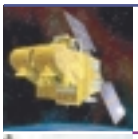
AUSTRALIAN CENTRE FOR REMOTE SENSING

DECEMBER 1999, ISSUE 20

ACRES UPDATE

20TH ANNIVERSARY ISSUE

FEATURES



ACRES

Contents

Cover: SPOT 4 image of Melbourne acquired on 2 October 1999, using bands 234 as Blue, Green and Red.

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ACRES AUSLIG

MANAGER'S MESSAGE

The last issue of *ACRES Update* focused on our new Landsat 7 product range and I'm pleased to report that our product launch on 23 August went very well. It was particularly pleasing that Australia was the first country outside the USA to have access to Landsat 7 products derived from directly downlinked data.

This *ACRES Update* focuses on another "new" mission. While SPOT 4 has been operational for some time, ACRES has only recently acquired the capabilities to receive and process data from this satellite. Data from the new HRVIR sensors looks very impressive, particularly the new infra-red band. ACRES believes it will have many useful applications.

November 1999 marked 20 years of operation for ACRES Alice Springs ground receiving station. It was a good time to look back on past achievements and look forward to the exciting future ahead. We also did the odd bit of celebrating!

I believe ACRES staff can be proud of the way their organisation has progressed from a small experimental outfit supporting a single mission (Landsat) to one that is now truly operational and multi-mission. We now downlink directly from nine satellites and process archival data from another five. Improvements in ACRES capacity, reliability and levels of service over the years have clearly contributed to the pleasing growth of satellite remote sensing applications in Australia over the past two decades.

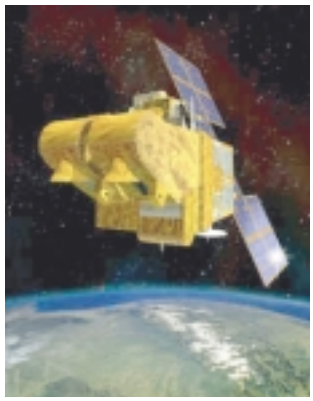
This progress must be very satisfying for those individuals who had the foresight to fight for the establishment of the Australian Landsat Station in the late 1970s and for the expansion of its role in the mid 1980s.

With this issue, we are delighted to include the first poster in a series of special satellite-images which will be produced for *ACRES Update* readers. The first poster, of the Alice Springs area, marks ACRES 20th anniversary.

Paul Trezise

ACRES AND STAFF WISH YOU A VERY MERRY CHRISTMAS AND AN ESPECIALLY HAPPY YEAR 2000.

ACRES RELEASES SPOT 4 PRODUCTS



The SPOT 4 satellite.

ACRES 10 year association with the French SPOT satellite series continues with the release of ACRES SPOT 4 products. The recent upgrade of ACRES Optical Data Processing System (ODPS) and data acquisition facilities at Alice Springs and Hobart has given ACRES the capability to downlink and process data captured by the SPOT 4 satellite.

The SPOT Earth Observation System, designed in France by CNES and operated by its subsidiary, Spot Image, has been operating since February 1986. When the SPOT 4 satellite was launched in March 1998, it added new capabilities to the SPOT family of satellites.

To ensure continuity of service, SPOT 4 imagery has the same geometric imaging characteristics as the SPOT 1, 2 and 3 satellites: a 10 metre panchromatic and a 20 metre multispectral resolution; a swath of 60km; and an oblique viewing capability of 27 degrees on each side of the local vertical. However, its performance has been increased by adding a new shortwave infrared spectral band (SWIR), extending its nominal lifetime from three to five years and improving operational possibilities.

PRODUCT DESCRIPTION

ACRES has worked with its SPOT distributor, SPOT Imaging Services, to design a product range that is right for the market.

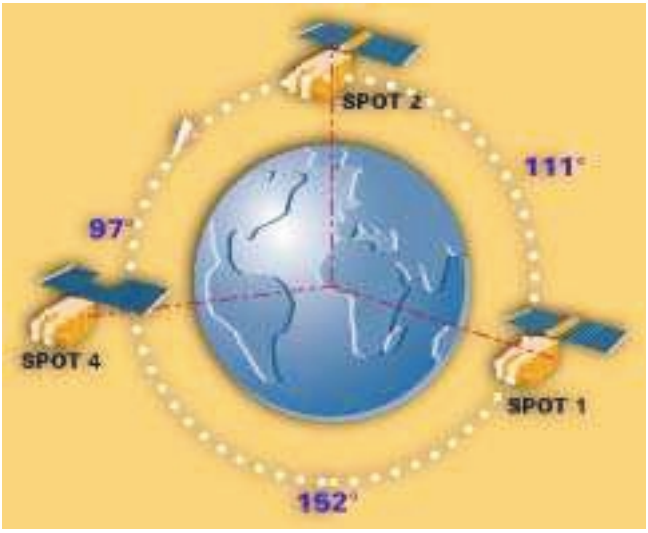
The tables on the next pages show the range of ACRES SPOT products currently available.

Raw Image

ACRES supplies Raw Image data (SPOT Level 1A) to users of SPOT data with high-end processing capabilities. This option is available as a full scene (approx. 60 x 60 km) in PAN for $1,900 and Xi or XS for $1,700.

Additional Copies

Data is available on CD-R, 8.5GByte EXABYTE® Tape and 1.3GByte DAT. Additional copies of digital datasets are available for $65 when ordered with the original dataset.



The SPOT system has three orbiting satellites.

SPOT 4 DETAILS

- **Launch date:** 24 March 1998
- **Sensor data acquired:** Multispectral and/or Panchromatic (on request by ACRES)
- **Satellite operator:** CNES, France
- **Altitude — at equator:** 822 km
- **Swath width:** 60 km–120 km
- **Orbit type:** near polar, sun synchronous
- **Orbit period:** 101 minutes
- **Repeat cycle:** 26 days
- **Repeat cover:** 4–5 days when sensors programmed max. off nadir
- **Current crossing time:** 1000–1030 hrs local standard time
- **HRV1 sensor status:** Nominal
- **HRV2 sensor status:** Nominal

SPOT PRICES – Digital Image Data

Sensor & Satellite	Scene Size	Processing Level: Path Image (SPOT Level 1B)	Map Oriented Image	Orthocorrected Image
PAN SPOT 1, 2 & 4 New and archive data. SPOT 3 Archive data only.	Small Scene Up to 225 sq km 5 x 15 km	–	$495	–
	Quarter Scene Up to 900 sq km eg 30 x 30 km	–	$980	$1,530
	Half Scene Up to 1,800 sq km eg 45 x 40 km	–	$1,530	$2,000
	Full Scene 60 x 60 km approx.	$1,900	–	–
	Full Scene Up to 4,800 sq km eg 80 E-W x 60 km N-S	–	$2,090	$2,630
	Super Scene Up to 13,000 sq km Max 100 E-W x 130 km N-S	–	$3,350	$4,130
Xi* SPOT 4 New and archive data.	Small Scene Up to 225 sq km 15 x 15 km	–	$495	–
XS SPOT 1 & 2 New and archive data.	Quarter Scene Up to 900 sq km eg 30 x 30 km	–	$950	$1,480
SPOT 3 Archive data only.	Half Scene Up to 1,800 sq km eg 45 x 40 km	–	$1,430	$1,870
	Full Scene 60 x 60 km approx.	$1,700	–	–
	Full Scene Up to 4,800 sq km eg 80 E-W x 60 km N-S	–	$1,870	$2,410
	Super Scene Up to 13,000 sq km Max 100 E-W x 130 km N-S	–	$3,000	$3,790

SPOT PRICES – Photographic Products

Sensor & Satellite	Scene Size	Processing Level: Path Image Small (1:1)	Path Image Large (>1:1)	Map Oriented Image Small (1:1)	Map Oriented Image Large (>1:1)	Orthocorrected Image Small (1:1)	Orthocorrected Image Large (>1:1)
PAN SPOT 1, 2 & 4 New and archive data.	Quarter Scene Up to 900 sq km eg. 30 x 30 km	–	–	$495	$740	$990	$1,230
SPOT 3 Archive data only.	Full Scene 60 x 60 km approx.	$840	$1,080	–	–	–	–
	Full Scene Up to 4,800 sq km eg 80 E-W x 60 km N-S	–	–	$840	$1,080	$1,210	$1,450
XS SPOT 1 & 2 New and archive data.	Quarter Scene Up to 900 sq km eg 30 x 30 km	–	–	$410	$630	$910	$1,120
SPOT 3 Archive data only.	Full Scene 60 x 60 km approx.	$645	$860	–	–	–	–
	Full Scene Up to 4,800 sq km eg 80 E-W x 60 km N-S	–	–	$645	$860	$1,020	$1,230

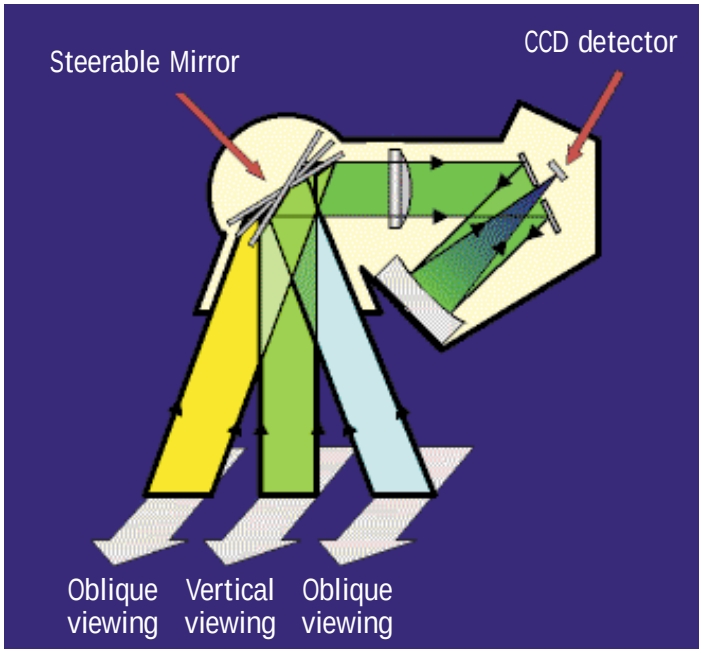
SPOT Standard Enlargements

Scale	Enlargement Factor	Scene Size	Size (mm)
1:400,000	Small (1:1)	Full Scene Contact	238 x 219
1:200,000	Large (2:1)	Full Scene Enlargement	476 x 438
1:100,000	Large (4:1)	Full Scene Enlargement	952 x 876

Photographic products are available as paper prints. Additional copies of products are available for $80 when ordered with the original print.
* NOTE: A small number of detectors on the SPOT 4 Xi SWIR band have experienced problems. SPOT IMAGE continuously monitors the detector status and ACRES uses SPOT IMAGE algorithms to compensate for these problems during processing. However it is possible that an occasional product may have a vertical line dropout through the image. Image processing techniques can normally be used to "fill" this dropout.

SPOT 4 SENSORS

There are two High Resolution Visible and Infrared (HRVIR) sensors on board the SPOT 4 platform. They are derived from the SPOT 1/2/3 design. The opto-mechanical architecture has again been used, which incorporates a telescope, calibration system and other devices. The main innovation is the addition of a channel in the shortwave infrared spectrum of 1.5 to 1.75 µm. This new spectral band required the design of a special detection unit with a lower operating temperature. Temperature control is to within one-hundredth of a degree.



The High Resolution Visible and Infrared Sensors on SPOT 4 have a steerable mirror for high frequency area coverage.

SPOT 4 uses the following four spectral bands:

- visible band B1: 0.50 to 0.59 µm
- visible band B2: 0.61 to 0.68 µm
- visible band B3: 0.78 to 0.89 µm
- shortwave infrared (SWIR) band: 1.58 to 1.75 µm

Bands 1, 2 and 3 have the same spectral ranges as the sensors on the SPOT 1, 2 and 3 satellites. These four bands were chosen to ensure the best possible discrimination between different surface covers (soils, rocks, etc), vegetation, surface covers with high or low water content, deserts, snow and urban areas. They also make optimal use of the transparency of the atmosphere and transmission stability, both of which are insufficient in certain areas.

The instruments have three viewing modes:

- the multispectral mode corresponding to bands B1, B2 and B3 plus the SWIR with a ground resolution of 20 m;
- the monospectral mode corresponding to band B2 with a ground resolution of 10 m;
- a combination of the multispectral + monospectral modes.

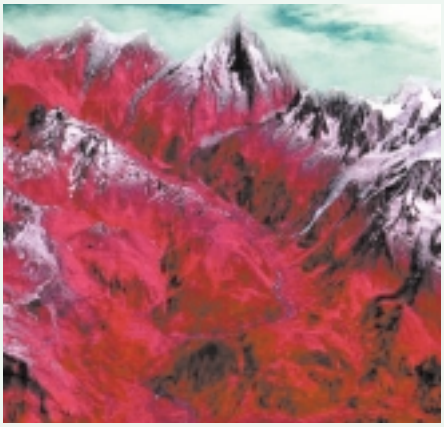
Concerning the mechanisms themselves, a steerable strip-selection mirror for changing the viewing angle increases the satellite's operational performance. They enable repeated observations of the same area at short intervals and the acquisition of an image of the same scene from different perspectives to yield a stereopair for stereo restitution and relief mapping.

Moreover, their ability to cover a scene is increased due to the fact that the two instruments generally operate independently. For instance, one instrument acquires an image with the greatest possible viewing angle to the left of the ground track, while the other sets its mirror to obtain an image to the right of the ground track.

SPOT 4 USEFUL FOR AGRICULTURE AND GEOLOGY

The new shortwave infrared (SWIR) band in the SPOT 4 sensor will add a new dimension to applications for users, especially those in agriculture and geology.

The new band will help discriminate between different crop types and plant covers and will further enhance crop performance information. Vegetation mapping for environmental monitoring purposes will also be greatly improved with SPOT 4 image data. Geology, soil mapping and geodiscriminate work performed by the mining sector will benefit from the use of SPOT 4 Xi image data.



This 3D view of the Arve Valley, at the foot of the Mont-Blanc massif in France, was reconstituted from a SPOT stereopair.

The main features of SPOT data are its high resolution, 10m panchromatic and 20m multispectral imagery and excellent geometric accuracy. An obvious application is medium scale mapping (from 1:50 000 to 1:250 000). The high resolution makes it possible to identify shapes and measure the sizes of elements on the ground. Cartographers appreciate the capability of a satellite to instantaneously cover vast areas (approximately 4000 square kilometres per scene), particularly those which are the most difficult to reach on the ground, and to be able to renew the observation whenever needed.

Another important feature of the SPOT satellite series is its oblique stereo viewing capability. SPOT satellites can acquire stereopairs in which the same area of the Earth's surface is seen from different angles. When analysed by a computer, a stereopair provides the elevation for each pixel and can then be used as a digital elevation model (DEM). This relief information can be used to create a three-dimensional relief map. It may be applied in particular to:

- telecommunications — to determine the best sites for relays for a future mobile telephone network;
- petroleum or mineral prospecting — to obtain a global view of a site and its geographical features;
- public works — to determine the best route for a highway, or a track for a high-speed train, etc;
- defence — to prepare missions and simulate an aircraft's flight over a region.

Natural disasters such as earthquakes, floods, fires, volcanic eruptions and mudslides are often unavoidable, but with the help of satellite imagery, their effects may be limited. SPOT satellite imagery, combined with other sources of information, can be used to make maps showing areas vulnerable to specific natural hazards by integrating physical, meteorological, demographic and economic factors.

With this information, which can be brought up to date quickly, it is possible to take preventative measures and draw up efficient emergency plans. The information can also be used after a disaster to assess the exact amount of damage suffered so that victims can be fairly compensated.

NEW FEATURES FOR GEODATA SPOT-LITE:

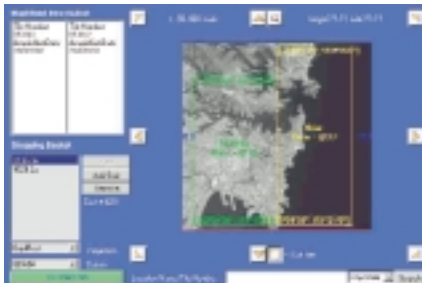
SUB-TILES NOW AVAILABLE FOR $50

An online customer survey conducted in May has helped ACRES point the way for the design and implementation of new features for the Internet-based GEODATA SPOT-LITE image mosaic. A number of new features have been added to the SPOT-LITE catalogue making the selection of image data easier and more affordable.

That age-old problem of having your area of interest straddle the four corners of adjacent maps has been solved by providing the user with the ability to scroll in half-image tile increments. Coupled with the new feature of purchasing variable-sized sub-tiles at a reduced price, it provides the user with the capability of selecting their specific area of interest. The minimum size of the sub-tile is 10 x 10km for $50. The sub-tile window can be stretched and positioned anywhere within a full 25 x 25km tile.

Other improvements to the SPOT-LITE system are the significantly faster start up time and less memory consumed on users' computers to run the catalogue's Java applet. You can also now search for SPOT-LITE tiles by specifying the 100K or 50K map number.

Beyond these enhancements, image tiles continue to be added to the SPOT-LITE database and tiles updated where necessary. If you need further information, please contact ACRES or your favourite ACRES Distributor (see the back cover for details).



This image shows how a SPOT-LITE sub-tile may be cut to select a specific area of interest.

LANDSAT 7 ETM+ IMAGE ARCHIVE GROWING DAILY

ACRES was the first ground station outside the United States to downlink and distribute imagery from the new Enhanced Thematic Mapper Plus (ETM+) sensor on board the Landsat 7 satellite.

Landsat 7 imagery of East Timor towns acquired by ACRES were in strong demand from the media.

ACRES has been regularly acquiring image data every day since the first pass on 6 July. At the time this article was written, the seventh cycle was nearing completion. This means that all image data that could be acquired within the reception areas of ACRES data acquisition facilities at Alice Springs and Hobart has been repeated seven times.

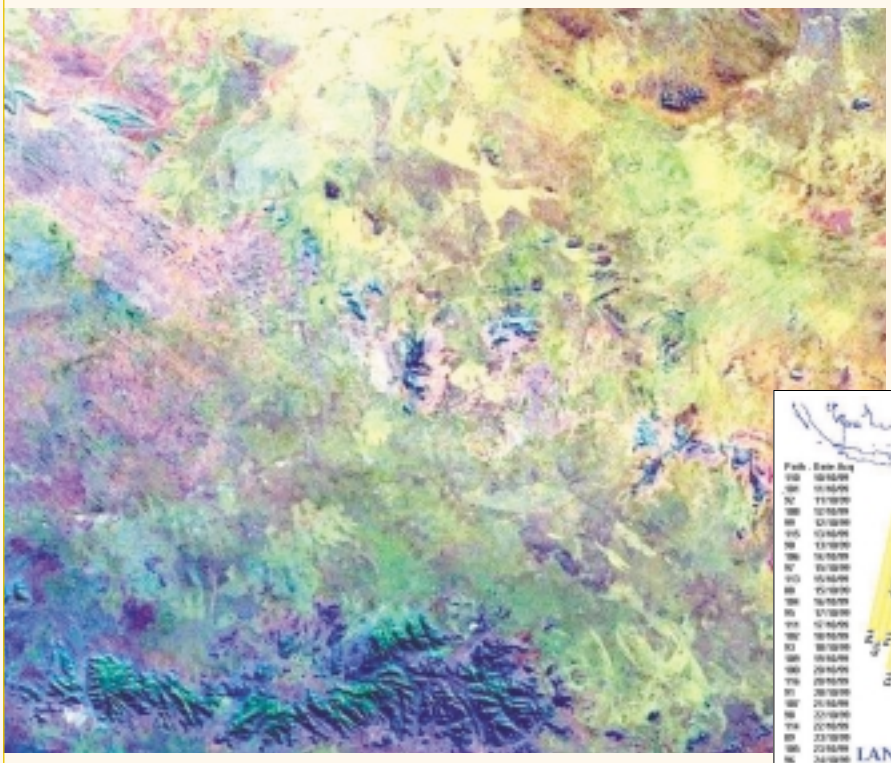
The areas cover Australia, New Zealand, PNG, East Timor and much of South-Eastern Indonesia. This regular, seven-day-a-week reception work has ensured that ACRES holds the largest database of Landsat ETM+ images of Australia, New Zealand, PNG and East Timor in the world.

There are also a few Landsat 7 ascending passes in the ACRES archive. These passes are scenes taken during the night. They have been acquired to fully exploit the thermal response collected by Band 6 of the ETM+ sensor for research purposes. The images consist of thermal infrared data only and display as monochrome images. One such pass is 211/160 (92/84), acquired on 10 August.

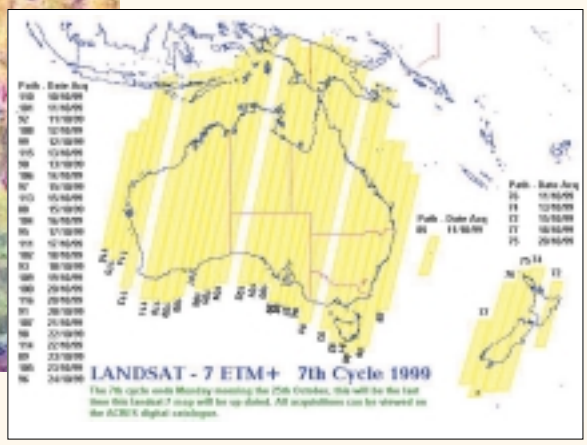
As a further development to ACRES Landsat product range, quicklooks on ACRES Digital Catalogue for new ETM+ image data are now displayed at a higher resolution. This allows for the detection of small pockets of cumulus cloud, not usually visible in the previous version of these quicklooks. It particularly brings out ocean features with more clarity. Search the ACRES Digital Catalogue at www.auslig.gov.au to view other Landsat 7 ETM+ quicklook images.

Landsat 5

In a further development, ACRES has reached agreement with Space Imaging for continuing reception of data from the Landsat 5 satellite with the TM sensor. No TM data was received between 1–13 October 1999, but data reception resumed on 14 October and will continue until further notice. Data from Landsat 5 complements image data from the Landsat 7 satellite. By receiving data from both satellites, ACRES can attempt a Landsat acquisition anywhere in Australia every eight days.



An example of the new, higher resolution, Landsat 7 ETM+ quicklooks, now available on ACRES Digital Catalogue. A small pocket of cumulus cloud is clearly visible at the bottom of the image. You can also see Uluru and The Olgas at the top of the image.



Landsat 7 ETM+ pass acquisitions for the 7th cycle nearing completion.

THE AUSTRALIAN LANDSAT STATION (ALS): 1979–86

When it opened in late 1979, the Australian Landsat Station (ALS) consisted of the ACT Data Processing Facility in Oatley Court, Belconnen, ACT, and the Data Acquisition Facility (DAF) in Alice Springs. Browse Centres, or sales centres, were soon established in all capital cities.

Above: ACRES longest serving Canberra member of staff, Bob Jones (left), outside the ALS in Oatley Court, Belconnen, ACT.

Below: ALS staff, December 1985.

There were 12 other Earth ground stations operating around the world in 1979: one each in Brazil, Japan, Italy, India, Argentina, Sweden and South Africa; two in Canada and three in USA. Today, there are 20.

In March 1984, when the ALS was transferred from the Space Projects Branch of the Department of Science and Technology to the Division of National Mapping in the Department of Resources and Energy, remote sensing technology had developed beyond the research and demonstration stage and had become a well-established method for mapping and assessing the Earth's resources.

The administrative move had some advantages for the ALS, as the Department of Resources and Energy was more closely associated with the mining industry, a major user of ALS products. It also assisted in integrating satellite remote sensing with the mapping and aerial photography activities of the Division of National Mapping.

THE AUSTRALIAN CENTRE FOR REMOTE SENSING (ACRES)

The ALS was renamed the Australian Centre for Remote Sensing (ACRES) on 1 October 1986. At the same time, a decision was made to upgrade facilities to receive Landsat TM and SPOT data. The new name more accurately reflected the Centre's extended capabilities and highlighted ACRES role as the Commonwealth Government's principal facility and archive for Earth resources data received from satellite remote sensing instruments.

ACRES staff celebrate the 20th anniversary on 11 November 1999.

The Centre's first major upgrade was completed in 1988, the same year ACRES was transferred to the Australian Surveying and Land Information Group within the Department of Administrative Services. Approximately $15m was invested over three years to upgrade and replace equipment at the ALS receiving and processing facilities in Alice Springs and Canberra. It allowed for the reception, archiving and processing of data from high resolution instruments such as Landsat's Thematic Mapper and the SPOT-HRV sensors.

The decision to proceed with the upgrade, made in a time of severe economic constraint, clearly indicated the Government's recognition that continued access to satellite remote sensing data would significantly benefit all resource related industries and enable more cost effective monitoring, management and development of our natural resources. The improved capabilities delivered by the upgrade would also contribute to the marketing of analysis and interpretation systems and skills overseas.

It was a time of great change for the organisation on many fronts and in January 1989, ACRES moved to the Don Gray Building in Dunlop Court, Fern Hill Park, a technology park in the Canberra suburb of Bruce. The building was purpose-built to provide optimum

continued...

Left: Don Gray Building, Fern Hill Park, Bruce, ACT.

Inset: ACRES current home in the Scrivener Building, Fern Hill Park, Bruce, ACT.

conditions for equipment and personnel and provide for the long-term storage of satellite data on high-density digital tapes and in photographic file format.

By 1990, ACRES was not only receiving Landsat MSS data, it was also involved with the Landsat TM, SPOT, MOS and NOAA programs. A year or so later, the ERS satellite program was added to the list.

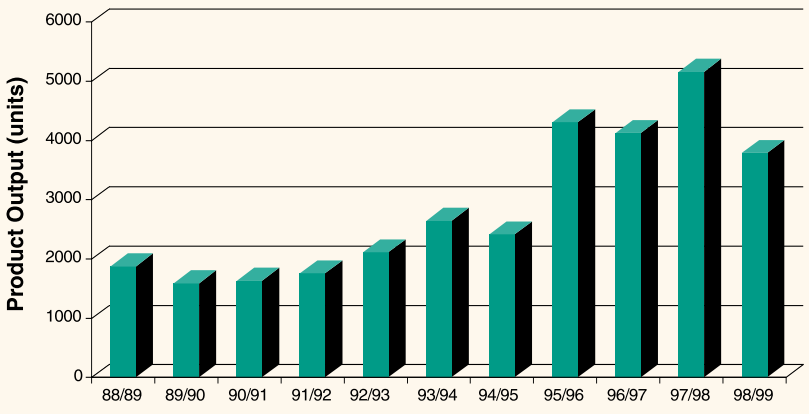
The Tasmanian Earth Resources Satellite Station (TERSS) near Hobart, Tasmania.

Subsequent upgrades have continued to expand the capabilities of the Canberra and Alice Springs facilities to provide imagery from an increasing number of satellite programs from around the world. Landsat 7 and SPOT 4 are the most recent examples.

Other significant milestones in ACRES history include:

- Web page established in 1994.
- First synthetic aperture radar processor for ERS SAR image data installed in 1995.
- ACRES online digital catalogue became operational in 1996.
- Gained responsibility for operating the Tasmanian Earth Resources Satellite Station (TERSS) near Hobart, Tasmania from 1 August 1996. It is now operated remotely by the Alice Springs DAF.
- All image data made available on CD-ROM in mid 1997.
- RADARSAT data processing began in 1998.
- ACRES Data Processing Facility moved from the Don Gray Building in Dunlop Court across the verge to the Scrivener Building in mid 1998.
- New processing system for optical imagery installed in early 1999.

The demand for remote sensing imagery and data has grown significantly during ACRES first 20 years. This graph shows the increase in "product output" for ACRES between 1988–89 and 1998–99. The drop-off in the 1998–99 financial year is due to a decline in demand for photographic products which corresponds with advances in more accessible digital computer and printing technologies.



AUSLIG

ACRES is a business unit of the Australian Surveying and Land Information Group (AUSLIG).

AUSLIG's heritage dates back to 1910 when a Lands and Survey Branch was established within the Department of Home Affairs. This Branch evolved to become the Australian Survey Office which later amalgamated with the Division of National Mapping in 1987 to become AUSLIG.

Topographic mapping as a Commonwealth responsibility first became a major concern of the Lands and Survey Branch in 1921. AUSLIG now provides complete topographic map coverage of Australia.

AUSLIG and its predecessors have undertaken a wide range of survey work on projects of federal interest including development of the national capital and the Alice Springs to Darwin rail link.

From 1975–98, AUSLIG operated the Orroral Geodetic Observatory and achieved world class status for its satellite laser ranging activities. It now operates a new facility at Mt Stromlo.

AUSLIG is increasingly supporting industry development via close links with the private sector. This includes outsourcing production, using Value Added Resellers to develop a variety of products to meet market niches, facilitating access to good quality national spatial datasets and providing opportunities for Australian industry to gain access to export markets.

AUSLIG General Manager, Peter Holland.

ALICE SPRINGS DAF — 20 YEARS IN THE BUSH

Eight kilometres from Alice Springs lies ACRES Data Acquisition Facility (DAF). The site was originally chosen because satellite imagery of the whole Australian landmass and surrounding waters could be acquired from there.

When the DAF first opened for business in 1979, it received data from only one satellite, Landsat 2. Five technical staff and one part-time clerical person ran the operation. The station itself consisted of two transportable huts and a 9.14 metre tracking antenna. Administration was conducted from some rented space in the CSIRO building about 100 metres from the DAF compound.

A new building was completed in 1990 and the antenna was upgraded by adding a third axis segment and X band tracking and data acquisition equipment.

In addition to routine acquisition of data for ACRES from Earth resources spacecraft over the past two decades, the DAF has been involved in numerous other significant space-related activities, such as:

Solar Maximum Mission

Assisted NASA in the launch of the Solar Max spacecraft in 1980.

Tracking and Data Relay Satellite System (TDRSS)

Houses the Bilateration Ranging Transponder (BRT) enclosure which forms part of NASA's TDRSS.

Landsat High Density Digital Recorder Support Program

Forwarded Multispectral scanner data to the Goddard Space Flight Centre for processing. This was made possible in 1982 when NASA installed a Martin Marietta High Density Digital Tape to record this data.

Alice Springs DAF, August 1999 (Photo by Anton Albina).

Station Manager, Warren Serone, and Shaun Evans inside the Alice Springs DAF, September 1999 (Photo by Anton Albina).

Contractors over the 20 years:

- **Fairy Australasia**
- **AWA**
- **CSA**
- **Computer Sciences Corporation**
- **British Aerospace Australia**

The DAF team circa 1985. (L-R) Rainer Holdinghausen, Alec Smith (dec), Warren Serone, Ben Douglas and Ian Lee. Warren has worked at the DAF since September 1979.

Signal Processing Experiment 1986

This joint Australian Landsat Station/CSIRO experiment was devised to gain experience in X band downlinking. "Thematic Mapper" imagery and processing scenes were collected from the data.

Very Long Base Interferometry (VLBI) 1982 and 1988

CSIRO Radio Physics used the DAF antenna for various VLBI experiments including observation of the Large Magellanic Cloud Supernova in 1988.

OSI 1988–91; MOSI B 1991-93

A cooperative venture with CSIRO Office of Space Science where applications were recorded and data archived from MOS1 & 1B S/C.

MANAGING THE FIRST 20 YEARS

DON GRAY
Station Director, Australian Landsat Station, 1979–86
Manager, ACRES 1986–89

Under Don's guidance as the first Station Director, the Australian Landsat Station led the development of Australian remote sensing and contributed to a greater acceptance of the benefits and uses of remote sensing by the Australian surveying industry.

Don's work over the next eight years led to a 1986–87 Commonwealth Budget decision which provided $15m to upgrade ALS facilities for a new generation of satellites. This was a turning point for remote sensing in Australia, laying the foundation for growth.

The "father" of remote sensing, Don retired as Manager of ACRES in 1989, having nurtured remote sensing in Australia from birth to maturity.

Don Gray — the father of remote sensing in Australia.

CARL McMASTER
Manager, ACRES, 1989–1994

Carl's significant achievements included the introduction of Synthetic Aperture Radar reception and processing, the use of Optical Tape technology for data archiving and the successful negotiation of significant international agreements with ESA (Europe), NASDA (Japan) and EOSAT (USA). Carl also guided ACRES from being a single sensor facility to a multi sensor, multi processor, world class organisation during his time as Manager.

Carl McMaster — driving ACRES towards world class status.

PAUL TREZISE
Manager, ACRES, 1994–

Paul's initial focus at ACRES was to further develop customer service initiatives. This included documenting customer service levels and increasing their visibility through the ACRES Customer Service Guarantee, strengthening the relationship with Distributors through regular communication on all marketing issues, and focusing infrastructure development towards projects which directly benefit customers. Other achievements include the introduction of the digital catalogue which gave visibility of the ACRES archive to the general public and the recent replacement of the optical processor to enhance customer service levels, particularly the delivery time for product.

After attending the opening of the TERSS reception station in Hobart, Paul has since managed the task of bringing this technically advanced facility into full production efficiency as an integral part of the ACRES national X-band network.

Paul's commitment and foresight are also demonstrated in the early introduction of Landsat 7 capability at ACRES and the development of radar technology from a research tool to a commercially based operation.

Paul Tresize.

"ACRES first 20 years have been a period of accelerating change and development. While it is a brave person who forecasts too far ahead in our business, it is pretty clear that the next five to 10 years will bring even greater rates of change." ***Paul Tresize***

THE NEW MILLENNIUM — ACRES LOOKS TO THE FUTURE

One thing that is certain, of course, is ACRES continued commitment to ensure that a range of quality remotely sensed imagery is readily available for the benefit of the Australian community, through partnerships with industry and government. ACRES works closely with distributors and customers to anticipate their future needs — this is essential given the long lead times associated with major infrastructure upgrades. Some of the needs already identified are:

- increased capacity to acquire data — the number of missions warranting support has grown dramatically over the last 10 years and will continue to do so for the next decade;
- improved reliability of data acquisition systems — a missed acquisition cannot be recovered and can be critical when remote sensing is used in monitoring applications;
- faster ordering and delivery times on all products including near real time product delivery for some applications;
- better quality/consistency of products with respect to radiometric calibration and geometric accuracy.

On the horizon there are many new missions that ACRES could be supporting — the NASA EO-1, Terra and PM missions, ESA's Envisat, NASDA's ALOS, Canada's RADARSAT 2, SPOT Image's SPOT 5 and hopefully a Landsat 7 follow-on. There are also a number of exciting hyperspectral satellites proposed, including Australia's own ARIES mission.

From an applications viewpoint, you can expect to see a further broadening of the applications base as the full potential of all these new data sources is realised. In particular, ACRES expects further growth and increased frequency in resource and environmental monitoring applications. Remote sensing will be used increasingly to explore and protect Australia's large maritime jurisdiction.

The broadening of the client base should include important sectors which have previously had only a minor involvement, such as local government.

ACRES technical environment will continue the transition from one which has involved very specialised hardware devices to one which involves a flexible, modular architecture using commercial off-the-shelf hardware and highly sophisticated software. ACRES staff will increasingly consist of highly skilled engineering and IT specialists focusing on improving performance and supporting new missions. Operational staff numbers will continue to fall as the operational process becomes more and more automated.

ACRES has maintained a number of partnerships which have been critical to its success. Two key examples are:

- the partnership with ACRES distributors which has greatly assisted the expansion of remote sensing applications in Australia; and
- the partnership with the Tasmanian Earth Resources Satellite Station consortium (TERSS) which has enabled ACRES to increase its direct data reception over the Australian region.

Partnerships will also be the way of the future. They will include an expansion of the current type of partnerships, such as the formation of an Australian X-band receiving network, as well as a new style of partnership with the new generation of commercial satellite operators.

Anyone involved in the space industry knows that it is a very risky and uncertain business. Forward planning needs to factor in the prospect of delays and mission failures. Having said this, the future of satellite remote sensing in the next decade is looking very bright, and ACRES is well positioned to take up the challenges of the new millennium.

By Paul Trezise

LANDSAT GROUND STATION OPERATIONS WORKING GROUP MEETING

ACRES Manager Paul Trezise attended the 28th annual meeting of the Landsat Ground Station Operations Working Group (LGSOWG) in Neustrelitz, Germany from 13–15 September. Neustrelitz is a beautiful rural town located about 100km north of Berlin. It is home to an excellent remote sensing groundstation facility operated by the German space agency DLR.

The meeting was attended by representatives and contractors from the US agencies responsible for the Landsat program (NASA and USGS), commercial companies Space Imaging and Eurimage and representatives from international groundstations in Europe, Germany, Australia, Thailand, Canada, Japan, South Africa, Indonesia and China.

With the Landsat 7 satellite successfully launched on 15 April 1999, LGSOWG 28 naturally focused on the early stages of the Landsat 7 mission. NASA reported that the mission was proceeding extremely well, the spacecraft and its ETM+ sensor were operating normally and no back-up systems were in use.

Space Imaging reported that the Landsat 5 satellite continues to operate well, after a remarkable 15 years in service. There are no obvious signs that the end of the mission is imminent. The satellite is in an eight-day phasing with Landsat 7, which means that Landsat data of any location can currently be acquired every eight days.

Space Imaging also reported that global Landsat sales dropped sharply during 1998, although ACRES defied this trend with an 18 percent increase. Australian Landsat sales in 1998 were the third highest reported by any country, only exceeded by the USA and Europe.

Delegates to LGSOWG 28, held in Germany, enjoyed their visit to one of the early palaces of Frederick the Great, located at Rheinsberg.

SPOT AND ESA GROUNDSTATION MEETINGS FOR AUSTRALIA

Plans are well advanced for Australia to host meetings of the international ground station operators of SPOT and ESA next year. ACRES will host the meetings in Canberra during the week of 21–25 February 2000.

The meetings will be an excellent opportunity for the 30 or so ground station operators from around the world to network and catch up with the latest plans of the satellite operators. Interest will undoubtedly focus on the progress of SPOT 5 and ESA's plans for the launch of Envisat in late 2000.

ACRES looks forward to welcoming its international colleagues to Canberra and providing them with some traditional Australian hospitality.

Following the successful launch of the Landsat 7 product range, and in conjunction with their remote sensing distributors, ACRES/AUSLIG held a series of seminars in Brisbane, Sydney, Melbourne, Hobart, Adelaide, Perth and Darwin. These seminars were presented during September to promote the availability and benefits of Landsat 7 satellite imagery.

L–R: Peter Holland (General Manager AUSLIG), the Hon Warren Entsch, MP, and Paul Trezise at the launch of the Landsat 7 product range in August at Parliament House, Canberra, ACT.

NEW RESOURCE IN REMOTE SENSING EDUCATION

A special kit on remote sensing in Australia is now available to help students understand the scientific principles of remote sensing.

The kit was launched on 30 August by the Parliamentary Secretary to the Minister for Industry, Science and Resources, Warren Entsch, at Gold Creek School in the ACT. It was developed jointly by AUSLIG and the Australian Geological Survey Organisation (AGSO) to promote Geoscience in the classroom and the wider community.

The Remote Sensing Kit provides a basic outline of remote sensing and its applications and is an important contribution by the Department of Industry, Science and Resources to education. It will be a useful resource for students and teachers at college level and will also provide an introduction to others wanting to learn about remote sensing.

The complete teaching kit includes a booklet with special activities, questions and answers, teacher's notes and curriculum links. It also contains four overhead projection sheets to illustrate the concepts of remote sensing and 10 sets of five full colour cards to demonstrate the scientific principles of remote sensing.

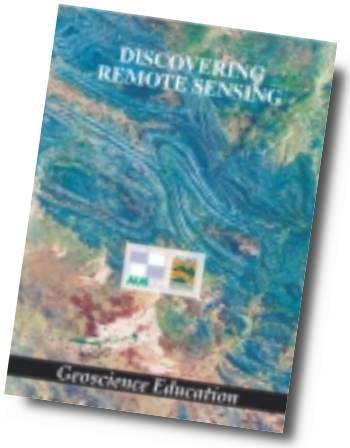
The 12 activities in *Discovering Remote Sensing* focus on the Tweed Heads region of northern New South Wales. They provide students with the experience of using images and obtaining information from them. AGSO has also developed an interactive website that demonstrates the use of false colours and algorithms to enhance satellite images.

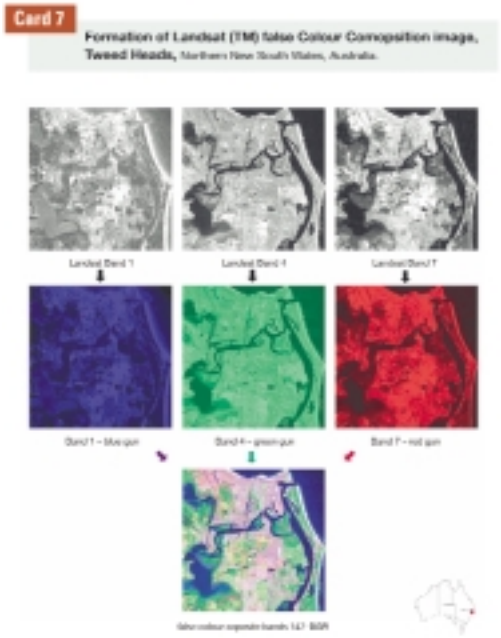
Another version of the booklet, *Discovering Remote Sensing — An Introduction*, is available separately to the wider community. It includes one set of five full colour cards demonstrating the principles behind remote sensing.

The complete Remote Sensing Kit is available from AGSO for $85 and the booklet is available from AUSLIG for $20.

Contact details for the kit:
AGSO Geoscience Education
tel 02 6249 9570,
fax 02 6249 9990
email Gary.Lewis@agso.gov.au

Contact details for the booklet:
AUSLIG Map Sales
Freecall: 1800 800 173
Email: mapsales@auslig.gov.au





Formation of Landsat TM false Colour Composition image of Tweed Heads.

CONFERENCE CALENDAR

10–12 January 2000 — **Florida, USA**

Second International Conference on Geospatial Information in Agriculture & Forestry

Contact: ERIM International, PO Box 134008, Ann Arbor, MI 48113-4008
Tel: +1 734 994 1200, ext 3234
Fax: +1 734 994 5123
Email: wallman@erim-int.com (inquiries only)
Web: www.erim-int.com/CONF/ICGIAF/2ndag.html

27–31 March 2000 — **Cape Town, South Africa**

28th International Symposium on Remote Sensing of Environment

Contact: The 28th ISRSE Organising Committee, PO Box 452, Stellenbosch 7599, South Africa
Tel: +27 (0) 12 334 5000
Fax: +27 (0) 12 334 5001
Email: wbotha@csir.co.za
Web: www.isrse.co.za

16–23 July 2000 — **Amsterdam, The Netherlands**

ISPRS 2000

Contact: XIXth ISPRS 2000, Congrex Holland BV,
P.O. Box 302, 1000 AH Amsterdam, The Netherlands
Tel: +31 20 50 40 203
Fax: +31 20 50 40 225
Email: isprs@congrex.nl
Web: www.itc.nl/~isprs

21–25 August 2000 — **Adelaide, South Australia**

10th Australasian Remote Sensing and Photogrammetry Conference

Contact: Australian Convention and Travel Services,
GPO Box 2200, Canberra, ACT 2601, Australia
Tel: +61 2 6257 3299
Fax: +61 2 6257 3256
Email: 10arspc@ausconvservices.com.au
Web: www.adelaide.edu.au/10arspc/

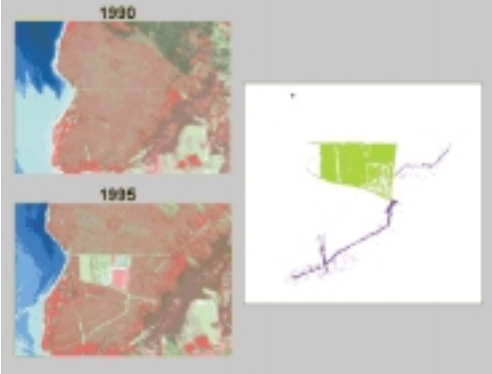
SATELLITE IMAGERY USED IN PROJECTS TO REDUCE GLOBAL WARMING

The full effects of 'greenhouse' gas emissions such as carbon dioxide, methane and nitrous oxide into the Earth's atmosphere are not yet completely understood. There is concensus amongst the scientific ommunity however that global warming caused by human activity cannot be ignored. This activity includes the burning of fossil fuels and land clearing.

An international treaty, the Kyoto Protocol, has been developed in response to the threat of global warming. Under this treaty, industrialised countries identify targets to reduce their net greenhouse gas emissions. These targets are based on their estimated 1990 emissions.

Australia's target is to limit growth in greenhouse gas emissions to eight per cent above the 1990 levels by the period 2008–2012. However, Australia will still be required to take substantive action to reduce its emissions from its 'business as usual' projected growth.

The Kyoto Protocol also commits signatories to limit greenhouse gas emissions from particular forest activities that result directly from human activity. This situation has focused interest in the use of forestry to measure the amount of carbon in the environment.



Vegetation change 1990–1995 for a portion of the Anson 1:100 000 mapsheet south west of Darwin and the associated data table.

Source: M Kitchin and M Barson (1998), Monitoring land cover change. Specifications for the Agricultural Land Cover Change 1990–1995 Project. Version 4 December 1998. Bureau of Rural Sciences.

Land cover change and forestry

Australia may be able to claim the benefits associated with the practice of reducing land clearing and revegetation programs. It has the capability to reverse some of the land clearing practices undertaken since the first European settlement here more than 200 years ago.

The clearing of land for farming and other uses releases carbon dioxide. Tree planting and revegetation however provide a 'sink' because they absorb carbon dioxide emissions from the atmosphere.

Over 20 percent of greenhouse gas emissions in Australia can be attributed to land clearing activities. This puts Australia in a unique position, in contrast to other developed countries where the land use change and forestry sector function as a 'sink' rather than a source for emissions.

The Kyoto Protocol allows Australia to include emissions from land clearing in its target. This arrangement provides additional scope for cost-effective mitigation action and delivers an environmental benefit because it ensures that all avenues for reducing emissions are covered in the Protocol.

The Australian Greenhouse Office (AGO) is responsible for coordinating domestic climate change policy and delivering Commonwealth programs. It provides a central point of contact for stakeholder groups. The AGO has established a National Carbon Accounting System (NCAS) which would provide accounting and forecasting capability for land-based sources and sinks of greenhouse gases. Estimation of emissions for the baseline year, 1990, is an immediate priority for NCAS.

Land cover change detection using satellite data

Land use change has been monitored quite extensively using remote sensing techniques. The Federal Government has provided funds to the Bureau of Rural Sciences (BRS) to establish a collaborative program with State agencies to monitor land cover changes in the agricultural areas of Australia between 1990 and 1995.

Landsat TM data, land tenure data, aerial photography and existing vegetation mapping were used to produce digital datasets for Land Cover Change 1990–1995, Structural Vegetation 1990 and Land Cover Themes 1990. These datasets should improve the estimates of greenhouse gas emissions associated with land cover change for Australia's National Greenhouse Gas Inventory. More information about these projects can be found at www.brs.gov.au/land&water/landcov/specs/index.html

One of the participating agencies in the BRS Land Cover Change project is the Queensland Department of Natural Resources (DNR). DNR has established the Statewide Landcover and Trees Study (SLATS) to provide objective baseline information on woody vegetation changes in Queensland.

SLATS regularly uses Landsat TM data to quantify the changes in woody vegetation due to land clearing regrowth and woodland thickening. SLATS has developed a satellite image and field measurement based methodology which relies on the quantitative spatial and temporal analysis of the data. Other State agencies have used different methods to achieve similar outcomes defined in the BRS project. More information about this study is available at www.dnr.qld.gov.au/resourcenet/veg/slats /index.html

Remote sensing analysis of land cover change 1970–1990

The AGO recently announced a project to be undertaken within the NCAS which will develop and test an optimal method using remotely sensed data to account for land clearing and vegetation regrowth over the period 1970–1990. This will assist in estimating Australia's emissions baseline for 1990 — a requirement under the Kyoto Protocol.

A key design feature of NCAS is its spatial capability. This will enable remote sensing data to be incorporated and provide a basis for manipulation of other spatial information for accounting and forecasting purposes. ACRES satellite imagery during the period 1979–1990 will be an important primary data source for the NCAS 1990 baseline project.

A remote sensing consultancy will develop the methodology for the project, which will build on existing Commonwealth and State land cover change analyses. The consultancy will examine options for spectral comparisons of data, taking into account regional variations in environmental factors. It will recommend a strategy to provide an understanding of the annual rate of change for the period 1970–1990. The consultancy will facilitate an expert workshop for methodology development and test the recommended methodologies in four key areas around Australia that will sample a range of environments.

In summary, remotely sensed data will be an important source of information for the National Carbon Accounting System and its related projects.

Craig Smith & Medhavy Thankappan

AGRECON AWARDED AUSINDUSTRY R&D GRANT

ACRES Distributor, Agrecon, has been awarded approximately $1 million by AusIndustry's Industry Research and Development Board within the Commonwealth Department of Industry, Science and Resources for research and development underpinning Agrecon's commercial activities over the next two years. The work involves estimating crop yields, generating yield maps and precision farming using satellite imagery.

The project proposes the development of products and services from predictive models based on satellite imagery to accurately forecast and improve crop production.

The outcome of the project will be a range of new precision farming, crop yield estimation and forecasting products and services for cotton, grains and other crops. Products include raw and enhanced satellite imagery in digital and printed form, low cost image processing and mapping software, accurate farm and field layout diagrams, and algorithms for pre-harvest yield mapping, yield estimation and crop forecasting — at site, field, farm, catchment, region, state, industry, national and international scales.

This technology will supersede inaccurate conventional techniques and facilitate precision farming without the need for growers to obtain expensive and technically demanding yield monitors at harvest. The proposed technology and resulting products have significant potential to revolutionise how cotton, grains and other crops are managed, how yield potential is assessed and how commodities are marketed. Resulting products will assist growers to improve farm management practices, increase productivity and profitability by lifting yields and reducing within- and between-field variability. Other industry stakeholders will be advantaged through improved strategic planning, financial and crop marketing. Beneficiaries include agronomists, input suppliers of fertilisers, chemicals, equipment and machinery, processors, insurers, risk assessors, financiers, peak industry bodies, government resource management agencies, commodity analysts, risk managers and legal practitioners.

A key feature of the Agrecon project is the proposal to provide clients with low and high resolution satellite imagery, spatially distributed biophysical and socioeconomic data, derived products, crop forecasts, financial and risk management advice through online Internet access via e-commerce. This will be integrated with a collaborative farm gate precision farming advisory service.

A cotton growing area near Moree showing the classification capabilities of satellite imagery for crop monitoring.

SATELLITE IMAGERY HELPS IN REGIONAL DEVELOPMENT

In response to the National Forestry Policy Statement, private industry is using satellite technology to assist in expanding Australia's commercial plantations of hardwoods and softwoods.

Conservation is of particular consequence in plantation development because of a community desire to retain native vegetation. Plantation development is directed towards the use of cleared but marginal agricultural lands to minimise the impact on the native biota. The use of marginal agricultural lands is necessary to contain costs and minimise disruption to local communities.

Development of a viable plantation industry depends upon the continuous supply of a minimum quantity of timber, where this necessitates the planting of substantial new areas each year. New plantings must continue for around 25 years, where this represents the harvest rotation period. Consequently there is a need to identify suitable areas for planting that meet multiple criteria such as rainfall, soil, vegetation, slope, aspect, proximity to mills, market availability and price.

The Environmental Research and Information Consortium Pty Ltd (ERIC) is aiding this process of site selection by developing GIS data layers to address these criteria. Analysis of satellite imagery has proven particularly useful by providing high resolution maps of land cover and vegetation. These images are used together with information on terrain, climate, and lithology to identify areas which are potentially suitable for plantations. For properties on the market in these areas, ground observations are then used to confirm site suitability and provide detailed information on the animal and plant life of the area.

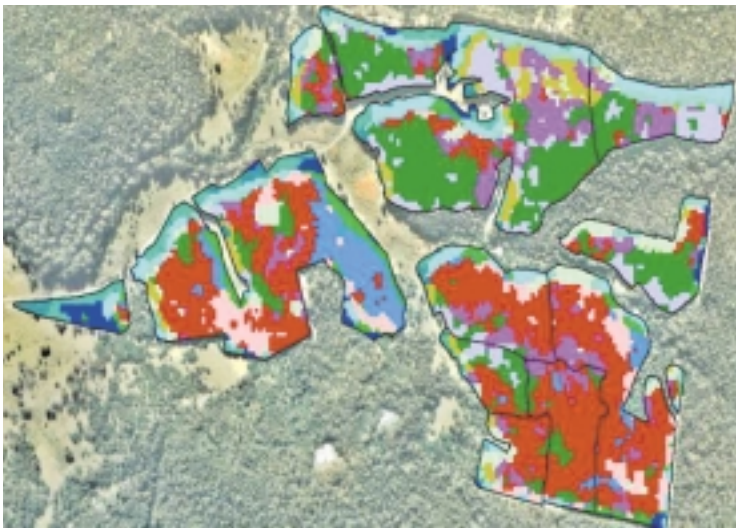
Evaluating results in the field.

Satellite imagery has also been valuable in planning plantation development because of the high accuracy of geo-registration. The vegetation mapping was carried out by using merged Landsat TM and SPOT Panchromatic imagery, where this was accurately registered to the topographic maps. The aerial photography used for planning plantation development can readily be registered to this merged imagery because of the detail provided by the multi-spectral, 10m resolution.

The registration accuracy achieved using satellite imagery has provided major benefits in evaluating plantable areas, the delineation of 1ha plots sold to investors and the verification of works undertaken by contractors.

The benefits of these initiatives by industry are now becoming evident. Visy Pty Ltd is establishing a pulp and paper mill at Tumut. The Softwood Development Corporation has announced the development of a softwood mill at Bombala which will be supplied with timber from forests established by Willmott Forests. There are further developments planned which are associated with timber exports from Eden. These developments bring new life and opportunities to regional communities which have been in decline during the past 20 years.

Brian Tunstall
Environmental Research & Information Consortium Pty Ltd.
Tel (02) 6260 5161



Plantation Forestry: Plantation Variation Map (Classified Merged Landsat and SPOT Pan overlaying aerial photograph).

A VITAL PROJECT

The Department of Natural Resources in Queensland, an ACRES distributor, is currently managing the Visual Terrain Analysis for Landcare (VITAL) project, with funding provided by the Natural Heritage Trust.

The project supports the development and implementation of sustainable natural resource management strategies by community groups, landholders and government agencies within the Fitzroy catchment in Central Queensland, through the provision of high quality GIS and remotely sensed products.

VITAL has added data supplied by community groups to image bases consisting of Landsat TM or SPOT imagery. These image based maps are used to illustrate issues, strategies and achievements or simply to represent the area of interest of a community group. One of the first groups to acquire VITAL products to assist in land management (weed management, bushfire control and a communication tool) was the Mimosa Catchment Landcare Association Inc.

One of VITAL's key objectives is to increase community awareness and understanding of the capabilities of remote sensing systems (including hyperspectral, radar and radiometrics) and their potential applications for resource management. To this end, the project has conducted information and training workshops for community groups around the Fitzroy catchment as well as producing poster displays, newsletters and maintaining an Internet site.

VITAL's current and proposed activities include:

- establishing the condition and trend of selected sub-catchment areas within the Fitzroy catchment;
- workshops to provide landholders and community members with basic map and image interpretation skills; and
- identifying the distribution of several species of declared weeds within the Fitzroy catchment, along with their spread over time.

More information on this project can be obtained from:

- Cham Hewavisenthi — ph: (07) 4938 4394, e-mail: Arjuna.Hewavisenthi@dnr.qld.gov.au
- John Lowry — ph: (07) 4938 4392, e-mail: John.Lowry@dnr.qld.gov.au

A member of the Mimosa Catchment Landcare Group explains his group's activities.

UPCOMING REMOTE SENSING SATELLITES

Satellite	Operators	Brief Description	Launch Date	More Information
TERRA	NASA	Multi-sensor EOS mission	16 December 1999	terra.nasa.gov
EROS A1	West Indian Space	1.8m PAN	4th Quarter of 1999	www.westindianspace.com
EO-1	NASA	10m PAN, 30m MS	April 2000	eo1.gsfc.nasa.gov
QuickBird 1	EarthWatch	1m PAN, 4m MS	1st Quarter of 2000	www.digitalglobe.com
OrbView-3	Orbital Imaging	1m PAN, 4m MS	2nd Quarter of 2000	www.orbimage.com
EROS A2	West Indian Space	1.8m PAN	3rd Quarter of 2000	www.westindianspace.com
ENVISAT	ESA	Multi-sensor mission	November 2000	envisat.estec.esa.nl
PM-1	NASA	Microwave Scanning Radiometer	21 December 2000	www.ghcc.msfc.nasa.gov
OrbView-4	Orbital Imaging	1m PAN, 4m MS, 8m HS	2000	www.orbimage.com
EROS B1	West Indian Space	0.82m PAN	2nd Quarter of 2001	www.westindianspace.com
RADARSAT 2	CSA, Orbital Imaging	3-100m SAR	Late 2001	www.rsi.ca
SPOT 5	CNES, Spot Image	3.5m PAN, 10 MS	4th Quarter of 2001	www.spotimage.fr
EROS B2	West Indian Space	0.82m MS	1st Quarter of 2002	www.westindianspace.com
ALOS	NASDA	2.5m PAN & MS, 10-100m SAR	1st Quarter of 2002	www.nasda.go.jp
EROS B3	West Indian Space	0.82m MS	4th Quarter of 2002	www.westindianspace.com

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Email: eric@eric.com.au
Web: www.eric.com.au

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spotimage@spotimage.com.au
Web: www.spotimage.com.au

Land Information Centre (LIC)
Department of Information Technology and Management
Panorama Avenue
PO Box 143
Bathurst NSW 2795
Tel: (02) 6332 8419
Fax: (02) 6332 8296
Email: info@lic.gov.au
Web: www.lic.gov.au

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GEOIMAGE PTY LTD
Suite G7 Paspalis Centrepoint Building
48-50 The Smith Street Mall
Darwin NT 0800
GPO Box 3499
Darwin NT 0801
Tel: (08) 8941 3677
Fax: (08) 8941 3670
Email: darwin@geoimage.com.au
Web: www.geoimage.com.au

QUEENSLAND

Department of Natural Resources
Geographic Data Services
Cnr Main and Vulture Streets
Woolloongabba QLD 4102
Locked Bag 40
Coorparoo Delivery Centre
QLD 4151
Tel: (07) 3896 3187
Fax: (07) 3406 2762
Email:
jo.plunkett@dnr.qld.gov.au
Web: www.dnr.qld.gov.au/slats

GEOIMAGE
13/180 Moggill Road
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PO Box 789
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geoimage@geoimage.com.au
Web: www.geoimage.com.au

Geo Mapping Technologies
Suite 2A, 17 Peel Street
PO Box 3857
South Brisbane QLD 4101
Tel: (07) 3846 2992
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Web: www.geomap.com.au

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Department for Environment, Heritage and Aboriginal Affairs (DEHAA)
Resource Information
Image Data
Mapland, Building 2
300 Richmond Road
Netley SA 5037
PO Box 550
Marleston SA 5033
Tel: (08) 8226 4904
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jcameron@dehaa.sa.gov.au
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Central Science Laboratory
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Sandy Bay TAS 7005
GPO Box 252-74
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Tel: (03) 6226 2156
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www.spaceimages.utas.edu.au

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Web: www.ria.com.au

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Level 2, 121 William Street
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Tel: (03) 9269 4575
Fax: (03) 9269 4500
Email: j.white@nrsc.com.au
Web: www.nrsc.com.au

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South Melbourne VIC 3205
Tel: (03) 9867 7322
Fax: (03) 9867 7422
Email: adriant@ersis.com.au
Web: www.datamall.com.au

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Web: www.geoimage.com.au

Satellite Remote Sensing Services
Department of Land Administration
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Wembley WA 6014
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Fax: (08) 9383 7142
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Web: www.rss.dola.wa.gov.au

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Web: www.auslig.gov.au

ACRES is a business unit of Australia's national mapping agency, AUSLIG, Commonwealth Department of Industry, Science and Resources.

AUSLIG

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