University, Faculty of Geosciences
TerraImaging B.V.

For full contact details, please consult appendix 1 to this document.

Below are contributions received from these members listing remote sensing activities in their organisations by 15 January 2010.

Royal Netherlands Meteorological Institute (KNMI)
Representative: Hans Roozekrans

The year 2009 has been a quiet year in terms of Earth observation developments at KNMI. There have been no launches of satellites that are of major importance for KNMI. Two exceptions are:

- The launch of the SMOS satellite, an Earth Explorer mission of ESA with the purpose to measure salinity of oceans and soil moisture content. SMOS data are of interest for the climate research activities of KNMI.
- The launch of the Indian satellite Oceansat-2 with on board a scatterometer to be used for wind measurements at sea surfaces. Although this scatterometer needs to prove itself for operational usage, it might become a welcome addition to the worldwide set of scatterometers. Especially, since the US scatterometer Quickscat has collapsed in the course of 2009.

The year 2009 was characterised by the focus on the continuation of operational EO tasks of KNMI: the production of EO products for the international user community, like Metop ASCAT wind products and OMI, Sciamachy and GOME-2 atmospheric chemistry products.
Also in 2009 KNMI has contributed to the decision process in relation to the future satellite programmes of EUMETSAT: Meteosat Third Generation (MTG) and Post-EPS. Both programmes are foreseen to bring new generation weather satellites in space by the end of the next decade.
The preparations for the development of the TROPOMI mission has been continued in 2009. TROPOMI is a gap-filler between the OMI instrument on board of the EOS-AURA satellite and the Sentinel 5 mission. KNMI will deliver the PI for TROPOMI that will take care of the global and regional monitoring of atmospheric tracegases. TROPOMI is planned to be launched in 2014.
Also in 2009 KNMI has started successfully the assimilation of Metop ASCAT and AMSU-A data in its weather model HIRLAM.

Centre for Geo-Information Wageningen UR & Alterra
Representative: Dr. Jan Clevers
Report written by Dr. Jan Clevers (WU) and Dr. Sander Mücher (Alterra)

The Centre for Geo-Information (CGI) is a joint undertaking of the laboratory of Geo-Information Science and Remote Sensing (http://www.geo-informatie.nl/) of Wageningen University and the department of Geo-Information (http://www.alterra.wur.nl/UK/research/Specialisation+Geo-information/) of Alterra. The Centre for Geo-Information comprises two full chairs: Geo-Information Science with special emphasis on GIS (Prof. dr. ir. A.K. (Arnold) Bregt) and Geo-Information Science with special emphasis on Remote Sensing (Prof. dr. M.E. (Michael) Schaepman until March 2009; Prof. dr. M. (Martin) Herold started in November 2009). In addition, two other chairs are affiliated with the Centre, namely an adjunct chair on theory of remote sensing and GIS (Prof. Dr. Martien Molenaar, rector ITC) and an intl. organization chair on radiative transfer (Prof. Dr. Wout Verhoef). The Centre focuses on education, fundamental research and applied research within the Geo-Information domain.
Concerning education the centre is in particular focused on the Master programme Geo-Information Science (http://www.mgi.wur.nl/UK). Besides the MSc Geo-Information Science, we also participate in the part-time MSc in Geographical Information Management and Applications (GIMA) (http://www.msc-gima.nl). PhD research is mainly affiliated with the C.T. de Wit Graduate School of Production Ecology & Resource Conservation (PE&RC).
Research processes within the Centre for Geo-Information are grouped and organized in thematic specialisation groups. Thematically they are subdivided into the following categories:

- Remote sensing
- IT technology
- IQ-Spatial data
- Spatial models
- Visualisation, design and usability

One of the specialist themes concerns Remote Sensing (RS) or Earth Observation (EO). This theme deals with the acquisition and analysis of spatial data through geo-information and RS techniques. The theme deals with image processing techniques (e.g., classification, segmentation, aggregation, change detection, data fusion, data mining, neural net-

works, wavelets), physical parameter estimations (atmospheric correction, BRDF, estimating vegetation parameters such as LAI, fAPAR, coverage, albedo, emissivity, plant and soil temperatures, soil moisture, and the synergy VIS/SWIR-TIR-MW) and data assimilation (coupled numerical modelling of complex water-soil-vegetation-atmosphere systems by assimilation of satellite observations).
Within the Centre, Alterra has recently formed a new team Earth Observation (coordinated by C.A. Mücher). A number of remote sensing activities have been identified which can be regarded as the core expertise of Alterra-CGI:

1. Use of RS for regional crop modelling and crop yield forecasting. Core objectives here are: 1) the use of RS derived observations for improved crop modelling and crop yield forecasting through data assimilation and recalibration techniques; 2) the direct use of remote sensing derived indicators in crop yield forecasting systems through statistical approaches. Additionally, RS techniques are used for stratification of spatial domains and (qualitative) validation of crop model parameter settings (e.g. sowing dates). A characteristic of the research done in this domain is that there has been an emphasis on near-realtime application and that analysis techniques and the research approach has been designed with NRT in mind.
2. Habitat & Landscape characterization in relation to ecological modelling: The core objective is to obtain a better spatial identification and characterization of habitats and landscapes using RS derived indicators. Integration of RS derived *in-situ* information with other spatial data sources and data plays a crucial role. For example, the improved spatial identification of European habitats (inside and outside protected areas) by habitat modelling with RS indicators provides a better basis for habitat monitoring and design of Pan-European Ecological Network (PEEN). A better characterization of European landscapes in terms of landscape structural elements derived from RS, next to habitat identification, leads to improved ecological modelling. For example, used as important variables for ecological dispersal and population modelling (e.g. with LARCH model).
3. Time-series analyses. Expertise on analyses of RS time-series focuses on techniques for cleaning, filtering and information extraction from time-series of RS data mainly provided by sensors as like SPOT-VGT, MODIS and NOAA-AVHRR. The expertise is applied in several projects such as Ecochange (trends in phenology), China-drought (land surface temperature and vegetation anomaly detection for drought monitoring), Land degradation in the Sahel, Geoland-Carbon (validation of global carbon models) and eSOTER (PhD Rogier de Jong). The techniques that have been developed are currently applied to analyses of sowing windows for global crop models, drought monitoring and prediction, and analysis of vegetation dynamic change in relation to climate change (e.g. EU-FP7 CEOP-AEGIS).
4. Land surface energy balance modelling: Deriving land surface energy balance components mainly using optical spectral domain has been a long standing area of research. Surface energy balance models, e.g. SEBI, SEBAL, SEBS, S-SEBI and a dual-source model, have been developed by the researchers. Expertise has been developed on the application of the approaches for surface energy balance (as further step evapotranspiration) mapping at different temporal and spatial scales through various projects over the past and currently on-going (EU-FP7 CEOP-AEGIS, AQUASTRESS, etc).
5. Quantitative remote sensing research: Highly specialized radiative transfer models to retrieve both atmospheric variables (atmospheric volumetric water content, aerosol optical depth etc.) and land surface variables (directional fractional cover, land surface temperature, and soil and vegetation component temperatures etc.) using multi-angular and multi-spectral radiometric observations have been developed and evaluated. An image simulation system for the thermal infrared domain has been developed and applied to several ESA projects. The system can be used to simulate the processes of radiative transfer and heat and water exchanges within the canopy and between the land surface and the overlying atmosphere, in turn the bottom of atmosphere (BOA) TIR images. By combining with atmospheric profiles, Top-Of-Atmosphere (TOA) TIR images can be generated.
6. Land use mapping and monitoring: Considerable expertise has been obtained on land use/cover mapping and monitoring in project as LGN, CORINE

Landcover, PELCOM and GLC2000. CGI creates and maintains the LGN national land use database (http://www.lgn.nl/, now version 6 is already available) and CORINE land cover database for the Netherlands (1990, 2000, 2006) which gives a strategic advantage for many projects. This knowledge is also used and combined in more advanced (and partially derived) products such as the European Landscape Classification (LANMAP, http://www.alterra.wur.nl/UK/research/Specialisation+Geo-Information/Projects/lanmap2).

During 2009 the following PhD graduations on remote sensing subjects within the Centre were finished:

- Dr. Harm Bartholomeus:The influence of vegetation cover on the spectroscopic estimation of soil properties.
- Dr Xiaomei Jin: Ecohydrology in water-limited environment using quantitative remote sensing - the Heihe River basin (China) case.
- Dr. Sander Mücher: Geo-spatial modelling and monitoring of European landscapes and habitats using remote sensing and field surveys.

Some specific on-going remote sensing activities concern:

- Hyperspectral Imaging Network (HYPER-I-NET), which is a four-year (2007-2011) FP6 Marie Curie Research Training Network designed to build an interdisciplinary European research community focusing on hyperspectral imaging activities (http://hyperinet.multimediacampus.it/).
- Mapping and monitoring land cover and land use in the Netherlands; recently the sixth version of the national land use of the Netherlands (LGN6, www.lgn.nl) has been produced.
- Assimilation of remote sensing data in regional crop growth models on crop yield forecasting has been applied to improve operational systems, such as the MARS-OP project coordinated by the European Joint Research Centre, Ispra, Italy.
- Assessment of the impact of global change on biodiversity of biomes and ecosystems by using advanced dynamic vegetation models parameterized with remote sensing data is performed within the FP6 ECOCHANGE project (http://www.ecochange-project.eu).
- Energy balance modelling and irrigation performance monitoring was performed for pilot projects in Ukraine, Morocco and China to map drought based on satellite imagery to improve operational water management.
- HABISTAT - A classification framework for habitat status reporting with remote sensing methods. This project will use the latest state-of-the-art super resolution (SR) image reconstruction algorithms to narrow the gap of spatial resolutions between airborne and spaceborne hyperspectral data. To improve classification accuracies and to strengthen an operational-oriented classification chain, we will investigate the operational potential of ensemble classifiers in terms of stability, accuracy, ease of use, and computing costs.
- More information, e.g. on ongoing PhD projects can be found at: http://www.grs.wur.nl/UK/Research.

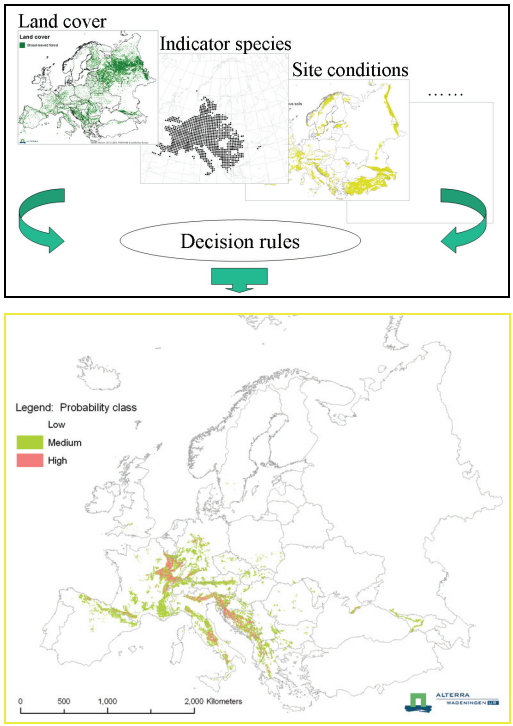

Figure 1: Methodological flowchart with decision rules based on expert knowledge that combines European data sets with a high spatial resolution to assess the spatial distribution of habitat 9150 “limestone beech forests” ranked into various probability classes on a 250 m grid basis. (Mücher, C.A., Hennekens, S.M., Bunce, R.G.H., Schaminée, J.H.J., Schaepman, M.E., 2009. Modelling the spatial distribution of Natura 2000 habitats across Europe. Landscape Urban Plan. 92 (2),148-159. doi:10.1016/j.landurbplan.2009.04.003).

International Institute for Geo-information Science and Earth Observation (ITC)
Representative: Freek van der Meer

At the International Institute for Geo-Information Science and Earth Observation (ITC), 240 staff fte including 18 professors devote their efforts to developing knowledge of geo-information management. By means of education, research and project services, we contribute to capacity building in developing countries and emerging economies. In doing so, considerable attention is paid to the development and application of geographical information systems (GIS) for solving problems. Such problems can range from determining the risks of landslides, mapping forest fires, planning urban infrastructure, implementing land administration systems, monitoring food and water security, to designing a good wildlife management system or detecting environmental pollution.

The key words characterising our activities are geoinformation management, worldwide and innovative. We concentrate on earth observation, the generation of spatial information, and the development of data integration methods. Furthermore, we provide tools that can support the processes of planning and decision making for sustainable development and the alleviation of poverty in developing countries and emerging economies.

Hence ITC's aim is to function as a gateway for international knowledge exchange: "ITC is an internationally recognized centre of excellence in international education. ITC aims at capacity building and institutional development of professional and academic organizations and individuals specifically in countries that are economically and/or technologically less developed." This gateway is developed through education based on knowledge exchange between scientific and professional organizations in less developed countries on the one hand and those in the Western world on the other, whereby ITC acts as a two-directional gateway for knowledge exchange. The knowledge field of ITC is geo-information science and earth observation, which consists of a combination of tools and methods for the collection - through aerospace survey techniques -, storage and processing of geo-spatial data, for the dissemination and use of these data and of services based on these data. ITC's approach is application-oriented, directed at finding solutions for and strengthening civil society in addressing issues of local, national and global dimensions such as the multifunctional use of scarce resources, including space, the effects of climate change and environmental security.

The year 2009 was characterised by the approaching integration of ITC with the University of Twente. On 25 March 2008, an agreement was signed, declaring that ITC would become a unique faculty of the University on 1 January 2010. With regard to the regular tasks of ITC, we can see that the high level of interest in our education developing over the past years has now stabilised, and has grown even further by approximately 4%. The MSc programme is now carried out entirely in the new format. In this respect, supervision of the students in the specialisation components and in preparation for their theses follows the themes of the research programme. We have also seen that the new configuration of the research programme has led to increasing publication productivity. Furthermore, the programme seems to hold great attraction for PhD students. At the end of 2008, 114 candidates were registered for the PhD programme: about half of these have fellowships and about half are participating on the basis of partnerships, mainly with organisations in ITC's target countries. The number of articles in peer-reviewed scientific journals, books, chapters in books and PhD theses amounted to 148 in 2008, some 20% more than in 2007 (124).

Some key facts and figures for ITC in 2009:
1968 students
1574 newly registered students
511 degrees/diplomas/certificates awarded
Courses
9 degree courses
7 diploma courses
16 short courses
4 refresher courses
15 joint education courses
9 distance education courses
49 tailor-made courses
114 registrants for the PhD Graduate programme

On 31 December 2010 ITC's Prof Martien Molenaar stepped down from his position

as Rector. Former Rector Professor Martien Molenaar was decorated with Royal Honours as Officer in the Order of Orange - Nassau (Officier in de Orde van Oranje-Nassau). The decoration was awarded by the Mayor of Enschede, Peter den Oudsten, during the 59th Dies Natalis of ITC on 17 December 2009.

The Supervisory Board of the International Institute for Geo-Information Science and Earth Observation (ITC) has, following the approval of the Executive Board of the University of Twente, appointed Prof. Dr. Ir. Tom (A.) Veldkamp (46) to be rector/dean of ITC. He will succeed Prof. Dr. Ir. Martien Molenaar, who is stepping down as rector on 1 January 2010.

Tom Veldkamp has a PhD in agricultural and environmental sciences from the Wageningen University and Research Centre (WUR). He is currently professor of land dynamics, head of the WUR Landscape Centre and interim scientific director of the Centre for Geo-Information and Remote Sensing (Environmental Science Group, WUR).

As of 1-1-2010 ITC is embedded in the University of Twente as the sixth faculty.

On 13 November 2009 the United Nations University (UNU), represented by its rector Professor Conrad Osterwalder, and ITC, represented by its rector Professor Martien Molenaar, extended the current agreement appointing ITC as an Associated Institution until 2014.

The agreement was extended due to the progress achieved between UNU and ITC in the successful implementation of the capacity building programmes in the fields of disaster geo-information management and land administration, as mentioned in the initial agreement. Both ITC and UNU want to further develop this relationship for the mutual benefit of both organisations.

With the extension of this agreement joint programme activities will be developed on disaster management and land administration which are designed to serve institutions with a task in disaster reduction and land administration with emphasis on sustainable development.

Department of Physical Geography, Utrecht University

Representative: Prof. Steven de Jong
Report written by: Steven M. de Jong, Victor Jetten, Hans van der Kwast & Elisabeth Addink

1. Introduction
The Faculty of Geosciences of Utrecht University in The Netherlands is a successful research and educational organisation (www.geo.uu.nl). The Faculty has four departments: Physical Geography, Earth Sciences, Human Geography & Planning and Innovation & Environmental Sciences. The remote sensing, GIS and geostatistical research and educational activities are mainly housed in the Department of Physical Geography. Below we present some examples of completed and ongoing PhD studies and of some staff projects.

2. PhD theses work at Utrecht University:
In 2009 one remote sensing related PhD thesis was successfully completed and defended. This PhD project was: 'Quantification of Top Soil Moisture Patterns: evaluation of field methods, process-based modelling, remote sensing and an integrated approach' by Hans van der Kwast. Hans left Utrecht University and is now working for VITO in Mol, Belgium. The project was a successful co-operation between UU, ITC Alterra and the University of Rabat in Morocco. A summary is given below.

A key variable both in agricultural land use and in degradation processes such as erosion and desertification is the spatial and temporal distribution of soil moisture. Knowing rainfall alone is not enough, the different soil types in the area have more or less water holding capacity and redistribution of rainfall takes place at the edge of the plateau through runoff. Since 1998 the consortium have cooperated in various research projects, all focussing on water scarcity, groundwater recharge, runoff and erosion, and large scale soil moisture predictions. The study area has a size of 55 km^2, and is located in the community of Sehoul about 20 km east of Rabat (Morocco). Apart from rainfed and irrigated agriculture there is also a large cork Oak forest.

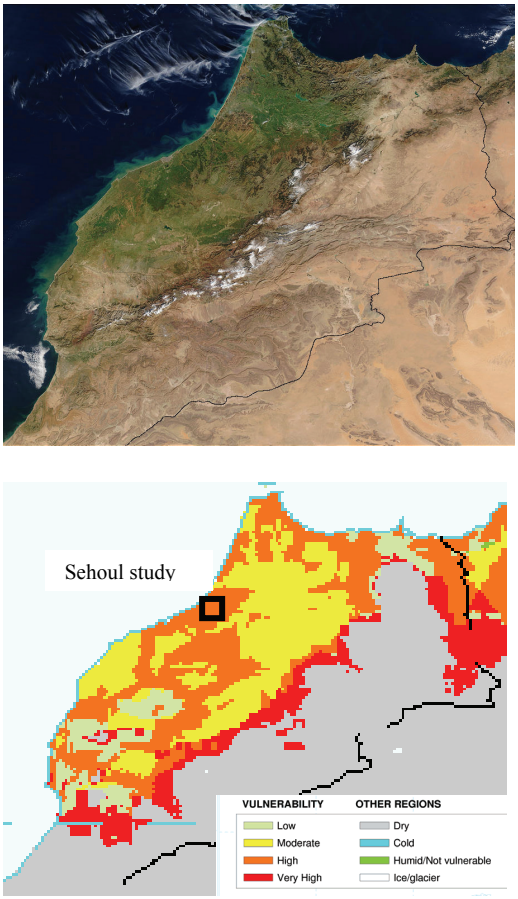

Figure 1. A MODIS image of Morocco (left) and the country of Morocco on the Global Desertification Vulnerability Map (USDA-NCRS, 1996). The Sehoul research area is situated in a high risk zone

In the past the edges of the plateau were protected from erosion by a mixed grass shrubland cover. However, historically the French colonisers took over the best soils on the plateau and forced the Moroccan farmers to occupy the edges of the plateau, causing overgrazing, intensification of the land use and consequently land degradation and erosion (see figure 2). Today large parts consist of sparsely covered unpalatable shrubs. Soil moisture modelling as part of operational environmental models are important tools for decision makers. These models need a combination of all available up-to-date data, from satellites and field measurements, for predictions of environmental variables at short time scales, i.e. hours to days after a rainfall event. These timescales are important for many natural hazard predictions as flooding and drought.

Figure 2. Examples of land degradation: degraded shrubland (left), gully erosion (right).

An important source of information for soil moisture is satellite images. Remote sensing provides information on vegetation cover and on the health status of vegetation by using information of red and infrared wavelengths, which is an indirect indication of soil moisture status. Moreover soil moisture can be determined more directly through solving the energy balance of the earth surface. This study therefore focuses on a coupling of energy balance modelling with soil moisture modelling to predict soil moisture patterns changes in time for a medium scale. A data assimilation approach is used whereby the soil moisture model that functions with an hourly time-step, is corrected by the energy balance model at the time of the overpass of the satellite. We investigate if this approach can improve soil moisture predictions.

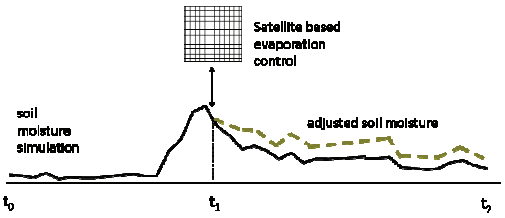

Figure 3. Methodology: a water balance model predicts soil moisture changes in time, the satellite image provides spatial information that can adjust and improve the model predictions at the day of overpass and afterwards.

Soil moisture prediction in the area is done in two steps. First the Surface Energy Balance System (SEBS) is used to estimate the evapotranspiration flux based on remote sensing data. Since there are only a few days with usable satellite images, the spatial patterns of evapotranspiration can be estimated but only for a few given sites. Moreover evaporation is one of the most important factors of the water balance but will not give directly the soil moisture. The second step is to employ a GIS based water balance model that can predict the soil moisture in time. The soil moisture prediction are checked against the satellite image and used to improve the spatial model predictions (see figure 3). Using remote sensing information to map the evaporation is based on the principle that a wet soil has a different spectral signature than a dry soil. Incoming solar radiation on a soil surface is used to heat up the soil, and evaporate any water present in the soil. On a dry soil the incoming radiation will be used to heat up the soil and evaporation is assumed zero. Since a dry soil has a high reflection and is very light in an image, while a wet soil is darker, differences in reflection can be translated to differences in evaporation. Using the potential evaporation rate, calculated from latitude and solar position, the image can be transformed into a map of a relative evaporation rates in the area. One of the advantages of the method is that it can be done with many different type of sensors, from the high resolution ASTER (10 m resolution) to the coarse resolution MODIS (250 to 1000 m resolution).

Second, a 3 layer spatial soil water balance model is constructed to predict the soil moisture for the top layer. Each layer is 15 cm in depth. On this scale it is assumed that all rainwater infiltrates and seeps slowly downward towards the groundwater. The model predicts the evaporation at the soil surface based on meteorological variables measured at one station in the area. The solar radiation, dryness and temperature of the air and wind speed determine the atmospheric demand for moisture. The actual evaporation depends on this demand and on the speed with which the soil can transmit water to the atmosphere. This is predicted on an hourly basis by the model. Summarizing the model predicts evaporation based on atmospheric information from only one meteorological station (one "point") but uses maps of soil properties and land use properties to make a spatial map of available soil moisture.

The soil moisture model was calibrated against measured TDR moisture values for a period of about 50 days (see figure 4). This was repeated for the rainy season of the year after. Results were good for the experimental locations. However, in order to succeed in calibration, the hydraulic conductivity of the soil types had to be increased to exceptionally high values. The reason for this is that several factors determine the water movement in the soil and the uncertainty of all these factors was combined in the conductivity, which is easiest to adapt.

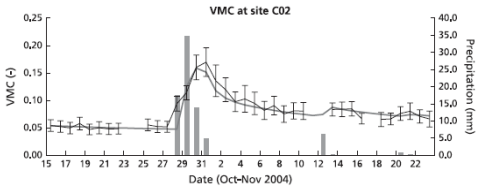

Figure 4. Measured (dots + uncertainty) versus modelled (lines) top soil volumetric moisture content (VMC) for field sites Cereal 02 at the start of the growing season, from 15 Oct to 23 Nov 2004. Vertical grey bars are daily rainfall.

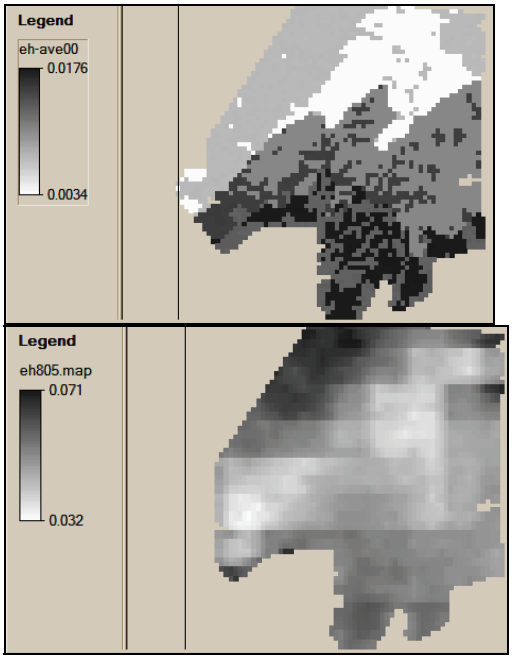

Figure 5. Example of the moisture map produced by the soil moisture model (upper) and by the energy balance method based on a MODIS image (lower)

Figure 5 shows the soil moisture content as simulated by the two approaches (soil model above, SEBS below) at a time of satellite overpass. Unfortunately no reliable high resolution cloud free images were available. Therefore the test was done with MODIS images which have a low resolution and consequently an unclear pattern. At this point only general observations can be made.

The first obvious result is that the units are different: the calibrated soil moisture model has a much drier top soil (about 5-10 times) than can be achieved with the satellite image. It should be mentioned that both methods have a large uncertainty which can be combined in various ways. The images in figure 5 do not have the have the same legend so that the pattern display is optimized. In both cases the north east part of the area is driest, and a similar variation in pattern can be seen in the south, indicating that some of the land use is captured, but there the similarity ends. The pattern on the left hand shows that model prediction seems very detailed, but the details do not change in time because the pattern is fixed by the soil and land use patterns imposed (from with the input variables are derived). Thus it may be that throughout the growing season this does not give accurate predictions and does not simulate real changes, in spite of the fact that the mode is calibrated for four locations. The image on the right hand side shows a real momentary soil moisture but unfortunately the resolution offers no practical results at this scale. Also the image derived evaporation seems more than is likely in reality: the lowest soil moisture from the image is higher than the highest soil moisture from the water balance model, and since the model is calibrated, the image cannot reproduce the measurements properly.
The objective of this research is to investigate the possibilities of using satellite data to improve soil moisture prediction by a spatial water balance model. The results are technically promising, both methods have there advantages and disadvantages. The water balance model produces better absolute values but has very rigid patterns, the satellite based method seems to produce better patterns but the absolute predictions are questionable. The results might be better in the sense that a better pattern comparison could be done, if high resolution images would be available regularly, but cloud free images are difficult to obtain, limiting the possibilities of this approach. The final conclusion at this point is that the spatial prediction of soil moisture for practical purposes remains difficult.

Further reading:
Van der Kwast, J., 2009, Quantification of Top Soil Moisture Patterns: evaluation of field methods, proces-based modelling, remote sensing and an integrated approach. Netherlands Geographical Studies 381, KNAG Utrecht. Full text available at www.uu.nl/igitur

Appendix 1: Full contact details of NL members in EARSeL

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Total members on 15-01-10: 9

Prof. Freek van der Meer

2.9 UNITED KINGDOM 2009 REPORT

General UK Developments

The UK investment in civil space activities is coordinated by the British National Space Centre (BNSC) partnership that includes 2 research councils (Natural Environmental Research Centre, NERC, and Science & Technology Facilities Council, STFC), the Technology Strategy Board (TSB), the Met Office and 6 government departments. At the ESA Council Meeting in November 2008, ESA and BNSC concluded an 'agreement in principle' for the Agency to establish a permanent presence at the Harwell Science and Innovation Campus in Oxfordshire. The centre was officially inaugurated by ESA's Director General Jean-Jacques Dordain on 22 July 2009; the first manager is Martin Ditter. The focus of the UK ESA centre is:

- Earth Observation/Climate Change: BNSC lead partner is NERC.
- Integrated Applications Promotion Programme: BNSC lead partner is TSB.
- Robotic Space Exploration: BNSC lead partner is STFC.
- Human Spaceflight: has no BNSC lead partner.

At the Harwell launch, Lord Drayson (Minister for Science and Innovation) also formally kicked off a consultation that seeks views on whether BNSC is the best fund-

ing structure to meet the challenges of the future and deliver the greatest benefit to the country. In 2009 the Government also announced the Space Innovation and Growth Team that will work alongside industry to define a clear plan (20 year vision) and strategy for the future growth of the UK space industry.

Remote Sensing and Photogrammetry Society

The Remote Sensing and Photogrammetry Society (RSPSoc) is a learned society promoting the education of remote sensing and photogrammetry. RSPSoc is an international society, although it is based in the UK and acts as the national affiliating body to the International Society for Photogrammetry and Remote Sensing. The *RSPSoc Newsletter* has been overhauled to provide a higher quality contemporary publication, which has received positive feedback.

RSPSoc holds technical events and in 2009 these included the Annual Student Meeting at Glaramara Centre (Lake District) in April, the Annual Lecture (by Professor John Townshend, University of Maryland, USA) and Conversazione at the University of Nottingham in June, the Annual Conference (New Dimensions in Earth Observation) at the University of Leicester in September, and the Geological Remote Sensing Group's Annual Meeting at the Geological Society (London) in December.

Forthcoming 2010 events include (for further details see http://www.rspsoc.org/events/):

- 15 – 17 March: Annual Student Meeting 2010, Mont Batten Activity Centre, Plymouth
- 5-6 May: RSPSoc 2-day Joint SIG meeting – Remote Sensing of Carbon – with Conversazione on 5th May, Burlington House, London, UK
- 22-24 June: ISPRS Technical Commission V Mid Term Symposium Close-Range Sensing: Analysis and Applications, Newcastle University
- 1-3 September: RSPSoc 2010 Annual Conference: From the Sea-bed to the Cloud-tops, University College Cork, Ireland
- 17 September: EH Thompson Centenary Event, Gustav Tuck Lecture Theatre, UCL, London

5. UK EARSeL representatives

Dr Paul Aplin (University of Nottingham) is the Chairman of RSPSoc and Dr Samantha Lavender (ARGANS Ltd and the University of Plymouth) is the Chairman of RSPSoc's External Affairs Committee and Vice-Chairman of RSPSoc. Dr Lavender is the regular UK representative at EARSeL Council meetings with Dr Aplin deputising for her.

Samantha Lavender
Vice-Chairman, RSPSoc

2.10 SWITZERLAND 2009 REPORT

Remote Sensing activities in Switzerland

1. HyperSwissNet

The Hyper-Swiss-Net project aims at developing and supporting the scientific expertise and infrastructure in Switzerland for the exploitation of imaging spectrometry technology for different Earth observation applications. The development of imaging spectrometers, the availability of Earth observations in high spectral resolution from air- and spaceborne platforms as well as the facility of their processing has remarkably evolved over the last decade. This trend leads to a level of maturity, which makes imaging spectrometry accessible and useful for a larger research and user community. Against this background Hyper-Swiss-Net will develop a range of prototype application products drawing from the diverse expertise present in the project consortium and the respective user community.

The development and implementation of the different products will be based on dedicated flight experiments with the airborne ESA imaging spectrometer APEX (Airborne Prism Experiment) and will directly build on and link into the operational capabilities of the APEX processing and archiving facility (PAF). The scientific expertise gathered during

the project will be further disseminated within the Swiss research community by integrating the developed capabilities into specific teaching modules.

The project work is carried out by a consortium of Swiss universities and scientific authorities who will develop the following products within the Hyper-Swiss-Ne - prototyping the use of imaging spectrometry to fulfil the requirements for environmental monitoring in different fields:

- Vegetation Dynamics: Remote Sensing Laboratories, University of Zürich
- Atmospheric trace gases: Laboratory for Air Pollution and Environmental Technology, EMPA
- Snow and Climate: Remote Sensing Group, University of Bern
- Geo-Biophysical Parameters: Space Centre EPFL, EPFL Lausanne
- Land Use Dynamic: Land Use Dynamics Unit, Swiss Federal Research Institute WSL
- Urban Climatology Institute for Meteorology, Climatology and Remote Sensing, University of Basel

Vegetation Dynamics (University Zürich)

Within the biodiversity indicator framework established by the UN Convention of Biological Diversity (CBD) the global trend in status and extent of ecosystems has been acknowledged as one of the headline indicators to assess the progress on the 2010 biodiversity target. APEX as an airborne instrument gives access to regional distribution of ecosystem pattern and trends bridging the gap between local field studies and global space-borne observations. The objective of this module is to develop a methodology based on Imaging Spectrometry technology for systematic, robust & repeatable observations of terrestrial ecosystems.

Research goals are:

- Development and implementation of physically-based algorithms based on Radiative Transfer Models
  - homogenous vegetation types: crops, meadows
  - heterogenous vegetation types: forests, shrubs
- Mapping of plant functional types / species
  - Land cover classification adapted to the high dimensionality of imaging spectrometer data
- Mapping the status and structure of selected ecosystems
  - Validation of developed algorithms (robustness over time and space)
  - Up-scaling to regional scale (space-borne platforms)

Products will be:

- Biophysical maps for ecosystem structure (LAI, fcover, 3D structure)
- Maps of ecosystem conditions and status (vitality, water stress)
- Spatial extent and distribution of plant functional types and species

Air pollution and trace gasses (EMPA)

EMPA will use the hyper-spectral measurements provided by APEX to study the distribution of key air pollutants and to obtain detailed information on individual emission sources. APEX offers a unique opportunity to measure air pollutants over extended areas at a spatial resolution exceeding the resolution of current satellite sensors by several orders of magnitude. A first objective is to develop the tools needed to retrieve NO2 vertical columns (between the surface and the aircraft cruise altitude) from the spectral radiance information provided by APEX. This will involve selecting appropriate spectral windows and adapting existing Differential Optical Absorption Spectroscopy (DOAS) code to the specifics of the

APEX data (spectral resolution, instrumental effects, pixel binning).

Research goals:

- to develop optimal strategies and the (software) tools required to obtain accurate trace gas retrievals from APEX
- to calculate maps of the NO_2 VLTC distribution for all flight stretches to build up a database of NO_2 air pollution maps for Switzerland
- methods will be developed and applied to estimate NO_2 emissions from individual sources such as large point sources (e.g. waste incinerators) and motorways

Snow properties & climate (University Bern)
In alpine regions such as the European Alps, snow is a predominant environmental factor. High accurate snow monitoring in the Alpine Region is of great importance as temporal and spatial variations in snow coverage have far-reaching consequences on the natural and the socio-economic systems. Within the Hyper Swiss Net project possible approaches to a more accurate snow monitoring in mountainous regions such as the European Alps will be elaborated. The important role of snow albedo in climatic issues can be addressed for example based on spectral information on snow impurities and grain size.

Research goals are:

- implementation of available snow algorithms (snow cover, grain size and impurities) for hyperspectral data based on scientific state of the art in this field
- investigation of Influence of grain size and impurities (deposited aerosol) on snow albedo
- effects of spatial and spectral resolution with regard to high-quality snow cover mapping

Geo-Biophysical Parameters (EPFL Lausanne)
EPFL will focus on the development of models to retrieve bio- and geophysical parameters for land applications based on hyperspectral data acquired by APEX and SAR data. The specific parameters to be retrieved are being defined in the moment.

Land use dynamic (Swiss Federal Research Institute WSL)
Preliminary results have shown that canopy biochemical properties can be retrieved with high accuracy at a regional level and that spatially distributed input of canopy biochemistry (specifically C/N ratios) are required in order to simulate biogeochemical processes accurately. Methods to a) improve the inter-/ and extrapolation to larger spatial scales and to b) up-scale air-borne regional models to retrieve vegetation canopy biochemistry are still to be developed.
Research goals are:

- calibration of canopy biochemistry for different habitat types using (APEX)
- scaling canopy biochemistry from high resolution hyperspectral data (APEX) to space-borne multi- and hyperspectral sensors
- run larger scale modelling experiments in order to explore the effect using spatially distributed input of canopy chemistry data into biogeochemistry models (e.g. BIOME-BGC)
- explore methods to map individual tree species in forest communities using APEX data
- explore methods of generating vegetation maps using APEX data

Urban Climatology (University Basel)
The architecture of urban areas reflects an extremely specific man-made structure introducing complex phenomena and influencing ecological, climatic and energetic conditions of the urban climate. Energy and radiation fluxes are the main drivers of urban climate, which significantly deviates from the climate of the rural surroundings. The Urban Climatology Module in the frame of the Hyper-Swiss-Net project will further develop and refine existing urban specific methods in imaging spectrometry towards the assessment of

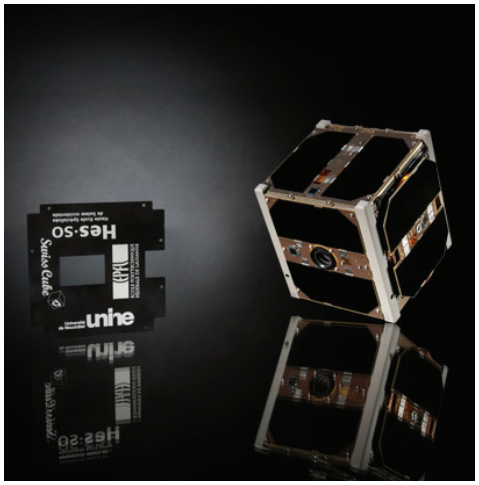
specific fluxes in the radiation and energy balance of urban surfaces.

Research Goals are:
Development of improved algorithms for:

- the analysis of spectral surface albedo and distribution of shortwave radiation fluxes of urban surfaces from APEX imagery including 3D-effects related to the topography of urban buildings and street canyons (shadow effects, (multiple) scattering properties, view angle effects)
- the identification of urban surface materials as a base for modelling the storage heat flux
- the impact of urban parks and greens and green roofs on the urban climate using APEX imagery for detection and analysis of vegetation conditions (e.g. water stress) as a base for modelling the latent heat flux
- the analysis of all wave radiation and complete heat fluxes of urban surfaces using APEX imagery (short wave radiation, storage heat flux, latent heat flux), thermal infrared imagery from helicopter flights (longwave radiation, sensible heat flux), a high resolution urban 3D surface model, *in situ* measurements and numerical modelling of radiation and heat fluxes
- the analysis of urban air pollution along a transect covering dense industrial areas, residential areas, the inner city district and urban greens

More information is available at https://hyperswissnet.wiki.geo.uzh.ch/Index
A first report is published in the proceedings of EARSeL SIG meeting on Imaging Spectroscopy in Tel Aviv during spring 2009.

2. Swiss Cube



SwissCube is the first satellite entirely built in Switzerland which has successfully been launched on the PSLV (C14 mission) from Satish Dhawan Centre near Chennai on September 23, 2009. It is very small in size since it occupies a volume of 1 litre (10x10x10 cm) and weights less than 1 Kg. SwissCube follows the Cubesat standard which was developed by Standford and CalPoly (USA) and allows universities and research centres to build their own satellites. Due to its size and available power (less than a few Watt are generated by the solar panels), SwissCube can of course not compete with the capabilities of much larger satellites. However, it carries most of the subsystems (e.g. structure, on-board computer, communication, attitude control, antennas) that exist on large satellites and allowed students to build a complex engineering system.

This picosatellite has been developed at the Ecole Polytechnique Fédérale de Lausanne (EPFL) in Switzerland in collaboration with several other Swiss engineering schools, universities and private industry. About 200 students participated in the adventure from EPFL, from the university of Neuchatel, from the HES-SO (Sion, Yverdon, Fribourg, St-Immer, Le Locle), and from the University of Applied Studies ar Brugg-Windisch.

The motivation for the overall SwissCube project development is primarily to educate students in space technologies and space system engineering.

The major SwissCube-Mission objectives are:

1. The project involves undergraduate and postgraduate students and young engineers through its whole life cycle.
2. The project cost is relatively low, in accordance with a university type of development.
3. Compared to an industry type space project, decisions are taken to simplify the design or design for low-cost and thus might not comply with the usual standards.

The project was managed in a similar manner to some of the programmes in space agencies such as ESA and NASA with detailed reviews after each major phase of the project. The goal is to prepare at best the students for their future professional careers. The SwissCube has been designed mostly in the framework of undergraduate semester and master projects. Students have learned systems engineering and concurrent design, and have been responsible for delivering on time and on budget complex sub-systems whose correct operation is essential to the success of the mission. During its development, several new technologies could be investigated, tested and for the ones ready, integrated in the flight satellite.

After discussions with several partners of the project, it was decided that the SwissCube mission should focus on the observation of the airglow phenomena. The motivation for these observations is to demonstrate the feasibility of using the airglow as basis for development of a low cost Earth Sensor (ES). A model of the airglow emissions as a function of intensity, latitude, longitude and time has been established and the objective the science mission is to collect data that will validate, or at least bring additional information to the model. The development of the Earth Sensor is a separate activity to SwissCube led by the EPFL-LMTS laboratory.

In addition, at the project level and as a technology demonstration, it was decided to develop a payload that has the most commonality/synergy as possible with the Earth Sensor. This decision impacts the design of the payload and the requirements to this effect can be found in the Project (level 2) requirements.

The nightglow is a photoluminescence of the atmosphere at night, occurring at approximately 100 km altitude. It is principally due to the recombination of the atomic oxygen, which is dissociated during the day. To study variations of the emissions as a function of time, the minimum science duration is 3 months, with an extended science mission of duration up to 1 year.

More information is available at http://swisscube.epfl.ch/

2.11 SWEDEN 2009 REPORT

Division of Geoinformatics
Department of Urban Planning & Environment
Royal Institute of Technology – KTH, Stockholm

The research activities at the Division of Geoinformatics at Royal Institute of Technology - KTH include the following topics:

- SAR Image Analysis & Multisensor Data Fusion
- Change Detection
- Object-Based & Knowledge-Based Feature Extraction
- Urban Landuse and Land-cover Mapping
- Disaster Management
- Environmental Impact Assessment
- GeoVisualization and Spatial Modelling

On-going Research Projects include:

- Satellite Monitoring of Urbanization in China for Sustainable Development, a project within Dragon 2 Program, a cooperation between ESA and the Ministry of Science and Technology (MOST) of China.
- Spaceborne SAR for Analysis of Urban Environment and Detection of Human Settlements, funded by the Swedish National Space Board

- Spatial-Temporal Patterns of Urban Growth & Sprawl: Monitoring, Analysis and Modelling, funded by The Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning
- ViSuCity: A Visual Sustainable City Planning Tool, A Visualization Heavy Project funded by the Knowledge Foundation, VINNOVA, Swedish Foundation for Strategic Research, etc.
- Development of real-time tsunami damage detection technology for expeditious disaster response of Japan and ASEAN countries, funded by NEDO, Japan.

Remote Sensing Laboratory
Department of Forest Resource Management and Geomatics
Swedish University of Agricultural Sciences, Umeå

It is quite much "business as usual" at the forest remote sensing section at SLU in Umeå. We are back at a size of about 20 persons, after the operators that are doing operational photo interpretation for the environmental protection agency have been transferred to a new unit (Called Landskapsanalys). We that are left are doing research related to forest resource assessment and vegetation mapping, and some operational nation-wide products like the "kNN-Sweden" forest map. Håkan Olsson is now back as formal head of the remote sensing section, after Mats Nilsson had that position for a number of years. The main new thing to report is that the EMMA program (Environmental Mapping and Monitoring with Airborne laser and digital images) financed by the Environmental protection Agency, started and is expected to continue during 4 years.

Metria

Metria is a service provider, whose focus is on the operational use of remote sensing and GIS techniques for environmental and forestry applications, as well as security-related aspects. Metria is based in Sweden. During 2009 we conducted several remote sensing/GIS projects under contracts with Swedish users, such as the Swedish Environmental Protection Agency, the Armed Forces, the Swedish Forest Agency, Swedish Board of Agriculture, the Swedish Nuclear Power Inspectorate and Swedish National Space Board.

Several development projects were concluded during 2009. Among them updating of forest delineations, forest stand development and monitoring of marine nature reserves can be mentioned.

Metria is presently involved in several projects, from local to international levels, relevant to GMES. The activities include the use of remote sensing and GIS for mapping as well as change detection (time series). During 2009 Metria was part of a successful consortium for GMES Fast track service soil sealing upgrade. Metria is already a partner in ESA GSE Forest Monitoring, GSE RESPOND, GSE Risk-Eos and GSE Land. The latter two were finalised during 2009.

Metria is a partner within the EU 7 FP GMES projects geoland 2 and SAFER.

Remote Sensing Laboratory
Department of Physical Geography and Quaternary Geology
Stockholm University

The research group conducts fundamental and applied research within the field of remote sensing and GIS. Our principal areas of interest are: glaciological remote sensing including palaeoglaciology; the detection of ecological and environmental change; marine bio-optics and remote sensing; data bases and data processing; and geoinformatics. We are currently engaged in the calibration and evaluation of data from MERIS and ASAR within “the 1st ENVISAT AO”. Research is financed by Swedish Research Councils (SNSB - Swedish National Space Board, FORMAS, VR - the Swedish Research Council), ESA and NASA.

RADAR Remote Sensing Group
Department of Radio and Space Science
Chalmers University of Technology, Göteborg

Radar remote sensing refers to the use of radio signals from aircraft and satellites for measuring properties of the Earth’s surface. The main advantage of using radar over conventional photography (e.g. Google Earth), is that radar can be used

both day and night, and even when there is dense cloud cover or fog. This makes radar remote sensing particularly attractive in polar regions where days are short and over rain forests with persistent cloud cover.

Our research is based on an understanding of radar system properties, allowing us to analyse and design new systems to improve measurement accuracy. The main applications studied in the group are for forestry and mapping of sea ice. For forests the goal is to map biomass and changes caused by deforestation, fires, replanting, etc. Global mapping is required to understand the role of forest in the global carbon cycle, and hence their effect on global climate change. Sea ice mapping is also of interest for climate studies since changes in ice cover are a good indicator of climate change, as well as affecting the transfer of energy between the oceans and atmosphere.

Department of Physical Geography and Ecosystems Analysis
Lund University, Lund

The Department of Physical Geography and Ecosystems Analysis has been active in research and education within remote sensing science since the early 1980s. The emphasis is on environmental land applications of remote sensing, particularly related to land cover and vegetation. Among the first studies, research related to desertification was particularly important. The information received from earth satellites provided a new tool for analyzing the processes linked to the desertification phenomenon. Already from the beginning, computer processing dominated the analysis, and the integration of remotely sensed data with other digital geographical information in what is today known as geographical information systems (GIS) was natural. In today's environmentally related research it is as natural to integrate remote sensing data with data from other sources. We emphasize analyses of ecosystem processes to achieve greater knowledge about how the systems operate and interact. Within remote sensing we have focused on the extraction of information from optical sensor data, to be used for understanding vegetation processes from a spatial and temporal perspective. Basic knowledge of the satellite signal and information needs within different environmental application fields is therefore necessary.

Current research projects include:

- Carbon balance: Remote sensing for assessing the carbon balance in Swedish ecosystems
- TIMESAT: Software for analysing time-series of satellite sensor data
- Sahel: Analysing environmental changes in the semi-arid Sahel zone of Africa
- Studying the photosynthetic process to estimate the light use efficiency
- DeSurvey; A Surveillance System for Assessing and Monitoring Desertification

2.12 ACTIVITIES OF THE EARSeL SPECIAL INTEREST GROUP 3D REMOTE SENSING

The main scientific activities of the group were mainly devoted to the following hot topics which are likely to become more and more important in the next future:

- to refine/establish new algorithms to generate DSM and DEM from very high resolution optical sensors, with a particular care to complex morphology areas (urban, mountain), also considering the geometric and radiometric potentialities of the new very high resolution sensors which became operational in 2009 (GeoEye-1 and WorldWiew-2)
- to validate new global DSM as the new ASTER DEM (http://asterweb.jpl.nasa.gov/gdem.asp), which was generated at JPL over a much wider area of the Earth surface with respect to previous ASTER and SRTM DEMs and could become a standard in the future
- to start to investigate the potentialities of the new high resolution radar sensors COSMO-Skymed and TerraSAR-X with respect to DSM generation, both adopting the standard interferometric technique and

exploiting the (older) radargrammetric technique, which now could live a second youth and give a remarkable contribution thanks to the independence from coherence and to high resolution amplitude imagery (at 1 metre level) which may be collected in SpotLight mode

Since this last topic about 3D radar remote sensing is obviously of great interest also for the EARSeL SIG Radar Remote Sensing, the two EARSeL SIGs will strictly cooperate both with respect to research activities and for the organization of sessions in Conference and Workshop, starting from the 30th EARSeL Conference in Paris, France (May 31 – June 3, 2010) (http://www.earsel.org/symposia/2010-symposium-Paris/index.php) and the EARSeL Joint Workshop in Ghent, Belgium (September 22-24, 2010) (http://www.geoweb.ugent.be/data-acquisition-3d/earsel-workshop).

As regards the conference activities, the most important event in 2009 was the 29th EARSeL Conference in Chania, Greece, where two specific sessions were organized and 13 researches were presented (7 oral, 6 poster). The main topics concerned the ASTER DEM (significantly, the new version was presented), the quality assessment of DSMs generated from high resolution satellite stereopairs, the status and prospects of new small (low cost) sensors and some applications.

It is the intention of the SIG to restyle the SIG web page (http://www.earsel.org/?target=SIGs/3DRS) and to open a call for interest for the above mentioned hot topics, in order to both facilitate the coordination and ideas exchange among Colleagues working on similar themes, and to better organize the future sessions in EARSeL events and participation to other international organizations (ISPRS, ASPRS, IGARSS,...) congresses and conferences.

Mattia Crespi and Karsten Jacobsen

3. NEWS ITEMS
Announcements

1. THE CENTRE FOR FIRE RESEARCH (CIFU) SEEKS CANDIDATES FOR POSITIONS OF RESEARCHER

Centro de Investigación del Fuego

The Centre for Fire Research (CIFU) is a research institute established in 2008, devoted to the study of the various disciplines, scientific and technical, related to forest fires. The CIFU is an organization of the Foundation General for Environment of Castilla-La Mancha, which, ultimately is dependant from the Government of the Autonomous Region of Castilla-La Mancha. The CIFU aims a establishing itself as a centre of excellence, of national and international reference, in the field of forest fires, with a focus on the effects of climate and global change on fires and ecosystems. The centre will have its own facilities, of ca. 3000 m^2, with laboratories and all needed infrastructure to carry out scientific and technical research, basic and applied, at the highest possible level. The facilities will be located in Toledo, adjacent to the Technological Campus of the Old Weapons Factory of the University of Castilla-La Mancha. The building will be completed by the end of 2010. Meanwhile, its activities will be carried out at the University of Castilla-La Mancha. Toledo offers outstanding living conditions, with all the necessary infrastructure of the capital of the Autonomous Region of Castilla-La Mancha. The city is connected to Madrid by free-ways and high speed train.

The positions being offered are: a technician (1) and a senior researcher (1) in Remote Sensing and GIS technologies.

Requirements

The candidates for the technician position must be expert in Remote Sensing and GIS technologies. They must have experience in working with large environmental databases and in dealing with digital processing of low-moderate spatial resolution (i.e., NOAA AVHRR and MODIS) and medium-high resolution (i.e., Landsat and/or QuickBird) images. Knowledge in using ArcGis, ERDAS and/or ENVI is required.

The candidates for the senior researcher position must demonstrate an excellent qualification in any of the fields listed above, with scientific publications that support it. Preference will be given to candidates with at least two years of post-doctoral research experience at a centre of prestige, and that are able to carry out their own projects. In any case, applications by recent PhD fellows back-up by a sufficient CV will also be considered. The selection will be made aided by external evaluation from the Spanish National Agency for Evaluation and Prospective, the University Quality Agency of Castilla-La Mancha or other similar evaluation bodies.

Contract conditions

The selected candidate will be hired for a period of three years, at the end of which she/he will be able to ask to be evaluated. If the evaluation is positive a tenured contract will be granted. The salaries offer will be in correspondence with the experience of the candidate. For this purpose, the contractual figures of the Spanish public university system (Ayudante Doctor, Contratado Doctor, Profesor Titular), or similar, will be used as reference. Accreditation by any agency, national or regional, for any of the university contractual categories will be considered a merit, and a contract will be offered in correspondence with the level of accreditation. The working language at the CIFU will be Spanish or English, although, in the latter case, it is expected that candidates will be able to get around in Spanish during the first two years.

Interested candidates should submit an electronic copy of her/his CV in pdf format to [cifu@uclm.es], indicating the position o positions that is being applied to, adding three names of scientist that would inform about their scientific trajectory and achievements. Admission of applications will end on March 30th, 2010.

Toledo, February 20th, 2010

José M. Moreno
Director

2. STOCKHOLM UNIVERSITY announces a position as

Senior Lecturer in Physical Geography with emphasis on geographical information systems (GIS), remote sensing and cartography

within the Department of Physical Geography and Quaternary Geology (ref nr SU 612-2715-09). Deadline for application: March 31, 2010.

The **Department of Physical Geography and Quaternary Geology** (INK) is one of the major departments within the Faculty of Science at Stockholm University. The department has approximately 120 employees and educates approximately 1500 students annually. The main research disciplines are Geomorphology, Glaciology, Climatology, Quaternary Geology, Hydrology, Remote Sensing, Geographical Data Processing, Ecological Geography and Tropical Geography. Education is oriented towards geography, earth sciences, geosciences and environmental protection.

Subject description: Physical Geography with emphasis on geographical information systems (GIS), remote sensing and cartography.
Main tasks: Teaching and pedagogic development of undergraduate and master's courses within the fields of GIS, remote sensing and cartography. Research and supervision of PhD-students and degree projects. Administrative tasks, as well as some review and development assignments are included in the position.
Required qualifications: To qualify for employment as a senior lecturer the applicant should have obtained a doctoral degree or demonstrated the equivalent academic competence, completed teacher training in higher education of at least 7,5 credits or acquired similar knowledge* in another way, and demonstrated pedagogical skill.
The applicant must have the ability to collaborate and the competence and qualities needed to carry out the work tasks successfully.
*Applicants who have not yet completed teacher training in higher education can be offered a temporary position (1+1 year) in order to obtain such competence.

Basis for the assessment: Equal weight is to be given to the applicant's pedagogic and scientific skills.

Special weight will also be placed on:

- Documented experience in the usage of both GIS and remote sensing in research and education in Physical Geography, with a focus that matches the Department's existing research profile.
- Documented skills in the development and teaching of courses in an internet-based environment.
- Experience from administrative tasks.

The faculty welcomes female applicants because the majority of the senior lecturers at the faculty are men.
Applicants may request appointment at the rank of professor; if so this must be stated clearly in the application. In order to qualify for promotion to professor applicants must have demonstrated well-documented academic expertise on a high international level, and well-documented pedagogical expertise.
Guidelines for the application are given in the *Template for application for employment and for promotion to the rank of professor or senior lecturer at Stockholm University*, at www.su.se/nyanstallning
Further information about the position can be obtained from
Head of Department Arjen Stroeven prefekt@natgeo.su.se , telephone +46 (0)8 16 42 30
Director of undergraduate studies Clas Hättestrand clas.hattestrand@natgeo.su.se , telephone +46 (0)8 16 49 52

Administrative coordinator Carina Nymark carina.nymark@science.su.se , telephone +46 (0)8 16 17 67 will provide further information about the application and appointment procedure if required.

Union representatives: Bo Ekengren, (SACO), Lisbeth Häggberg (ST/ATF), telephone +46 (0)8 16 20 00 (vx) and Gunnar Stenberg (SEKO) +46 (0)70 316 43 41.

Please send your application, quoting ref no SU 612-2715-09, to:

Stockholm University
Registrator/PÄ
SE-106 91 Stockholm
SWEDEN or registrator@su.se

Applications must reach the Registrars office **no later than March 31, 2010.**
Disclaimer: In case of discrepancy between the Swedish original and the English translation of the job announcement, the Swedish version takes precedence.

3. An open call for 15 post-doctoral positions at the **JRC Institute for Environment and Sustainability** has been launched.

Information is available at: http://ies.jrc.ec.europa.eu/Job-opportunities/open-calls/call-for-grantholders.html

One of the positions is on Forest fire regimes, land use dynamics and climate in Europe, at the Land Management and Natural Hazards Unit (H07).

4. Remote Sensing of Vegetation – principles, techniques and applications

Hamlyn Jones and Robin Vaughan, published by Oxford University Press, approx 400pp, £29.99. Publication due May 2010.

The aim of this book is to provide a rigorous, yet fairly simple, grounding in the relevant basic physics and plant physiology to allow the reader to choose from and critically assess the plethora of new techniques that are becoming available for the remote study of vegetation (and other surfaces). The mathematical derivations have been kept throughout to a level accessible to most advanced undergraduate and graduate students, emphasising the meaning rather than the mathematics.

Although the main objective has been to describe the application of remote sensing to the study of plants and vegetation canopies, for completeness, and for the convenience of the reader, a fairly comprehensive introduction has been included to much of the basic radiation physics, image analysis and remote sensing technology and also to the physiological basis of key aspects of plant functioning that might be amenable to remote sensing. Correct interpretation of RS data to provide useful information also requires a good understanding of the ways in which these data are obtained and especially of their inherent limitations. Also included are discussions of analysis techniques, sampling, errors and scaling, as well as a chapter which demonstrates some sample applications.

Hamlyn Jones is Professor of Plant Ecology at the University of Dundee. Robin Vaughan, a past Treasurer and Chairman of EARSeL, has recently retired as Reader in Remote Sensing, also at the University of Dundee, and recently helped to write "The History of EARSeL – the first thirty years" which is available from the Secretariat.

5. Subject: EnviSDI Summer School 2010

EnviSDI – Summer School on "**Spatial Data Infrastructure for environmental datasets**", **June 29 - July 9, 2010** in **Salzburg, Austria**
The international Summer School EnviSDI aims at establishing a European education network to improve the access to spatial environmental data for public sector bodies, private companies and citizens.
The Summer School considers aspects of data organization, data harmonization as well as semantic and technical interoperability in order to produce seamless geospatial information across Europe and to improve the data access for a wide community of different user groups.
Learning about methodologies and the application of structural specifications for the description and harmonization of spatial environmental data within Europe as well as the operation of a corresponding Spatial Data Infrastructure (SDI) are main objectives. Participants will establish and operate an education network (SDIe_NET) dealing with services for spatial datasets and metadata. The ultimate training objective of the Summer School is to jointly set up a (geo-) web service to discuss data schemes from different disciplines in order to understand the challenge of arriving at one denominator within a very heterogeneous field of researchers and applications. Participants have the opportunity to attend sessions at the GI Forum 2010 (http://www.gi-forum.org/) and the AGIT Symposium (http://www.agit.at).
For registration and further details please visit our website at http://www.eduzgis.net/ss/envisdi2010 or contact us at envisdi2010@edu-zgis.net.
Registration starts on January 1, 2010. Applications are accepted until May 15,2010. Due to limited places we strongly recommend an early registration!

We are looking forward to your participation!

Hermann Klug, Meingassner Lisa
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A - 5020 Salzburg
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6.Subject: GISLERS Summer School 2010

GISLERS - Summer School 2010 on "Bridging GIS, Landscape Ecology and Remote Sensing for Landscape Planning" June 29 - July 9, 2010 in Salzburg, Austria

The International Summer School GISLERS is dedicated to the theme of "Bridging GIS, Landscape Ecology and Remote Sensing for Landscape Planning" and is hosted by Salzburg University's Centre for Geoinformatics (Z_GIS < http://www.unisalzburg.at/zgis >). In a set of lectures, group work and practicals participants focus on using Geographic Information Systems and Spatial Analysis techniques to model spatially explicit processes, and develop reliable models for scenario output.

The course emphasises on spatial patterns, landscape management and resource protection while considering the spatial distribution and flow of substances, materials, energy and individuals in the environment - and in consequence the distribution of landscape features. The Summer School will provide an insight into leading edge developments of GIS and Object Based Image Analysis (OBIA).

Participants have the opportunity to attend sessions at the Geoinformatics Forum 2010 < http://www.gi-forum.org/ > and AGIT symposium < http://www.agit.at >.

For registration and further details please visit our website page at http://www.edu-zgis.net/ss/gislers2010 or contact us at gislers2010@edu-zgis.net.

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We are looking forward to your participation!

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4. FEATURE ARTICLE

GROUND PENETRATING RADAR AS NON INVASIVE SENSING AND DIAGNOSTIC TOOL

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Abstract

The relevance of GPR as diagnostic tool is now assessed in many applicative fields due to its easiness of use and portability. Here, we briefly present the main features of this instrumentation and focus the attention to the topic of the data processing that is necessary to mitigate the main drawback of the technique, consisting in a low interpretability of the measurements. In particular, we present a recently developed data processing based on microwave tomography whose effectiveness is here demonstrated in a realistic case of civil engineering diagnostics.

Introduction

Ground Penetrating Radar (GPR) is now an assessed instrumentation to investigate opaque media with the aim of detecting, locating and gaining information about the geometry of buried/embedded targets.

GPR is based on the same operating principles of classical radars (Daniels, 2004). In fact, it works by emitting an electromagnetic signal (generally modulated pulses or continuous harmonic waves) into the ground; the electromagnetic wave propagates through the opaque medium and when it impinges on a non-homogeneity of the electromagnetic properties (representative of a buried target) a backscattered electromagnetic field arises. Such a backscattered field is then collected by the receiving antenna located at the air/opaque medium interface and undergoes a subsequent processing and visualization, usually as a 2D image.

Anyway, significant differences arise compared to the usual radar systems in free space.

The first one is that, while most radar systems act in a free-space scenario, GPR works in more complicated scenarios with media that may have losses and exhibit frequency-dependent electromagnetic properties thus introducing dispersion effects.

Secondly, while the range of radars may be also of hundred of kilometres, in the case of GPR we have ranges, even in the most favorable cases, it is of some metres due to the limited radiated power and to the attenuation of the signal in lossy media.

Moreover, GPR resolution limits, which ranges from some centimetres to some metres (in dependence of the working frequency and losses in the host medium), are different from the ones of the usual radar systems acting in free space.

According to the working principles described above, the architecture of the radar system can be schematized in a simplified form by the following blocks:

• An electronic unit that has the task to drive the transmission and the reception of the antennas (transformation of electronic signals in electromagnetic waves) and to send the collected data to a monitor and/or to a processing unit;

• Two antennas that have the task of radiating the field impinging on the target (transmitting antenna) and of collecting the field backscattered by the targets (receiving antenna);

• A monitor/processing unit that has the task of the subsequent processing and visualization of the measurements collected by the receiving antenna.

From the schematization above, it emerges that a first advantage of the GPR instrumentation resides in its relatively low cost and easiness of use; in fact no particular expertise is required to collect the data.

Usually, the instrumentation is portable (unless very low frequencies are exploited, which increases the size of the antennas) and allows to survey even hundreds of square metres in a reasonable time. Finally, the flexibility of the GPR system is ensured by the adoption of different antennas working at different frequencies and that can be straightforwardly changed on site.

The advantages said above have allowed the use of GPR in many application sectors ranging from the classical ones such as “geophysics”, cultural heritage, archaeology prospecting (Conyers and Goodman, 1997), civil engineering (Hugenschmidt and Kalogeropoulos, 2009) diagnostics to other ones very recent and under development as the security (Solimene et al., 2009; Catapano and Crocco , 2009), exploration of other planets (Ciarletti et al., 2009) , hydro-geophysics (Lambot et al. 2008)

It is worth noting that the necessities of probing lossy media and of achieving high resolution dictates the choice of the working frequency and consequently of the antennas to be deployed in the survey. In particular, the choice of the frequency depends on the particular application and is a trade-off between the necessity to have deeper investigation domains (that pushes to keep low the operating frequency so to mitigate the attenuation of the em wave when it propagates in the ground) and the aim of achieving good spatial resolution, that is possible by increasing the working frequency. As result, the overall working frequency band exploited in GPR applications range from some tens of MHZ to some GHz.

2. The measurement configuration and the radargram

GPR can be deployed in different measurement configurations on dependence of different applicative motivations and necessities such as the kind of investigation to be performed, the kind of targets to be detected, the extent of the investigated region.

In general, all the reasons above lead to the adoption of the simplest acquisition mode, for which the GPR system works in a monostatic or bistatic configuration. In the former case, the locations of the transmitting and the receiving antennas are coincident (or very close in terms of the radiated wavelength), whereas in the second case the transmitting and the receiving antennas are spaced by a fixed offset that is constant while they move along the survey line.

By moving the antenna system along a selected profile (line) above the ground surface, a two-dimensional reflection profile (radargram) is obtained where for each location of the an-

tenna system a trace is achieved where the amplitude and the delay time of the recorded echoes (that are related to the depth of the underground reflectors) is drawn (Daniels, 2004).

Such a radargram provides a rough information about the presence and the locations of the targets but the actual shape of the target is blurred due to the effect of the propagation/scattering of the electromagnetic wave in the soil. Such a statement can be made clearer by considering the scattering by a point-like object (an object small in terms of the probing wavelength) that is imaged as a hyperbola in the radargram. More precisely, let us consider a point-like target located at $\underline{r}_{sc} = (x_{sc}, z_{sc})$ and let us denote as $\underline{r}_O = (x_O, z_O)$ the measurement point, i.e. the position where the scattered field is recorded. In particular, we assume $z_O = 0$ as the height of the measurement point and $x_O \in [-X_M, X_M]$, where $\Sigma = [-X_M, X_M]$ is the measurement aperture (see Fig. 1).

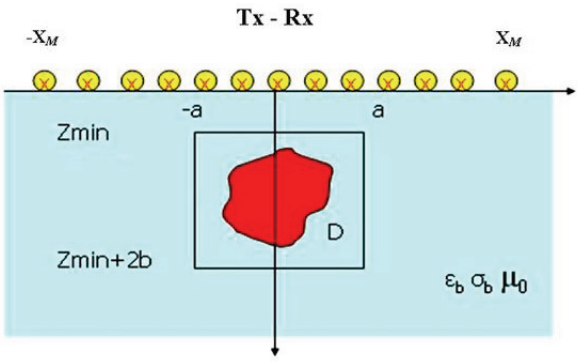

Figure 1. Geometry of the subsurface prospecting problem

If $s_T(t)$ is the transmitted signal (ideally a delta impulse), the corresponding backscattered field (for the case at hand a B-scan measurement) is given by

$$s_R(\underline{r}_O, t) = s_T\left(t - 2\frac{|\underline{r}_O - \underline{r}_{sc}|}{v}\right) \quad (1)$$

where v is the electromagnetic velocity of the wave propagating through the soil and the amplitude factor due to the propagation spreading has been neglected. Accordingly to the considerations said above (see eq. (1)), the backscattered signal in the $x_O - t$ data space appears as a diffraction hyperbola whose apex is in $(x_{sc}, 2z_{sc}/v)$ which can be immediately translated in the $x - z$ image space by the coordinative transformation $x = x_O$ and $z = vt/2$ (see Fig. 2).

The hyperbolic features provided by the radargram arise due to the finite directivity of the antennas, and the data processing aims to compensate for such a spreading by refocussing each segment of the hyperbola to its apex. To do this it, let us stress that the travel-time cannot be directly translated into depth because equal travel-times imply equal distances but the direction of arrival is not specified.

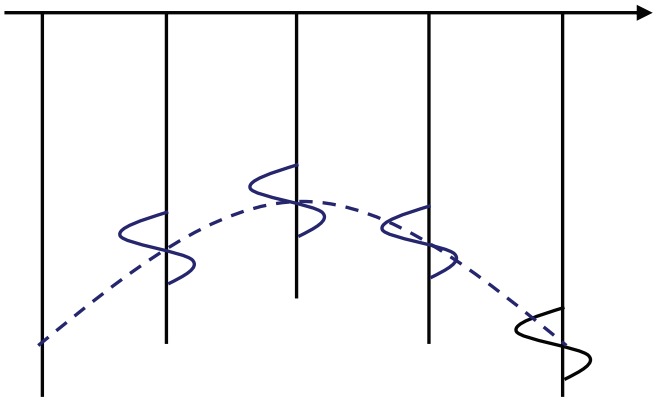

Figure 2. Pictorial description of the radar response of a target

As a result, the shape of the hyperbola depends on the electromagnetic properties of the investigated medium (electromagnetic velocity), the configuration (monostatic or bistatic) and on the depth of the scatterer.

Besides the configuration said above, others acquisition modes can be deployed in the survey. Among them, let us outline here the common midpoint (CMP) where the transmitting and receiving antennas are progressively moved away from a constant central point. The adoption of this sounding configuration is particularly useful when one aims to determine the velocity of the electromagnetic wave in the medium (Huisman et al., 2003).

Further configurations are also exploited, but they have the drawback that are not particularly simple, as the multi-fold ones where one transmitting antenna is located at a fixed position while the backscattered field is collected by the receiving antenna moving at different locations. The same measurement configuration can be further complicated by repeating the measurement procedure for different location of the transmitting antenna.

All the configurations presented above are concerned with a reflection mode where both the transmitting and receiving antennas are from the same side with respect to the investigation domain (as for example in the case of subsurface prospecting). A different mode can be considered for the case of a masonry structure, as the transillumination or transmission mode, where the transmitting antenna and the receiving one are at the opposite sides of the structure to be investigated.

3. Data processing

Despite of the easiness of use, one of the obstacles to the employment of the GPR resides in the “low interpretability” of the radargram and therefore a high level operator’s expertise and often *a-priori* information are required to achieve an understandable “interpretation and visualization” of the investigated scene. This difficulty of the interpretation is further on increased when no *a priori* information is available as, for example, it often happens in the case of historical heritage (Masini et al., 2010), in particular when there is a lack of knowledge about the constructive modalities and materials of the structure.

Therefore, some processing of GPR data is often necessary to achieve more easily interpretable images of the scene, i.e. images that be easily understandable even by a not expert operator.

The usual radaristic approaches are based on migration procedures that essentially aim at reconstructing buried scattering objects from measurements collected above or just at the air/soil interface (from the air side). They were first conceived as a graphical method (Hagendoorn, 1954) based on high frequency assumption, afterward this approach found a

more consistent mathematical background based on the wave equation of the em scattering (Stolt, 1978).

Here, we discuss the development and exploitation of new data processing based on the inverse scattering problem (Catapano et al., 2006; Soldovieri and Orlando, 2009). In particular, those based on microwave tomography (Leone and Soldovieri, 2003; Persico et al., 2005), that have been gaining interest in the latest years.

Therefore, in this section we introduce the equations governing the electromagnetic scattering phenomena. Furthermore, we also show as they get simplified under the Born approximation for the case of penetrable scatterers (Chew, 1995).

Accordingly, the subsurface imaging problem is cast as an inverse scattering problem where one attempts to infer the electromagnetic properties of the scattering object starting from the scattered field measured somewhere outside it.

The statement of the problem is then the following: given an incident field, E_{inc}, that is the electromagnetic field existing in the whole space (the background medium) in absence of the scattering object and is generated by a known source, by the interaction of the incident field with the embedded objects the scattered field E_S arises; from the knowledge of the scattered field some properties about the scattering targets, either geometrical and/or structural, have to be retrieved.

Hence, it is mandatory to introduce the mathematical equations subtending the scattering phenomena to solve the above stated problem. To this end, we refer to a two-dimensional and scalar geometry. We consider a cylindrical dielectric object (i.e. invariant along the axis out-coming from the sheet) enclosed within the domain D illuminated by an incident field linearly polarized along the axis of invariance. The scattered field is observed over the domain Σ (not necessarily linear). Moreover, we denote by $\varepsilon(\underline{r})$ e by $\varepsilon_b(\underline{r})$ the permittivity profile of the unknown object and of the background medium, respectively. In particular, the latter is not necessarily constant (i.e., a non-homogeneous background medium is allowed too) but has to be known. The magnetic permeability is assumed equal to that of the free space μ_0 everywhere. The geometry of the problem is detailed in Fig. 1.

The problem, thus, amounts to retrieving the dielectric permittivity profile $\varepsilon(\underline{r})$ of the unknown object(s) from the knowledge of the scattered field E_S. The physical phenomenon is governed by the two equations (Chew, 1995)

$$\begin{aligned} E(\underline{r},\underline{r}_S;k_b) &= E_{inc}(\underline{r},\underline{r}_S;k_b) + k_b^2 \int_D G(\underline{r},\underline{r}';k_b) E(\underline{r}',\underline{r}_S;k_b) \chi(\underline{r}') d\underline{r}' \qquad \underline{r} \in D \\ E_S(\underline{r}_O,\underline{r}_S;k_b) &= k_b^2 \int_D G(\underline{r}_O,\underline{r};k_b) E(\underline{r},\underline{r}_S;k_b) \chi(\underline{r}) d\underline{r} \qquad \underline{r}_O \in \Sigma \end{aligned} \tag{2}$$

where $E = E_{inc} + E_S$ is the total field, k_b is the subsurface (background) wavenumber and $\chi(\underline{r}) = \varepsilon(\underline{r}) / \varepsilon_b - 1$ is the dimensionless contrast function. G is the pertinent Green's function (Leone and Soldovieri, 2003), $\underline{r}_O$ is the observation point and $\underline{r}_S$ is the position of the source.

In accordance to the volumetric equivalence theorem (Harrington, 1961), the above integral formulation permits to interpret the scattered field as being radiated by secondary sources (the ”polarization currents”) which are just located within the space occupied by the targets.

The reconstruction problem thus consists of inverting the “system of equations (2)” versus the contrast function. However, since (from the first of the equations 2) the field inside the buried targets depends on the unknown contrast function, the relationship between the contrast function and the scattered field is nonlinear. However, the problem can be cast as a linear one if the first line equation is arrested at the first term of its Neumann expansion. After doing this $E \cong E_{inc}$ is assumed within the targets and the so-called Born linear model is obtained (Chew, 1995). Accordingly, the scattering model becomes

$$E_S(\underline{r}_O, \underline{r}_S; k_b) = k_b^2 \int_D G(\underline{r}_O, \underline{r}; k_b) E_{inc}(\underline{r}, \underline{r}_S; k_b) \chi(\underline{r}) d\underline{r} \qquad \underline{r}_O \in \Sigma \tag{3}$$

Let us just remark that, within the linear approximation, the internal field does not depend on the dielectric profile, which is the same as to say that mutual interactions between different parts of any object or between different objects are neglected. In other words, this means to consider each part of the object as an elementary scatterer that does not depend on the presence of the other scatterers.

Consequently, at this point the problem can be cast as the inversion of the linear integral equation (3) and the numerical implementation of the solution algorithm requires the discretization of eq. (3). This task is pursued by resorting to the method of moments (MoM) (Harrington, 1961).

Results

Now we present the potentiality of the microwave tomographic approach under a linear model in order to improve the interpretability of the GPR images. The data are concerned with the civil engineering diagnostics; they were collected from a commercial GPR with the aim of investigating the depth and location of reinforcement bars in concrete ceiling slabs (Soldovieri et al., 2006).

The radar used for the investigation was a Groundvue 5 GPR by Utsi Electronics. This radar uses twin horn antennas and has a central operating frequency of 4GHz; the survey time sweep was 5ns with a spatial sampling interval equal to 8mm.

The raw data are depicted in Figure 3; At first sight, the raw data present a strong return from the interface at 0.5 ns. This strong signal is not representative of the interface but accounts for the direct transmission to receiving antenna crosstalk, traditionally removed by a horizontal filtering technique such as background removal. In addition, the radargram shows noticeable returns from a shallower layer of parallel (original) rebars at about 1 ns and also some return from a line of deeper reinforcement mesh of rebars (at about 3 ns), which however are less clearly identified.

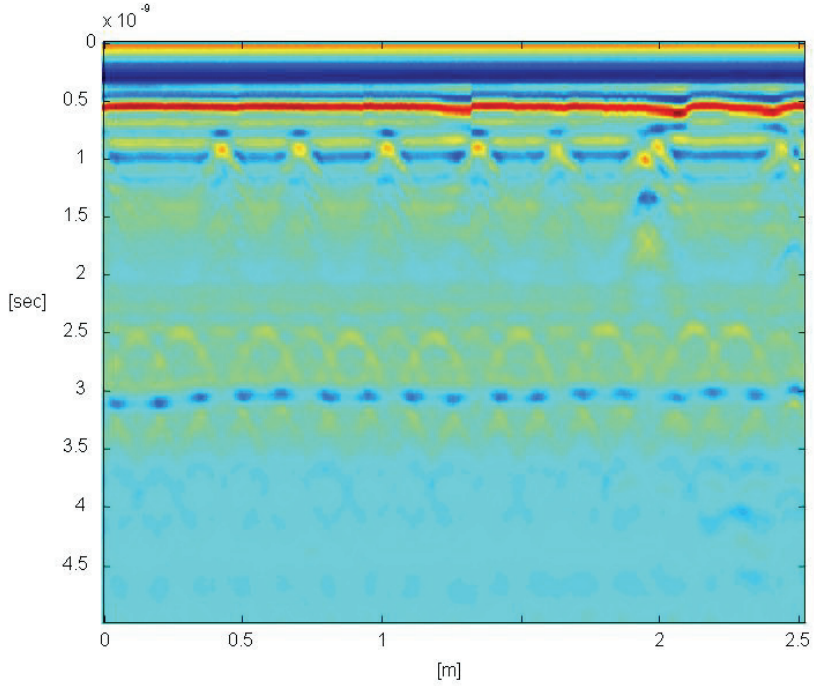

Figure 3. Raw data as collected by GPR

A tomographic inversion was performed with the aim of achieving clearer and cleaner images of the structure under investigation especially for the deeper reinforcement mesh. It is worth noting that the adopted tomographic reconstruction algorithm deals with frequency domain scattered field data. Conversely, the exploited data concern a time-domain total field, i.e. the sum of the field scattered by the buried object, plus the transmitting to receiving antenna crosstalk too. For this reason, a pre-processing step is necessary in order to obtain suitable data for our processing algorithm.

Still, let us note that, in order to keep the computational cost of the solution procedure affordable, the measurement domain of figure 4 (having extent 1.92 m) has been divided into 8 subdomains of extent of 24 cm. Then, for each subdomain, measurements at 31 spatial points (with spatial step of 0.008 m) have been exploited. The tomographic reconstruction results report the depth in metres; the conversion time-depth has been performed by making use of a propagation velocity of 0.1 m/ns.

Figure 4 depicts the reconstruction of the tomographic approach; now the upper rebars are clearly imaged and the visualization is further improved by means of a thresholding procedure. In this inversion, moreover, a pre-processing able to emphasize the shallower rebars has been performed.

Now, we show the result of an inversion conceived for emphasizing instead the deeper mesh. To do that, we have removed the first 2.4 nanoseconds in the raw data, then we have performed the Fourier transform of the time-domain data and, finally we have performed the inversions. Corresponding to this “cut” in time domain, the reconstruction results have been achieved by investigating depths between 8 cm and 20 cm. The result is presented in figure 5 where a threshold has been adopted to cut-off artefacts.

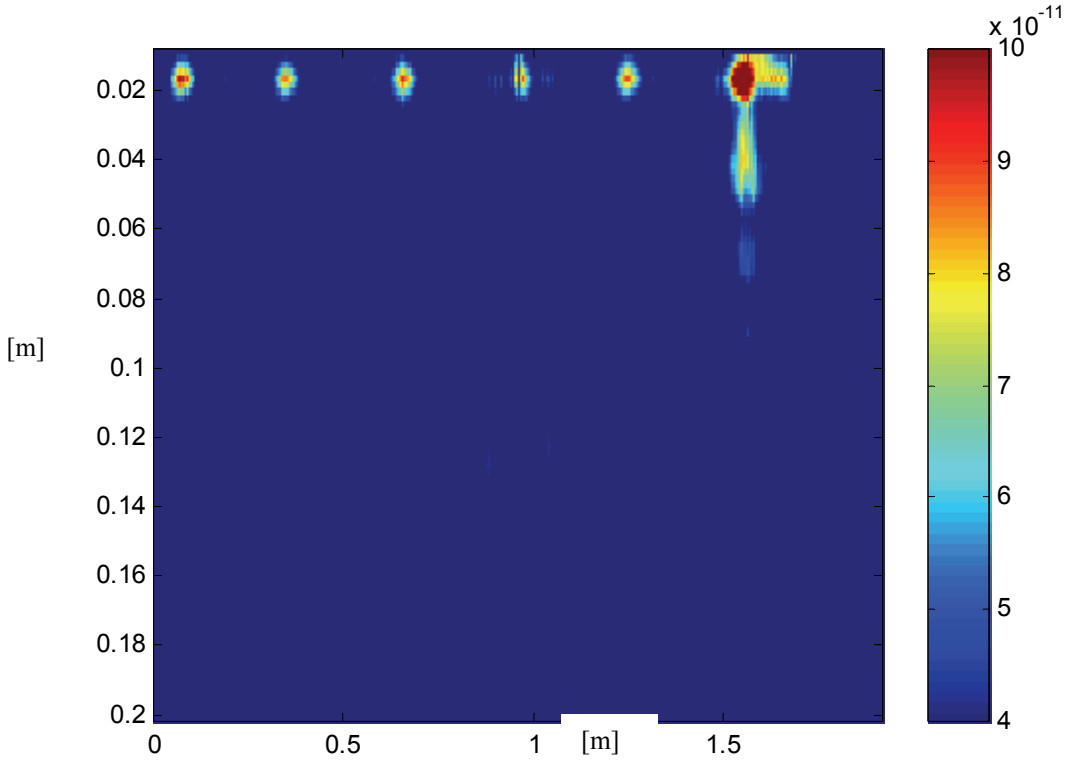

Figure 4. Tomographic reconstruction of the upper rebar layer.

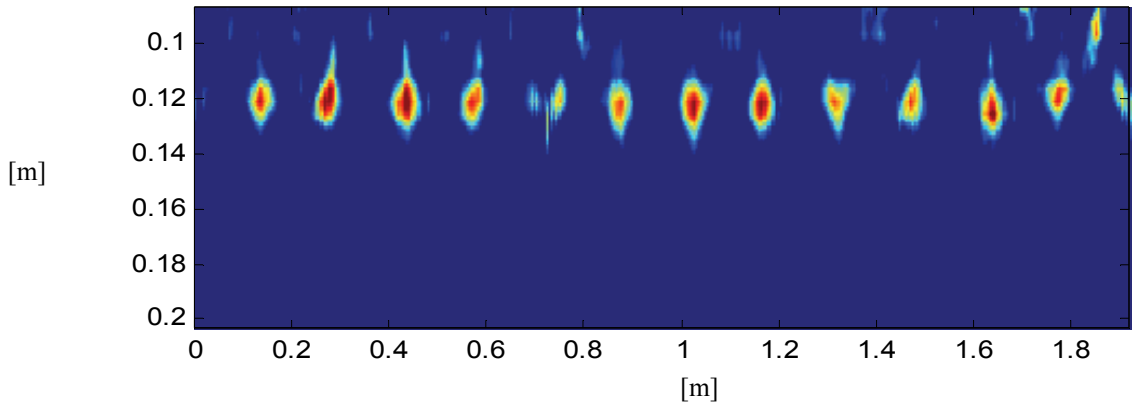

Figure 5. Tomographic reconstruction of the reinforcement mesh.

Conclusions

In this paper we have presented the some issues about GPR prospecting. In particular, first the attention has been focused to the operating principles of the GPR and then we tackle in detail the problem of the low interpretability of the raw data. In this framework, we have presented a state of art data processing approach based on an accurate formulation of the electromagnetic scattering. This reconstruction approach permits us to achieve a meaningful focusing effect as inferred by the presented results regarding a real case.

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Figs. 3, 4 and 5 are courtesy of NDT&E International.

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5. FUTURE EVENTS

5.1 CONFERENCES, SYMPOSIA AND WORKSHOPS

FORTHCOMING CONFERENCES

1) Geospatial Data and Geovisualization: Environment, Security, and Society
Orlando, Florida, USA November 15-19, 2010
a special joint symposium of ISPRS Technical Commission IV and AutoCarto 2010
in conjunction with the ASPRS/CaGIS 2010 Specialty Conference

This is the first call for abstracts for a special Symposium of AutoCarto 2010 and the International Society for Photogrammetry and Remote Sensing (ISPRS) Technical Commission IV, "Geodatabases and Digital Mapping". Sponsored by the American Society for Photogrammetry and Remote Sensing (ASPRS) and the Cartography and Geographic Information Society
(CaGIS), this Symposium will include special participation from ISPRS, the International Cartographic Association (ICA), and the International Geographical Union (IGU).
Cartographers, geographers, and other scientists conducting research on the cutting edge of cartography and geospatial science and technology are invited to submit abstracts for papers and posters. This special international research symposium will be held at the Doubletree Hotel in Orlando, Florida, USA on **November 15-19, 2010.**
ISPRS Symposium papers will be published in the ISPRS – International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, and selected papers from AutoCarto 2010 will be published in the Cartography and Geographic Information Science journal.

Abstracts should be submitted electronically using the form available at the conference web site, www.asprs.org/Orlando2010. Authors will be asked to select a category for their paper according to the categories and topic areas listed on the web site, and they will be asked to state a preference for oral or poster presentation. Abstracts may not exceed 300 words in length. Abstracts also should include 3–5 keywords and contact information for the senior author and presenter. If electronic submission using the web site is not possible, abstracts and required information may be mailed to Technical Program Co-chairs:

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2) **NEW European LiDAR and Mobile Mapping Conference**

The European LiDAR Mapping Forum [ELMF10], to be held in **The Hague from November 30-December 1, 2010** is a two-day technical conference focussing on the use of airborne, bathymetric and terrestrial LiDAR with a particular focus on mobile mapping to support transport, urban modelling and asset management and GIS applications.

Alongside there is an associated international exhibition for system and component manufacturers, operators and service companies.

Building on 10 years of experience with the annual International LiDAR Mapping Forum (ILMF) in the USA, the organisers are bringing this unique event to Europe. With its focus on LiDAR technology and applications, ELMF 10 recognises the technology advances spear-headed in Europe, and the particular challenges and opportunities which face operators in applying LiDAR to new developments in the European market.

The ELMF10 theme is "LiDAR Across The Market Spectrum", and the conference programme will feature technical presentations by the industry leaders and opinion formers. With three conference tracks, technical papers will report on actual projects in: airborne use of LiDAR for urban and rural mapping, transport and rail asset management; bathymetric mapping along the coastal zone, and a whole session devoted to technologies and operations in the fast-emerging market sector of mobile mapping.

Mobile mapping and surveying is the driving force behind the next major step-change in the global LiDAR market. With its benefits of increased speed of data acquisition and onsite processing, Mobile Mapping is enabling a whole range of applications and business opportunities for the LiDAR community. This exciting addition to the LiDAR conference programme makes ELMF 10 an essential industry event for both data users and service providers.

CONFERENCE CALL FOR PAPERS

The conference Advisory Board is seeking papers in the following areas of interest:

- Advances in LiDAR technology, including systems development, data acquisition, data visualization and interfacing with GIS systems
- Recent examples of actual projects in Europe where LiDAR systems have been used (airborne, terrestrial, bathymetric and mobile mapping/surveying)
- Political, government and commercial issues relating to the LiDAR market

Authors wishing to submit a paper for the conference are requested to supply an abstract of no more than 250 words online at www.lidarmap.org which will close on **1st July 2010**.

INTERNATIONAL EXHIBITION

The extensive exhibition held with ELMF10 is expected to attract over 30 of the international leaders in LiDAR technology development, service providers and specialists in data management /GIS. A number of dedicated vehicles used in mobile mapping will also be present and performing demonstrations. Exhibition stands are limited. For more information email jo.trippett@intelligentexhibitions.com

THE HAGUE, NETHERLANDS

The international city of The Hague is located between the major Dutch cities of Amsterdam and Rotterdam. The Hague has a lively downtown area with trendy restaurants, culture and entertainment. In addition, The Hague serves as the seat of the Dutch national government and the royal residence. Without some of the edginess of Amsterdam, The Hague is the perfect blend of urban sophistication mixed with tradition and history. The Hague also offers great transport links with a 30 minute direct train from Amsterdam Schiphol International Airport, one of the major European transport hubs that handles over 40 million passengers per year. Over 100 airlines fly to Schiphol, including twenty budget airlines offering cheap flights from many European countries.

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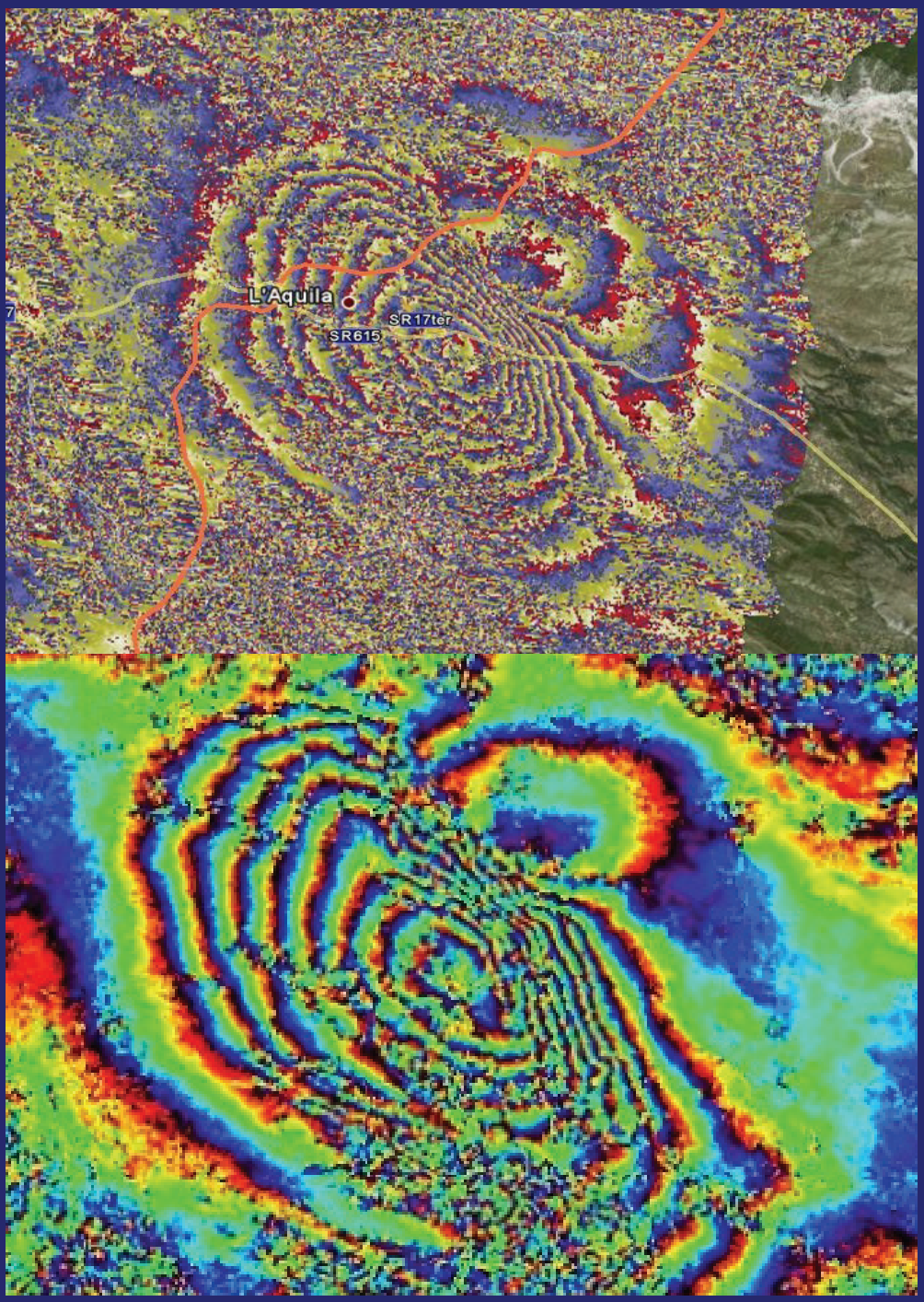
Back Cover – Central picture: Envisat satellite images show the effect of the L'Aquila earthquake.(April 2009)

Earthquake shockwaves (credit: IREA-CNR)



Earthquake shockwaves (credit: ASI -Italian Space Agency)

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