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ROME - 10 JANUARY 2002 - PAN IMAGE - GEOMETRIC RESOLUTION 0.6 M/PX

1 EDITORIAL

This issue of the EARSeL Newsletter will no doubt provide you with welcome relief from those long, boring days of the summer vacation. :-) (For non-users, like myself, of "emoticons" in their SMS and e-mail messages, :-) is a side-ways "happy-smiley face", intended to convey irony). Irony aside, this issue of the Newsletter contains reports on a wide variety of recent major remote sensing (RS) events, such as the 22nd EARSeL Symposium in Prague, the launch of several new RS satellites, and applications of RS related to three-dimensional "virtual" cities, night-time light emissions, urban rain, forest fires, and icebergs. I am also pleased to welcome Boudewijn van Leeuwen of ITC, The Netherlands, whose first "Observations" column (formerly written by Wim Bakker) is in this issue.

One recent major event which will influence all European research – not just that related to RS – took place on 15th May 2002, with the European Parliament's approval of the Commission's proposed Sixth Research and Development Framework Programme (FP6). The new four-year (2003-2006) programme will have a budget of 17.5 billion Euros, which is 17% bigger than the FP5 budget, and 3.9% of the EU's total 2001 budget. Apart from its budget-size, FP6 is a major advance relative to previous framework programmes in terms of, for example, its new implementing instruments – mainly Integrated Projects and Networks of Excellence – which are designed to integrate European research according to the concepts of the European Research Area. (Incidentally, the deadline for receipt of Expressions of Interest for the use of Integrated Projects and Networks of Excellence for the Thematic Priorities of FP6 was 11th June 2002). FP6 will be officially launched on 11-13 November 2002. Further information on FP6 is at the website europa.eu.int/comm/research/fp6/index_en.html.

During the last few months the joint ESA / EU initiative on GMES (Global Monitoring for Environment and Security) has continued to develop, with two key events:

- On 19th March 2002 the first meeting of the GMES Steering Committee was held in Brussels. The Steering Committee, cochaired by ESA and the European Commission, and including representatives from key players in security and environment, will assist in implementing the GMES action plan.
- On 15-17 July 2002 the first conference of the GMES Forum – a key element of the GMES Action Plan – will be held in Brussels. The aim of the GMES Forum is to build a shared understanding of the issues relating to GMES, and to develop a common approach for action, to be ready in early 2004. The conference (the first of four to be held in 2002-2003) includes thematic sessions on: environmental stress and land management; marine resources at risk; facing natural and technological hazards; civil security – prevention and crisis management.

The latest news on GMES is at the websites europa.eu.int/comm/space/intro_en.html and gmes.jrc.it/Documents/documents.htm.

Finally, I wish you all a very pleasant summer break – except for those of you (like me), who will take their vacation in the autumn. :(

The Editor

2 NEWS FROM THE ASSOCIATION AND ITS MEMBERS

2.1 Report: 22nd EARSeL Symposium in Prague

The annual General Assembly and 22nd EARSeL Symposium 'Geo-Information for European-Wide Integration' attracted some 160 delegates from eastern, central and western Europe, as well as North Africa, Canada, Turkey and the USA. Some delegates were prevented from attending due to difficulties obtaining the necessary visas.

The meeting was organised by Dr. Tomáš Beneš of the UHUL Forest Management Institute, the Director of which welcomed delegates at the Opening Session, which was also addressed by the Vice-Minister of Agriculture of the Czech Republic, followed by Mr. Hugo de Groof of the European Commission's DG Environment in Brussels. Then Dr. Livio Marelli, deputising for Dr. José Achache, Director of Earth Observation at the European Space Agency, expressed willingness to co-operate further with EARSeL.

We were very happy to welcome Prof. John Trinder, President of the ISPRS, who stressed his appreciation of the increased co-operation between EARSeL, which is a regional Member and various Working Groups of ISPRS. Keynote speakers were Dr. E.A. Herland, Head of Science Division at ESA / ESTEC, giving the state-of-the-art of the development of ESA satellites for earth observation. Dr. Roland Doerffer of the GKSS Research Centre in Geesthacht, Germany, discussed the remote sensing capacities for studying sea surfaces, and Prof. Mike Barnsley of Swansea University in the UK gave an overview presentation on Environmental Modelling. The technical sessions were of a high standard, and details of these are available on the EARSeL website.

The list of exhibitors at the Symposium included: Kluwer Academic Publishers, Netherlands; TopoL Software Ltd., Prague, Czech Republic; Geodis Ltd., Brno, Czech Republic; Leica Ltd., Switzerland; Erdas / Arcdata Ltd., Prague, Czech Republic / regional dealer for some central and eastern European countries; Intergraph / Zeiss Imaging Ltd., Prague, Czech Republic and Germany.

The Bureau and Council hold a regular meeting on the occasion of the General Assembly, which offers an excellent opportunity to make an overview of ongoing actions and to consider strategy issues as the international scene changes. New satellites have recently been launched and new systems are in advanced planning stage, and these present new challenges and opportunities to develop more and more operational applications of the remote sensing tool. Discussing these issues with the members present at the General Assembly and Symposium is always extremely fruitful.

The main decision taken by Council and the General Assembly was the appointment of a slightly modified Bureau, following the resignation of Prof. Paul Mather for health reasons. The new Bureau is now: Prof. Dr. E. Parlow – Chairman; Prof. Dr. R. Goossens – Vice Chairman; Dr. Rainer Reuter – Secretary General; Prof. Dr. José Luis Casanova – Treasurer. The Bureau has appreciated very much the contribution of Paul Mather during his year of office, and he has agreed to carry on as advisor to Bureau and Council whenever asked.

Other decisions taken included the official launching of the new SIG 'Remote Sensing for Multilateral Environmental Agreements' led by Dr. Gérard Begni, and preliminary discussion concerning the establishment of a SIG on 'Remote Sensing of Urban Areas' led by Prof. Carsten Juergens in collaboration with Prof. Maktav in Istanbul. This SIG will be officialised at the EARSeL Council meeting in January 2003, as will a new SIG on '3D Remote Sensing', led by Karsten Jacobsen and co-chaired by Dr. Peter Winkler (Hungary) and Prof. Dr. Rudi Goossens (Belgium). A special session on this topic will be held in Ghent in 2003. The Annual Symposium and General Assembly in 2004 will be held in Dubrovnic (Croatia).

Concerning EARSeL educational activities, Dr. Rainer Reuter has inaugurated a list of on-line basic courses and educational web-sites, as well as possibilities for free access to data. This can be constantly added to and improved, and all members are welcome to contribute to this section on the EARSeL web-site, by sending their ideas and contributions to Dr. Reuter (r.reuter@las.physik.uni-oldenburg.de). The aim is to prepare a basic course in RS for use by teachers not only of geography, but also of physics, biology and other natural sciences, for inclusion in the curricula, in order to encourage students to study RS at university level.

The social events at the 22nd Symposium in Prague, organised by Dr. Beneš, were very much appreciated. There was an official reception at the Lichtenstein Palace beside the Vltava (Moldau) River, and then the symposium dinner on board a paddle steamer built in 1938, on which, after a circular cruise of 12 km offering splendid views of Prague by night, there was offered once again delicious buffet meal. Delegates will certainly keep an excellent souvenir of our 22nd Symposium, and Dr. Beneš is to be warmly thanked for his excellent organisation.

Concerning the 23rd Annual Symposium in Ghent in June 2003, we shall have a convener system, where specialists are appointed to chair sessions on specific topics, and are then responsible for ensuring a good scientific level of oral presentations with invited and contributed papers. Topics chosen for the Ghent meeting include: Envisat, ice and snow, imaging spectroscopy, remote sensing for high school education / exploiting image data bases; vegetation and biomass; hazards and risks; ground-penetrating radar; high-resolution data applications; remote sensing from small satellites; data analysis techniques; ocean and atmospheric studies; and data calibration. The Call for Papers was distributed in Prague, and more copies are available from the Secretariat.

2.2 News from the Special Interest Groups

SIG Remote Sensing of the Coastal Zone (web-site: las.physik.uni-oldenburg.de/projekte/earsel/): The SIGs 'Lidar Remote Sensing of Land and Sea' and 'Water Applications' have recently merged, and will now combine their efforts to deal with 'Remote Sensing of the Coastal Zone'. The new SIG shall be a platform for information exchange among people interested in: the physical dynamics of currents, tides, waves and sediment transport; the flux and transformation of chemical and biological seawater constituents including pollutants; the relevance of physical conditions for biological and chemical processes; morphodynamical processes and their relevance for coastal engineering; the relevance of these factors for living conditions, tourism, shipping and economy and their investigation with Remote Sensing. This covers the microwave, visible and infrared spectral range, active and passive methods, algorithms for data interpretation, ground truth methods, and modelling of processes using parameters for starting conditions and output validation that can be remotely sensed. The SIG is planning its first workshop to follow the 2003 symposium in Ghent, to be organised by Dr. Rainer Reuter. The 1st Announcement is now ready and can be consulted on the SIG web site (see above).

SIG Data Fusion (web-site: www.data-fusion.org): IEEE (GRSS / Geoscience and Remote Sensing Society) and ISPRS Group III/6 have invited EARSeL to co-organise the Joint Workshop on Remote Sensing and Data Fusion over Urban Areas (URBAN 2003), to be held in Berlin, Germany, on May 22-23 2003. For more information, contact Prof. Olaf Hellwich, WG III/6 Chair (phone: + 49-30-31422796; fax: +49-30-31421104; e-mail: hellwich@fpk.tu-berlin.de; web: http://www.fig.net/figtree/events/events2003.htm).

SIG Developing Countries (web-site: www.rsrg.uni-bonn.de/earsel_2002/index.htm): There has been a good response to the Call for Papers for the 2nd EARSeL workshop to be held in Bonn, Germany, on 18-20 September 2002. A formal agreement has been reached to hold a workshop in Cairo in 2004, which will include a field trip.

SIG Forest Fires (web-site: www. geogra.uah.es/EARSeL/SIG_group.htm): This SIG will organise the 4th International Workshop on Remote Sensing and GIS Applications to Forest Fire Management on 6-7 June 2003, following the EARSeL General Symposium in Ghent, Belgium. This follows on from three previous workshops held in Alcalá de Henares (1995), Coimbra (1998), and Paris (2001), by the SIG. The main topic of the workshop will be the application of new methods of image interpretation to fire prevention, detection of active fires and burned land mapping. Special emphasis will be devoted to global and regional approaches, and to the integration of high and low-resolution data. Innovations coming from new sensors, such as lidar, hyper-spectral and high-spatial resolution instruments will be reviewed. A meeting of the GOFC-GOLD (Global Observation of Forest and Land Cover Dynamics) Fire Implementation Team, focused on fire danger estimation, will precede the workshop. This meeting is planned for 5th June 2003.

The structure of the workshop will be based on three keynote lectures on the application of radiate transfer models to moisture content estimation and burned land mapping, and to the potentials of lidar and hyperspectral technologies for different phases of fire management. All paper contributions will be presented in three poster sessions which will be focused on the three phases of fire management: fire danger estimation studies (pre-fire planning); detection of active fires (during the fire); and burned land mapping (post-fire assessment). Topics that may be addressed are: the estimation of live and dead fuels moisture content; fuel type mapping (high-spatial resolution sensors, lidar and Insar applications); integration of remote sensing and socio-economic data; spatial modelling of human fire risk; fusion of high and low resolution data; gas emission estimation; global burned land mapping programmes; discrimination of burning intensities, etc. More information may be obtained from the SIG convenor: Dr. Emilio Chuvieco, Departamento de Geografía, Universidad de Alcalá (Spain), (e-mail: emilio.chuvieco@uah.es) or from the SIG web-site (see above).

SIG Forestry (web-site: www.felis.uni-freiburg.de): The Call for Papers for a Workshop to be held in Seç Czech Republic (ca. 100 km from Prague), on 10-11 March 2003, is now being distributed. The workshop will be in conjunction with the regular annual meeting on 'Information Systems for Agriculture and Forestry'. Transport from Prague will be arranged and the overall cost for participants will be quite modest.

SIG Geological Applications (web-site: www.itc.nl/~siggeo): This SIG organised a joint session during the symposium in Prague in co-operation with the Geological RS Group in the UK. It is possible that the ERIM Geological RS Conference may come to London in 2002 or 2003. Sponsorship is being sought.

SIG Land Ice and Snow (web-site: dude.uibk.ac.at/lissig): The workshop held in Berne, Switzerland, on 11-13 March 2002, gathered over fifty participants, and was much appreciated by all. A report is published below (Section 5.3). The papers are being reviewed for publication on CD-ROM in the EARSeL eProceedings series.

SIG Multilateral Environmental Agreements: This new SIG was officially launched at the General Assembly in Prague, led by Dr. Gérard Begni, as a joint SIG with ISPRS. A core group of high-profile scientists has been formed. These Terms of Reference were agreed:

- To identify the issues that underpin the principal multilateral environmental agreements signed or endorsed by the EU and European countries (including accession countries), an issue in which EARSeL should participate through its expertise as a network of in remote sensing research laboratories;
- To document the major methods and technologies of RS that should be able to satisfy specific international environmental policies and protocols signed or under consideration by the EU and accession countries;
- To create links with the relevant aspects of the European GMES initiative, and develop day-to-day interactions with the relevant research structures, circulating needs expression and research results in the related fields;

- To document further policy and treaty issues that could be addressed using RS;
- To encourage synergies between RS and in situ measurements and techniques and their integration within relevant models;
- To encourage synergies with experts from other disciplines (including economic and social sciences) to build an integrated environmental assessment science;
- To encourage synergies with other international research structures involved in similar domains, such as ISPRS and the international research programmes such as IGBP, IHDP, WCRP, DIVERSITAS and their relevant core project of joint structures;
- To organise general purpose or dedicated workshops bringing together European and invited outside experts to share views on research results and needs;
- To prepare recommendations to European and national relevant structures about RS research topics which address shortcomings of methods currently being used to address international policies and treaties;
- To report annually to the EARSeL Council about activities and recommendations that should be endorsed prior to formal actions.

In response to these actions: the national representatives in EARSeL will keep their relevant national authorities informed of the conclusions and recommendations as reported to the Council by SIG-MEA; the EARSeL bureau will report to the relevant managing structures of the EC and ESA about these conclusions and recommendations, with a special emphasis on the ad hoc GMES structures. Any scientist willing to be involved in SIG-MEA is kindly invited to contact Gérard BEGNI (begni@medias.cnes.fr).

2.3 New EARSeL Member in Targoviste, Romania

A new Remote Sensing Laboratory has been recently inaugurated at the Valahia University of Targoviste, Romania. Thus has been materialised a project created and promoted by Dr. Vasile Loghin (vloghin@valahia.ro), doctor of Geography, and sustained by our university's management. This is one of the few RS Laboratories of Romanian universities. In spite of being newly created, it has become an EARSeL member in March 2002.

The RS laboratory was created as an interdisciplinary education and research centre, the main objectives of which include: improving the Earth and Environment Sciences in University and post-university education, by using high-technology spatial RS sensors, computers, and software in studying the Earth and drawing up the scientific papers – the practical classes in RS, GIS and Geo-Informatics take place in the new laboratory; development of interdisciplinary scientific research regarding resources, the environment and land planning in Romania – the research projects are oriented to use GIS; taking part in European and Romanian Research Programmes, national and international scientific meetings.

The RS laboratory will be equipped in two stages. In the first stage (2002), the data processing infrastructure is being set up, initially consisting of a network of six Intranet- and Internet-linked computers. The laboratory has a small library with text-books and special reviews, satellite atlases, images and maps, multimedia materials (twenty-five titles of CD-ROM; slides). We also access a very rich information source, via the websites of different Spatial Agencies, RS Centres, Universities and companies providing spatial documents. Currently, two geographers, one computer operator and one informatics specialist work in the laboratory. In the second stage (2003-2004), spatial images and topographic maps for Romania (printed and electronic), will be acquired for use in our research. Then, we plan to buy advanced software programmes to extract information of interest from the satellite images and maps. The technical conditions to use GPS will be established. We will always train young specialists, therefore, our students and researchers are attending different training courses (university; master's; doctorate; post-doctorate) from European universities and professional societies.

These achievements will be possible only by using Valahia University's modest funds, by involving foreign funds, and by international and European fund programmes for higher education and scientific research development projects.

3 NEWS FROM ESA, THE EC AND INTERNATIONAL ORGANISATIONS

3.1 News from ESA

3.1.1 On-line gallery of new Envisat images

ESA recently released a new set of spectacular Envisat images of the Earth, which are available in the Multimedia gallery at the ESA web-site (www.esa.int). These images highlight the potential of Envisat, the world's largest environmental satellite. Launched in March 2002, Envisat carries a suite of ten powerful instruments designed to provide valuable information about our environment, and perform the most thorough set of observations of our planet ever made from space. Data from these sensors will help scientists, governments, and others in better understanding the causes, and consequences, of global environmental changes – from detecting El Nino events and unravelling the mysteries of global warming, to gaining crucial insights into the rise in ocean levels and tracking global deforestation. The Envisat Earth Images gallery contains both high- and low-resolution versions of images, acquired by Envisat's three imaging sensors since the launch of the satellite, including: Advanced Synthetic Aperture Radar (ASAR); Medium Resolution Imaging Spectrometer (MERIS); Advanced Along-Track Scanning Radiometer (AATSR). Additional Envisat imagery will be made available in this gallery periodically.

In particular, the images from Envisat's Advanced Synthetic Aperture Radar (ASAR) instrument demonstrate the increased capabilities of the ASAR on-board the Envisat spacecraft, as compared with the SAR sensors on the earlier ERS generation of satellites, while offering a continuity of service to users. Envisat's ASAR instrument is the first permanent space-borne radar to incorporate dual-polarisation capabilities – the instrument can transmit and receive signals in either horizontal or vertical polarisation. This Alternating Polarisation (AP) mode can improve the capability of a SAR instrument to classify different types of terrain. Because the reflective properties of a surface are dependant on the polarisation of the incoming radar signal, the use of more than one type

Envisat – ASAR image of the Netherlands, from 18th March 2002 of polarisation provides valuable extra information. Different types of terrain might look very similar using only one polarisation mode. However they can be much more clearly discriminated using a combination of several modes.

The ASAR AP mode provides two simultaneous images (or channels) of the same scene taken with different radar polarisation options. Since the radar can transmit and receive in both the horizontal (H) and vertical (V) polarisations, researchers can create image pairs, with possible combinations, HH&VV, HH&HV and VV&VH. A cross-polarisation option employs a channel in which the polarisation signal transmitted by the spacecraft is received on a different polarisation – i.e. transmitted using a horizontal polarisation and received on the vertical for an HV combination, or the reverse for a VH combination. Some of the different applications of the ASAR’s unique AP mode include:

- Land classification: The cross-polarisation combinations offer better discrimination between terrain types, such as between vegetation and bare soil, or between forests and deforested, clear-cut regions. Cross polarisation channels become much stronger when terrain such as vegetation causes multiple scattering of the radar signal before it returns to the receiver, compared with making simple single bounces from surfaces such as bare soil.
- Sea ice: The AP mode can help better identify the boundaries between sea ice and open water. This is an important distinction for mariners operating in ice-laden waters.
- Oceanography: Envisat’s ASAR can highlight different oceanographic features with different AP schemes. For example, the HH polarisation channel can better identify ocean wave phenomena that could include internal waves or effects caused by the proximity of the ocean floor. In contrast, a VV polarisation channel can be more effective at recording ocean features caused by localised differences in atmospheric conditions.

This article is based on two reports from ESA’s Envisat web-site (www.esa.int/envisat) on 11th June 2002 and 24th May 2002.

3.1.2 Artemis slowly reaching working position

The experimental ion propulsion system, designed to test a new form of technology for station-keeping on future satellites, is performing well in its new role to get ESA's Artemis to geostationary orbit, and save the day.

The Artemis (Advanced Relay and TEchnology MISsion) communications satellite, built by Alenia Spazio as prime contractor, was launched by Ariane 5 last summer. After launch the spacecraft was left in a far lower than intended orbit, with insufficient conventional propellant even to raise it to its nominal orbit. Adapting the use of the ion propulsion system combined with unconventional operation of the chemical-based thrusters, offered a daring solution. Following more than six months of intense preparation and testing, the challenge of having to implement new in-flight software and control strategies using electric propulsion for the orbit raising is finally paying off.

Since the start of the orbit-raising operations on 19th February 2002, the spacecraft controllers have had to respond to all kinds of unforeseen situations, since the new strategy could only be put to the test in-flight on the spacecraft itself. Unlike traditional pre-flight acceptance testing, no test-bed is available to replicate the current scenario exactly. Since the ion propulsion system was conceived as an experimental unit, and intended for an entirely different function, the new orbit-raising strategy has of course required fine tuning of the engines as well as of its alignment mechanism operations. The combined team from ESA and Industry has risen to the challenge, and ion propulsion is indeed proving itself, keeping Artemis ‘alive’ and able to serve users for as near to the originally planned lifetime as possible.

To date, the first milestone of a 1000 km increase in orbit altitude has been passed. Artemis is continuing to approach geostationary altitude at a rate of almost 20 km per day. If all goes according to plan, Artemis will reach geostationary orbit before the end of this year. This article is based on a report from the ESA website (www.esa.int) on 17th May 2002.

3.2 News from the EC

3.2.1 IMAGE and CORINE Land Cover 2000 Project

Vanda Lima and Susan B. Christensen, Institute for Environment and Sustainability, Land Management Unit, European Commission, DG-JRC, Ispra, Italy

The interest in and demand for using land cover as a basic layer for spatial analysis, are strongly increasing at European and national levels. In addition, harmonised and standardised spatial reference data are considered as mandatory in support of environmental management in different European policies, such as:

- Territorial impact assessment and regional planning (Structural Funds, European Spatial Development Perspective)
- Impact of agricultural policies on the environment
- Natural protection of biodiversity (the Natura2000 network)
- Strategic environmental assessment of the Trans-European network
- Integrated coastal management
- Water Framework Directive
- Environmental assessment and sustainable development

To responds to these needs, the IMAGE 2000 & CORINE Land Cover 2000 (I&CLC2000) Project was launched by the European Environmental Agency (EEA) and Joint Research Centre (JRC) of the European Commission. The aim of the I&CLC2000 Project is to update the European Land Cover database (CLC2000), and to produce a mosaic of satellite data (IMAGE2000) necessary for the updating of the European Land Cover database, which will be the Spatial Reference for Europe. I&CLC2000 is a three-year joint project between EEA and JRC, co-funded by the European Commission and participating countries. Initiated in 2000 in the Member States, the project was extended in 2001 to the accession countries, and currently covers twenty-six countries.

IMAGE2000 – the European Spatial Reference System

The aim of IMAGE2000 is to produce a time and quality consistent European Mosaic, using data from the Landsat 7 satellite's Enhanced Thematic Mapper Plus (ETM+) instrument. IMAGE2000 is a unique multi-purpose product, meeting national and European requirements for a harmonised spatial reference system. Image purchase, ortho-rectification and quality control are centralised under the responsibility of the JRC. This centralised approach gives advantages in overall management and assures consistency in quality of the end product.

- Product consistency: In order to assure time consistency, satellite data are required for the reference year 2000, allowing a deviation of maximum ±1 year (1999 / 2001). Cloud-free data are selected within the optimal period for image interpretation. The images are ortho-rectified according to national requirements and delivered in national projection systems and European projection system.
- Quality control – internal and external quality checking: As IMAGE2000 is foreseen to be used in many important applications, either as spatial reference data or in thematic applications, quality control is essential to ensure that the spatial accuracy of 25 metres is reached. The quality assessment of Image2000 consists of both internal and external quality controls, which are performed in three steps at national and European level (Figure 1).

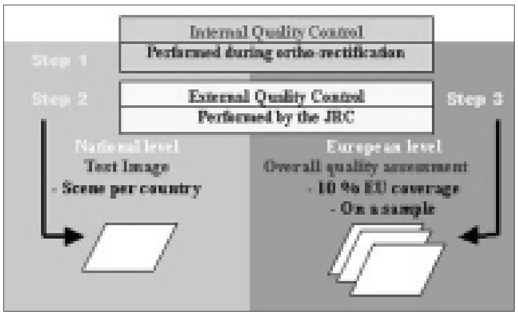

Figure 1: Procedure for quality control of Image2000

Implementation and ortho-rectification of Image2000 products is on going. Currently 70% of image coverage for European Union has been delivered. Full image coverage for EU and candidate countries is expected to be ready by August 2002. More information can be found on the web-site image2000.jrc.it.

3.3 RS activities in 2001: UNESCO

Report on UNESCO activities 2001 to EARSeL Council on 18th January 2002

Robert Missotten, Earth Sciences Division, UNESCO

Last year Mr. Marcio Barbosa was appointed as Deputy Director General of UNESCO (United Nations Educational, Scientific and Cultural Organisation). Mr Barbosa is currently President of the International Astronautical Federation and co-organiser of the World Space Congress to be held in Houston 10-19 October 2002. He was formerly Head of the Brazilian Space Agency, INPE and former Vice-President of ISPRS. Mr Barbosa is strengthening the RS and GIS activities of UNESCO related to Natural Science projects and the protection of World Heritage. He will continue to reinforce the co-operation with specialised NGOs in the implementation of UNESCO's programmes. This could be an opportunity for EARSeL to strengthen its links with UNESCO.

UNESCO is currently exploring new areas of co-operation with ESA. One of these is the use of RS and GIS for the management of World Heritage sites. There are 721 sites inscribed on the World Heritage list, of which 167 are Natural Heritage sites such as landscapes, specific ecological environments, mountains etc. ESA and UNESCO are currently developing a methodology to improve the management and protection of these sites. A first pilot activity is launched to study the gorilla habitats in central Africa.

UNESCO is currently co-chairing IGOS (Integrated Global Observing Strategy) Partnership, together with ESA. This brings together the Global Observing Systems (GCOS, GOOS, GAW, GTOS), the international agencies which sponsor the GOS, International Global Change Programmes (WRCP-IGBP), the International Group of Funding Agencies for Global Change Research (IGFA), and the space agency Committee on Earth Observation Satellites (CEOS). IGOS develops a strategic planning process in order to achieve the necessary harmonisation and maximum cost-effectiveness for space and in-situ observations. Since it is not practical to attempt to define a single global system capable of satisfying all needs for environmental information, the Partnership has chosen to address a series of 'Themes' for observing selected field of common interest, based on an assessment of priorities for overcoming deficiencies in information, and an analysis of relevant existing and planned observing systems. Theme teams have been established to outline the basic requirements from ground and space to optimise monitoring and identify the most important parameters to support long-term observation. Current themes: Oceans; Integrated Global Atmospheric Chemistry Observation; Integrated Global Water Cycle Observation; and Integrated Global Carbon Observation. A sub-theme on Coral Reefs was initiated in November 2001, and will be further developed into a Coastal Theme.

On the initiative of UNESCO, ESA and ICSU, consultations started in May 2000 for the development of a Geo-Hazards Theme. An ad hoc working group held a workshop on Geo-Hazards on 4-6 March 2002 at ESA, Frascati, organised by Dr Stuart Marsh, head of RS at the British Geological Survey. The aim will be to define a detailed and integrated methodology for the main geological and geophysical hazards (earthquakes, volcanoes, landslides and land subsidence), stressing operational aspects and end-user requirements, in terms of data needs and 'standard' products. A completed proposal was prepared, for submission to the IGOS Partners meeting in Paris on 31st May 2002. Theme study preparation is a good mechanism for the scientific community to work closely with the space agencies, and UNESCO hopes that the initial interest shown by EARSeL in the Geohazard Theme development will be maintained. Further information is at the web-site www.unesco.org.

3.4 RS activities in 2001: Slovak Republic

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Activities of the Slovak Commission for Research and Peaceful Use of Outer Space

The activities of research institutions from Slovakia in the field of space research were internationally recognised by the UN General Assembly, by appointment of Slovakia as a full member of COPUOS (Committee on Peaceful Uses of Outer Space). Under the Slovak Commission for Research and Peaceful Uses of Outer Space (analogous to Space Agencies in other countries), six scientific boards were created: space meteorology; RS; space physics; space biology and medicine; satellite and space technology; space law and diplomacy.

Projects and international collaboration in RS during 2001

Research activities of the Institute of Geography, Slovak Academy of Sciences (IG-SAS, Bratislava), in co-operation with Slovak Environmental Agency (Banská Bystrica) in RS and GIS, concentrated during the last three years on inventory, analysis and assessment of landscape changes. One of the most important achievements has been development and practical application of a methodological approach to landscape changes identification, analysis and assessment, in the territories of four PHARE countries (Czech Republic, Hungary, Romania, Slovak Republic). The changes were identified on a national level from Landsat TM and MSS satellite images, by application of the CORINE Land Cover databases for two time-horizons (late 1970s and early 1990s), at the second hierarchic level. Based on identified factors, landscape changes were grouped into seven types: intensification of agriculture; extensification of agriculture; urbanisation and industrialisation; enlargement of mining or exhaustion of natural resources; afforestation; deforestation; and other anthropogenic causes. The results of the groupings were presented in the form of contingency tables and maps showing the spatial distribution of the changes. Assessment of the identified changes through DPSIR framework (Driving forces, pressures, states, impacts, responses) was based on analysis of relations between the environmental and human systems. This work was part of the tasks of the PHARE Topic Link on Land Cover Consortium, co-ordinated by the company GISAT (Prague), and including IG-SAS (Bratislava), Romanian Geological Institute (Bucharest), and HNIT Baltic (Vilnius).

The Forest Research Institute in Zvolen developed a methodology for change detection of forest health on a national level in Slovakia, based on archived Landsat TM data. Classification was done for 1990-1996 and 1996-1998, using an image differencing change detection algorithm. Results were presented as thematic maps of forest damage changes in Slovakia, at scale 1:500,000. Each output thematic map is classified into six groups (by z-scores). New research, aimed at using high-resolution satellite data, started in 2000. Meanwhile, a methodology was developed for geometric correction, classification of tree species, forest decline, and change detection from the IKONOS satellite, for test areas. The results, based on image spectral analyses, showed only weak potential for classifying forest damage and tree species. Other research uses object-oriented processing of image information, based on 'inherent' image features (colour, texture, and form features).

In the framework of the co-operation with EUMETSAT, the Slovak Hydro-Meteorological Institute (SHMI, Bratislava) has started preparation on the project aimed on the utilisation of satellite data in the hydrological warning service. A working group was established from the representatives of the EUMETSAT co-operating and member states. SHMI organised the 4th EUMETSAT Central and Eastern European User Forum in Bratislava, on 29-31 August 2001. The MSG (Meteosat Second Generation) EUMETSAT-SHMI training course for participants from Central and Eastern Europe was held in Bratislava on 6-8 March 2001. The scientific presentations addressed: satellite systems; conceptual models; radiation sensing; satellite application facilities concept; MSG satellite; satellite imagery. These theoretical presentations were followed by practical exercises.

A team led by Prof. Peter Sincák, Faculty of Electrical Engineering and Informatics (Laboratory of Artificial Intelligence, Kosice), within the project 'Computational Intelligence Tools in Complex Decision Support Systems', is working on study Artificial Intelligence methods, such as neural networks classification of RS images, prediction and extrapolation functions, intelligent control and others. Others RS activities are carried out by organisations such as Forest Management Institute, Zvolen, Forest Research Institute, Zvolen, Comenius University (Department of Cartography, Geoinformatics and Remote Sensing), which provide air photo-based services and processing using digital stereo-photogrammetry.

3.5 GI for Sustainable Development in Africa

The Geographic Information for Sustainable Development (GISD) initiative outlines a US-led international collaboration and alliance whose objective is to apply a new generation of Earth observation (EO) data, state-of-the-art GIS-linked technologies, and field-tested geographic knowledge to on-going sustainable development problems in diverse target areas in Africa. This is being done in collaboration with activities and funding by many partners both within and outside the continent of Africa. The aim is to assist local, national, and international agency users working in Africa better to address long-term challenges such as disaster mitigation, natural resource management, trade, and poverty alleviation. The results and lessons learned will demonstrate the value of international collaboration in using geographic information (GI) for a broad range of sustainable development challenges over the next decade. Some of the lessons learned will be shared on-line and at exhibits and side-events at the upcoming WSSD (see below) in Johannesburg in August 2002, and at the African Ministerial Conference on Environment (AMCEN) in Kampala, Uganda, in July 2002 (www.nemaug.org), and other venues to be announced.

The World Summit on Sustainable Development (WSSD), to be held on 26th August – 4th September 2002 in Johannesburg, South Africa, will be a forum for world leaders to assess progress on the Agenda 21 issues raised at the last summit in Rio de Janeiro in 1992. Leaders must also chart a course for the next decade by supporting practical, results-oriented programmes to alleviate poverty, environmental degradation, food insufficiency and mismanagement of natural resources. While many of the problems covered by Agenda 21 remain severe, the past decade has seen a big improvement in EO data and information management systems that can help address those issues at global, national, regional, and local levels. A key challenge for the international community during the next decade is to make GI more accessible and useful to decision-makers working on sustainable development problems, especially in regions such as Africa.

Over the past decade, the public and private sectors have successfully collaborated in: the collection of EO data (from LANDSAT to IKONOS); the technologies that allow such data to be accurately geo-referenced (global positioning system / GPS), organised, and displayed (geographic information system / GIS); application of geospatial tools for development and disaster mitigation, e.g. FEWS (Famine Early Warning Systems); testing new approaches to 'bridging the knowledge divide' and harnessing telecommunications media that allow data and information to be broadly and quickly disseminated locally and internationally (Internet) – e.g. the Leyland Initiative.

Scientists around the world have undertaken pioneering work in applying these data and technologies to a wide range of pressing natural resource management problems – from forest fire prevention to soil conservation and famine early warning systems (FEWS). The USA has also committed significant resources to working with the United Nations, other governments, NGOs, and the private sector on developing the decision-making tools and Earth science-based information needed by local and national resource managers, to make environmentally and economically sound decisions. A priority for the future is sustainable agricultural production and natural resource management to feed a growing world population, reduce poverty, and promote trade competitiveness. Further information on the GISD initiative and the WSSD summit meeting is at the web-sites www.opengis.org/gisd and www.johannesburgsummit.org.

3.6 Visit opportunity: Ocean Systems Laboratory

Places are now available for funded visits of up to several months duration to the Ocean Systems Laboratory (OSL), at Heriot-Watt University, in Edinburgh, Scotland. The laboratory is part of the EU-funded EIERO (European Infrastructure for Energy Reserve Optimisation) infrastructure facility, together with the university's Department of Petroleum Engineering. Research topics of interest include, but are not limited to: image analysis, computer vision, sub-sea robotics, signal processing, sensor fusion, autonomous underwater vehicles, though-water communication, navigation, control, sonar modelling, and design. The facility provides free access to a range of analytical laboratories and computing facilities for researchers working in the EC or an associated state (Bulgaria, Republic of Cyprus, Czech Republic, Estonia, Hungary, Iceland, Israel, Latvia, Liechtenstein, Lithuania, Norway, Poland, Romania, Slovakia, and Slovenia). Access is supported by the European Commission's Human Potential Programme: Access to Research Infrastructures (see web-site: www.cordis.lu/improving/infrastructure/access.htm).

Researchers interested in coming to Edinburgh are asked to make informal contact initially, leading to completion of a simple application form together with a two-page research proposal, to Professor David Lane (e-mail: dml@cee.hw.ac.uk). For more information about the laboratory, see www.cee.hw.ac.uk/oceans. Further details of the visit opportunity and the funding available, are on the EIERO web-site: www.pet.hw.ac.uk/eiero.

3.7 EEA appoints new acting Executive Director

On 1st June 2002, Mr. Gordon McInnes, the most senior manager at the European Environment Agency (EEA), became acting Executive Director. The EEA is the main European-level provider of environmental information to policy-makers and the public. Mr McInnes, 50, will take over from Domingo Jiménez-Beltrán, (Executive Director since the EEA became operational in mid-1994), until a permanent successor is appointed. Mr Jiménez-Beltrán left the EEA at the end of May at his own request. A British scientist with twenty-five years of experience of air pollution issues, Mr McInnes has been with the EEA since it started operations nearly eight years ago. He was a member of the task force that prepared the Agency's organisation and work programme before it was set up. As head of the EEA's Reporting and Networking Coordination department, Mr McInnes has been responsible in particular for co-ordinating the development of EEA's European Environment Information and Observation Network (EIONET) and of its Topic Centres ('centres of thematic expertise'). He also led a major internal re-organisation of the EEA, completed last year.

The EEA is the main source of information for the EU and its Member States in developing environment policies. The Agency aims to support sustainable development and to help achieve significant and measurable improvement in Europe's environment by providing timely, targeted, relevant and reliable information. Established by the EU in 1990 and operational in Copenhagen since 1994, the EEA is the hub of EIONET, a network of six hundred bodies across Europe, through which it both collects and disseminates environment-related data and information. More information is at the web-site org.eea.eu.int.

4 RS DATA, PRODUCTS AND PROJECTS

4.1 Observations

Boudewijn van Leeuwen (leeuwen@itc.nl), ITC, The Netherlands

EO-1

EO-1 is the first Earth Observing satellite in Nasa's New Millennium Program (NMP). The NMP develops and tests advanced technologies in space flight. The satellite was successfully launched in November 2001. The primary focus of the mission was to develop and test three instruments: the Advanced Land Imager (multispectral / panchromatic spectrometer), the Atmospheric Corrector (instrument to enhance the accuracy of surface reflectance measurements) and Hyperion (hyperspectral imager).

NASA's one-year EO-1 technology demonstration / validation mission was successfully completed in November 2001. As the end of the initial mission was getting closer, an interim agreement was reached between NASA and USGS to continue EO-1 operations in an EO-1 Extended Mission. As long as users want to pay for the data, and the satellite will not malfunction, the operations will continue. The EO-1 Extended Mission represents a change from a technology demonstration to an operational mission, and is chartered to collect and provide Hyperion and ALI products from the USGS EROS Data Centre (EDC) who will also permanently archive such data. Users will be able to schedule the data collection by Data Acquisition Requests. Under the Extended Mission, previously and newly acquired data is considered to be in the public domain. Web-site: eo1.gsfc.nasa.gov/miscPages/home.html.

JASON-1

On 7th December 2001, the Jason-1 oceanography satellite, a joint NASA / CNES (French Space Agency) project, was successfully launched from Vandenberg Airforce Base. A Delta II launcher brought Jason-1 to a 1336 km, circular orbit with an inclination of 66°. Jason-1 is the follow up of the TOPEX / POSEIDON mission (which celebrated its 9th anniversary in August last year). The main focus of the mission is the continuation of the ocean surface topography data set. The data is collected with a CNES Poseidon-2 Altimeter and corrected by several other instruments on the platform. Jason-1 released its first data on 28th February 2002. After a six-month validation period, data will become available to the public. Web-site: topex-www.jpl.nasa.gov/mission/jason-1.html

SAGE III

The Stratospheric Aerosol and Gas Experiment (SAGE III) is a fourth generation satellite instrument designed to observe the long-term health of the upper atmosphere. SAGE III, managed by the NASA Langley Research Centre, is part of NASA's Earth Science Enterprise programme of climate research. The first of two instruments was launched on a Ukraine-built Zenit-2 rocket, on board a Russian Meteor 3M spacecraft, on 10th December 2001. This three-year mission is a collaboration between NASA and RASA (Russian Aviation and Space Agency). A second instrument is scheduled to fly on the International Space Station in 2005. The goal of SAGE III is to obtain global high-resolution vertical profiles of components of the upper atmosphere – the most important being ozone, aerosols, and water vapour. The data will be distributed via Langley Research Centre's Atmospheric Sciences Data Centre. Web-site: www-sage3.larc.nasa.gov.

Grace

On Sunday 17th March 2002, 24 hours behind schedule, a Russian rocket successfully launched two GRACE satellites from Plesetsk Cosmodrome in Northern Russia. The satellites are flying at a distance of about 220 kilometres from each other in a polar orbit of 500 kilometres above the Earth. GRACE, the Gravity Recovery and Climate Experiment, is a collaboration between NASA and DLR. The mission's goal is to measure precisely variations in the Earth's gravity field. The mission consists of two identical platforms, using GPS and a microwave ranging system. During the scheduled five-year mission, the data from GRACE will be used to estimate global models for the Earth's gravity field. Over the mission's lifetime, the two satellites will remain in co-planar orbits. Due to drag force differences, the along-track separation will be variable. Station-keeping manoeuvres will be carried out every 30-60 days, if necessary, to keep the two satellites at their nominal separation. To ensure the uniform exposure and ageing of the K-Band antennae in the two satellites, once during the mission, the leading and trailing satellites will exchange positions. The altitudes of the two satellites will decay in tandem, from near 500 km at the beginning of the mission, to 300 km and lower at the end of mission. If necessary, the altitudes of the two satellites may be re-boosted once, in order to ensure an overall mission lifetime of five years. At various intervals it will be also necessary to carry out instrument calibrations. Web-site: www.csr.utexas.edu/grace.

Aqua

On Saturday 4th May 2002, at 09:54 GMT, NASA's Aqua satellite was launched by a Delta II from Vandenberg Air Force Base. The satellite was successfully placed in a 705 kilometres polar, sun-synchronous orbit. Aqua is a joint project of USA, Japan, and Brazil. Aqua's six instruments will gather data about the Earth's water resources. The main goal of the six-year mission is to provide data for global climate change research and improve weather forecasts. Aqua, as well as for example Terra, SAGE III and Landsat, is part of NASA's Earth Science Enterprise (ESE). The satellite was formerly known as EOS PM, after the Earth Observation System (EOS) which is the centre of the ESE, and its afternoon equatorial crossing time. In time, data will be made available via EODIS (Earth Observing System Data and Information System). Web-site: aqua.gsfc.nasa.gov. (See also Section 4.7 in this Newsletter).

So, and what happened in Europe?

Galileo

On Tuesday 26th March 2002, The EU Ministers of Transport agreed on the go ahead for the European global positioning project, Galileo. The project will be funded on a 50-50 basis between the EU and ESA Galileo will be the first satellite navigation and positioning system that is designed for civilian purposes. It will consist of thirty satellites, twenty-seven of which will be in operation and three in reserve. The satellites will circle the Earth in three circular Medium Earth Orbits, at an altitude of 23616 km, and an inclination of 56° with the equator. Two Galileo control centres will be set up in Europe to monitor the operation of the satellites and to manage the navigation system. Galileo is expected to be operational in 2008. Web-site: www.europa.eu.int/comm/energy_transport/en/gal_en.html.

SPOT 5

Just a few hours before NASA launched Aqua on 4th May 2002, Arianespace launched SPOT 5. An Ariane 4 launcher placed the French satellite in a sun-synchronous orbit about 830 kilometres above the Earth. SPOT 5 will ensure continuity of the SPOT programme. Major enhancements over the earlier systems are the improved resolution of the two High Resolution Geometric (HRG) imaging instruments in panchromatic mode (from 10 to maximum 2.5 metres) and multispectral mode (from 20 to 10 metres). As well as this a new instrument, the High Resolution Stereoscopic (HRS), provides near-simultaneous stereo imagery, instead of the across-track imagery from the older SPOT systems. SPOT 5 will also fly the VEGETATION 2 instrument, which is an enhanced version of the instrument on SPOT 4. SPOT 5 data is expected to be operational after a commissioning phase of about two months. Web-site: www.spotimage.fr. (See also Section 4.5 of this Newsletter).

High resolution images for sale…

Quickbird

In December 2000, DigitalGlobe received a license from NOAA to operate a 0.5 metres resolution satellite. Now, two years later, DigitalGlobe has started to sell high-resolution products from Quickbird. After the launch failure on 20th November 2000, DigitalGlobe tried again on 18th October 2001. This time Quickbird was launched successfully in a 450 km sun-synchronous orbit, by Boeings DELTA II launcher. The sensor delivers panchromatic and multi-spectral data at a basic resolution of 0.61 metres and 2.44 metres at nadir (0.72 and 2.8 off-nadir looking), with a nominal swath width of 16.5 km. DigitalGlobe distributes its data via International Master Distributors. For Europe this is Eurimage, but direct ordering at DigitalGlobe is possible. Web-sites: www.digitalglobe.com; www.eurimage.com.

Launches

According to the schedule, a Titan 2 launched NOAA-M from Vandenberg Air Force Base on 24th June 2002. (See also Section 4.6 of this Newsletter).

4.2 3D Virtual Cities: the TRIDENT Project

The article below provides an overview of one Work Package of the international project TRIDENT (Three-Dimensional Restitution via Internet of Digital Elevation Networks in Towns). The aim of TRIDENT, which is co-funded under the IST (Information Society Technologies) Programme of the European Commission's DG Information Society, is to develop a prototype system for on-line three-dimensional (3D) urban cartography, integrating advanced technologies of aero-stereographic image acquisition, digital 3D cartography restitution, databases, and internet / intranet networking, in order to improve services provision to EU administrations and citizens. The prototype has been developed for three European cities – Madrid, Helsinki, and Rome. TRIDENT has been carried out by an international consortium, coordinated by DATAMAT in Rome, Italy, and including the following seven partners: ENEA (Ente per le Nuove Tecnologie, l'Energia, e l'Ambiente), Rome, Italy; SRD – Internet Service Provider, Rome, Italy; Consortium ULISSE (Università e Laboratori Industriali per lo Sviluppo di Sistemi Elettronici), Rome, Italy; ELISA Communications Research Centre, Helsinki, Finland; UCM – LOT (Universidad Complutense de Madrid – Laboratorio de Observacion de la Tierra), Spain; Regional Government of Madrid, Spain; Institute for Environment and Sustainability, DG Joint Research Centre, European Commission, Ispra, Italy. Specifically, this article describes a method which has been developed by ENEA as part of TRIDENT, for producing detailed 3D models of cities using advanced digital aero-photogrammetry techniques and GIS. For more information on TRIDENT see the web-site www.trident3d.net.

Digital Aero-Photogrammetry Techniques and GIS for the Production of On-Line 3D Virtual City Models within the TRIDENT Project

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Abstract

This article describes work carried out within the TRIDENT (Three-Dimensional Restitution via Internet of Digital Elevation Networks in Towns) Project, to develop a prototype system able to organise and manage different information levels, based on realistic three-dimensional (3D) models of a given urban area. Digital aero-photogrammetry techniques have been used to generate 3D urban models by the production of digital elevation models (DEMs). The DEM extraction process has been focused on the characteristics of urban areas, and the results have been validated through a comparison with analogical measurements. The obtained 3D city model has been integrated via GIS tools, with other urban and cartographic information, in order to cope with project needs for specific applications. The resulting 3D model has then been processed and translated into the VRML format so that it can be accessible on-line and linked to specific databases.

Introduction

The TRIDENT project is aimed at developing a prototype system for integrating advanced technologies of stereo-photogrammetric image acquisition, digital 3D cartography restitution, databases, internet / intranet networking, in order to improve services provision administrations and citizens in the EU. The end-product will be represented by a remotely accessible 3D reconstruction of a sample urban area extracted from two test sites – Madrid (Spain) and Rome (Italy) – correlated with relevant geo-referenced information, and by a set of specific applications exploiting these data to provide innovative IT services to the citizens and to the local administrations. (Note that the TRIDENT work for Helsinki is based on a pre-existing 3D urban model).

Digital aero-photogrammetry techniques, using stereo-correlation algorithms and specific software, can provide a description of complex environments such as the urban one. Buildings and man-made objects frequently cause occlusions that can be only resolved through the elaboration of specific DEM extraction strategies within 'ad hoc' developed procedures. The following are the procedures implemented and applied for the two very different test areas (i.e. Madrid and Rome) in the project:

- Preliminary operations: high-resolution scan and pre-processing of the aerial pictures; ground control points (GCPs) survey.
- Aero-photogrammetry: internal orientation and triangulation; DEM extraction strategy elaboration; buildings DEM extraction ('high-pass' strategy); ground DEM extraction ('low-pass' strategy); 3D model generation.
- GIS and database production: elaboration and homogenisation of vector data; integration of different information layers (basic cartography, cadastral map, street map); vector data validation; geo-referenced database production, including geometric parameters of buildings and additional attributes.

The software environment includes Erdas Imagine / OrthoMax, ESRI ArcInfo / Arc View, MicroSoft Access, other software, and tools especially created by the TRIDENT consortium.

Digital aero-photogrammetry techniques for DEM extraction

Digital aero-photogrammetry techniques, using stereo-correlation algorithms and specific software, can provide a description of complex environments such as the urban one. This approach uses statistical algorithms for corresponding point-correlation and matching, which results in a DEM generated mainly from interpolated points, and only a few matched points. Matched points are those for which the correlation was successful, and a height value was determined from parallax displacements. For those points where correlation failed, the algorithm interpolates their heights from those of the nearest points matched. The correlation algorithm needs to be manually set up through a series of parameters, in order to obtain a coherent, suitable and efficient strategy. For urban areas, two strategies have to be set: a 'high-pass' and a 'low-pass'. The high-pass strategy meets the requirements for the buildings' extraction (i.e. buildings DEM) while the low-pass is set to extract the surface beneath the buildings (i.e. ground DEM).

Ground DEM production

In order to obtain an urban ground surface at a large scale and high resolution by digital photogrammetry, specific techniques (i.e. low-pass DEM extraction) have been designed and implemented in order to 'swap out' building height information, while retaining that of the ground. It was not possible to use the low-pass DEM directly resulting from the stereo-correlation extraction process, as it suffers from many spikes and holes due to correlation errors. It was necessary to process the low-pass DEM using specifically developed procedures, including the selection of well matched points and 'kriging' interpolation, in order to produce a correct representation of an effective ground surface. The result is an interpolated ground surface underneath the buildings, obtained from digitally matched points via a semi-automatic process, which is suitable to describe the ground surface trend in urban areas. The subtraction of the high-pass and low-pass DEMs (to obtain the buildings DEM with elevations relative to the ground) is deeply influenced by the accuracy of the ground DEM, as low quality data will affect the output database.

Buildings DEM production

As stated above, the DEM extraction process is usually affected by several problems intrinsic in the photogrammetric techniques. These problems arise in dealing with buildings, and are mainly due to unavoidable occlusions and countless noise sources. All of these factors contribute to eliminating parts of certain buildings, and lead to poor correlation during the extraction procedure. Another issue is the complexity of urban texture. An clear example is provided by the Madrid test area, where one finds zones of small and dense building next to taller ones. The differences in urban texture could give several errors in the DEM extraction, such as correlation failure or poor description of man-made objects, so that it was often not possible to use a unique strategy within the selected urban test areas.

To solve these problems it is necessary to implement different extraction strategies and methods, taking into account the urban texture complexity and the occlusions for the different regions, and the quality and typology of the input data. Therefore, the final DEM (containing 3D raster data of buildings within the test area) is obtained by merging together several DEMs produced using different high-pass strategies. Depending on the input data, for the Rome test area the DEM extraction process has been performed twice, using the different air photo coverage available (80% and 60% overlap). The data regarding the interpolated and matched points are presented in Table 1. As can be seen, we find better results in DEM extraction from the 80% air photo coverage.

80% Air Photo Coverage		**60% Air Photo Coverage**	
Point type	**%**	**Point type**	**%**
Interpolated	70	Interpolated	91
Good matched	2	Good matched	0,5
Fair matched	13	Fair matched	4,5
Poor matched	15	Poor matched	4
Overall matched	30	Overall matched	9

Table 1: Results of buildings DEM production for Rome, for interpolated and matched points

Finally, in order to test the quality of the output results, a data comparison with analogue measurements has been performed. Figure 1 shows the different behaviour between matched (rhomboidal symbols) and interpolated points (square symbols), and their respective analogue measurements. Points are relative to a mean within a single building body, for each class (matched, interpolated). The test has been carried out in the north-east sector of the Rome test area. The data set closer to the 'real' values is represented by the matched points. As can be seen, although there are some values around 10-20 metres, corresponding to correlation errors (i.e. spikes and holes corrected by manual editing), the difference mean is 2.5 metres.

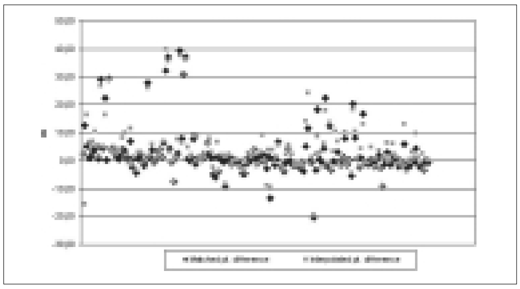


Figure 1: Quality of interpolated and matched points relative to analogue measurements

GIS and database

GIS processing was then performed in order to integrate additional information layers: basic cartography, buildings and ground elevations, cadastral maps, street maps. The first problem that had to be resolved was the integration of basic cartography and cadastral maps, as the two different sets of data were not homogeneous due to the different production and restitution methods. Moreover, the cadastral maps, updated continuously using data from different sources, caused a mismatch with the 2D cartography, which meant that a geometric overlap and integration could not be easily carried out. In order to associate the cadastral data set to the cartography it was necessary to perform a logical association between the building geometry and the cadastral attribute.

Every building body's centroid inside a cadastral parcel acquired the cadastral attribute, through the GeoProcessing function in ArcView 3.2. The information of the street map was linked to the façades facing the roads through the GeoCode and GeoProcessing functions in ArcView 3.2. GeoCode was used to generate the façades' centroids to be associated with the linear features (streets) of the street map though GeoProcessing. The information contained in the GIS was exported as a MicroSoft Access database.

Final product – the VRML model

The MicroSoft Access database was the basis for the production of the online VRML (Virtual Reality Mark-Up Language) 3D virtual city model, developed with other TRIDENT partners. VRML is one of the most suitable ways to have online 3D representations of GIS data. The project applications are aimed at urban monitoring (for the Municipality of Rome) and urban planning (for the Municipality of Madrid). (The Helsinki application, which uses its own 3D urban model, is aimed at linking the 'virtual city' environment with the telephone directory database). The prototype allows the users to easily access the information of their interest contained in the TRIDENT database, through a 3D graphical interface.

Regarding new perspectives for the project, the introduction of new technologies and methodologies will allow to improve and / or validate the results of TRIDENT in different ways. For example, the 3D model production (DEM extraction and optimisation) via laser scanner acquisition for elevation data, or stereo-images acquired by high-resolution satellite sensors, is now under evaluation in order to be integrated into the procedures developed during the project.

4.3 MANTLE: Mapping Night-Time Light Emissions

MANTLE (Mapping Night-Time Light Emissions) is a Shared-Cost Research Technological Development (RTD) Project (2000-2002), funded under the IST (Information Society Technologies) Programme of the European Commission's DG Information Society, to assess the potential of using satellite resources to produce maps of light emissions and urban night-time light intensity levels in the EU. The satellite data are from the US Air Force Defence Meteorological Satellite Programme (DMSP), which is routinely used to map night-time light emissions over large areas, and are available from the National Geophysical Data Centre (part of NOAA). MANTLE aims to investigate whether these data can be used as a surrogate for a range of socio-economic indicators, including; population size / density, urban population numbers, total energy consumption by sector of activity, energy waste, GDP urban typology, rural tranquillity and landscape / skyscape quality. The nature of relationships between light emission intensities / patterns and source characteristics like urban typology will be investigated within and between urban areas.

Satellite-derived information on light emissions from urban areas is a potentially important data source, which can be used in support of EU policies. Light emissions are a significant form of environmental pollution; they also provide a valuable socio-economic and environmental indicator. This project therefore has the following goals:

(a) to explore the capability of existing satellite sensors (carried by DMSP) to provide a means of mapping and quantifying night-time light emissions across Europe;
(b) to evaluate the use of these data as a socio-economic and environmental indicator, for policy support in the EU;
(c) to investigate the possibility to enhance the value of these data by improving their spatial resolution, either through the use of post-processing of existing data, or by the use of alternative sensors.

The MANTLE project has four specific objectives:

- To assess the potential of using existing satellite data, from DMSP, to produce maps of light emissions and urban night-time intensity levels in the EU, and to quantify the accuracy of these maps at different spatial scales; and in different countries and areas of the EU, in order to assess the potential for routine mapping of urban night-time light emissions using either existing satellite technology or new sensors.
- To investigate the factors that affect urban night-time light, including: urban morphology and layout; land use characteristics; lighting configuration (e.g. linear, clustered lighting); population density; the extent of urban areas.
- Based on this analysis, to assess the ability to use urban light emissions as indicators of: population size / density; urban population numbers; total energy consumption by sector of activity; energy waste; gross domestic product; urban ty-

pology; rural tranquillity; landscape / skyscape quality.
- To evaluate the capability to enhance the spatial resolution of this information by post-processing existing satellite data (e.g. time-series data), or using higher resolution sensors.

The US Air Force DMSP system depends on two operational satellites in space to provide global weather information for US military and civilian users. The DMSP satellites are in low altitude (830 km) sun-synchronous polar orbits with an orbital period of 101 minutes. There are currently two fully operational satellites (F13 and F15). With 14 orbits per day per satellite they generate a global night-time and day time coverage of the Earth every 4-8 hours. The onboard Operational Line-Scan System (OLS) is an oscillating scan radiometer with low-light visible and thermal infrared (TIR) imaging capabilities. The OLS acquires swaths of data that are 3000 km wide with a nominal spatial resolution of 2.8 km. At night the OLS uses a Photo Multiplier Tube (PMT) to intensify the visible band signal. The PMT data have a broad spectral response of 440-940 nm, with highest sensitivity in the 500-650 nm region. This covers the range suitable for detecting street lighting at night. Normally the OLS is operated at continuously variable gain settings that are optimised for cloud detection using moonlight as the illumination source. These data will provide images showing the extent of urban street lighting. However prior to 1998 it was not possible to obtain accurate measurements of the density of street lighting because the sensor became saturated over brightly-lit urban areas.

Under special requests to the Air Force, the National Geographical Data Centre was able to collect OLS PMT data at reduced gain settings. During these experimental data collections, on board algorithms which adjust the visible band gain, are disabled. On one set of nights the gain is operated at a lower setting in order to avoid saturation of the sensor for major urban centres, but this does not permit the detection of city edges and lighting in smaller towns. To overcome this dynamic range limitation, data are also acquired at higher gain settings on a separate set of nights.

The MANTLE Project is being carried out for the following four study areas:
- <u>Northampton (UK):</u> Despite getting its town charter in 1189, Northampton is classified as a 'new town', and is undergoing a period of rapid expansion and industrialisation. The surrounding county is predominantly rural with agriculture as the major land use. This study area therefore covers an area with a wide range of building styles and ages and the full range of associated lighting strategies up to and including the most modern.
- <u>Zealand (Denmark):</u> The island of Zealand is conveniently self-contained as a study area as well as being very well supplied with statistics which should help with the analysis of the source-emission relationships for the area. The Danish capital of Copenhagen is also on the island which covers the full range of habitat types from small rural farmsteads to extensive urban and suburban areas.
- <u>Liguria (Italy):</u> The Liguria study area has been chosen for the most intensive data gathering exercise of the four study areas. As well as the DMSP data, night-time airborne imagery will be acquired in the coastal region between Genoa and La Spezia in conjunction with a simultaneous ground-based survey. This region of Italy has a good representative selection of land-use types covering industrial, urban, touristic and agricultural. The airborne survey will be greatly facilitated by the generally favourable climatic conditions normally experienced in the area.
- <u>Crete (Greece):</u> Crete is the most southerly of the four study areas. It has a number of features which make it advantageous as a study area: it is an island and can be studied in isolation; it has a an extensive range of topological features in close conjunction; it has a significant variation in population between the summer (tourist) season and the winter season; it is undergoing a period of rapid development of its infrastructure.

The MANTLE Project is being carried out by a consortium led by HTS Development Ltd, UK, and including: Imperial College of Science, Technology and Medicine (ICSTM), UK; Centre for the Application of Computer Science in Agriculture (CeSIA), Italy; National Observatory of Athens

(NOA) – Institute of Environmental Research and Sustainable Development (IERSD), Greece; Science Systems (Space) Ltd. (SSSL), UK; Rassmussen and Witthøft (R&W), Denmark; Institute of Agrometeorology and Environmental Analysis for Agriculture (IATA), Italy; Regione Liguria – Environmental and Territory Department, Italy. For further details, contact: ManFai Tang, GIS / Remote Sensing & Natural Resources Consultant, HTS Development Ltd (formerly Hunting Technical Services), Thamesfield House, Boundary Way, Hemel Hempstead, Hertfordshire HP2 7SR, UK. Telephone: +44-1442-202440. Fax: +44-1442-219886; E-mail: manfai.tang@htsdevelopment.com. Web-site: www.mantle-project.com.

4.4 Clocks on Space Station to test Einstein!

Ultra-precise clocks on the International Space Station and other space missions may determine whether Albert Einstein's Theory of Relativity is correct, and could dramatically change our understanding of the universe. The theory, introduced in 1905, holds that if an observer moves at a uniform speed, no matter how fast or in what direction, the laws of physics and the speed of light are always the same. For example, if you stand still and drop a coin, it will fall straight down. If you drop a coin inside a car while you're driving down the motorway at a steady speed, it will also fall straight down. However, recent theories attempting to combine gravity and particle physics suggest that relativity might not always apply. Changes in space and time may occur that could not be measured easily on Earth.

'The International Space Station will have ultra-sensitive clocks on board, and it is a good place to test the theory', said Alan Kostelecky, professor of physics at Indiana University in Bloomington, USA. 'By comparing extremely precise clocks that can operate under zero gravity, minuscule changes in the ticking rate might be found as the spacecraft moves around Earth'. This would violate Einstein's theory, which says there should be no change if different clocks in the same gravity environment are compared. 'Finding such changes would cause an upheaval in the science community and revolutionise our thinking about the fundamental structure of space and time', Kostelecky said. 'It would lead to insight about how our universe formed and how nature operates'.

A prehistoric alarm clock – a forerunner of the ultra-precise clocks for the Space Station experiments…

Measurements in space have several advantages over ones on Earth, because the Earth's rotation axis and its rotation rate are fixed. In space, the orbital axis of a satellite and its rotation rate can change, and higher speeds are possible. Measurements in space would therefore be more sensitive to minute changes that would violate Einstein's Theory of Relativity. Kostelecky and his colleagues propose using specific types of clocks on the space station. For example, one type would use a 'maser', a cousin of the laser. Instead of emitting light, like a laser, the maser emits microwave energy at a specific frequency, which produces a very specific ticking.

Other types of clocks already planned for flight on the International Space Station could be used as well. Upcoming missions include the Primary Atomic Reference Clock in Space, the Rubidium Atomic Clock Experiment, and the Superconducting Microwave Oscillator. All three are part of NASA's Fundamental Physics Programme. In addition, the Atomic Clock Ensemble in Space will be flown on the International Space Station by the European Space Agency. Kostelecky said clock experiments in space may yield other intriguing results. For example, they might provide evidence for 'string theory'. In addition to the International Space Station, other future missions may also test the Theory of Relativity. The proposed NASA SpaceTime mission would fly three clocks beyond Jupiter and then drop the spacecraft rapidly toward the sun, like an extreme version of an amusement park freefall ride. The high speed of this mission would make possible new kinds of sensitive tests.

The paper by Dr. Kostelecky and his colleagues is in the March 4 issue of Physical Review Letters. It is available at ojps.aip.org/journal_cgi/dbt?KEY=PRLTAO &Volume=88&Issue=9. Further information is available at physics.indiana.edu/~ kostelec. This article is based on a report on the web-site spaceflightnow.com on 29th May 2002.

4.5 SPOT 5 in orbit!

Right on cue, the Earth Observation satellite SPOT 5 of CNES (Centre National d'Etudes Spatiales / French Space Agency) was successfully placed into orbit by an Ariane 4 from the Guiana Space Centre, Kourou, during the night of 3-4 May 2002. Satellite positioning operations and check-out of the satellite's systems went according to plan. The solar panels delivering power to the satellite deployed correctly, and the attitude control system is maintaining the satellite in Earth-pointing configuration. SPOT 5 carries three instruments – HRS (High-Resolution Stereoscopic), HRG (High-Resolution Geometric), and VEGETATION 2. The first images from the SPOT 5 HRG images were obtained on Tuesday 7th May 2002 (see image below).

SPOT 5 image (2.5 metres resolution / black-and-white), of Munich, Germany. © CNES 2002 – distribution Spot Image

Compared to its predecessors, SPOT 5 offers greatly enhanced capabilities that are going to strengthen Spot Image's position in the satellite imagery market. The company is leveraging these new capabilities to redefine the sales strategy underpinning its product and service range and its distribution network. It has already signed two channel partnership agreements for exclusive distribution of SPOT data, with DigitalGlobe in the United States and ImageONE in Japan, anticipating users' keen interest in SPOT 5 imagery.

Thanks to SPOT 5's improved 5-metre and 2.5-metre resolution and wide imaging swath (60x60 km or 60x120 km in twin-instrument mode) Spot Image is ready to serve new customers. The ideal balance between high resolution and wide-area coverage offered by SPOT 5 is a key asset for applications such as medium-scale mapping (at 1:25,000 and 1:10,000 locally), urban and peri-urban planning, and natural disaster management. SPOT 5's other key feature is the unprecedented acquisition capability of its HRS stereo-viewing instrument, which covers vast areas in a single pass. Stereo-pair imagery is vital for applications calling for a precise picture of terrain, such as flight simulator databases and mobile phone network planning. The VEGETATION 2 passenger instrument on SPOT 5 will also provide continuity of environmental monitoring around the globe, like its predecessor on SPOT 4. SPOT 5 is expected to enter operational commercial service within about two months of its launch.

The Spot Image group comprises four subsidiaries, an office in Germany and a dense global network of receiving stations, channel partners and distributors. Through this network, it offers solutions to support private and public decision-makers anywhere in the world. Spot Image, whose first satellite was launched in 1986, is the world's pioneering provider of commercial satellite imagery. For further information, contact Spot Image – Corporate Communications: Anne-Marie Bernard (telephone: +33-5-62194010; fax: +33-5-62194054; e-mail: Anne-Marie.Bernard@spotimage.fr), or Sandrine Franck-May (telephone: +33-5-62194007; fax: +33-5-62194054; e-mail: Sandrine.Franck-May@spotimage.fr). Website: www.spotimage.fr/spot5/spot5_eng.html.

4.6 Launch of NOAA-17 / M weather satellite

On 25th June 2002, the first image from space sent by the USA's newest environmental satellite, NOAA-17 (named 'NOAA-M' until reaching Earth orbit), was beamed to NOAA. Following its textbook launch on 24th June from Vandenberg Air Force Base, California, the new satellite is undergoing a routine functions check before becoming fully operational. Its first image shows cloud patterns over the Great Lakes area. Like other NOAA satellites, NOAA-17 will collect meteorological data and transmit the information to users around the world, to enhance weather forecasting. In the USA the data will be used primarily by NOAA's National Weather Service for its long-range weather and climate forecasts. Interestingly, NOAA-17, a civilian satellite, was launched on its $298 million mission to continue a forty-year legacy of tracking Earth's global weather from space, by a left-over relic of the Cold War, the Titan-2 rocket, which stood as a nuclear-tipped Intercontinental Ballistic Missile in Little Rock, Arkansas from 1969 to 1987.

NOAA-17, built by Lockheed Martin Space Systems Co., Sunnyvale, California, and launched for NOAA under technical guidance and project management by NASA's Goddard Space Flight Centre, is the third in a series of five Polar Operational Environmental Satellites with improved imaging and atmospheric sounding capabilities that will operate to the end of this decade. NOAA-17 will replace a sister-craft launched four years ago, ensuring an uninterrupted flow of data such as imagery, temperature measurements and atmospheric profiles, the building blocks of weather forecasts. The satellites also build long-term databases for climate monitoring and global change studies. 'The launch of NOAA-M will maintain the continuity of polar satellite data and services that started over forty years ago', said Mike Mignogno, NOAA's polar satellite programme manager. '(NOAA-17) will enable continuity of data for monitoring events such as El Nino, droughts, volcanic ash, fires and floods. In addition, it will support the international COSPAS-SARSAT system by providing search and rescue capabilities essential for detection and location of ships, aircraft and people in distress', said NOAA Administrator Conrad Lautenbacher.

Users of the satellites range from NOAA and the National Weather Service, to the Department of Agriculture, US military, Federal Aviation Administration and foreign governments. Meteorologists use the data gathered by the craft to generate weather predictions; agricultural scientists need the information for drought management and monitoring vegetation and soil moisture; and the aviation community uses NOAA satellites to detect and track volcanic ash plumes and re-route aircraft for safety. The NOAA relies on two polar orbiters, each covering the globe every twelve hours.

NASA is responsible for managing the construction of the NOAA weather satellites, getting them launched into space and performing the initial on-orbit checkout. Control of the craft is then handed to NOAA for operations. The remaining two NOAA polar orbiters in this series – NOAA-N and NOAA-N-Prime – will be launched by Boeing Delta 2 rockets in 2004 and 2008, respectively. The launch of NOAA-17 was the eleventh for a refurbished Titan 2 since 1988. All have been successful. Two more are scheduled: the October 2002 launch of the much-delayed DMSP F16 military weather satellite, and the January 2003 flight of the Coriolis ocean wind research craft. This article is based on reports on the web-site spaceflightnow.com on 24-25 June 2002.

4.7 NASA's new 'water-observing' Aqua satellite

NASA's newest Earth Observing System (EOS) satellite, Aqua, is successfully providing data and engineering images. Since its launch on 4th May 2002 from Vandenberg Air Force Base in California, the spacecraft and its six instruments have been undergoing a checking period, and have been performing extremely well. To date, science data in the form of engineering images have been received from five of Aqua's six instruments, with Japan's Advanced Microwave Scanning Radiometer for the EOS (AMSR-E) producing Aqua's first geophysical product: a global map of sea surface temperatures. Initial data from Aqua's MODIS (Moderate Resolution Imaging Spectroradiometer) instrument are expected in late June 2002.

Aqua's AMSR-E began sending high quality data on 1st June 2002. Initial (uncalibrated) AMSR-E data show impressive pictures of the planet's sea surface temperature from the 6.9 GHz vertical polarisation channel, and brightness temperatures from the 89.0 GHz vertical and horizontal polarisation channels and the 23.8 GHz vertical polarisation channel, averaged over the three days (2-4 June 2002). The sea surface temperature map from AMSR-E is indicative of the high level of detail the microwave imager will routinely provide even in the presence of substantial cloud cover. 'After years of preparation on Aqua, I and hundreds of other scientists are thrilled to have the spacecraft launched, and its EO instruments sending down high-quality data', said Claire Parkinson, the Aqua project scientist at NASA Goddard. 'If all goes as planned, these data will lead to improved weather forecasts and a better understanding of Earth's climate system – especially the role of water in it'.

Aqua is an international partnership between USA, Japan and Brazil. The primary role of Aqua, as the name implies, is to gather information about water in the Earth's system. Each of Aqua'a six high-performance instruments collects measurements on a different aspect of the Earth system, providing a holistic view of our home planet. Aqua is part of NASA's Earth Science Enterprise. This article is from a report on the web-site (aqua.nasa.gov/newsroom.html) on 24th June 2002.

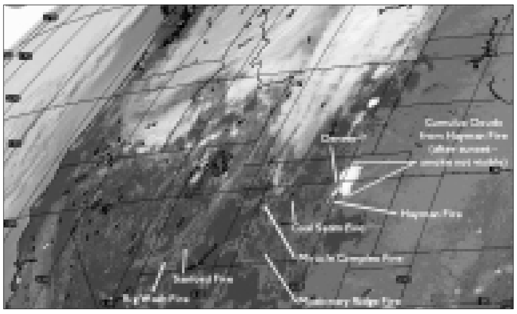
4.8 Satellites detect and monitor US wildfires

Detecting forest fires is now easier for fire-weather forecasters in the National Weather Service and other emergency workers in the United States. This summer, the National Environmental Satellite, Data, and Information Service (NESDIS) of NOAA (National Oceanic and Atmospheric Administration) is routinely producing fire products using a technique – called the GOES Wildfire Automated Biomass Burning Algorithm (WF-ABBA) – that automatically detects wildfires in environmental satellite imagery. NOAA and University of Wisconsin (UW) – Madison researchers worked together at the Space Science and Engineering Centre (SSEC) to develop the technique with information from the GOES (Geo-Stationary Operational Environmental Satellite) weather satellite. The technique is being used to track the massive forest fires that started in June 2002, in Colorado, Arizona, and other western US States.

NOAA researcher Elaine Prins, who leads the group's efforts, said that this environmental satellite is the 'only one that allows us to detect a fire right after it occurs'. The technique is particularly useful with rapidly growing fires, for it can provide information on the fire's progress in real-time. It is also very useful in finding fires in remote areas. Prins noted that three years ago it took up to three hours to process a single GOES image over South America. Since then, her group has taken advantage of faster computers to completely revamp the code that processes the satellite information.

An example of the GOES WF-ABBA product is shown in the accompanying figure.

The fires are overlaid on a satellite-derived (AVHRR) map, classified into thirteen land cover types: tropical forest; forest; savannah; cropland; grassland; swamp / marsh; coast; water; tundra; bare rock; desert; urban area; ice. The WF-ABBA algorithm distinguishes six categories of fire-pixel: processed fire; high-possibility fire; saturated pixel; medium-possibility fire; cloudy fire; low-possibility fire.



NOAA GOES-8 Wildfire Automated Biomass Burning Algorithm (WF-ABBA) imagery, showing fires in the western US at 10:45 EDT on 9th June 2002. The WF-ABBA detects fires every half-hour over the western hemisphere

In March 2002 Chris Schmidt (of SSEC) transferred the GOES WF-ABBA processing system to the NOAA NESDIS Office of Satellite Data Processing and Distribution (OSDPD) Satellite Services Division (SSD), in preparation for the system to become operational this summer. Preliminary tests and comparisons of the WF-ABBA fire product produced at SSD and at SSEC's Cooperative Institute for Meteorological Satellite Studies (CIMSS) indicate that the system is performing as expected. 'A wide range of products that were developed in Wisconsin from GOES measurements are now operationally produced by NOAA / NESDIS in Washington, DC. This includes information on atmospheric motions, Sea Surface Temperature, atmospheric moisture and stability, and clouds,' said Tim Schmit, NOAA researcher at SSEC, who heads the group producing most products from GOES data. CIMSS focuses on developing products from satellite data that will help make more accurate forecasts. The WF-ABBA is the latest in a string of products developed at UW – Madison that are used routinely by the National Weather Service and elsewhere. This article is from a report on the SSEC web-site (www.ssec.wisc.edu/media/WF-ABBA.html) on 19th June 2002.

4.9 NASA satellite confirms 'urban rain' theory

On 18th June 2002 it was reported that NASA researchers have for the first time used a rainfall-measuring satellite to confirm that 'urban heat-islands' create more summer rain over and downwind of major US cities, including Atlanta, Dallas, San Antonio and Nashville.

Dr. J. Marshall Shepherd and colleagues at NASA's Goddard Space Flight Centre, Greenbelt, Maryland, found that urban areas with high concentrations of buildings, roads and other artificial surfaces retain heat and lead to warmer surrounding temperatures, and create urban heat-islands. This increased heat may promote rising air and alter the weather around cities. 'Cities tend to be 1-10 degrees Fahrenheit (0.56-5.6 Celsius) warmer than surrounding suburbs and rural areas, and the added heat can destabilise and change the way air circulates around cities', said Shepherd. Rising warm air may help produce clouds that result in more rainfall around urban areas.

Using the world's first space-based rain radar aboard NASA's Tropical Rainfall Measuring Mission (TRMM) satellite, Shepherd and colleagues found that mean monthly rainfall rates within 30-60 kilometres down-wind of the cities were, on average, about 28% greater than the upwind region. In some cities, the down-wind area exhibited increases as high as 51%. It was also found that, on average, maximum rainfall rates in down-wind regions often exceeded the maximum values in up-wind regions by 48-116%. These results are very consistent with earlier related experiments in St. Louis, Missouri and near Atlanta. 'A recent United Nations study estimates that 80% of the world's population will live in cities by 2025, so a better understanding of the impact of urban land use change on Earth's water cycle system is vital', Shepherd said. The study appears in the July 2002 issue of the American Meteorological Society's Journal of Applied Meteorology.

Earlier research has used ground-based instruments, including rain gauge networks, ground-based radar, or model simulations, to show that urban heat islands can impact local rainfall around cities like St. Louis, Chicago, Mexico City and Atlanta. Although useful, many of these studies were limited to specific cities that had access to relevant data from special observation networks or computer model simulations. But satellites broaden the scope of such research by monitoring changes in rainfall patterns over urban areas on global scales over long periods of time. By showing how space-borne platforms can be used to identify rainfall changes linked to cities and urban sprawl, the research may help land managers and engineers design better drainage systems, plan land-use, and identify the best areas for agriculture. Also, it highlights the need for scientists to account for impacts of urbanisation when they design computer models that forecast the weather or predict regional climates.

This study was funded by the TRMM Project Science Office and NASA Headquarters. TRMM is a joint NASA / Japanese Space Agency mission to study tropical rainfall and its implications for climate (web-site: trmm.gsfc.nasa.gov). Each day, the TRMM spacecraft observes the Earth's equatorial and tropical regions, including the southernmost USA and all of Africa. TRMM is part of NASA's Earth Science Enterprise. Further information and images related to this study are at www.gsfc.nasa.gov/topstory/20020613urbanrain.html. For more information contact Cynthia M. O'Carroll (Cynthia.M.OCarroll.1@gsfc.nasa.gov), Goddard Space Flight Centre, Greenbelt, Maryland, USA.

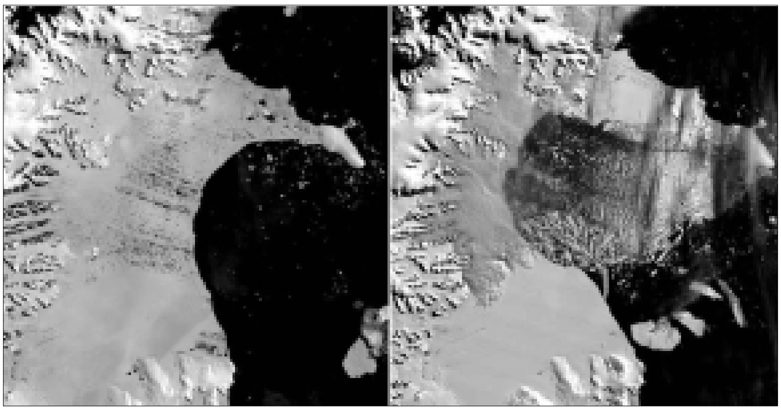
4.10 Satellites capture Antarctic ice break-up

Analysis of Moderate Resolution Imaging Spectroradiometer (MODIS) satellite imagery from January-March 2002, at the University of Colorado's National Snow and Ice Data Centre (NSIDC), revealed that the northern section of the Larsen B ice shelf, a large floating ice mass on the eastern side of the Antarctic Peninsula, had shattered and separated from the continent. The shattered ice formed a plume of thousands of icebergs adrift in the Weddell Sea. A total of about 3,250 km^2 of shelf area disintegrated in a 35-day period, beginning on 31st January 2002. In the last five years the shelf has lost a total of 5,700 km^2, and is now about 40% of the size of its previous minimum stable extent.

Ice shelves are thick plates of ice, fed by glaciers, that float on the ocean around much of Antarctica. The Larsen B shelf was about 220 m thick. Based on studies of ice flow and sediment thickness beneath the ice shelf, scientists believe that it existed for at least 400 years prior to this event, and likely existed since the end of the last major glaciation 12,000 years ago. For reference, the area lost in this most recent event dwarfs Rhode Island (2717 km^2) in size. In terms of volume, the amount of ice released in this short time is 720 billion tons, enough ice for about 12 trillion 10 kg bags. This is the largest single event in a series of retreats by ice shelves in the Peninsula over the last 30 years. The retreats are attributed to a strong climate warming in the region. The rate of warming is approximately 0.5 degrees Celsius per decade, and the trend has been present since at least the late 1940s. Overall in the Peninsula, extent of seven ice shelves has declined by a total of about 13,500 km^2 since 1974. This value excludes areas that would be expected to calve under stable conditions.

Ted Scambos, a researcher with the National Snow and Ice Data Center (NSIDC) at University of Colorado, and a team of collaborating investigators, developed a theory of how the ice disintegrates. The theory is based on the presence of ponded melt water on the surface in late summer as the climate has warmed in the area. Melt water acts to enhance fracturing of the shelf by filling smaller cracks and forcing them through the thickness of the ice due to the weight of the water. The idea was suggested in model form by other researchers in the past (Weertman, 1973; Hughes, 1983); satellite images have provided substantial observational proof that it is in fact the main process responsible for the Peninsula shelf disintegrations. Christina Hulbe of Portland State University and Mark Fahnestock of University of Maryland collaborated with Scambos on the research.

The melt water fracturing theory fared well in this last event. Sequential images (see accompanying graphic) from the MODIS sensor, a new satellite imager flying on NASA's Terra platform, showed extensive melt ponding over the Larsen B on 31st January 2002, consistent with an unusually warm summer and extended melt season. In a series of images taken in February 2002, several melt ponds disappeared, presumably draining through opening fractures in the ice. By 23rd February, 790 km^2 had shattered from the front. The next image (5th March) showed another 1960 km^2 of ice gone, which was almost solely the region covered by melt ponds in the January image. The event continued to 7th March with an additional loss of 525 km^2. The area lost by the shelf was almost solely the region covered by melt ponds in late January. The timing of the event, at the end of a particularly warm summer, is consistent with the theory.



MODIS (Moderate Resolution Imaging Spectroradiometer) satellite images of the Antarctic Larsen B ice shelf, from 31st January 2002 (left) and 5th March 2002 (right) – i.e. before and after its collapse. MODIS images courtesy of NASA's Terra satellite, supplied by Ted Scambos, National Snow and Ice Data Centre, University of Colorado, Boulder

Other scientists, and Scambos, continue to look for additional mechanisms that may contribute to the break-ups. One idea is that meltwater seeping between ice crystals and warming of the shelf as a whole, reduces the fracture toughness of the ice so that the shelf shatters under the same stresses imposed by local geography and the flow it used to tolerate. Another idea is that meltwater seeps into shallow cracks and expands the cracks as it refreezes during the winter. Ocean warming and sub-ice currents dragging on the underside of the ice have also been cited as possible contributors. Although several recent large iceberg calving events have been observed on the Ross and elsewhere in Antarctica, none of these are thought to be related to ice shelf instability. This article is from a report on the NSIDC (National Snow and Ice Data Centre) web-site (nsidc.org/iceshelves/larsenb2002), on 21st March 2002.

4.11 Arctic ice 'melting from below'

Scientists believe they have identified a mechanism which can explain the thinning of the Arctic sea ice. They say the thinning, which in summer reaches more than 40% in some areas, has two causes. Rising air temperatures, possibly the consequence of global warming, are melting the ice from above. And warmer water is also rising from the depths to attack the ice from below. Professor Peter Wadhams, of the Scott Polar Research Institute in Cambridge, UK, said in 2000 that he had established the degree of thinning using measurements from submarines in 1976 and 1996. He said these showed that in that time a large area of the sea ice, stretching from the North Pole to the Fram Strait between Svalbard and Greenland, had thinned by 43% during the Arctic summer. US data from the other side of the Arctic, between the Pole and the Bering Strait, found a similar thinning over the same period.

The reported melting has been questioned by some scientists who believe the ice is still there, concentrated in areas where the submarines have not looked for it. But Professor Wadhams says the thinning he has detected, from 4.8m twenty years ago to 2.7m today, is scientifically explicable. He said, 'People say global warming can't be raising air temperatures enough to melt the ice, because the Arctic winter temperature is around -30C anyway, and a one-degree warming would be irrelevant. But it's the summer temperatures that matter. Arctic summers are getting longer, so there is longer for the warmer air to melt the snow and affect the ice beneath. The other mechanism is the warming of one or two degrees in the water under the ice – enough to increase the bottom melting quite considerably. There is a cold water layer immediately beneath the ice. But that's changing its stability and salinity, because of changes in the distribution of Siberian river water in the Arctic. Over a large area that cold water is becoming more saline and denser, which means it's letting more heat rise through it.'

Professor Wadhams thinks the Arctic could be virtually ice-free during the summer by about 2080. He said, 'The north-east passage across the top of Siberia is already close to becoming commercially viable. It will shorten the existing route from Europe to the Far East by about 40%, from 20,000 km to 13,000 km. Containers going from Germany to Japan on Russian vessels are now using that route experimentally. There'll be huge savings for shipping. And as the route lies through Russia's territorial waters, it will collect fees for providing ice breakers, search and rescue services and so on'.

But for wildlife the prospects are less good. Polar bears are likely to face problems as the sea ice retreats, making it harder for them to hunt the seals on which they depend. Scientists from Norway have begun a long-term programme to tag and monitor bears which, they say, are under threat from both climate change and pollution. They fear man-made chemicals are entering the animals' food chain. One of the research team, Andrew Derocher of the Norwegian Polar Institute, told the BBC the Arctic was being increasingly polluted by industrial chemicals carried northwards by currents and winds. Because the chemicals bond well with fat, high levels build up in the seals' blubber. Initial studies show the bears' fertility is being affected by the chemicals. This article is from the BBC News web-site on 27th March 2002 (news.bbc.co.uk/hi/english/sci/tech/newsid_1894000/1894740.stm).

4.12 Canada's forest inventory uses eCognition

On 8th June 2002, it was reported that Definiens Imaging GmbH (www.definiens-imaging.com) and the Canadian consulting firm Silvatech Consulting Ltd. (www.silvatech.ca) have provided the forest authorities in British Columbia with a strategy for efficient generation of forest inventories, based on eCognition, the object-oriented geo-imaging software of Definiens, for automatic forest analysis. Definiens and Silvatech successfully completed a joint consulting project for the Ministry of Sustainable Resource Management (MSRM) of British Columbia, to automate a portion of the forest inventory creation and update process. MSRM required a fast and precise solution for interpreting satellite images, to map efficiently new clear-cut areas, and classify land.

Experts of Definiens and Silvatech developed specific processes, methods and algorithms for eCognition to meet the requirements of MSRM. eCognition can recognise automatically polygons of different vegetation and identify change features such as new cut blocks and logging roads. Data inputs included Landsat 5 and 7 ETM multispectral and panchromatic imagery, with spatial resolutions of 30 and 15 metres, as well as Ikonos imagery with spatial resolutions of 1 and 4 metres. Integration with value-adding processes is facilitated by eCognition's interface with most of the common software systems for remote sensing analysis, including PCI, Erdas, and Arcview.

The precision and reliability of eCognition were assessed using satellite images of forest areas for which already a huge amount of reference data is available. Definiens and Silvatech also tested the software with images of other test areas, and showed that eCognition's fuzzy classification approach is robust regarding parameter variations. According to Cameron Brown, Strategic Planning and Analysis Forester at Silvatech Consulting, 'the MSRM is very pleased with the results as both aspects of the project – mapping new harvest areas and automating the British Columbian land classification scheme – showed great potential'.

eCognition software provides object-oriented multi-scale satellite image analysis capabilities, and classifies an image based on attributes of the image objects rather than on the attributes of individual pixels. This classification process allows users to collect a large range of statistical parameters and detailed information about any Earth Observation data, and any raster- or vector-based information, tailored specifically to their information needs. Once defined, classification rules can be applied to further images, thus enabling automation of the image assessment. Results can directly be imported into standard GIS, via vector formats. eCognition was awarded the European Information Society Technology prize in 2001, was evaluated by the NIMA pathfinder process in the same year and is globally available through international distributors.

Definiens Imaging GmbH was established in 2001, evolving from Delphi2 Creative Technologies GmbH. For more information contact Markus Heynen, Trappentreustrasse 1, 80339 Munich, Germany (telephone: +49-89-23118045; e-mail: mheynen@definiens.com), or visit the web-site www.definiens-imaging.com.

4.13 Free ViewFinder tool from Leica Geosystems

On 7th May 2002, Leica Geosystems (formed from the recent integration of ERDAS and LH Systems), announced the introduction of ViewFinder 2.1, the latest version of its imagery viewing and manipulation tool. ViewFinder V2.1 is a free viewing tool that provides the ability to: display image files; spatially query image files prior to exporting; overlay, smooth, sharpen and enhance imagery; re-project multiple images 'on-the-fly'; rapidly navigate large imagery data sets; and move imagery from its existing projection system to one of many predefined output datums and projections, creating files in either IMG or TIFF formats. ViewFinder 2.1 supports Windows platforms, and is available for download at www.erdas.com/login/main.asp.

Loaded with the same functionality as ViewFinder V1.1, the previously released version that provided basic image viewing and manipulation capabilities, the latest ViewFinder release has the following new and enhanced features: improved initial display speed; added Military Grid Reference System (MGRS) coordinate display in the Inquire Cursor dialog; added Brightness and Contrast thumbwheels for quick and easy image enhancement; ability to copy the contents of the Main View to the Windows clipboard – data is then easily available for pasting into any application that uses the clipboard; display of image information – provision is also made for building image statistics and pyramid layers; extended library of US and international projection systems for transformations; extended range of raster formats are supported; filtering of files on all raster formats to see all supported images in a directory; ability to swap quickly between non-stretched and Standard Deviation modes of displaying the images; easy display of separate files as a multi-band True Colour image. Further information is at the website www.gis.leica-geosystems. com.

4.14 QuickBird integration in ERDAS IMAGINE

On 21st June 2002, Leica Geosystems GIS and Mapping Division announced that its primary geographic imaging products support QuickBird data, making it convenient for customers to buy and use QuickBird (DigitalGlobe) imagery to create 'GIS-ready' geo-spatial data layers for GIS database revision and update. 'QuickBird sensor model integration in ERDAS IMAGINE provides users with the ability to prepare and extract accurate geo-spatial content using high-resolution satellite imagery', said Mladen Stojic, Product Manager, Leica Geosystems, GIS and Mapping Division. Leica Geosystems imaging products support QuickBird Basic Imagery and Standard Imagery products. Basic Imagery is provided with a full rigorous sensor model and with RPC (Rational Polynomial Coefficients) information. Standard Imagery is provided with RPCs only.

DigitalGlobe's QuickBird commercial imaging satellite provides high-quality 61-centimetre panchromatic and 2.44-metre multi-spectral Basic Imagery and Standard Imagery products. QuickBird Imagery Products are delivered in industry standard 8-bit and 16-bit formats with associated meta-data supported by Leica Geosystems software applications packages, including IMAGINE Advantage, IMAGINE OrthoBASE, IMAGINE OrthoBASE Pro, and Stereo Analyst. In addition to supporting QuickBird Imagery Products in its imaging products, SOCET SET (short for Softcopy Exploitation Tools), the foundation of the GIS and Mapping Division's airborne data acquisition products, will also support this technology. This added capability for SOCET SET is expected to be available in October 2002.

QuickBird was launched in October 2001 from Vandenberg Air Force Base in California. As a high-resolution commercial satellite, QuickBird circles the Earth in a 450-km, 98-degree sun-synchronous orbit, which provides consistent re-visit times year-round. In addition to providing the high-resolution imagery, QuickBird also collects an industry-leading 16.5-km imagery swath. Further information is at the web-site www.gis.leica-geosystems.com.

4.15 QuickBird integration in PCI Geomatics

The opportunity to work closely with DigitalGlobe on the Quickbird project has allowed PCI Geomatics to produce an extremely effective ortho-rectification module, a long-term development priority for PCI Geomatics. The results so far have exceeded all expectations. PCI Geomatics offers a high-resolution module for specifically ortho-rectifiying QuickBird data. Geomatica OrthoEngine High Resolution Models is a powerful satellite ortho-rectification add-on module to Geomatica Fundamentals or Geomatica Prime. The module contains speciality sensor math models for generating precise ortho-images from Quickbird imagery (and other high resolution data such as IKONOS Geo data), correcting for distortions caused by the satellite position, Earth terrain, curvature, and the cartographic projection.

DigitalGlobe provides the highest-resolution satellite imagery product, offering the greatest collection capacity, and the largest image size commercially available. On February 1st 2002, DigitalGlobe announced that they have commenced initial operations with select customers, and are conducting a controlled and phased roll-out of the company operations. A broad commercial product will be available in the third quarter of 2002. As DigitalGlobe operations continue to progress, PCI Geomatics will continue to offer its customers its new high-resolution module for specifically ortho-rectifiying QuickBird data.

The Earth Observation Magazine's (EOM) April 2002 article, co-written by PCI Geomatics Senior Scientist, Dr. Philip Cheng, entitled 'QuickBird - A Milestone for High-Resolution Mapping', is available at www.eomonline.com/Common/currentissues/Apr02/cheng.htm. Search the DigitalGlobe Archive (archive.digitalglobe.com) for various Quickbird Imagery. Further information is at the web-site www.pcigeomatics.com.

4.16 Atmospheric correction with ACORN Version 4

ACORN (Atmospheric CORrection Now) Version 4 is an atmospheric correction software, available from Analytical Imaging and Geophysics (AIG), which uses the ImSpec-licensed Modtran 4 radiative transfer modelling to calculate the effect of atmospheric gases as well as molecular and aerosol scattering. These atmospheric characteristics are used to convert the calibrated sensor radiance measurements to apparent surface reflectance. The technique uses a fast and accurate look-up-table approach to calculate water vapour amounts on a pixel-by-pixel basis. The user may choose to use the water vapour absorption bands at 940 or 1150nm or both, for the water vapour derivations. Additionally the user may input a visibility, or ask ACORN to attempt to estimate the visibility from the data. A set of sophisticated artefact suppression options are included in ACORN. Full documentation, a set of examples and a tutorial are provided with ACORN.

Using ACORN's optional Single Spectrum Enhancement feature, a single known field (ground truth), library, or estimated spectrum is used to assess and compensate for calibration and radiative transfer artefacts in the initial atmospheric correction. ACORN will automatically and accurately convolve this spectrum to the hyper-spectral or multi-spectral data characteristics. This mode produces enhanced atmospherically corrected hyper-spectral or multi-spectral data sets. Examples and a tutorial are provided with ACORN. The upgrade to ACORN 4 is free of charge to all current ACORN users. For further information, including the new features in ACORN Version 4, and the base features from ACORN 3 included in ACORN 4, visit the web-site www.aigllc.com/acorn/intro.asp.

4.17 ORBIMAGE's fish-finding system: Orbmap 5.0

On 13th May 2002, ORBIMAGE announced the release of Version 5.0 of its OrbMap software, in support of its SeaStar Fisheries Information Service. This service combines the world's highest quality plankton data from ORBIMAGE's OrbView-2 satellite with other meteorological and ocean data, to provide digital maps that significantly improve the efficiency of finding fish for high seas fishing vessels. OrbMap software was developed as a decision-making tool for fishing fleet captains to easily view and manipulate ocean information from the OrbView-2 SeaWiFS sensor. New features of OrbMap Version 5.0 include: Fish Finding Wizard; GPS Interface; International Language Support; Enhanced Visualisation; Improved Sea Surface Height anomaly (SSHa / altimetry) Images.

ORBIMAGE is a global provider of Earth imagery products and services, with a planned constellation of four digital remote sensing satellites. The company currently operates the OrbView-1 atmospheric imaging satellite launched in 1995, the OrbView-2 ocean and land multi-spectral imaging satellite launched in 1997, and a world-wide integrated image receiving, processing and distribution network. ORBIMAGE's SeaStar Fisheries Information Service provides fish-finding maps that include OrbView-2 satellite imagery of the world's oceans, to fishing customers world-wide. Currently under development, ORBIMAGE's OrbView-3 high-resolution satellite will offer one-metre panchromatic and four-metre multi-spectral digital imagery on a global basis. More information is available from the web-site www.orbimage.com or by e-mail (seastar @orbimage.com).

5 REVIEWS, PUBLICATIONS AND REPORTS

5.1 March issue correction: Buchroithner review

In the March 2002 issue of the EARSeL Newsletter, in the article in Section 5.4 entitled 'New Croatian textbook on earth imaging', we published an excellent, concise review of the following text-book: Earth Imaging and Exploration from Space: Satellites, Sensors, Applications / SNIMANJE I ISTRAŽIVANJE ZEMLJE IZ SVEMIRA. Edited by Marinko Oluić. Published by the Croatian Academy of Sciences and Arts and GEOSAT Corporation, Zagreb. 516 pages, many colour illustrations and tables. Zagreb 2001. Price: 150 DM.

However, after the review appeared we noticed that the name of the reviewer – Prof. Dr. Manfred Buchroithner of the University of Dresden, Germany (e-mail: buc@ karst.geo.tu-dresden.de) – had been accidentally omitted from the article. I wish to apologise to Prof. Dr. Buchrothner for this unfortunate editorial error.

5.2 Bravo Europe!

Reflections on the successful launch of Envisat

Prof. (em.) Preben Gudmandsen, Lyngby, Denmark

'Bravo Europe' were the first words of a speech given in Kourou by Jean Marie

Luton, after the successful launch of Envisat on Friday 28th February 2002 with Ariane 5 (Flight 145). Mr Luton is Chief Executive Officer of Arianespace that produced the launcher Ariane-5, and is known by many members of EARSeL from the time when he was Director General of ESA. He repeated these words when he commented on the work by the various teams that have been involved in this large programme, at a cost of 2.3 billion €.

From the point of observation (Toucan) about four kilometres from the launch site, it looked like a flawless launch, with the lift-off at exactly 22.07 hours, with an impressive acceleration after the ignition of the main rocket followed two seconds later by that of the two boosters. A few seconds after lift-off, a large 'fire ball' developed, with the heavy bang now reaching the observers. It was an impressive view to follow the launcher through a thin cirrus cloud, gently illuminated by an almost full moon, and further northwards blended with brief information about the drop of the boosters and contacts with the satellite from a radar at Wallops Island, and later by the telemetry station in Svalbard and the separation from the upper stage of the launcher. For many of us who have been involved in the programme since its inception, it was a great relief to see how well the vehicle matched the estimated trajectory. It was presented in real time on a screen, based on radar returns to the tracking station on a hill close to the Guiana Space Centre. About four hours later we learned (through a telephone call to a friend in the mission centre at Darmstadt) that the solar panels had been unfolded successfully, thus ensuring that power will be available for later operation and testing of the ten instruments on board. It turns out that the satellite came into an orbit close to the one projected: 100 metres too high and slightly off the orbital plane; this will be corrected for subsequently, so that the satellite will operate in the same 35-day orbit as ERS 2.

'Lift-off on schedule. All parameters nominal', as it is expressed in ESA jargon. For many days before the launch the ESA Portal on the web gave this expectation with its repeated information on actions taken in Kourou, coloured by personal 'postcards' from Gilles Labruyère (Principal Integration and Test Engineer at Kourou) who reported in a relaxed way on what happened, including that his car was stolen one day. However, we learned later that the launch was near to being postponed due to exceptionally high winds (70 km per hour) during the night between Wednesday and Thursday. It broke two pipes that injected clean and dry air into the equipment casing on top of the launcher, to protect it from the very humid atmosphere prevailing in Guyana. To ensure proper operation, the launcher with the satellite was brought back to the assembly building about two kilometres from the launch site for testing. After a hectic period for all teams involved, the launcher was back again at noon on Thursday, the day before launch.

We congratulate the teams in ESA and in industry for the excellent work carried out, and the mission manager Jacques Louet of ESTEC. But there are also good reasons for congratulating ourselves with this success. The many people, scientists and application researchers, who have waited for this occasion for so long, do appreciate that data from this satellite will add a new dimension to their work. The success was duly celebrated afterwards by guests and team members from ESA and industry, and in his speech, Mr. Antoine Bouvier, Chief Executive Officer of Astrium, stressed the spirit of co-operation between the various teams but referred also to the scientists who have defined the objectives of the Envisat Mission and followed the instrument developments in the Science Advisory Groups.

However, in all the celebration, thoughts about the more distant future did surface among scientists present. What will be available at the end of the life of Envisat (and ERS-2)? Will it be possible to extend the time series of observations by ERS and Envisat for monitoring the environment and the effects of a possible climate change? The outcome of the ESA Council meeting in Edinburgh in late 2001, deciding on the budget for the so-called Envelope Programme for Earth Observation, is certainly not promising. With the success of the Envisat launch, and exploitation of the data acquired, we shall have good arguments for a continuation that should be fully exploited on the political scene. The Envisat programme has created a great amount of experience in industry that should be utilised in future Earth observation programmes to justify the large investment made – of European tax-payers' money.

At the end of his speech, Mr. Luton repeated his initial statement - BRAVO EUROPE – that also included the status of the Ariane programme, where he proudly declared the Ariane-5 launcher fully operational. This was echoed by José Achache, the new Director of Earth Observation Programmes: 'it is important for ESA, it is important for Europe'.

Note: Arianespace announced in its May 2002 newsletter (No. 175) that the projected orbit was reached within 140 metres, with a deviation in orbital inclination of 0.0013°. As a result of this, an additional 2 years of operation of the satellite may be effected due to the saving in the on-board propellant earmarked for orbital adjustment.

5.3 Report: EARSeL Snow and Ice Workshop, Berne

Report on the 3rd EARSeL Workshop 'Observing our Cryosphere from Space: Techniques and Methods for Monitoring Snow and Ice with Regard to Climate Change', held in Berne, Switzerland, on 11-13 March 2002

Dr. Andreas Kääb, Department of Geography, University of Zurich, Switzerland

In a recent world-wide survey on the quality of life in cities, Berne, the capital of Switzerland, was ranked 9th. However, on 11-13 March 2002 Berne was clearly the number one for scientists interested in remote sensing (RS) of snow and land ice! During this time the 3rd Workshop of the EARSeL Special Interest Group on Remote Sensing of Land Ice and Snow, (SIG LIS) took place at the Department of Geography, University of Berne. Just over fifty scientists from Austria, Finland, France, Germany, Norway, Switzerland and USA, enjoyed a successful meeting. The two SIG leaders, Stefan Wunderle and Thomas Nagler, and Stefan's Remote Sensing Research Group, were in charge of the perfect organisation, together with the EARSeL Secretariat.

Snow and land ice are widely recognised not only as one of the most important climate indicators, but also for having a crucial influence on climate. As was made clear in the three invited keynote speeches – given by Hans-F. Graf (Max-Planck-Institute for Meteorology, Hamburg), Martin Beniston (Department of Geosciences, Institute of Geography, University of Fribourg), and Rune Solberg (Norwegian Computing Centre, Oslo – one of the major future tasks for RS of land ice and snow is linking respective observations to climate modelling and understanding. Furthermore, the important feedback mechanisms between snow- and ice-cover and climate were stressed.

The distribution of authors and topics at the workshop made clear the present focus of European research in the field of RS of land ice and snow: microwave RS concerning the technology, and snow concerning the application field. The latter focus on optical- and microwave-based snow applications might reflect the larger impact of snow cover on our environment and society, compared to land ice. The technical emphasis on microwave RS reflects Europe's science policy, but also the still large amount of research needed in order to bring this technology forward as an operational monitoring tool. Radar RS of snow especially includes a number of open questions mostly connected to the variable water content of snow. Most of the studies presented applied ERS 1/2 data, but also other active sensors such as RADARSAT, or passive ones such as SSM/I (Special Sensor Microwave Imager).

For the optical sensors, the focus of the workshop was on large-scale applications using NOAA-AVHRR or MODIS, but also some small-scale studies applying Landsat TM and ASTER, or even airborne LIDAR were shown. Thereby, a trend could be observed in enhancing the information retrieval, by combining RS results with GIS modelling. Such a trend might also be increasingly found in microwave and multi-sensor RS.

The presentations were structured in dedicated workshop sessions on: global and local models; glaciers; snow hydrology; calibration / validation; snow monitoring (optical RS and SAR); snow modelling; snow properties.

Besides the high scientific quality of the contributions, the open and constructive atmosphere during the meeting deserves special mention. The studious yet relaxed frame of the meeting (also extended into the evenings) enabled deep discussions and a lively exchange of knowledge. The author considers the schedule of the sessions, combined with the remarkable discipline of the speakers regarding time-keeping, to be key to that success: 30 minutes were allotted for each talk, but only 15-20 minutes were used by each speaker which offered time for exceptionally lively discussions. Extensive time was also reserved for poster presentations.

The papers are currently being reviewed and will be published in the EARSeL e-Proceedings series on CD-ROM this summer. The next workshop of the SIG LIS is planned for 2004. Further information on the workshops and the SIG LIS is at the web-site dude.uibk.ac.at/lissig/. Warm thanks go to all the organisers, helping hands and participants who contributed to this remarkable workshop!

5.4 Manual of Remote Sensing, Vol. 3, in French

Précis de télédétection, Volume 3: traitements numériques d'images en télédétection (Manual of Remote Sensing, Volume 3: digital processing of images). Régis Caloz et Claude Collet; préface de Ferdinand Bonn

Reviewed by Dr. Lucien Wald, ENSMP, Sophia Antipolis, France

The book is a hard-cover book of 386 pages written in French. It is the third volume of a series, where Volume 1 deals with principles and methods (512 pages), and Volume 2 with thematic applications (670 pages). Volume 3 presents the concepts and the methods used in the digital processing of images in remote sensing (RS). The audience of this book is of course French-reading. It is composed of researchers and students but also of practitioners. The book is very easy to read. The terminology is clear and permits to understand the large variety of subjects presented in the eight chapters. Most, if not all, needs of users of RS data in image and data processing are covered by this book.

Chapter 1 is an introduction to the digital processing of an image, and to the book. Chapter 2 defines an image and several terms used throughout the book. Chapter 3 details the formats of images and defines a few statistical quantities. Chapter 4 deals with the transformations that apply to the radiometry of an image acquired in a single mode. Among these is the correction of atmospheric and sensor effects. Methods are proposed for the restoration of images, and the reduction of atmospheric, illumination and terrain effects on the signal. Chapter 5 discusses the geometrical transformations of images, including ortho-rectification.

Chapter 6 is complex. Under the theme 'visual enhancement of the image', it begins by the contrast enhancement and then introduces the notion of spatial frequencies (the wavevector) and discusses several spatial transforms such as the Fourier and wavelet transforms. It goes on with spatial filters, image fusion and image compression. I do not like this mix and I would have preferred several chapters to treat this complexity instead of a single one of 108 pages. The changes in contrast 'contrast enhancement' should have been treated separately. They are very common in commercial softwares in image processing and it is useful for students to read fundamentals on this subject. The introduction of the Fourier transform could have been maybe shortened with regards to the mathematical developments and I would have preferred more didactical examples (even outside remote sensing) of the Fourier and wavelet transform and of the multi-resolution analysis. A final comment on this part is that it does not mention at all the existence of other transforms of similar objectives. Having introduced all the notions and concepts, the spatial filtering is clearly presented. Finally, I was puzzled by the presence of a section 'image fusion' and of another 'image compression'. Image fusion cannot be reduced to the presented section and a more detailed title should have been selected to avoid confusion. The compression technique has an influence on the perception of information but this section may appear separately, e.g. in Chapter 3, since the concepts of spatial frequencies are not necessary in this section.

Chapter 7 deals with the production of non spectral images, that is of images that result from a processing of one or more modalities (spectral images). A section details the vegetation indices. Another one discusses the orthogonal transformations and focuses on the tasseled cap and on the principal component analysis. A last section is devoted to the production of images representing the textural information. I found this chapter very useful because it presents in a few pages several indices (vegetation and textural) that are often used in remote sensing but which I regularly forget.

Chapter 8 deals with the most important type of processing in remote sensing: classification. This chapter is rich but written in a simple manner and reaches its objectives. It proposes several references for further reading in this domain. One may note that many segmentation techniques (e.g. Markov fields) are omitted but since they are not implemented in the commercial software used by practitioners and many researchers, I believe it was not in the scope of the authors.

The authors decided to include very recent tools in their book. It is very fruitful for persons not aware of these tools and willing to acquire a first knowledge. However, I would have liked to see a note stating that the presentations aimed at a first contact and that these domains are evolving as well as their understanding and the underlying concepts and further their presentation to the general public. As a whole, for all subjects, the bases are well presented. The standard tools are discussed and the latest proven advances are briefly presented. A list of references is given for each chapter. Most of them are those I would have cited myself. Finally, some exercises (and their solutions) are given that are very useful for students. Many of them are simple but this has an advantage: by combing them, one gets exercises of higher complexity, and I appreciate this modularity.

Writing such a book is a very difficult and complex task. The authors succeed in this task in a very satisfactory manner and they should be congratulated. I consider that this book is very complete and that it is a reference book in remote sensing that I will use in my day-to-day work. It is equivalent to the best reference manuals presently available in English. I recommend this book to the French-reading persons working in remote sensing.

5.5 RS and Digital Image Processing Book Series

Book Series: Remote Sensing and Digital Image Processing

Series Editor: Freek D. van der Meer, Delft University of Technology, and Institute for Geo-Information Science and Earth Observation, Enschede, The Netherlands. Editorial Advisory Board: Michael Abrams, NASA Jet Propulsion Laboratory, Pasadena, California, USA; Paul Curran, University of Southampton, Dept. of Geography, UK; Arnold Dekker, CSIRO, Land and Water Division, Canberra, Australia; Steven M. de Jong, Dept. of Physical Geography, Utrecht University, The Netherlands; Michael Schaepman, Remote Sensing Laboratories, University of Zurich, Switzerland.

Published by: Kluwer Academic Publishers (www.wkap.nl/prod/s/RDIP)

Earth observation satellites have been used for many decades in a wide field of applications. With the advancements in sensor technology, Earth imaging is now possible at an unprecedented level of detail. Imaging spectrometers and thermal multi-spectral systems acquire detailed spectroscopic information of physical properties of the Earth's surface. Dynamic processes can now be studied with interferometric systems. SAR interferometry, laser altimetry and high-resolution imaging allow a very detailed, three-dimensional reconstruction of the Earth's surface. With the advent of multi-sensor mission comes a new era of imaging, opening the possibility of integrating data from various sensor systems. The books published in the series explore these topics in remote sensing, and provide a framework for related advanced digital image processing approaches.

Volumes published in 'Remote Sensing and Digital Image Processing': (a) Volume 1: Spatial Statistics for Remote Sensing. Alfred Stein, Freek D. van der Meer, Ben Gorte. Paperback, ISBN 1-4020-0551-2, March 2002. Price: 45.00 EUR / 45.00 USD / 30.00 GBP. (b) Volume 1: Spatial Statistics for Remote Sensing. Alfred Stein, Freek D. van der Meer, Ben Gorte. Hardbound, ISBN 0-7923-5978-X, November 1999. Price: 122.50 EUR / 143.00 USD / 89.25 GBP. (c) Volume 2: Radar Interferometry. Ramon F. Hanssen. Hardbound, ISBN 0-7923-6945-9, April 2001. Price: 75.00 EUR / 69.00 USD / 47.00 GBP. (d) Volume 3: Mathematical and Physical Modelling of Microwave Scattering and Polarimetric Remote Sensing. A.I. Kozlov, L.P. Ligthart, A.I. Logvin. Hardbound, ISBN 1-4020-0122-3, December 2001. Price: 95.00 EUR / 89.00 USD / 60.00 GBP. (e) Volume 4: Imaging Spectrometry. Freek D. van der Meer, Steven M. de Jong. Hardbound, ISBN 1-4020-0194-0, January 2002. 125.00 EUR / 115.00 USD / 78.00 GBP.

5.6 USDA Forest Service's Global Fire Leaflet

The USDA Forest Service – International Programmes is pleased to announce the first edition of our newsletter, 'Global Leaflet.' This first issue covers fire and how the Forest Service engages in this topic around the world. It features research, policy and management issues from Indonesia, Russia and Brazil. The newsletter is available at the web-site www.fs.fed.us/global/news/welcome.htm.

6 FORTHCOMING MEETINGS AND COURSES

6.1 POL-inSAR Workshop at ESA in January 2003

ESA (European Space Agency) has awarded, in the framework of the General Studies Programme, two studies on the benefits of SAR Polarimetry and Polarimetric Interferometry (POL-inSAR) for applications development. The successful launch of the Envisat ASAR in March 2002 is demonstrating the interest of multi-polarisation for new applications development. In this context, the POL-INSAR Workshop will be hosted by ESA and held at ESRIN, Frascati, Italy, from 14-16 January 2003. The Workshop is open to ESA Principal Investigators and scientists working in the field of SAR Polarimetry and Polarimetric Interferometry (POL-inSAR), and to representatives from national, European and international space agencies.

The main objectives of the workshop are: to provide a forum for scientific exchange; to present new results from European studies in the field; to present the geophysical parameters that can be retrieved and their accuracy; to assess the available POL-inSAR tools and data sets; to demonstrate the latest techniques; to assess the state-of-the-art in the field; to make recommendations for algorithm development and new products; to formulate recommendations for future missions and applications.

The event will comprise the following sessions: studies on polarimetry / interferometry; agriculture / land cover vegetation; sea ice; advances in polarimetric interferometry; applications development; Envisat early results; airborne / spaceborne systems and products. The deadline for the submission of abstracts is 15th September 2002. Further information is on the website earth.esa.int/polinsar.

6.2 OEEPE organises on-line courses in RS, GIS

The European Organisation for Experimental Photogrammetric Research (OEEPE) is organising e-learning courses about advanced techniques in photogrammetry, remote sensing and GIS. The first three courses will take place in October and November 2002. The courses will be started at an introductory seminar at Aalborg University, Denmark (10-12 October 2002), where a computer conference system and the course-ware will be introduced. The two-week distance learning courses will use the Internet together with interactive learning software and other course-ware. Communication with researchers of OEEPE will be part of the courses and seminar. The first three courses include 'Integrated Sensor Orientation', 'Automatic Orientation of Aerial Images on Databases', and 'Airborne Laser-Scanning and Interferometric SAR'. The courses will be held by Prof. C. Heipke, University Hannover, Prof. J. Höhle, University of Aalborg, and Prof. K. Tempfli, ITC Enschede. More information and an application form can be found at the web-site www.i4.auc.dk/jh/eduserv/homepage or www.oeepe.org. A few scholarships are available for students. Interested persons can send an application to J. Höhle (jh@i4.auc.dk) until 1st August 2002. A certificate for successful participation will be given to the participants at the end of the courses. OEEPE is planning a repetition of these courses as well as new courses with other topics.

6.3 Snow Processes Workshop at IUGG2003, Japan

Between June 30 and July 11 2003, the Science Council of Japan and sixteen Japanese scientific societies will host IUGG2003, the 23rd General Assembly of the International Union of Geodesy and Geophysics (IUGG), in Sapporo, Japan (web-site www.jamstec.go.jp/jamstec-e/iugg). As part of IUGG2003, the International Commission on Snow and Ice (ICSI) of the International Association of Hydrological Sciences (IAHS) is organising, together with the International Association of Meteorology and Atmospheric Sciences (IAMAS), the workshop 'Snow Processes: Representation in Atmospheric and Hydrological Models' (JWH01), on 9-10 July 2003.

This workshop aims to bring together researchers from the hydrological and climatological communities to examine current methods of modelling snow in order to develop a more consistent and comprehensive approach to representing snow in various models. The workshop will have two main sessions, one on open environments and the other on forested environments. Both sessions will examine snow accumulation and ablation processes and modelling. A synthesis session will highlight recommendations on improving representations of snow processes in various modelling strategies. Poster sessions will be available. All accepted abstracts will be published in the Proceedings of the 23rd IUGG. Full manuscripts can be reviewed and assessed for optional inclusion in a special issue of the Journal of Hydrometeorology devoted to the workshop. Papers for this special issue will be submitted to the Convenor at the workshop.

The deadline for electronic submission of abstracts is 30th January 2003. Full abstract information is on the IUGG web-site (see above). Notification of acceptance will be in March 2003. It is recommended to contact the Convenor before the abstract deadline, with the title of your proposed contribution, preference for oral or poster presentation, and your intentions regarding submission to the Journal of Hydrometeorology special issue. Further information is available from the Convenor (Prof. John Pomeroy, Institute of Geography and Earth Sciences, University of Wales, UK; e-mail: john.pomeroy@aber.ac.uk) or from the web-site www.cig.ensmp.fr/~iahs/sapporo/iahs-sapporo.htm.

6.4 Calendar of Forthcoming Meetings

5-9 August 2002
Edinburgh, Scotland

International Symposium ForestSAT: Operational Tools in Forestry using Remote Sensing Techniques
Contact: Juan C. Suaérez. E-mail: juan.suarez@forestry.gsi.gov.uk / ForestSAT@forestry.gsi.gov.uk. Web: www.forestry.gov.uk/forestSAT.

NEW
8-9 August 2002
Fairbanks, Alaska, USA

International Workshop on Small-Scale Sea Ice-Ocean Modeling (SIOM) for Near-Shore Beaufort and Chukchi Seas
Contact: Ms. Kathy Glodowski, International Arctic Research Centre, Fairbanks, Alaska. E-mail: katcam@iarc.uaf.edu. Web: www.frontier.iarc.uaf.edu:8080/SIOM-Workshop-02/

12-16 August 2002
Ceské Budejovice, Czech Republic

4th International Conference on Reservoir Limnology and Water Quality
Contact: Jakub Borovec, Conference Secretary. Phone: +420-38-777 5877. Fax: +420-38-530 0248. E-mail: reslim@hbu.cas.cz

16-19 September 2002
Budapest, Hungary

GSDI 6 Conference – From Global to Local
Contact: EUROGI. E-mail (general information): eurogi@euronet.nl. E-mail (local arrangements): gabor.remetey@fvm.hu

16-18 September 2002
São José dos Campos, Brazil

ISPRS Comm. VI Mid-Term Symposium: New Approaches for Education and Communication
Contact: Dr. Tania Maria Sausen, INPE, Brazil. E-mail: tania@ltid.inpe.br

18-20 September 2002
Bonn, Germany

2nd EARSeL Workshop: Remote Sensing for Developing Countries
Contact: Prof. Dr. G. Menz. E-mail: menz@rsrg.uni-bonn.de. Web: www.rsg.uni-bonn.de/earsel_2002/index.htm

19-23 September 2002
Zakopane, Poland

Conference on GIS and RS in Mountain Environment Research
Contact: Jagiellonian University, Krakow. Phone: +48-12-4230354. Fax +48-12-4225578. E-mail: confe2002@enviromount.uj.edu.pl. Web: www.enviromount.uj.edu.pl

23-24 September 2002
Antalya, Turkey

Remote Sensing of Mediterranean Coastal Areas
Contact: Prof. Merya Maktav. E-mail: dmaktav@ins.itu.edu.tr

23-27 September 2002
Crete, Greece

SPIE Conference: Remote Sensing for Environmental Monitoring, GIS Applications, and Geology II
Web: spie.org/conferences/calls/02/rs/confs/RS09.html

NEW
2-4 October 2002
Prague, Czech Republic

23rd Urban Data Management Symposium (UDMS) / 3rd Conference on Municipal Information Systems (MIS)
Contact: Ms. E.M. Fendel, UDMS Executive Secretary, Delft, The Netherlands. E-mail: e.m.fendel@citg.tudelft.nl. Web: www.imip.cz/digim/en; www.udms.net

10-19 October 2002
Houston, TX, USA

World Space Congress and Exhibition
E-mail: wsc2002@aiaa.org. Web: www.aiaa.org/WSC2002

18-22 November 2002

2nd European Conference on Radar Meteorology (ERAD)
Web: www.copernicus.org/erad. Abstracts: 14 April 2002

3-6 December 2002 Hyderabad, India	**ISPRS TC VII: Mid-Term Symposium: Resource and Environmental Monitoring** Contact: ISPRS TC VII Symposium Secretetarit E-mail: isprstcvii@nrsa.gov.in. Web: www.commission7.isprs.org
2-6 December 2002 Dundedin, New Zealand	**16th IAHR International Symposium on Ice** Global Climate Change and Ice-Covered Waters Contact: Pat Langhorne, University of Otago, Dunedin. Fax: +64-3-4790964 Web: www.physics.otago.ac.nz
NEW 14-16 January 2003 Frascati, Italy	**ESA Workshop: POLinSAR2003 – Applications of SAR Polarimetry and Polarimetric Interferometry** Contact: Veronica Arpaia, ESA / ESRIN, Frascati, Italy. Phone: +39-06-94180605. Fax: +39-06-94 180552. E-mail: envmail@esa.int. Web: earth.esa.int/polinsar
NEW 22-23 May 2003 Berlin, Germany	**Joint ISPRS WG III/6 / IEEE / EARSeL Workshop on Remote Sensing and Data Fusion over Urban Areas** Contact: Prof. Olaf Hellwich, WG III/6 Chair. Phone: + 49-30-31422796. Fax: +49-30-31421104. E-mail: hellwich@fpk.tu-berlin.de; Web: http://www.fig.net/figtree/events/events2003.htm.
3-6 June 2003 Gent, Belgium	**23rd EARSeL Symposium** Contact: Prof. Rudi Goosens, University of Gent. E-mail: Rudi.goossens@rug.ac.be / earsel@meteo.fr
21-25 July 2003 Cambridge, UK	**Cambridge Conference for National Mapping Organisations** Email: cambridge2003@ordsvy.gov.uk. Web: www.ordnancesurvey.co.uk/cambridge