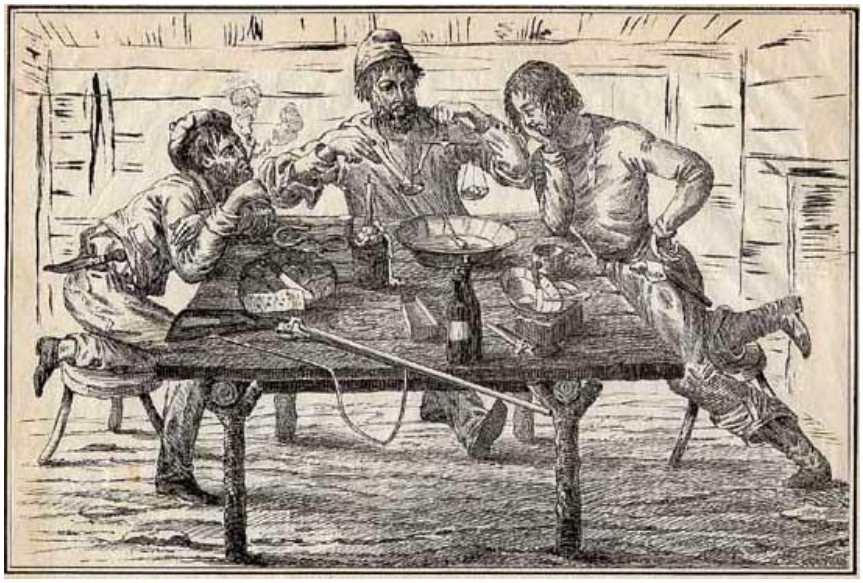
"Good things may come to those who wait, but only the things left by those who hustle". (Abraham Lincoln)

Abraham Lincoln didn't have ASTER data specifically in mind - but our hats are off to those of you who had the foresight and opportunity to build a library of ASTER data while it was still free. After a year-and-a-half of free availability, NASA announced on August 12th, 2002 that future orders for ASTER scenes will be priced at US$60 a scene. (More information on pricing can be found at the USGS ASTER website at 'http://edcimswww.cr.usgs.gov/pub/imswelcome/' and on page 5 of this newsletter.) While the freebies are over, the low data cost and multispectral coverage of ASTER still represent an incredible value and we can expect it to be a major tool used for geological remote sensing for years to come.

To help you make the most of your existing stockpile of images, or catapult new users to power-user status, the GRSG will host two full days of ASTER-themed presentations at our Annual General Meeting in London in December. Sixteen papers have been accepted for the AGM and these have been organised into sessions for mineral exploration, hydrocarbon exploration, geological mapping, environmental applications, and processing techniques. While the meeting programme is nearly full, we might be able to squeeze in an extra presentation or two, so if you have some really exciting results please consider contacting the GRSG with an abstract. There will also be a one-day workshop covering all aspects of ASTER data use including data options, ordering procedures, processing techniques, and geological interpretation.

If the number of papers submitted is any indication of the level of interest, we're expecting a large turnout and believe you will find it a very worthwhile meeting. I hope to see you there.

Dan Taranik
GRSG Chairman
August 2002

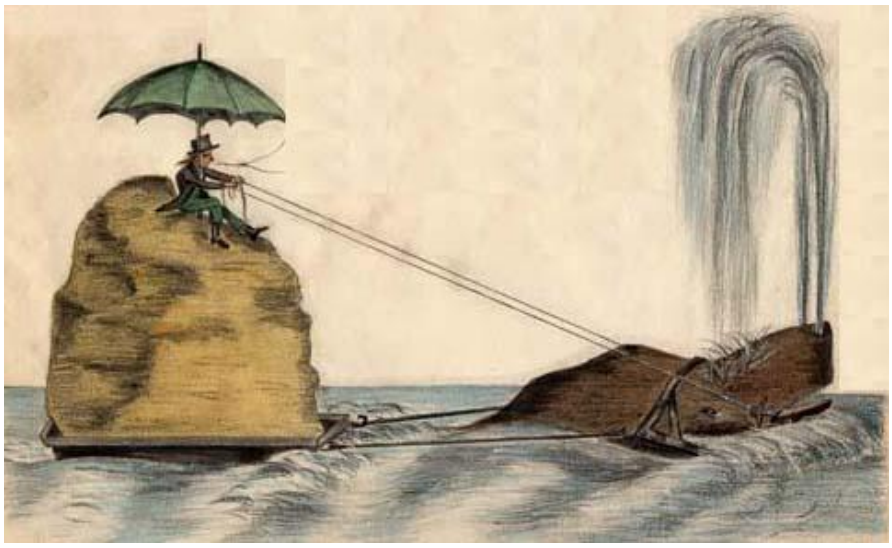


GRSG Committee plans at the Captain's Cabin

AGM

As many GRSG members will be aware the committee is currently planning the next AGM at Burlington House, London. Due to significant interest the meeting has been arranged to cover two days - the 5th and 6th December 2002. The theme of the meeting is "ASTER Unveiled" and will contain up to date and informative presentations and discussions on processing techniques, digital elevation models and applications to the hydrocarbon and mineral industries. It will be a great opportunity to gather and talk about the ups and downs of ASTER data in a relaxed but informative environment. We hope to see you all there.

For those of you planning to cross the water to join us at Burlington House the picture below is for you!



It's OK Fido, only a little further to London

NPA celebrates it's 30th year

NPA, a valued contributor to GRSG over the years, is celebrating 30 years since Nigel Press began the company with interpretation services of Landsat imagery (mostly in black and white!). Today teams within the company are working on projects all over the world. One group has recently spent time in the International Court of Justice in The Hague. The InSAR team is currently studying millimetric surface movements in earthquake prone regions of Japan; and in Europe NPA is involved in a multi-million Euro programme to improve the safety and security of the high-pressure gas pipeline network. NPA's geological interpretation work continues apace with active projects in Alaska and Arabia as well as many areas offshore, in conjunction with most of the world's major oil companies NPA has already screened 60% of the world's basins for seepage using radar. A number of anniversary celebrations with clients, collaborators and friends are taking place this year, the first was held amongst the dinosaurs (not geologists!) at the Natural History Museum and was a great success.

Aqua

From www.aqua.nasa.gov

The Aqua spacecraft was successfully launched on May 4th 2002 and is the latest Earth observing satellite from NASA. Aqua is dedicated to advancing our understanding of Earth's water cycle and our environment. Launching the Aqua spacecraft marks a major milestone in support of NASA's mission to help us better understand and protect our planet.

The primary goal of Aqua, as the name implies, is to gather information about water in the Earth's system. Equipped with six state-of-the-art instruments, Aqua will collect data on global precipitation, evaporation, and the cycling of water. This information will help scientists all over the world to better understand the Earth's water cycle and determine if the water cycle is accelerating as a result of climate change.

Aqua is the latest in a series of the Earth Observing System spacecraft, following the Terra satellite launched in December 1999. Aqua will cross the equator daily at 1:30 p.m. as it heads north. The early afternoon observation time contrasts with the Terra satellite, which crosses the equator between 10:30 and 10:45 a.m. daily. Aqua's afternoon observations combined with Terra's morning observations will provide important insights into the daily cycling of key scientific parameters such as precipitation and ocean circulation.

Aqua is a joint project among the United States, Japan and Brazil. The United States provided the spacecraft and four of the six scientific instruments. NASA's Goddard Space Flight Center provided the Moderate Resolution Imaging Spectroradiometer and the Advanced Microwave Sounding Unit. NASA's Jet Propulsion Laboratory, Pasadena, Calif., provided the Atmospheric Infrared Sounder and NASA's Langley Research Center, Hampton, Va., provided the Clouds and the Earth's Radiant Energy System instrument.

The Aqua satellite acquired data in south-eastern San Antonio, where floods devastated a large area. The rivers that were barely discernible in satellite imagery acquired in late June 2002 stand out clearly in an Aqua MODIS image from July 7, 2002. Heavy rains during the first week of July brought as much as 2 feet of rain to some places in south-eastern Texas, resulting in massive flooding of three major river systems along the Gulf of Mexico. A false-colour image of the area can be seen at http://aqua.nasa.gov/ along with many more examples.

Envisat

Envisat continues in the commissioning phase on a 35 days repeat cycle, 30 minutes ahead of ERS-2; both satellite being controlled to overfly the same ground track, within ±1 Km. The ENVISAT spacecraft with all instruments performs well with stable performances.

As from January, reliable operational services for a subset of calibrated and validated ENVISAT products will start. Validation of products will continue and the turn around time and quality of products and services will be further improved.

According to current plans, Artemis will reach its geo-stationary orbit and be ready for interface testing from February 2003 onwards. The integration of the Artemis relay capability will complete the operational set-up of the mission.

QuickBird

DigitalGlobe(TM) has announced the availability of QuickBird Orthorectified, QuickBird Color (Pan-Sharpened) and QuickBird Two-Foot Imagery.

The new, GIS-ready QuickBird products will offer:

- Orthorectified Imagery - Highest resolution and adherence to established mapping accuracy standards for users requiring GIS-ready products or for users pursuing analytical applications;
- Color (Pan-Sharpened) Imagery;
- Two-foot Standard and Orthorectified Imagery;
- and a Subscription Program which allows customers to receive regular updates of GIS ready orthorectified imagery for change detection and base mapping purposes.

ASTER Pricing Policy

At the direction of NASA, the Land Processes (LP) Distributed Active Archive Center (DAAC) at the U.S. Geological Survey (USGS) EROS Data Center have begun charging for selected ASTER data products. Effective from August 12th 2002, a $55 (US) charge will be assessed for **each** ASTER Level 1A, ASTER L1B, and routinely processed Decorrelation-Stretch granule (image) ordered through the LP DAAC. Additional charges for shipping and handling may also apply.

ASTER Data will still be available at no cost to NASA-funded researchers and affiliated users. Investigators who receive funds directly from NASA through a Grant, Contract, or Cooperative

Also, in the near future the LP DAAC will implement a direct access mechanism (FTP) allowing all users to download ASTER L1A and L1B data without charge (scenes covering the US only). Although these data will be offered at no cost to the general public, distribution is limited to FTP only; media products cannot be generated. Please monitor the LP DAAC home page at http://edcdaac.usgs.gov/ for the announcement introducing the release of this new tool.

Although a charge will be in affect for ASTER L1A, L1B, and routinely processed decorrelation stretch products, all ASTER on-demand products, including digital elevation models, will remain without charge. For more information please visit the ASTER On-Demand web site at http://edcdaac.usgs.gov/asterondemand/

SRTM

Digital topographic data of the United States obtained by the Shuttle Radar Topography Mission have been released to the public. The data can be accessed through the SRTM web site which gives more detail on what's available:

http://www.jpl.nasa.gov/srtm/cbanddataproducts.html

GRACE

After the successful launch on March 17, 2002 the twin GRACE (Gravity Recovery and Climate Experiment) satellites have been orbiting the Earth for more than 4 months. The satellites are in the commissioning phase and are expected to transition into the calibration/validation phase in September.

With the exception of the inertial measurement unit on GRACE 1, all sensors and instruments are operating in the science data collection mode. A preliminary assessment of the early data indicates that the sensors are meeting the mission objectives.

The GRACE mission will accurately map variations in the Earth's gravity field over its 5-year lifetime. The GRACE mission consists of two identical satellites flying about 220 kilometers apart in a near-polar orbit, at about 500 kilometers above the Earth.

Variations in the Earth gravity field affect the twin satellites at different times, leading to a change in the inter-satellite range. The Earth's gravity field is thus inferred from accurate measurements of the distance change between the two satellites using a K-Band microwave ranging system, along with non-gravitation force measurements from a precise accelerometer, and absolute position measurements from a GPS receiver. The system will provide scientists with an efficient and cost-effective way to map the Earth's gravity field with unprecedented accuracy. The results from this mission will yield crucial information about the distribution of mass within the Earth.

The gravity variations that GRACE will track include: changes due to surface and deep currents in the ocean; runoff and ground water storage on land masses; exchanges between ice sheets or glaciers and the oceans; and variations of mass within the Earth. Another goal of the mission is to create a better profile of the Earth's atmosphere. The results from GRACE will make a significant contribution to the goals of NASA's Earth Science Enterprise, Earth Observation System (EOS) and global climate change studies.

GRACE is a partnership between the National Aeronautics and Space Administration (NASA) in the United States and Deutsches Zentrum für Luft- und Raumfahrt (DLR) in Germany. Dr. Byron Tapley of The University of Texas Center for Space Research (UTCSR) is the Principal Investigator (PI).

MSG

ESA Media Relations Bulletin

Almost 25 years after the November 1977 launch of the very first Meteosat, the first representative of the next generation (MSG-1) of European weather satellites has been placed in orbit.

On 27 August at 1945h local time (2245h GMT), a European Ariane-5 launcher lifted off from the Guiana Space Centre, Europe's spaceport at Kourou, French Guiana. The two payloads were placed in geostationary transfer orbit. One of these was the first satellite to be launched under the Meteosat Second Generation programme. Controlled from the European Space Agency's operations centre at Darmstadt, Germany, MSG-1 will now make a series of manoeuvres using its onboard propulsion system which will take it to its definitive geostationary orbit a few weeks hence.

Eumetsat will be taking over MSG-1 at the end of September, following in-orbit checking of its systems, and will then proceed with acceptance of the payload. The first image from the satellite is expected by the end of October. About a year after launch, MSG-1 will commence operational service above the equator, at 0 longitude, taking over from Meteosat-7 as the main weather- and climate-monitoring satellite. Two and a half times larger than the Meteosat-1 to -7 series, MSG-1 is a cylindrical satellite 3.22 metres in diameter and 3.74 metres in height. Its mass on lift-off was 2 tonnes, almost half accounted for by the propellant needed to place it on station and keep it there during its seven-year mission.

The MSG programme aims to build on Meteosat's success to date by flying new, more powerful and accurate instruments for continuous observation of the Earth's atmosphere through to the year 2014. The MSG satellites are going to carry on the uninterrupted monitoring performed by their predecessors over the past quarter of a century, generating a multitude of data essential to the understanding and modelling of our planet's climatic activity.

The two main instruments on board are the SEVIRI and GERB radiometers.

SEVIRI (Spinning Enhanced Visible & Infrared Imager) will be able to supply, at intervals of 15 minutes (compared to 30 with the first generation), images of the hemisphere observed by the satellite in 12 different visible and infrared wavelengths (a fourfold increase). This enrichment of the spectrum of observations is a major advance, making for improvement of numerical climate modelling. By delivering data at twice the previous frequency, MSG-1 will make it easier for climatologists and meteorologists to detect the start of sudden weather phenomena, such as snow, thunderstorms and fog. Similarly, with the improvement of image resolution in the visible spectrum, to 1 km from 2.5 km previously, observation and monitoring of local phenomena will be improved.

The GERB (Global Earth Radiation Budget) radiometer will supply crucial data on the Earth's radiation budget - the balance between the incoming radiation from the sun and the radiation returned to space. The radiation budget, about which much has yet to be learnt, plays a key role in climate change.

MSG-1 is also flying a payload for receiving and relaying, almost in real time, data from automated stations on the ground. In addition, a special transponder will relay distress signals from ships, aircraft and any other vehicles equipped with one of the beacons used by the COSPAS-SARSAT international search and rescue system.

MSG-1 is to be followed by two identical satellites, for which Eumetsat will be fully responsible. MSG-2 is currently scheduled for launch in early 2005, MSG-3 in spring 2009. Consideration is being given to building a fourth satellite to maintain continuity of the programme beyond 2014.

Leica

Leica Geosystems' GIS & Mapping Division announced that it will release ERDAS Stereo Analyst® Extension for ArcGIS, a fully integrated ESRI ArcGIS software extension that allows users to collect, update, interpret and visualize 3D geospatial information using stereo imagery. The ERDAS Stereo Analyst Extension for ArcGIS is the first system to bring the concept of an oriented image into the ArcGIS world, enabling the GIS user to create and update geo-spatial data stored within the Geodatabase using accurate stereo imagery as reference backdrop. The software is expected to be shipped in the autumn of 2002.

"ERDAS Stereo Analyst's ability to directly transform up-to-date, high-resolution images into a map-accurate database of geospatial information eliminates tedious digitizing and merging of multi-source data, significantly improving the reliability of a GIS while also reducing the steps and time associated with populating and creating a GIS with data" stated Brad Skelton, Vice President, Core Software Development & Integration, Leica Geosystems, GIS & Mapping Division.

The result of collaboration between development staff at Leica Geosystems and ESRI, ERDAS Stereo Analyst Extension for ArcGIS features the ability to create oriented images based on direct support of existing SOCET SET® and IMAGINE OrthoBASE® aerial triangulation data as well as high resolution imagery obtained from IKONOS and QuickBird. In addition, the system includes intelligent photogrammetric functions that enable the customer to use this product without advanced training and education in photogrammetry and 3D feature collection.

Leica Geosystems has signed an agreement designating ESRI® Japan Corporation as Japan's exclusive distributor of the ERDAS IMAGINE® geographic imaging product line from Leica Geosystems. The ESRI Japan joint venture formed by PASCO Corporation and ESRI will function in Japan as an international distributor and consultant of ESRI and ERDAS IMAGINE software. Both ESRI and PASCO are strategic partners of Leica Geosystems. PASCO has also been distributor of ERDAS IMAGINE in Japan from 1987 until the establishment of ESRI Japan, and recently passed a benchmark of selling 1,000 licenses of the imaging system.

Leica Geosystems' GIS & Mapping Division and SeaSpace Corporation have teamed up to create a seamless data transfer between ERDAS IMAGINE® and TeraScan®. This joint development project benefits users of both systems, as the DLL (dynamically linked library) will allow the direct read of TeraScan TDF format files into ERDAS IMAGINE without using a third-party format.

The ERDAS IMAGINE product suite is a geographic image processing software system that allows users to manipulate, visualize and integrate any type of geospatial data into a 2D or 3D environment. ERDAS IMAGINE products are commonly used for oil/gas/mineral exploration, natural resources management, urban and regional planning, environmental monitoring, forestry, academia, engineering, telecommunications, utilities, cartography, oceanography, meteorology, hydrology and military applications.

SeaSpace TeraScan ground receiving stations are used worldwide for reception of direct broadcast data from most satellite systems including L-, S- and X- Band telemetries. TeraScan systems are today being used in environments from Alaska to Antarctica by operational, research and military users. For more information on

SeaSpace's land-based, portable, and shipboard direct broadcast reception and processing systems and software, please visit www.seaspace.com.

For more information about Leica Geosystems GIS & Mapping Division or its products and services, contact: +1 404 248 9000, toll free: +1 877 463 7327, or visit www.gis.leica-geosystems.com.

Research Systems Inc

ENVI 3.5 now has readers for ENVISAT ASAR 1b, MERIS 1b and AATSR 1b. Anyone wishing to have these just need to contact RSI. These readers will also be distributed with ENVI 4.0.

ENVI 3.5 has a plugin for Interferometry called Phasar. Please contact Research Systems for more information at www.rsinc.com.

ENVI 4.0 should be released in Sept/Oct some of the highlights of the new release are:

(a) ENVISAT ASAR 1b, MERIS 1b and AATSR 1b.
(b) EROS 1a & 1b
(c) SPOT 5
(d) Radiometric calibration tool for Quickbird data
(e) A tool to georectify SPOT imagery
(f) Spectral Feature Fitting Tool - Similar to Tetracorder
(g) A change detection tool for use with thematic data

ENVI also have an atmospheric correction tool called FLAASH. FLAASH was developed by Spectral Sciences, Inc., a world leader in optical phenomenology research, in collaboration with U.S. Air Force Research Laboratory (AFRL) and Spectral Information Technology Application Center (SITAC) personnel. Spectral Sciences has been integral to the development of modern atmospheric radiation transfer models, and has worked extensively in collaboration with AFRL personnel on MODTRAN since its inception in 1989. The following URL has more information on its functionality http://www.rsinc.com/envi/flaash.asp

PCI

PCI Geomatics is celebrating their 20th year as a producer of highly capable yet accessible geospatial solutions for the worldwide geomatics marketplace. Geomatica, PCI's flagship product and internationally best selling software solution, unites Remote Sensing Image Processing, GIS/Spatial Analysis, Cartography, and Desktop Photogrammetry into a single productive work environment. Supresoft specializes in the development of professional software for spatial systems, geographical information, and remote sensing. Supresoft's IMAGiS 2.2 offers an advanced 3D visualized geographic information system (GIS) based on 3D environment modeling and landscape reconstruction. IMAGiS technology provides true 3D landscape reconstruction that assists GIS users involved with urban planning, environmental protection, and many other GIS intensive disciplines

Analytical Spectral Devices

Analytical Spectral Devices Inc. has announced the availability of SpecMin Pro, a spectral information and mineral identification system for the earth sciences and mineral resources industries. Developed by Spectral International, Inc. (SII), SpecMin Pro includes a mineral spectral database with over 1,500 spectra of 500 mineral species compiled using a full-range ASD FieldSpec Pro spectroradiometer.
SpecMin Pro is compatible with field and laboratory spectrometers as well as hyperspectral and other remote sensing data sets. It will accept spectra from any

spectrometer or remote sensing images, and will export library spectra for use in image processing programs. In addition to the ASD database, SpecMin Pro includes established mineral databases from the USGS (United States Geological Society) and JPL (Jet Propulsion Laboratories). Data can be searched by mineral species, class, or by wavelength. Information including physical characteristics and bibliographies are provided for each mineral built-in the database. Users may incorporate proprietary data sets using the customised database builder feature.

GeoMedia

Intergraph Mapping and GIS Solutions have announced worldwide shipping of GeoMedia(R) Transaction Manager 5.0. The product is a long term transaction, versioning, and temporal data management software solution that provides a true enterprise approach to managing spatial information for the GeoMedia Professional and Oracle9i(TM) environment. Using GeoMedia Transaction Manager, professionals in the fields of mapping, IT, and GIS can manage the life cycle of data changes while the integrity and validity of valuable enterprise geospatial information is safeguarded.

Key features of GeoMedia Transaction Manager effectively manage long term transactions and temporal data for organisations such as land information management, utilities management, mapping, and transportation agencies that build and maintain data models within or across departments. GeoMedia Transaction Manager capabilities include just-in-time locking; change management; project collaboration; and temporal data capture, query, and visualisation.

For more information about GeoMedia Transaction Manager, visit Intergraph Mapping and GIS Solutions' Web site at www.intergraph.com/gis.

The first remote sensing geologist?

Analytical Spectral Devices (ASD) Inc.
5335 Sterling Drive, Boulder, Colorado USA
Tel: +1 303 444 6522 Fax: +1 303 444 6825
Email: info@asdi.com Web: http://www.asdi.com

Veridian
P.O. Box 134008, Ann Arbor, Michigan
48113-4008, USA
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NPA Group
Crockham Park, Edenbridge, Kent, TN8 6SR
Tel: 01732 865023 Fax:01732 866521
http://www.npagroup.com/

ERDAS (UK) Limited
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http://www.erdas.com

Natural Environment Research Council
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Anglo American
20 Carlton House Terrace,
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http://www.angloamerican.co.uk/mainframe.asp

GeoCorp
480 East Street, Reno, NV
89512 USA
Tel/Fax: ++ (775) 337 1545
Email: geocorp@sbcglobal.net

The Envisat Calibration Review will be held at ESTEC, Noordwijk, The Netherlands, from the 9th to the 13th September 2002.

The Envisat Validation Workshop will be held at ESRIN, Frascati, Italy, from the 9th to the 13th December 2002.

- **11th Australasian Remote Sensing and Phologrammetry Conference**

  September 2-6, 2002
  Brisbane, Australia

- **Remote Sensing for Environmental Monitoring, GIS Applications and Geology II**

  September 23-27, 2002 (SPIE conference)
  Crete, Greece,

- **2nd EARSeL Worshop on Remote Sensing for Developing Countries**

  18-20 September 2002
  University of Bonn, Bonn, Germany.

  This Workshop is organised by the EARSeL Special Interest Group (SIG) on Remote Sensing for Developing Countries, led by Prof. Dr. Rudi Goossens of the University of Gent, Belgium, and by Prof. Dr. Gunther Menz of the University of Bonn, Germany.

- **Geographic Information Systems and Remote Sensing in Mountain Environment Research**

  19-23 September 2002
  Zakopane, Poland.

- **International Symposium on Geographic Information Systems "GIS2002"**

  23-26 Sept 2002
  Istanbul, Turkey

  Contact: P: +90-212-285-3921/3782
  email: gis2002@itu.edu.tr
  www.gis2002.hkmo.org.tr

- **9th International Symposium on Remote Sensing"Remote Sensing 2002"**

  23-27 Sept 2002
  Crete, Greece

  Contact: P: +1 360/676-3290
  email: spie@spie.org
  spie.org/conferences/calls/02/rs/

- **Second International Conference on Geographic Information Science "GIScience 2002"**

  26-28 Sept 2002
  Boulder, Colorado, USA

  Contact: David M. Mark dmark@geog.buffalo.edu
  www.giscience.org/

- **Celebrating 50 Years of Geodetic Science Commission II**

  1-5 Oct 2002
  Columbus,Ohio, USA

  Contact: Prof. Chen Jun (President Comm II)
  email: chenjun@nsdi.gov.cn

- **4th African Association of Remote Sensing of the Environment (AARSE) Conference**

  14-18 Oct 2002
  Abuja, Nigeria

  Dr. Tsehaie Woldai
  Tel: +31-53-4874279, Fax: +31-53-4874336, email: woldai@itc.nl
  email: secretariat@aarse.org, www.aarse.org/, www.itc.nl/~aarse/

- **VII International Congress on Earth Sciences**

  21-25 Oct 2002
  Santiago, Chile

  Contact: Col.J.E.G.Palacios
  Tel: +56-2-460-6814/6813, Fax: +56-2-460-6878
  www.igm.cl

- **International Symposium on interaction between volcanoes and their basement and related geological hazards**

  22-23 Oct 2002
  Santiago, CHILE

  Contact: Professor Alessandro Tibaldi
  Tel: +39-2-64484332, Fax: +39-2-64484273
  email: alessandro.tibaldi@unimib.it, www.igm.cl/Inicio.htm

- **SPIE's Third International Asia-Pacific Symposium on Remote Sensing of the Atmosphere, Environment, and Space**

  23-27 Oct 2002
  Hangzhou, CHINA

  Contact: Kristi Kelso
  Tel: +1-360-676-3290, fax: +1-360-647-1445
  email: kristi@spie.org www.spie.org

- **International Symposium of Remote Sensing (ISRS 2002)**

  30 Oct - 1 Nov 2003
  Sokcho, Korea

  Tel: +82-2-910-4813, fax: +82-2-910-4809
  email: ksrs@ksrs.or.kr
  www.ksrs.or.kr

- **ISPRS – 2002 Integrating Remote Sensing at the Global, Regional and Local Scale.**

  November 8-15, 2002
  Denver, Colorado, USA

  The 15th William T. Pecora Memorial Remote Sensing Symposium/Land Satellite Information IV Conference and the ISPRS Commission I (Platforms and Sensors) Symposium for more information see www.isprs.org.

- **UN Regional Workshop on the Use of Space Technology for Disaster Management for Asia and the Pacific**

  11-15 Nov 2002
  Bangkok, Thailand

  Contact: Office for Outer Space Affairs
  Tel: +43-1-26060-4950, fax: +43-1-26060-5830
  email: oosa@oosa.un.or.at or visit www.oosa.unvienna.org/SAP/stdm/

- **International Symposium on Resource and Environmental Monitoring**

  December 3-6 2002-08-27
  Hyderabad, India

  For further information contact ISPRS TC-VII in association with the Indian Society of Remote Sensing.

NERC Airborne Remote Sensing Facility

Workshop 17-18 December 2002

First Announcement and Call For Papers

The NERC Airborne Remote Sensing Facility invites students and researchers who are using or planning to use airborne remote sensing data to a workshop to be held on the 17-18 December 2002 at a venue yet to be arranged. The provisional programme will include presentations and posters from the user community, and will also provide a forum for the discussion on future airborne sensors. A workshop dedicated to practical training on the use of the ARSF software is planned.

The main objectives are to:

- Report on the progress of current and recent projects, and highlight the science achieved by the user community.
- Introduce the facility capability and data product to new users.
- Provide a forum for the discussion of possible future instruments and platform developments.
- Train future users on the use of airborne and ground instruments and software capability.
- Increase the exchange of information between the Facility and users.

Who should attend?

- Remote sensing researchers planning to use airborne RS data
- Remote sensing researchers planning to use field spectral measurements to calibrate airborne remote sensing data (supported by NERC Equipment Pool for Field Spectroscopy)
- Postgraduate researchers, students and others wishing to develop their understanding of airborne remote sensing applications
- Lecturers and teachers interested in using airborne remote sensing in teaching or training

Programme

The programme is based on the availability of presenters, papers and posters. We intend to represent both the main and new areas of research utilising ARSF data - presenters will have the opportunity for a short (15 minutes) presentation or for poster papers. Detailed agenda, accommodation details and arrangements to follow.

Further information from: http://www.nerc.ac.uk/arsf/home.htm

or

Mrs Ursula Cockrem
Tel 01793 411721
Fax 01793 411545
Email : uc@nerc.ac.uk

Mr Fabrizio Tadina
Telephone 01865 374391
Email : ft@nerc.ac.uk

ASTER in mineral exploration: A brief review

Marc Goosens

Introduction

ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer) is an imaging instrument that is flying on Terra, a satellite launched in December 1999 as part of NASA's Earth Observing System (EOS). ASTER is used to obtain detailed maps of land surface temperature, emissivity, reflectance and elevation.

Its high spectral resolution (3 bands in the VNIR, 6 bands in the SWIR and 5 bands in the TIR), combined with its good spatial resolution (15m for the VNIR, 30m for the SWIR and 90m for the TIR, see table below) makes it a very promising tool for the mineral exploration industry.

The fact that the data are available at such low cost (US$50/scene) increases the attractiveness of using Aster data. Aster imagery has been available now for two years and judging by the rapidly increasing number of orders (over 200 per day, often several hundreds of scenes per order) everybody seems to be aware of its potential. The mineral exploration industry is now discovering the new possibilities offered by Aster. Much experimenting is taking place in order to find out how much we can get out of the data and in what way.

VNIR (µm)	**SWIR (µm)**	**TIR (µm)**
Band 1: 0.52-0.60 (nadir looking)	Band 4: 1.600 - 1.700	Band 10: 8.125 - 8.475
Band 2: 0.63-0.69 (nadir looking)	Band 5: 2.145 - 2.185	Band 11: 8.475 - 8.825
Band 3: 0.76-0.86 (nadir looking)	Band 6: 2.185 - 2.225	Band 12: 8.925 - 9.275
Band 3: 0.76-0.86 (Backward looking)	Band 7: 2.235 - 2.285	Band 13: 10.25 - 10.95
	Band 8: 2.295 - 2.365	Band 14: 10.95 - 11.65
	Band 9: 2.360 - 2.430	
Ground resolution: 15m	Ground resolution: 30m	Ground resolution: 90m

Mapping alteration and geology

We have had the opportunity to perform extensive analysis, including field checking, in various parts of the world, in various geologic settings, and for different styles of mineralisation. On the basis of our experiences we want to present a very brief review of the usefulness of Aster imagery as a tool in mineral exploration.

Spectral Mapping

When we look at the ability to map alteration it is useful to consider some important spectra of individual minerals first (Figure1). We have divided the spectra into four categories: those with the most diagnostic absorption features in the VNIR (a) , in the SWIR-2200nm region (b), in the SWIR- 2300nm region (c), and in the TIR.

The VNIR-minerals (such as goethite, hematite, jarosite) are ususally easily identified. Jarosite also has an absorption feature at 2260nm, but our experience is that the VNIR gives much better results as this feature is often rather weak and thus gets overprinted by clays.

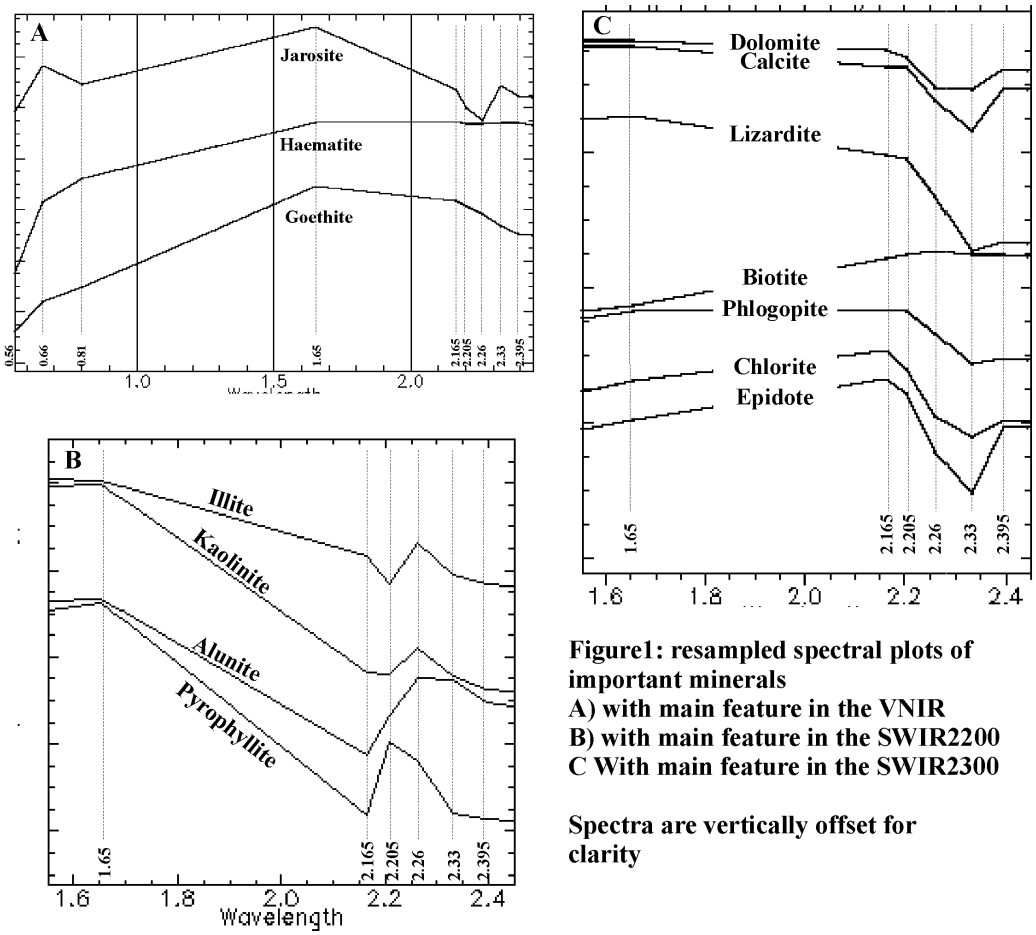


Figure1: resampled spectral plots of important minerals
A) with main feature in the VNIR
B) with main feature in the SWIR2200
C With main feature in the SWIR2300

Spectra are vertically offset for clarity

The SWIR-2200 minerals are normally easily detectable, as they usually exhibit a large absorption feature. Inspection of the SWIR456-color composite will already give an indication of the presence of these minerals. Selection of the appropriate end-members and subsequent classification will normally yield good results. The main confusion will probably arise from mixing. The spectra given in figure 2 a demonstrate for example that a mixture of 40% illite and 60% alunite gives a spectrum that is very similar to that of pure kaolinite.

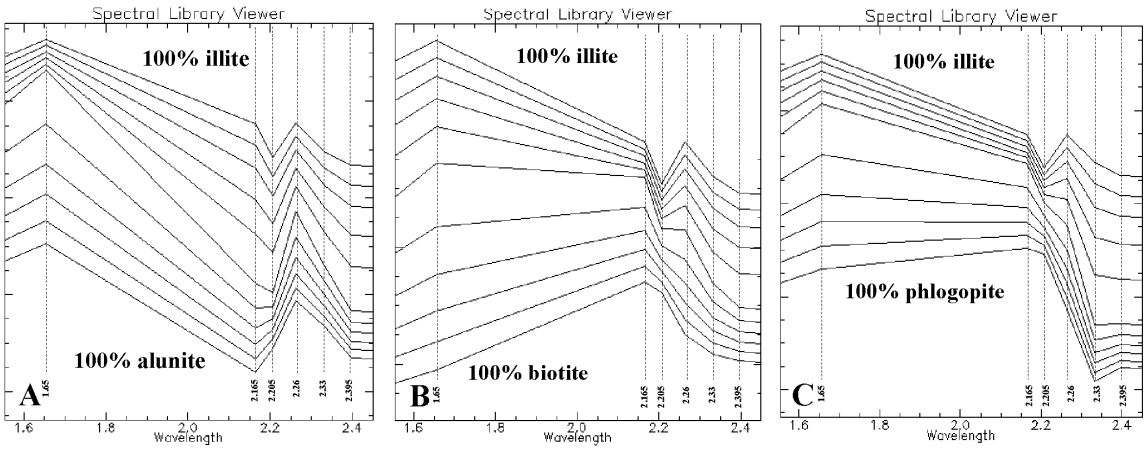
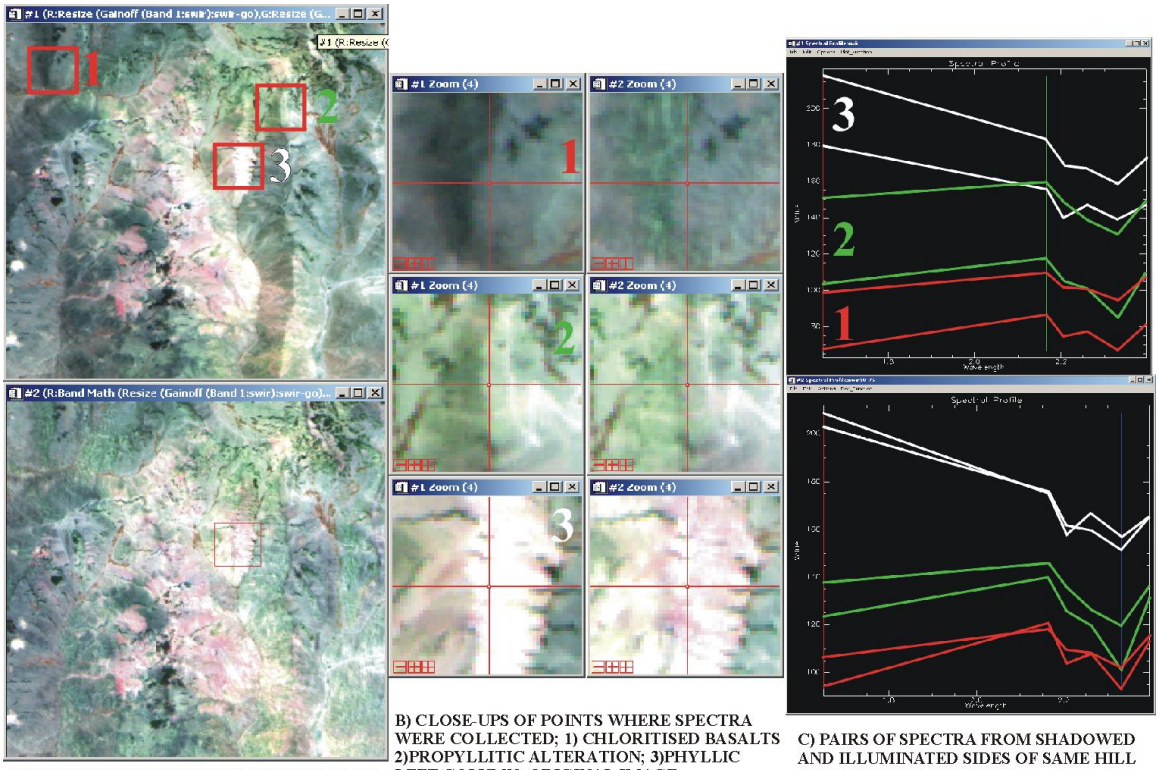


Figure 2: computed spectra for linear mineral mixes. Spectra are offset for clarity

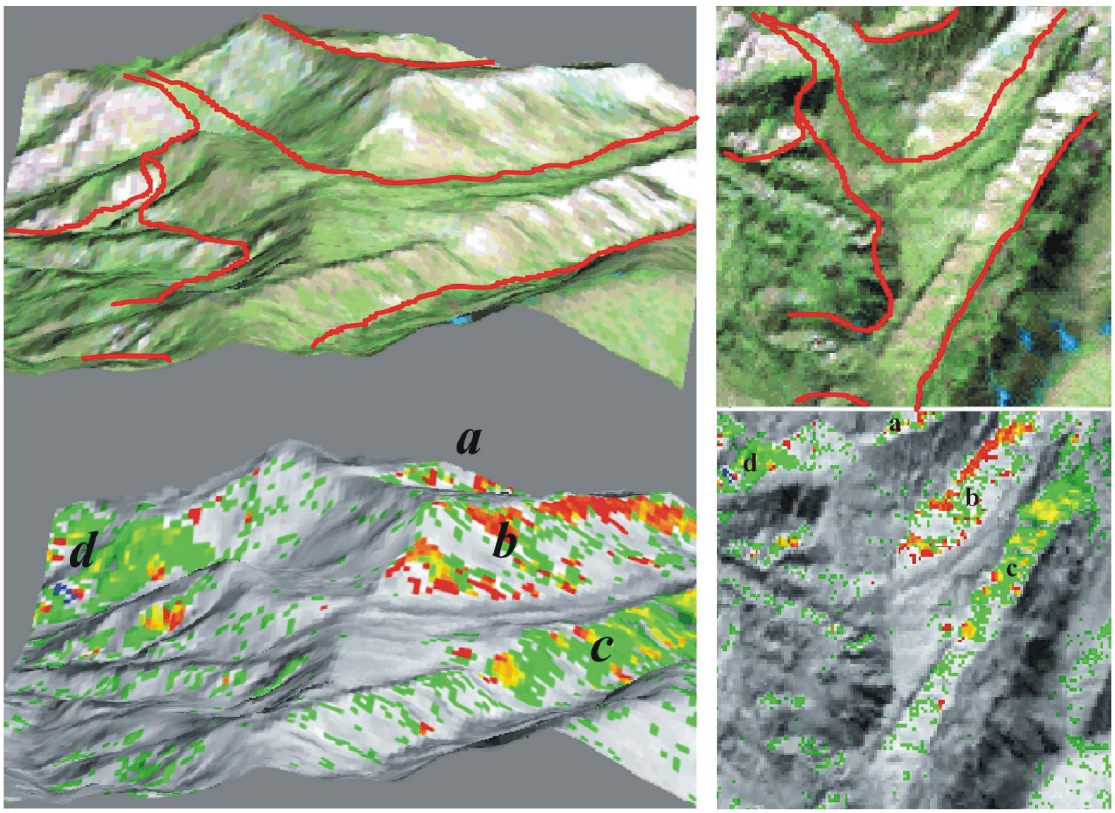


A) SWIR COLOR COMPOSITE. TOP: ORIGINAL BOTTOM: AFTER SHADOW CORRECTION

B) CLOSE-UPS OF POINTS WHERE SPECTRA WERE COLLECTED; 1) CHLORITISED BASALTS 2)PROPYLLITIC ALTERATION; 3)PHYLLIC LEFT COLUMN: ORIGINAL IMAGE; RIGHT COLUMN: AFTER CORRECTION

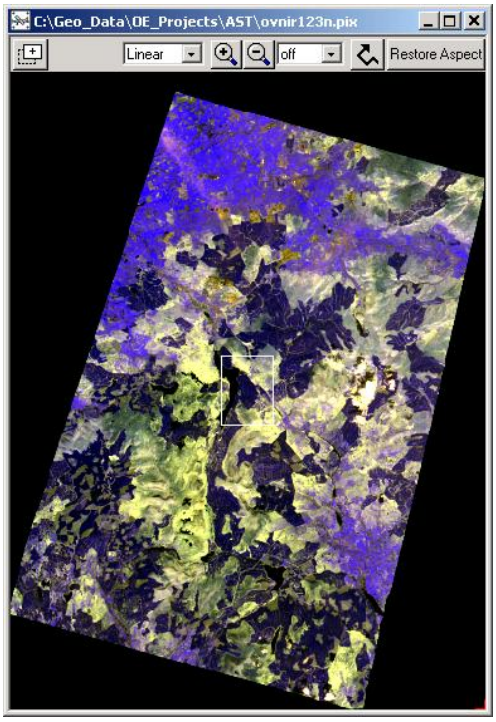
C) PAIRS OF SPECTRA FROM SHADOWED AND ILLUMINATED SIDES OF SAME HILL TOP: ORIGINAL SPECTRA; BOTTOM: CORRECTED SPECTRA

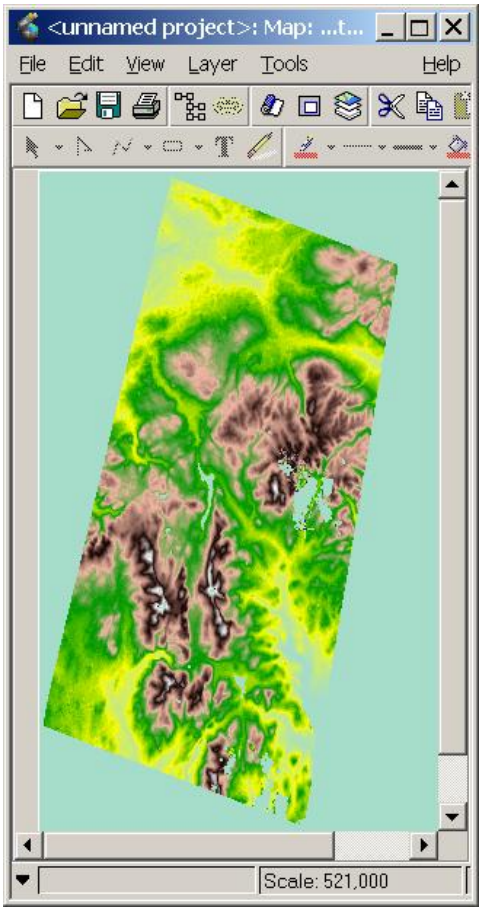
Colour image 1 – (ASTER in mineral exploration, Goosens p21)



A DEM CAN BE VERY HELPFUL FOR LITHOLOGIC MAPPING (TOP) AND INTERPRETATION OF SPECTRAL ANOMALIES (BOTTOM)

Colour Image 2 (ASTER in mineral exploration, Goosens p21)





Left: Graphic 7 (Selby p23) The DEM created from the two input epi-polar ASTER image files
Right: Graphic 8 (Selby p23) The orthorectified VNIR bands 123 image from the area around Loch Doon

Perspective view of Lulworth Cove and the Purbeck Hills (5m aerial photography mosaic from Getmapping), NPA field trip, p28.

The SWIR-2300 minerals mainly consist of carbonates and mafic minerals. Classification of the latter group can be problematic, as they often occur in dark and fine-grained rocks, with subtle spectral variations and low signal/noise ratios. Compared to the SWIR-2200 minerals they are much stronger affected by factors such as mixing (fig.2b,c) and slope. Slope differences result in differences in both albedo and in physical constitution of the surface material. Very often one side of a hill is drier than the other, one side will have more vegetation than the other, and eolian processes will remove soil material from one side of a hill while it will be deposited on the other side. These albedo differences can be corrected for (see colour image), but dealing with the other issues requires field-knowledge.

The TIR images are fundamentally different to the VNIR and SWIR, as they record emitted energy as opposed to reflected. In figure 3 we have presented some representative spectra for rocks and some important rock-forming minerals. These spectra demonstrate that it should be possible to map lithologic variation using the SWIR. Unfortunately, most of the available Aster data are daytime images. As a result the solar heating bands become highly correlated and the images are dominated by shadowing of topographic features, thus partially loosing their lithological information content. However, though subtle, features such as silicification can still be identified sucessfully.

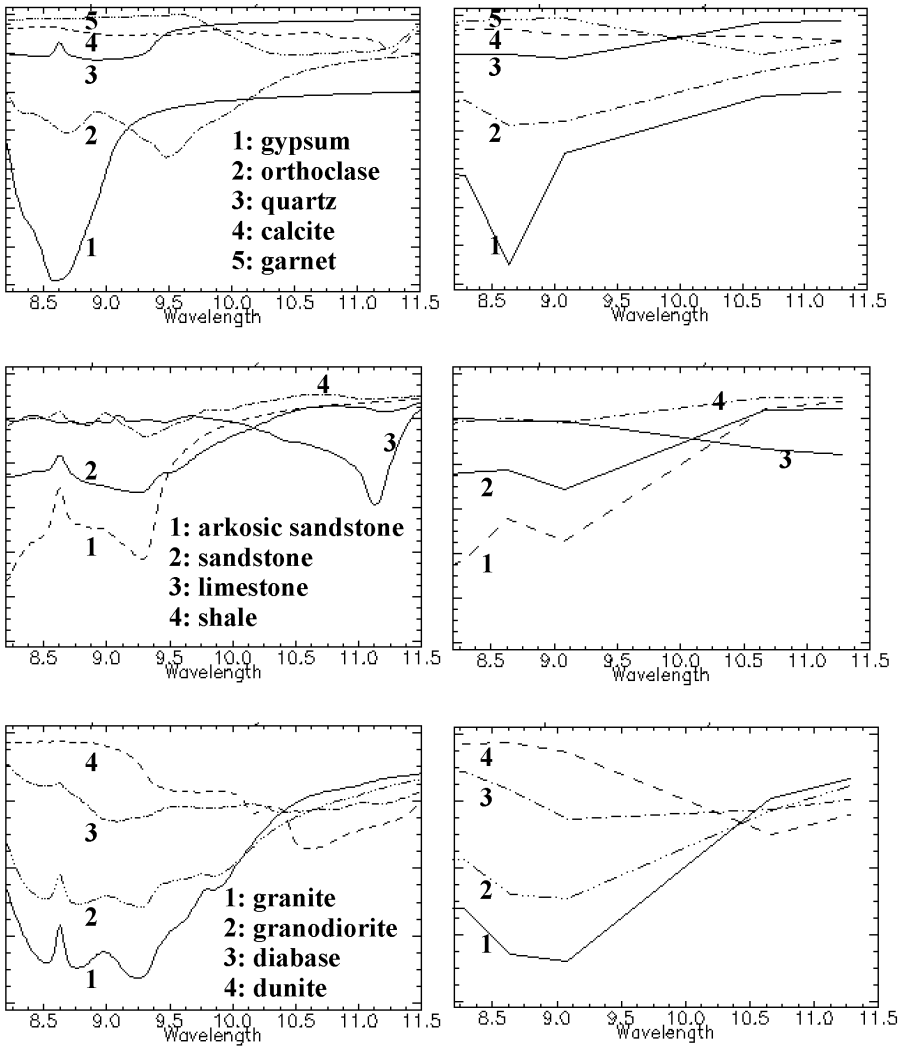


Figure 3: Thermal emissivity spectra for important rocks and rock-forming minerals. Left: full spectrum; Right: resampled to Aster band positions

Lithologic mapping

The ability to map lithology depends strongly on a number of factors:

1) Primary mineralogy; Spectral mapping only works for rocks that are relatively bright are composed of minerals that have an absorption feature either in the SWIR or in the TIR. The VNIR is not very suitable for spectral mapping of lithology;
2) Weathering; Frequently rocks can be mapped by means of their weathering products .Those weathering products, such as chlorites, montmorillonite etc can be mapped with the SWIR (see colour image 1,on p18.);
3) Geomorphology: The high resolution VNIR, combined with the possibility to generate Digital Elevation Models, lends itself well for mapping geomorphologic characteristics, and for extraction of geologic/lithologic information (see colour image 2, top)

ASTER digital elevation models

The Digital Elevation Model contains topographic information derived from along-track, 15m Aster optical stereo data acquired in Near Infrared bands 3n and 3b. It can be created as a Relative DEM (no ground control points) or an absolute DEM (with ground control points, supplied by the user). These DEMs have a horizontal resolution of 15m, and a vertical resolution of a few meters (5 degrees over horizontal distances of more than 100m).

According to the specifications given by the Aster science team, the accuracy is up to 7m horizontal and vertical accuracy with appropriate ground control, and up to 10 m relative accuracy without ground control). Aster DEMs should meet 1:50.000 to 1:250.000 map accuracy standards.

The fact that it is possible now to produce high-quality DEMs in a relatively cheap manner literally adds a new dimension to the use of satellite imagery in mineral exploration. In the first place, many areas in the world lack good topographic maps. Combination of the 15m-VNIR with contours extracted from the DEM provides us with an excellent topographic base at scales as detailed as 1:50.000. Secondly, the DEM can be used to improve the radiometric quality (atmospheric correction, slope correction, see colour image 1) and geometric quality (orthorectification) of the image. Lastly, the availability of a DEM enables 3D-visualization which facilitates the geologic interpretation of satellite images and the evaluation of spectral anomalies (colour figure 2, on p18.).

Creating Digitial Elevation Models and Orthoimages from ASTER Imagery

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The aim of this article is to demonstrate how to create a Digital Elevation Model (DEM) and orthorectified image from ASTER satellite imagery using PCI Geomatica OrthoEngine software package. The imagery used is from Southern Scotland, around Loch Doon in the United Kingdom. These web sites provide contextual pictures of the area.

http://www.callycastles.plus.com/castles/strathclyde/lochdoon.htm
http://www.videoscotland.com/postcards/513%20loch%20doon%20south.htm
http://www.gla.ac.uk/medicalgenetics/LochDoon.jpg

A DEM created from ASTER imagery can be expected to have a vertical accuracy of approximately 25 meters. Although in areas with less vegetation or man made features, this can rise to approximately 11 meters. It is therefore useful for small to medium scale mapping applications, 1:50,000 to 1:100,000. Elevation models at this scale can be used in areas where DEM data is currently not available, or as an alternative to commercial DEM data products.

In addition to creating the DEM, ASTER imagery can be orthorectified using the DEM generated or any other DEM available for the area. Orthorectification is the geometric correction process by which distortions in the imagery caused by the sensor and the terrain are removed. The output orthoimage can then be used for meaningful ground measurements and to fit with existing map data.

The ASTER sensor is carried on board the Terra satellite that was launched in December 1999. The sensor has 14 spectral bands; three for Very Near Infra Red (VNIR) at 15 meters resolution, six for Short Wave Infra Red at 30 meters resolution, five for Thermal Infra Red at ninety meters resolution. An extra channel of image data is created by the sensor capturing a backwards looking image for the third VNIR band. So for image band three there exists one (nadir) image channel and also a backwards looking (off nadir) image channel. This creates an along-track stereo effect. It is from this along-track stereo pair of images that the operator is able to automatically extract the DEM.

Data types used most commonly for automatic DEM generation such as SPOT and IRS, use data that is across-track stereo. That is the images making up the stereo pair have been captured from two different orbits. The two images may therefore have not been captured in the same time period, which can affect the success of the DEM creation process.

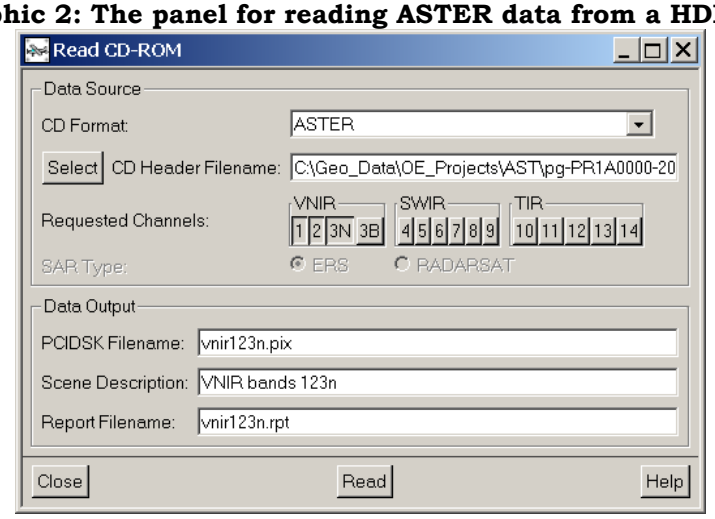
ASTER imagery is along-track stereo. So the two images that make up the stereo pair have been taken very closely together in time. Thus atmospheric, ground surface condition and illumination changes between the two images will be minimal. The downside of along-track stereo is that the stereo separation of the images may not be as optimal for DEM generation as across-track stereo can provide.

Along-track and across-track stereo have their own advantages and disadvantages.

Data Processing

Firstly the output projection required for the output DEM and orthoimages should be set. In this case the UK national projection was used. The ASTER data should then be read from the HDF format distribution file.

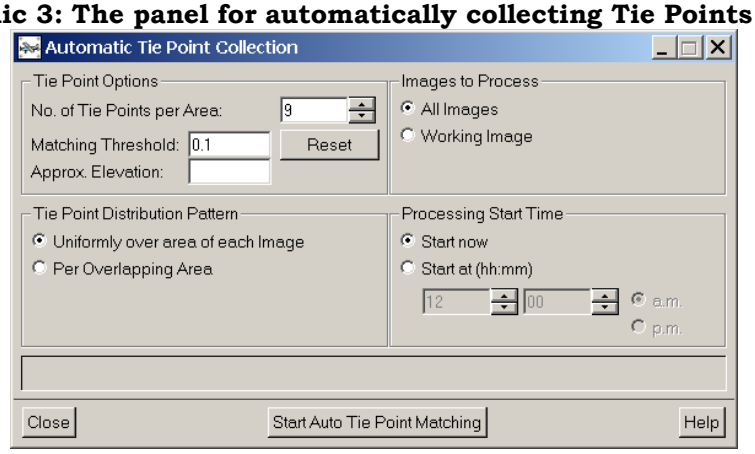
Graphic 2: The panel for reading ASTER data from a HDF file



The first three channels of data are read into one file and the fourth channel into another. The reason for not reading them into a single file is because the backwards looking channel (3B) has a different pixel/line size to the first three channels.

It is possible to automatically create a DEM from these two input files using Tie Points (TPs) only. The addition of Ground Control Points will permit precision geocoding and scaling of the DEM in the Z direction. TPs can be collected manually and/or automatically.

Graphic 3: The panel for automatically collecting Tie Points (TPs)

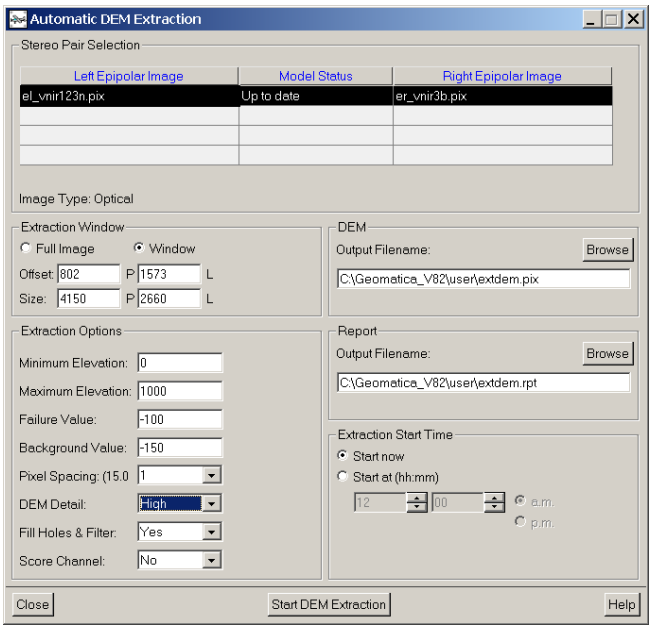


Once any TPs and GCPs have been collected then a Bundle Adjustment operation should be performed. The Bundle Adjustment computes the photogrammetric model using the orbital and sensor ephemeris information, plus the GCPs and TPs.

Epi-polar images are created for both input files. Creating epi-polar image versions of the original input files will remove any offsets between them in the Y direction. The autocorrelation pixel matching algorithm (that is run to automatically create the DEM) will run more quickly on the epi-polar images, because it shouldn't have to search so many pixels to find a match.

When extracting the DEM the whole stereo overlap area between the epi-polar files can be used, or just a sub window processed.

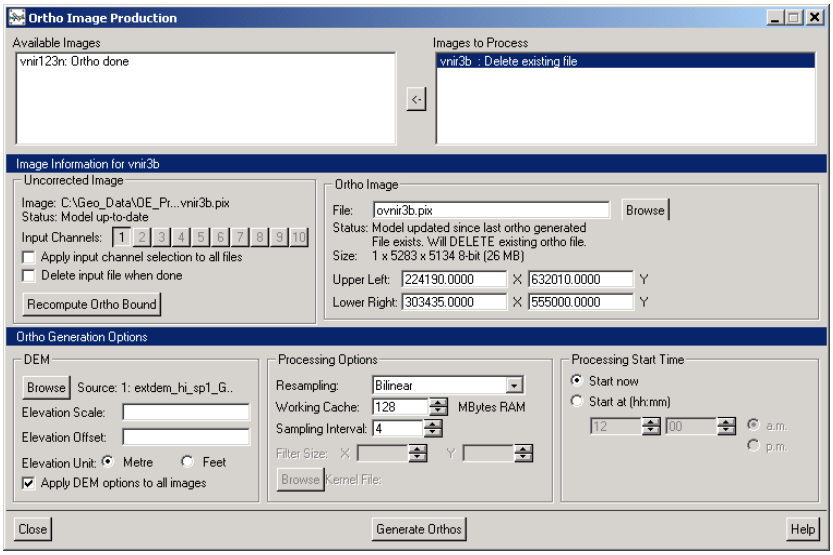
Graphic 4: Setting automatic DEM extraction options for the epi-polar files



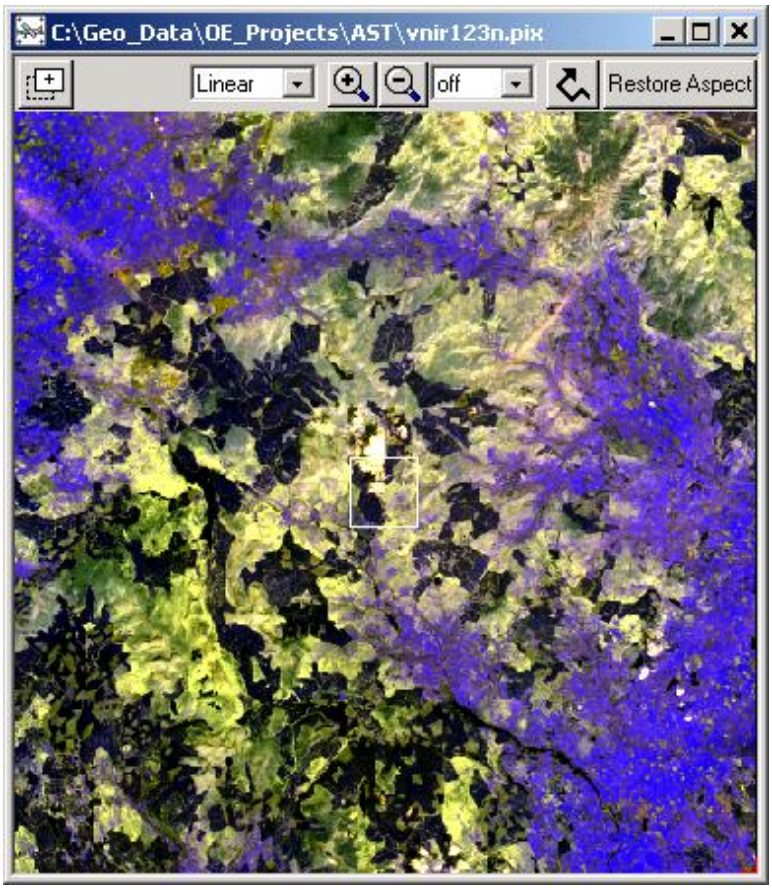
Before creating a DEM for the whole area, it is wise to extract just a sub window of the input files or at a lower resolution first. This way failures in the DEM extraction can be quickly identified and if possible remedied. Failures tend to occur in areas of the image with very low contrast, such as shadows, clouds, water bodies and snow. Small failure holes in the DEM can be filled automatically by interpolation. Large failed areas require manual editing to complete the DEM.

Following the automatic extraction of the DEM, stereo editing can be performed if required to edit out failures. The DEM is then automatically geocoded. Once geocoded it can be used with other data sets and to orthorectify any of the image channels within the ASTER file.

Graphic 5: Setting the orthorectification options for an ASTER image file



Graphic 6: The uncorrected VNIR 123 image from the area around Loch Doon



Conclusion

Extracting a DEM automatically from ASTER data is a relatively straightforward procedure. The addition of Ground Control Points will enable a fully scaled and preciscion located DEM and orthoimages to be created. The resulting DEM and orthoimagery can be used for interpretation of land form and geology. A more detailed step by step version of this tutorial with associated data and evaluation software is available free of charge from the PCI Geomatics UK office.

Measuring Antarctic Ice Shelf Tides from Space

Adapted from space daily

In efforts to determine how Antarctica is changing, whether due to natural or human-produced climate scientists are using satellite and radar technologies to monitor the height and thickness of the continents ice shelves.

The height changes of the ice sheet due to climate can be very small, perhaps only an inch or so per year. In contrast, the ocean tides that flow underneath ice shelves can push them up and down by several feet over the course of a day. This large effect can make it difficult to measure the small climate-related changes with satellites.

Researchers at Scripps Institution of Oceanography at the University of California, San Diego, and Earth and Space Research of Seattle have measured Antarctic ice shelf tides from space for the first time. Helen Fricker of Scripps has analysed 8 years of ERS radar altimeter data to calculate the changes that have occurred in the height of the ice shelves on the 500 mile wide Filchner-Ronne Ice Shelf in Antarctica's Weddell Sea.

"Antarctic ice shelves can be sensitive areas in terms of climate change. We want to monitor their thickness and see if they're in steady-state or whether they are changing with time because of changes in climate." Fricker said the ice shelves can play a critical role in buttressing, or holding back, ice from detaching from the Antarctic continent. Removing them, she said, may increase the flow of ice off the continent. "As that ice melts, it will increase sea level around the world. It's important to monitor not only the grounded ice on the continent and how that's changing, but the floating ice as well," said Fricker. "To do this, we need accurate repeat measurements of ice shelf height and we have to remove the tidal signal because that will mask the true ice shelf elevation."

The next step will take the form of a new satellite called ICESat being prepared by NASA for launch later this year. A new instrument on ICESat, the Geoscience Laser Altimeter System (GLAS), will be the first to measure ice shelves using a sophisticated space-based laser instrument.

GLAS will beam laser pulses 40 times per second, from approximately 400 miles above the Earth's surface, and time each pulse to determine the surface height with an accuracy of better than six inches. Over time this will result in a determination of the surface height change with an accuracy of better than half an inch per year.

"GLAS will be the first spaceborne laser altimeter to cover Antarctica. It will have a much smaller footprint on the ground than the radar altimeter and be able to give us much more accurate measurements than ERS," said Fricker

for more information see http://scripps.ucsd.edu/ or
http://www.spacedaily.com/news/antarctic-02n.html

Also in Antarctica...

ASAR data from the Envisat satellite is being used to plot a safe route through the ice sheet for an ice breaker as it head to rescue a German supply vessel stuck in Antactica. The German vessel has been stuck since 11 June. For more information see http://www.esa.int/export/esaSA/ESAOC976K3D_earth_0.html.

Seep Hunting along the Jurassic Coast

By Robin Cleverly and Alan Williams, NPA Group

As part of NPA's 30 year birthday celebrations (and the generosity of Chairman Nigel) remote sensing staff from NPA Group recently spent an enjoyable weekend hunting for oil and gas seeps along the stunning Dorset Jurassic coast (although the part we visited was more like the Cretaceous coast!).

Fifteen (out of a total of 25) suitably attired and expectant seep hunters (see below) made the trip; including geologists and support staff who all have extensive remote sensing experience, many of whom being part of NPA's offshore exploration team, mapping oil seeps on radar data across the globe. The trip was a good opportunity to show them some actual seeps, albeit not quite on the dramatic scale of say Baku or La Brea (California) and also to demonstrate to the whole group the use of satellite and aerial photography data in the field and the use of GPS for location, tracking and real-time navigation.

The visit kicked off with a quick visit to Wytch Farm – one of Dorset's best kept secrets and Europe's largest onshore oil field and the sixth largest in the UK (thanks to our former BP colleagues for their hospitality). Oil not far below the tourist beaches of Studland and Bournemouth is extracted using very long reach wells (up to 12 km from the well sites). The oil field is currently on decline but still produces about 50,000 bopd – half its peak production – and four times more water than oil. The environmental pressures are such that the oilfield is only visible from the air (or from space) and is indeed a model of how a major oil field can be successfully developed within an AONB (Area of Outstanding Natural Beauty) without harm to the environment and without alienating the local populace.

The Wytch Farm oil reserves are mainly reservoired in the Triassic Sherwood sandstone, at a depth of 1,585 metres, trapped in a fault block inverted during the Tertiary, and sourced from the Jurassic Lias. Oil is also recovered from the Lower Jurassic Bridport reservoir (924m) and most recently from the Middle Jurassic Frome reservoir (800m). All these units are exposed further west along the Devon coast but there was not time on this trip to visit them. The trip focussed on other indications of oil in the region: oil and gas seepages in the Cretaceous section.

The starting point for the geology (and the team hotel) were the much visited, classic exposures of Lulworth Cove and Stair Hole where sticky oil stained sands can be seen, associated with widespread mineralisation. On the eastern flank of the Cove some very indurated bitumen may be indicative of a palaeo-forest fire. The excellent exposure in Stair Hole allowed both Mike Oehlers and Robin Cleverly to impress their captive audience with an explanation of the fascinating structural geology on view, specifically on the origin of the famous Lulworth Crumples (the rock formation, that is, rather than the local confectionery).

Further discussion was stimulated by a walk round the cove to the famous fossil forest but a chance to wonder at the impressive remains of the fossilised tree stumps some 150 million year old, was thwarted by the Lulworth firing range being open on a Saturday. The sounds of tank firing, the danger from ricochets and the many red flags would deter all but the most foolish geologists! Access to a second impressive exposure of oil-stained Cretaceous sandstone (the Wealden Beds) in Mupe Bay was similarly thwarted, we having chosen the only Sunday during the summer when the range was in use.

More oil was found at Osmington where oil has migrated laterally along permeable sand units, and in places dripped down the cliff face. Widespread evidence of fossil burrowing and bioturbation worked up an appetite for lunch at the Smugglers' Inn.

A highlight of the trip was a boat trip to the Lulworth Banks to look at an active seep. The seeps here form a cluster over a Tertiary inversion structure about 2.5km offshore Lulworth Cove (N50.59243 W2.24087). This structure was the site of the first offshore well in the UK, drilled in 1963 from a converted land rig. The tide and sea state were unfortunately not conducive to seep spotting, but clusters of gas bubbles were seen rising from the seabed, and showed up clearly on the onboard sonar. In calmer conditions gas can be seen issuing from the seabed and can be filmed with underwater cameras or sampled with an ROV. In calm seas occasional droplets of oil and oil films can be seen. Seeps in this locality have been used for testing seep detection and sampling methods for the last 15 years, principally by Dr Roger Duckworth, formerly of BP Exploration, but who still retains an unbounding enthusiasm of a true offshore seep hunter.

After a rough sail back to Weymouth, several of the greener staff could appreciate a remote sensing approach to slick spotting. However, the spirits, of the team, particularly those of the lady members, were buoyed by the expectation of meeting the infamous George the Amorous Dolphin who had recently been observe in the Weymouth area demonstrating an unhealthy, distinctly non-Cetacean interest in both propeller shafts and female bathers. Alas, no sighting, George had decided after all that French bathers were more his scene.

On Sunday, an early scenic walk to the stunning Durdle Door helped to dispel any lingering hangovers and provided an opportunity to examine the geomorphology and structure of the coast with excellent views westwards to the Isle of Portland

No visit to this area would be complete without a pilgrimage to Kimmeridge Bay to see the nodding donkey on the cliff-top. The field has been on production by BP for over 40 years and still produces 65 barrels a day. So far cumulative production has been many times the oil-in-place estimate. A rummage amongst the cliff debris produced several ammonite specimens, but the stink of rotting seaweed – redolent of the depositional environment of the Kimmeridge Clay itself – soon drove us off for a final debriefing in the garden of the Scott Arms, Kingston, overlooking the dramatic ruins of Corfe Castle with a view beyond to the Wytch Farm oilfield where the weekend's adventure had begun.

Not that this is applicable to NPA Staff!

NPA's Robin Cleverly explaining the meaning of life (and the origin of the Osmington trace fossils)

NPA staff on their way to find some offshore seeps…

22nd EARSeL Symposium, Prague, 4-6 July, 2002

Richard Teeuw, Geographical Information Sciences Lab, University of Hertfordshire.

The European Association of Remote Sensing Laboratories ran a joint session with the GRSG this year, chaired by Freek van der Meer (ITC and Delft University). Richard Teeuw (University of Hertfordshire) opened the session with a keynote paper on *Trends in geological remote sensing: the GRSG perspective.* This was a GRSG team effort, with examples provided from our members in industry, government and academia. Given the Symposium theme of *RS for European Integration,* the GRSG paper started with a slide from NPA Group, showing zones of high population density and tectonic activity across Europe, overlain by a map showing coverage of ERS data for interferometric studies. The use of InSAR to map the 1999 earthquake around Izmit in Turkey was examined in detail, concluding with a detailed temporal difference image showing structural damage. The pioneering Permanent Scatter Interferometry technique, developed by TRE of Italy in association with NPA Group, was also covered, the example from central London highlighting significant subsidence associated with new Underground railway line excavations. The next slides examined new satellite imagery: the BGS contribution focused on the use of ETM imagery to map Quaternary geological features in Scotland, while Imperial College provided some stunning 3-D views of features in China, derived from ASTER DEMs and VNIR overlays. Moving to airborne systems, Infoterra's expertise in mapping mineral abundancy, using hyperspectral imagery, was illustrated with a case study that utilised HyMap, with PIMA (Portable Infra-red Mineral Analyser) ground-truthing, to map the distribution of minerals such as chlorite, talc, mica and dolomite.

On the environmental geology front, the Environment Agency's National Centre for Environmental Data & Surveillance illustrated the landscape visualisation capabilities of laser altimetry (LiDAR), as well as its ability to carry out bathymetric mapping and to quantify sedimentation processes by DEM differencing. Collecting Compact Airborne Spectral Imager (CASI) data simultaneously with LiDAR has allowed the EA to get accuracies of ca.80% when classifying coastal vegetation types. Most European countries have airphoto coverage that spans the past 50 years: the arrival of relatively low cost and easy to use digital photogrammetry software has allowed us to utilise that valuable archive, examining changes to land cover and landforms. An example from the University of Hertfordshire quantified changes in meander migration (using airphotos from 1948, 1963, 1976, 1988 and 1995) and illustrated how the erosion of flood defence structures could have been predicted. The closing slides included a review of activities in NERC's *de facto* study region for geological airborne remote sensing, centred on the Sorbas Basin of SE Spain. The talk finished with a look to the future, considering the recent arrival of IKONOS and Quickbird imagery; ASTER's boost for mineral exploration; the high expectations of hyperspectral satellites, such as Hyperion and ARIES-1; and a reflection on how ENVISAT's regional-scale data might benefit European integration. Powerpoint slides of this presentation should soon be accessible on the GRSG website.

Robert Vaughan and M.S.Al-Rowili of Dundee University reported on research into the mapping of sand hazards in the Libyan desert, using multi-temporal satellite imagery and the Active Sand Index (MIR-Blue)/(MIR+Blue), along with NDVI. The technique highlighted areas of dune migration since 1987 and is being augmented by particle size distribution studies during the ground-truth surveys. Eugenio Sansosti *et al.* (IREA, Italy) revealed how Differential Synthetic Aperture Radar (DifSAR) has been used to monitor terrain deformation around Vesuvius and the

Bay of Naples over 1992-2000. The study highlighted a cycle of subsidence and swelling in the Campi Flegrei (Phligrean Fields) area, with up to 6.8 cm of crustal movement. DifSAR measurements around Vesuvius are more difficult, due to its dense vegetation cover, and are mostly limited to the extensive recent lava flows. Permanent Scatter Intoferometry studies of Naples showed that periodic changes in the elevations of metal rooftops were due to corresponding heatwaves; and, as with London, significant subsidence was found in association with a new underground railway.

One of the best papers of the joint session – for both content and entertainment value – was given by Klaas ("007") Scholte of Delft University, who is examining mud volcanoes in Azerbijan, using ASTER imagery and ASD field spectrometry. Each of the handful of mud volcanoes in the Baku area contains a unique assemblage of minerals, resulting from the underlying stratigraphy. This is primarily of use in petroleum exploration, as there is a surface expression of underlying source rock, reservoir, and cap rock lithologies. As these mud volcanoes occasionally explode, emitting millions of tons of methane, a temporal change study of the ASTER mineral abundance images may also be of use to Baku's civil emergency planners.

Some well-illustrated posters were presented at the joint session. Akman *et al.* (MTA & NED, Japan) reported on the use of JERS-1, Landsat TM, a DTM and associated GIS analyses to map mineralisation in NE Turkey: some zones of negative relief were found to be associated with hydrothermal alteration. Berardino *et al.* (IREA-CNR, Italy) reviewed the use of ERS DifSAR to map terrain deformation around Vesuvius over the past 10 years. Fadda (Al-Balqa University, Jordan) carried out regional mapping in basaltic terrain, using Landsat TM (742 RGB and 5/7 3/1 5/4 RGB). Mroz & Perski (Olsztyn and Silesia Universities, Poland) used InSAR to map subsidence associated with coal mining, but also went on to produce Inerferometric Land Cover maps, using variations in coherence. Finally, Saad & Mesbah (CNTS, Algeria) used Landsat TM to map the alteration (ferruginisation and kaolinisation) associated with uranium mineralisation.

In the main conference proceedings there were a number of papers with geological applications. In the '3-D remote sensing' session, Goosens *et al.* (Belgium) reviewed ASTER's DEM capability; Ahokas *et al.* (Finland) examined LiDAR accuracies; geoscience applications of the Shuttle Radar Topographic Mission were considered by Selige *et al.* (Germany); and Rott *et al.* (Austria & Italy) showed how ERS InSAR has been used to map slope instability in the Alps – notably movement of up to 4cm/y above a reservoir near Innsbruck.... In the 'Mapping post IKONOS' session, Goosens et al. (Belgium & Germany) presented a study of landscape change in Morocco, using 1960s CORONA spy satellite photos and recent IKONOS imagery: the latter may have a slightly higher spatial resolution, but its look-angles produce greater distortions in resulting DEMs. There was some interesting discussion of small satellite data costs, which – relative to aerial photography - are aspiring to produce 95% performance at 5% cost and 70% performance at 1% cost.

The first-night reception at the Liechtenstein Palace was well attended by delegates keen to sample Prague's champagne, wines and beers. It may have been coincidental, but many of the speakers for in the next morning's 'Data fusion' session were missing, notably those on multi-sensor image and data fusion to investigate gold mineralisation in the Aegean (Mavranta *et al.,* Greece) and the integration of Radarsat-1 and Landsat-7 imagery for kimberlite exploration in Alberta (Paginelli *et al.*, Canada). The Remote Sensing Department at Trier (Germany) were well represented, with presentations comparing the performances of multispectral and hyperspectral sensors (Sclerf *et al.*), and comparing the use of ANNs with Landsat and HyMAP imagery, albeit for forest mapping rather than geological applications.
The 'Environmental dynamics & risks' session had a sprinkling of geoscience papers: Wunderle *et al.* (Switzerland & Netherlands) used ERS InSAR to map

landslides in the Alps and Honduras; whilst Kuosmanen *et al.* (Finland) used HyMAP, the AISA spectrometer and ultra-dimensional image data (!) to map contamination around a chromite mine.

The final day of the Symposium started with a keynote paper from Touth (Canada), comparing the imagery of the new generation of high spatial resolution satellites: this over-ran somewhat (to the discomfort of delegates still recovering from the previous night's Symposium Dinner, champagne, wines and beers), but it had some nuggets of valuable information, notably that Quickbird's 61cm pan pixels appear to have a true resolution that is closer to 10cm….. In the final session, 'Remote sensing & GIS', Solomon & Quiel (Sweden) used Landsat & SPOT to map hydrogeological features around wells in Eritrea and then used GIS to compare their RS-derived indicators of groundwater potential with yields from the wells.

The conference closed with presentations about forthcoming EARSeL meetings: the 2003 Symposium in Ghent (theme: *Remote sensing in transition)* and the 2004 Symposium in Dubrovnic (theme: coastal remote sensing) – a joint GRSG-EARSeL session is likely to become a regular fixture at these symposia. Information about GRSG activities was enthusiastically received (though we need to ensure that we allow for membership fees to be paid in Euros, not just £ or $) and many of the delegates commented on how impressed they were with the GRSG Newsletter. Many thanks to the EARSeL administrators and the Prague Symposium organising committees for their efforts; thanks also to the Czech Ministry of Agriculture and the UHUL Forestry Institute for their support. I'd like to thank Ant Denniss (Infoterra), Claire Ainsworth and Ren Capes (NPA Group), Liu and Alex Davis at Imperial College, Kyle Brown (Environment Agency) and Stuart Marsh (BGS) for supplying examples for the GRSG presentation.

Freek Van de Meer and Richard Teeuw relaxing on the Vltava river after the conference

The Earth from the Air – a photographic portrait of our planet

Review by Claire Ainsworth

The Earth from the air is an exhibition of photographs of the planet. It has been hosted in the gardens of The Natural History Museum, London, for the past three months and is due to finish in early September 2002. The exhibition has brought together a range of photographs taken from helicopters and small planes by French photographer Yann Arthus-Bertrand.

The exhibition has taken 10 years of research and fieldwork to produce, in which time Arthus-Bertrand has taken over 100,000 shots and clocked up more than 3,000 flying hours, travelling across 100 countries. The images, each over two metres across in size, capture the characteristics and patterns of the natural world which can only be seen from a bird's-eye view.

The photographic project is a fascinating record of the state of our planet today and the exhibition enables you to walk through a range of events that occur on a daily basis on our planet. Each picture captures a notable scene from a wide range of activities including farming, industry, the often devastating results of human activity, and many soothing pictures of the changing landscape of the Earth that appeal to a budding geologist like myself. To accompany the photographs is well-researched information describing the location and any environmental issues that may affect the region.

One picture that has stuck in my mind is of the Perito Moreno Glacier located in the Los Glaciares National Park in Argentina. The photograph displays the vast extent of the Perito Moreno Glacier (a total of 5,000 meters wide and 60 meters thick) as it flows into an arm of an Argentine Lake. As it travels along the valley glacial debris and rocks are picked up from the valley floor and banks, which then add to the erosion and carve the landscape. Every three or four years the glacier dams up the regions where the two arms of the lake meet. The pressure of the water builds up and eventually shatters the ice barrier with a sound that can be heard for several kilometers (a few miles) around.

The combination of images tells a unique story of the planet and provides a relaxing break from the bustle of London life. If you get the chance I would highly recommend a visit to the exhibition, to wander the pictures and soak up the atmosphere.

For those interested in viewing a selection of the images have a look at http://www.yannarthusbertrand.com.

GRSG's Web Site **http://www.grsg.org**

Webmaster: **Mike Oehlers, NPA Group**

Email: info@grsg.org

We have recently updated the web site, please let us know what you think and keep us informed of what you would like to see on your web site.

The new front page looks something like this…

Geological Remote Sensing Group

Geological Society

This Web site is hosted by The NPA Group - Specialists in satellite exploration and mapping. Please send any comments to Mike Oehlers

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The GRSG does not purport to have a unified view and this newsletter is a forum for the views of all its members and their colleagues in industry, colleges and government on a free and equable basis.

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