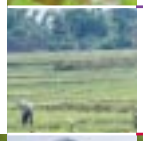
AUSTRALIAN CENTRE FOR REMOTE SENSING

AUGUST 1999, ISSUE 19

ACRES UPDATE

LANDSAT 7 SPECIAL EDITION

CONTENTS



ACRES

Contents

Cover: Landsat 7 image of Palmer River region Northern Queensland, acquired at Alice Springs on 28 May 1999 with a combination of bands 3, 4, 5 & 8.

PUBLICATION DETAILS

Published by ACRES, Australian Centre for Remote Sensing, a business unit of Australia's national mapping agency, AUSLIG, Commonwealth Department of Industry, Science and Resources.

ACRES, PO Box 28,
Belconnen ACT 2616, Australia
FREECALL 1800 800 173

ACRES AUSLIG

MANAGER'S MESSAGE

I hope you like the colourful new look of *ACRES Update*. As promised, this edition focuses on the revised pricing and data policy conditions for Landsat 7.

I am delighted we are now able to offer greatly reduced prices on Landsat 7 data products sourced from ACRES. This has been made possible through the impact of the re-negotiated agreement for reception of Landsat with the US Government, combined with the greater production efficiencies associated with our new processing systems. We have also extended these price reductions to our vast archive of Landsat 5 and earlier data. ACRES has high hopes that these price reductions will broaden the applications base for satellite remote sensing in Australia and permit more regular and extensive use of data in existing applications.

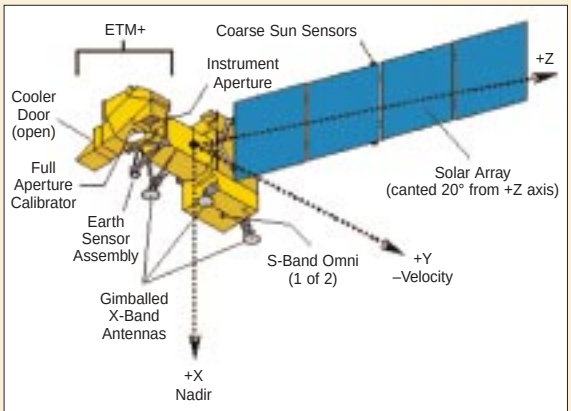
While these price reductions are significant, no less important is ACRES continuing commitment to provide a comprehensive archive, an extensive product range, high quality standards and outstanding service.

ACRES preparations for routine Landsat 7 reception have progressed well over the last few months. We managed a successful acquisition on our first attempt in late May, and within a week had processed imagery to demonstrate end-to-end capability. Shortly afterwards, ACRES successfully achieved a similar milestone for SPOT 4 reception and processing. These achievements were a great credit to the ACRES engineering team led by Erik Elmar and Robert Denize and to our key system suppliers, the University of South Australia Institute for Telecommunications Research and Macdonald Dettwiler.

Paul Trezise

LOWER PRICES FOR HIGHER QUALITY LANDSAT 7 PRODUCTS

ACRES is now ready to provide products from the Landsat 7 satellite which was successfully launched in April. Using the new Enhanced Thematic Mapper Plus sensor (ETM+), Landsat 7 provides higher spatial resolution than earlier Landsat satellites. As an added bonus, Landsat 7 products will be available from ACRES at greatly reduced prices.



The ETM+ sensor has the same seven spectral bands as its predecessor, TM, but has an added panchromatic band with 15 metre resolution and a higher resolution thermal band of 60 metres. The ETM+ sensor also has a five percent absolute radiometric calibration.

'These features make Landsat 7 products more attractive to satellite imagery users for applications in agriculture, mining and exploration, environmental monitoring, land use and mapping, hydrology and coastal resources. New applications are also likely to be developed,' said the Parliamentary Secretary to the Minister for Industry, Science and Resources, Warren Entsch, when he announced the new prices on 9 July.

ACRES has been able to cut its prices for Landsat products, including those from earlier Landsat satellites, by up to 75%.

The new price structure reflects ACRES lower costs in accessing Landsat data, as well as production efficiencies arising from installation of ACRES new Optical Data Processing System.

In addition, new licensing conditions will relax restrictions on copying and redistribution of Landsat 7 and MSS data wherever possible, providing unique opportunities for Australian industry.

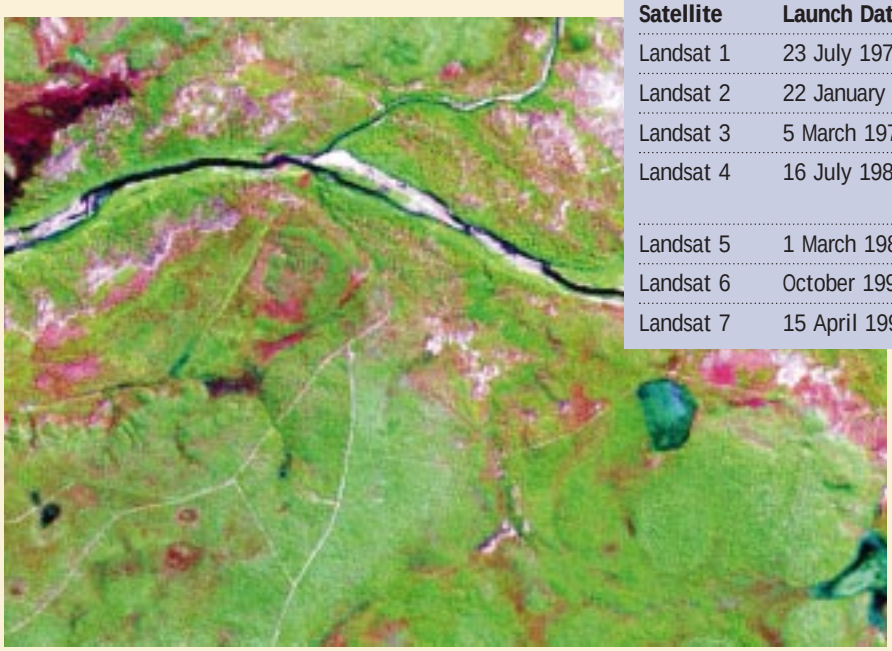
ACRES receives, archives, processes and distributes data from a wide range of Earth observation satellites. Its decision to continue a 20 year commitment to the Landsat program is based on strong demand from users for reliable and timely access to Landsat data.

The ACRES Landsat image archive now totals approximately 440,000 'scenes' or image areas, each with a ground coverage of about 185km x 185km. This provides a valuable resource for Australia, particularly for comparisons of the same area over different time periods. Landsat satellites pass over the same area every 16 days. With ETM+ data acquired on a daily basis, the ACRES archive will be the largest repository of Landsat 7 images covering Australia.

Continued next page

History of the Landsat launches

Satellite	Launch Date	Notes
Landsat 1	23 July 1972	Decommissioned 6 January 1978
Landsat 2	22 January 1975	Decommissioned 25 February 1982
Landsat 3	5 March 1978	Decommissioned 31 March 1983
Landsat 4	16 July 1982	Sensor turned off in August 1992 and satellite kept in standby mode
Landsat 5	1 March 1984	Operational
Landsat 6	October 1993	Failed on launch
Landsat 7	15 April 1999	Operational



Landsat 7 images show more detail due to the sharpening effect of the new PAN Band 8. This image is a Landsat 7 PAN, Band 8 image (15 metre resolution), merged with Bands 345 (30m resolution).

The live telecast of the Landsat 7 launch by NASA TV.

Radiometric characteristics of the ETM+ and TM Sensors

Band No.	Spectral Range (microns)	EM Region	Generalised Application Details
1	0.45–0.515	Blue	Coastal water mapping, differentiation of vegetation from soils
2	0.525–0.605	Green	Assessment of vegetation vigour
3	0.63–0.690	Visible Red	Chlorophyll absorption for vegetation differentiation
4	0.75–0.90	Near Infrared	Biomass surveys and delineation of water bodies
5	1.55–1.75	Middle Infrared	Vegetation and soil moisture measurements; differentiation between snow and cloud
6	10.40–12.50	Thermal Infrared	Thermal mapping, soil moisture studies and plant heat stress measurement
7	2.09–2.35	Middle Infrared	Hydrothermal mapping
8*	0.52–0.90 (panchromatic)	Green, Visible Red, Near Infrared	Large area mapping, urban change studies.

* The panchromatic band 8 is only on the ETM+ sensor.

Other Satellite and Image Characteristics

Property		Landsat 7 ETM+	Landsat 5 TM
Ground sampling Interval (pixel size)	Bands 1–5 & 7	30 x 30 m	30 x 30 m
	Band 6	60 x 60 m	120 x 120 m
	Band 8	15 x 15 m	N/A
Swath width		185 km	185 km
Repeat coverage interval		16 days (233 orbits)	16 days (233 orbits)
Altitude		705 km	705 km
Quantisation		Best 8 of 9 bits	8 bits (256 levels)
On-board data storage		375 Gb (solid state)	Magnetic tape failed
Orbit type		Sun-synchronous	Sun-synchronous
Inclination		98.2°	98.2°
Equatorial crossing		Descending node: ≈10:00am	Descending node: ≈10:10am

PRODUCT DESCRIPTION

With the new capabilities offered by Landsat 7, ACRES range of products has expanded to offer users even greater diversity in their use and application of image data.

Digital Media

Data is available on CD-R, 2.3 GByte EXABYTE Tape and 1.3 GByte DAT. Additional copies of digital datasets are available for $150 when ordered with the original dataset.

Raw Digital Data

ACRES supplies RAW (0) Data to users of Landsat ETM+ data with high-end processing capabilities. This option is available as a full scene (approx. 184x172km) with all 8 bands for $1,000.

Photographic Media

Small prints are available on paper or transparency. Large prints are only available on paper. Additional copies of products are available for $80 when ordered with the original print.

Trading Conditions

Special copyright conditions apply to the sale of satellite data. In order to purchase satellite data products, users must agree to the licence conditions covering its use.

For a copy of the relevant Licence Agreement, please contact ACRES or your nearest ACRES distributor.

Delivery Details

ACRES products are dispatched by airfreight. The price of data includes freight charges within Australia.

All prices are subject to variation without notice and are quoted in Australian Dollars. See page 16 for your nearest Landsat distributor.

PRICES – Digital Image Data

Sensor & Satellite	Scene Size	Bands	Processing Level: Path Image	Map Oriented Image	Orthocorrected Image
ETM+ Landsat 7 New and archive data.	Small Scene Up to 625 sq km e.g. 25 x 25 km	All 8	–	$500	–
	Ninth Scene Up to 3,600 sq km e.g. 60 x 60 km	All 8	–	$600	$700
	Quarter Scene Up to 8,100 sq km e.g. 90 x 90 km	All 8	–	$750	$850
	Full Scene 184 x 172km approx	All 8	$1,300	–	–
	Full Scene Up to 40,500 sq km — Max 225 E–W x 180 km N–S	All 8	–	$1,600	$2,000
	Super Scene Up to 60,000 sq km — Max 240 E–W x 250 km N–S	All 8	–	$2,400	$3,000
TM Landsat 5 New and archive data.	Small Scene Up to 625 sq km e.g. 25 x 25 km	1-5 & 7; or all 7	–	$650	–
	Ninth Scene Up to 3,600 sq km e.g. 60 x 60 km	1-5 & 7; or all 7	–	$750	$900
	Quarter Scene Up to 8,100 sq km e.g. 90 x 90 km	1-5 & 7; or all 7	–	$900	$1,000
	Full Scene 184 x 172km approx	1-5 & 7; or all 7	$1,625	–	–
	Full Scene Up to 40,500 sq km — Max 225 E–W x 180 km N–S	1-5 & 7; or all 7	–	$2,000	$2,500
	Super Scene Up to 60,000 sq km — Max 240 E–W x 250 km N–S	1-5 & 7; or all 7	–	$3,000	$3,750
MSS Landsat 2–5 Archive data only.	Full Scene 184 x 172 km	All 4	$550	–	–
	Full Scene Up to 40,500 sq km — Max 225 E–W x 180km N–S	All 4	–	$700	–

PRICES – Photographic Image Data

Sensor & Satellite	Scene Size	Bands	Map Oriented Image: Small (1:1)	Large (>1:1)
ETM+	Quarter Scene Up to 8,100 sq km 90 x 90 km	Choice of 3*	$350	$400
	Full Scene Up to 36,000 sq km Max 200 E-W x 180 km N-S	Choice of 3*	$550	$600
TM	Quarter Scene Up to 8,100 sq km 90 x 90 km	Choice of 3	$450	$500
	Full Scene Up to 36,000 sq km Max 200 E-W x 180 km N-S	Choice of 3	$700	$750
MSS	Full Scene Up to 36,000 sq km Max 200 E-W x 180km N-S	Choice of 3	$520	$570

* Bands 1–5 & 7 are only available for ETM+ photographic products.

PRICES – Combined Digital & Photographic Products

Where the same digital and photographic image is purchased within a single order, the following discounted prices apply. ($250 has been added to the digital price equivalent for Small Prints, and $300 for Large Prints).

Sensor & Satellite	Scene Size	Bands	Path Image		Map Oriented Image		Orthocorrected Image	
			Small (1:1)	Large (>1:1)	Small (1:1)	Large (>1:1)	Small (1:1)	Large (>1:1)
ETM+ Landsat 7 New and archive data	Quarter Scene Up to 8,100 sq km 90 x 90 km	Choice of 3*	–	–	$1,000	$1,050	$1,100	$1,150
	Full Scene 184 x 172 km approx	Choice of 3*	$1,550	$1,600	–	–	–	–
	Full Scene Up to 36,000 sq km 200 x 180 km	Choice of 3	–	–	$1,850	$1,900	$2,250	$2,300
TM Landsat 5 New and archive data	Quarter Scene Up to 8,100 sq km 90 x 90 km	Choice of 3	–	–	$1,150	$1,200	$1,250	$1,300
	Full Scene 184 x 172 km approx	Choice of 3	$1,875	$1,925	–	–	–	–
	Full Scene Up to 36,000 sq km 200 x 180 km	Choice of 3	–	–	$2,250	$2,300	$2,750	$2,800
MSS Landsat 2–5 Archive only	Full Scene 184 x 172 km approx	Choice of 3	$800	$850	–	–	–	–
	Full Scene Up to 36,000 sq km 200 x 180 km	Choice of 3	–	–	$950	$1,000	–	–

* Bands 1–5 & 7 are only available for ETM+ photographic products.

Standard Enlargements

Scale	Enlargement Factor	Scene Size	Size (mm)
1:1,000,000	Small (1:1)	Full Scene	238 x 219
1:500,000	Large (2:1)	Full Scene	476 x 438
1:250,000	Large (4:1)	Full Scene	952 x 876

UPCOMING REMOTE SENSING SATELLITES

Satellite	Operators	Brief Description	Launch Date	More Information
TERRA	NASA	Multi sensor EOS mission	4th Quarter of 1999	terra.nasa.gov
Ikonos 2	Space Imaging	1m PAN, 4m MS	3 September 1999	www.spaceimage.com
QuickBird 1	EarthWatch	1m PAN, 4m MS	November 1999	www.digitalglobe.com
EO-1	NASA	10m PAN, 30m MS	15 December 1999	eo1.gsfc.nasa.gov
EROS A1	West Indian Space	1.8m MS	4th Quarter of 1999	www.westindianspace.com
OrbView-3	Orbital Imaging	1m PAN, 4m MS	4th Quarter of 1999	www.orbimage.com
ENVISAT	ESA	Multi sensor mission	November 2000	envisat.estec.esa.nl
PM-1	NASA	Microwave Scanning Radiometer	4th Quarter of 2000	wwwghcc.msfc.nasa.gov/AMSR/amsr.html
EROS A2	West Indian Space	1.8m MS	3rd Quarter of 2000	www.westindianspace.com
OrbView-4	Orbital Imaging	1m PAN, 4m MS, 8m HS	2000	www.orbimage.com
EROS B1	West Indian Space	0.8m MS	2nd Quarter of 2001	www.westindianspace.com
SPOT 5	CNES, Spot Image	3.5m PAN, 10 MS	4th Quarter of 2001	www.spotimage.fr
RADARSAT 2	CSA, Orbital Imaging	3-100m SAR	Late 2001	www.rsi.ca
EROS B2	West Indian Space	0.8m MS	1st Quarter of 2002	www.westindianspace.com
ALOS	NASDA	2.5m PAN & MS, 10-100m SAR	2002	www.nasda.go.jpa

These two images show the continuity in quality and characteristics between the Landsat 5 & 7 data. The Landsat 5 image on the left shows Bands 345, Palmer River, acquired July 1995, with vegetation in green. The Landsat 7 image on the right shows Bands 345, Palmer River acquired 28 May 1999 gives an identical image.

ACRES NEW SIMPLIFIED PROCESSING OPTIONS

With the introduction of products from the Landsat 7 ETM+ sensor and the capabilities of ACRES new Optical Data Processing System (ODPS), ACRES has been able to simplify its image data processing options.

Product framing

For products which retain the sensor ground swath framing, a nominal scene will be the smallest area available. However, the centre of the frame may be shifted along-track to cover the area of interest. Map oriented products are available as Variable Windows so users can now select their areas of interest within predetermined ranges.

Nominal Coverage	Nominal Rectangular Extent	Descriptive Name
Up to 625sq km	25x25km	Small Scene
Up to 3600sq km	60x60km	Ninth Scene
Up to 8100sq km	90x90km	Quarter Scene
Up to 40,500sq km	180x180km	Full Scene
Up to 60,000sq km	250x180km	Super Scene

Variable Window options for Landsat have the data aligned with the north-south, east-west map-grid direction. The nominal coverage of SPOT Variable Windows remains unchanged.

Spectral band combinations

Satellite & Sensor	Sensor Bands	Combination for digital products
Landsat MSS	4	All 4 bands only
Landsat 5 TM	7	6 bands without TIR as 6 fit on a CD but all 7 bands may be selected for output to tape
Landsat 7 ETM+	8 (incl Pan)	All 8 bands only
SPOT 1 to 3	4 (incl Pan)	Pan band only or 3 multispectral bands only or all 4 bands
SPOT 4	5 (incl Mono)	Mono band only or 4 multi-spectral bands only or all 5 bands

Processing levels

The common ODPS processing options will be Levels 5, 8, and 10. Levels 0 and 1 are available to meet SPOT Image and USGS requirements. Level 0 data is not recommended for use with a standard image analysis package and Level 1 data is intended for use in soft-photogrammetry applications using SPOT Pan data.

ACRES has also taken the opportunity to move away from a numerical system of identifying processing levels to more descriptive names.

Continued next page

New processing levels with new names and description

New Name	Existing Processing Level	Description
Raw(0) Data (USGS Level 0R equivalent)	0	No radiometric or geometric corrections. *Recommended only for ground station interchange and for application software intended for use with very low level products.*
Raw Image (SPOT Image Level 1A equivalent)	1	Radiometrically corrected but no geometric corrections. *Recommended only for SPOT products to be used in stereo-pairs for DEM generation in specific application software.*
Path Image (USGS Level 1G and SPOT Image Level 1B equivalent)	5	Satellite path oriented with systematic radiometric and geometric corrections applied to the data. Two dimensional resampling to fit a specific earth datum and map grid.
Map Oriented Image	8	Map oriented with systematic radiometric and geometric corrections applied to the data. Two dimensional resampling to align with a map grid.
Orthocorrected Image	10	Map oriented with systematic geometric corrections refined with the use of Ground Control Points and the AUSLIG/AGSO 9 second DEM. This DEM extends over Australia only. Two dimensional resampling to align with a map grid. *This is the most map-accurate product, suitable for input into a GIS.*

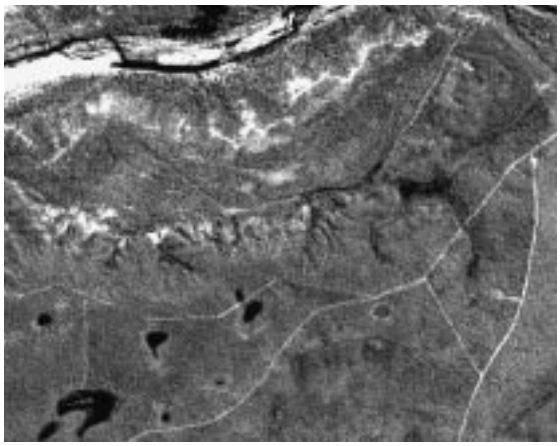
Summary

Satellite & Sensor	Band Options	Raw(0) Data	Raw Image	Path Image	Map Oriented Image	Orthocorrected Image
Landsat MSS	All 4 only	No	No	Yes	Yes	No
Landsat 5 TM	1–5 & 6 or all 7	No	No	Yes	Yes	Yes
Landsat 7 ETM+	All 8 only	Yes	No	Yes	Yes	Yes
SPOT 1,2,3	Pan, MLA or all	Yes*	Yes	Yes	Yes	Yes
SPOT 4	Mono, Xi or all	Yes*	Yes	Yes	Yes	Yes

* For SPOT Image only — CRIS L0

ETM+ ON BOARD LANDSAT 7

The Enhanced Thematic Mapper Plus (referred to as ETM+) is a new sensor on board the Landsat 7 satellite. Built by Raytheon, Santa Barbara Remote Sensing, the ETM+ is an improved version of the Landsat 4/5 Thematic Mapper (TM) payloads designed to provide data continuity with all prior Landsat missions. Data continuity is now possible because the TM and ETM+ instruments have the same spatial resolution in the reflective bands and almost identical spectral characteristics of comparable bands.



Landsat 7 Pan Band 8 is a 15 metre resolution, black and white image. A new band on the ETM+ compared to TM.

The ETM+ is a fixed position, nadir viewing, whisk broom (ie. line scanner) multispectral scanning radiometer. It has some major advantages over the TM sensor:

- Increased spatial resolution of thermal IR (band 6) data from 120m to 60m.
- Improved radiometric calibration process.
- Addition of panchromatic (band 8) data at 15m spatial resolution.
- Improved band-to-band registration will assist in generating the merged (Pan + multispectral) products quicker and more accurately.
- 2 x 75 MBPS data rate.
- Two gain states — low gain and high gain. For thermal band data, both low and high gain data are available by default. For other bands (1 to 5, and 7) the satellite will acquire image data in one of two possible gain settings. The low gain setting measures a greater

Continued next page

radiance range but with decreased sensor sensitivity, while high gain measures a lesser radiance range but with increased sensitivity. Table 1 below provides more details.

The 185km swath width of the sensor is produced by an oscillating mirror sweeping across track. Figure 1 shows a simplified view of the optical path within the ETM+ sensor. The ETM+ optics contain the scan mirror, telescope, scan line correction assembly, primary focal plane and cold focal plane, among others. The 7Hz scan mirror provides the across track motion for the imaging while the forward velocity of the spacecraft provides the along track motion. The scan line correction assembly is used to remove the 'zig-zag' motion of the imaging FOV produced by the combination of the along and across track motion.

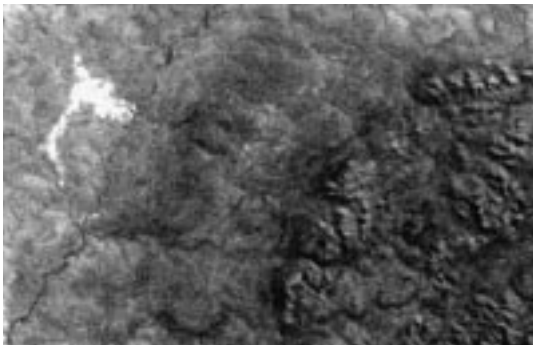
There are two focal planes used by the ETM+. The primary focal plane uses silicon photodiode material as a sensor and detects radiation for bands 1 to 4 and 8. The cold focal plane uses detectors made up of Indium Antimonide (In Sb) for bands 5 and 7 and Mercury Cadmium Telluride (HgCdTe) for band 6.

The absolute radiometric calibration of ETM+ is of the order of ±5%. The calibration of ETM+ is accomplished using several types of calibration schemes. The sensor is equipped with an internal calibration paddle that moves into the path of incoming radiation once every scan line. This paddle has several calibration lamps with known energy signatures which are sensed by the detectors and supply calibration data at the end of every scan line.

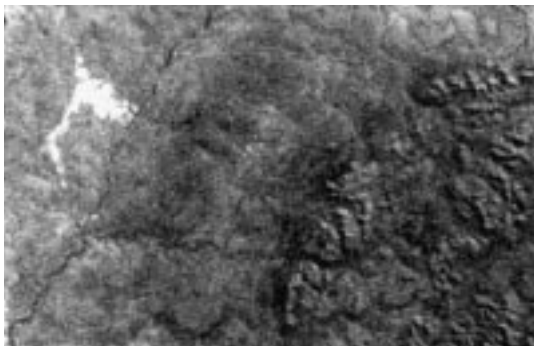
The ETM+ can also perform two types of calibration using the sun's radiation. They are Full Aperture Solar Calibration (FASC) and Partial Aperture Solar Calibration (PASC). PASC will be scheduled once every day, while FASC will be performed once every four to six weeks. Both FASC and PASC are used for calibration of bands 1 to 5, 7 and 8.

In addition to the PASC and FASC operations, Ground Look Calibration (GLC) will use ground truth images to help characterise the effective radiance seen by the ETM+. GLC will occur approximately once every 2–6 months.

It is expected that the ETM+ sensor will be replaced in future with the next generation, lighter version of the sensor called ALI (Advanced Land Imager), which will be flown in December 1999 as a part of the EO–1 mission payload.



Landsat 7 band 6H illustrates high gain thermal data.



Landsat 7 band 6L illustrates low gain thermal data.

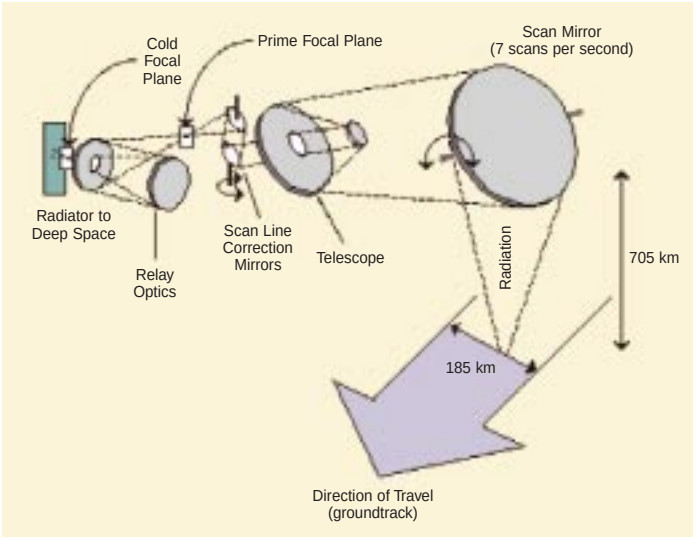


Figure 1: ETM+ optical path.
(Source: NASA web site http://ls7pm3.gsfc.nasa.gov/science.html)

Table 1: Spectral characteristics of the ETM+

Channel	Wavelength (µm)	Nominal spatial resolution	Minimum saturation radiances (mW cm^{-2} Sr^{-1} μ^{-1})			
			High gain	Low gain	High/Low ratio	TM equivalent
1	0.450–0.515	30	19.1	28.6	0.67	15.40
2	0.525–0.605	30	19.4	29.1	0.67	29.11
3	0.630–0.690	30	15.0	22.5	0.67	22.50
4	0.775–0.900	30	15.0	22.5	0.67	24.00
5	1.550–1.750	30	3.15	4.73	0.67	3.00
6	10.40–12.50	60	275K–320K	200K–320K	0.67	
7	2.090–2.350	30	1.11	1.67	0.67	1.65
Pan	0.520–0.900	15	15.7	23.5	0.67	N/A

Source: Darrel Williams and Jim Irons, Landsat Project Science Office, NASA, March 1999.

HOW LANDSAT DATA IS USED

Landsat 7's Enhanced Thematic Mapper Plus continues supplying the database of Earth imagery begun in 1982 by the Landsat 4 Thematic Mapper. The same spectral bands provide consistent change detection.

The Landsat program has benefited a wide variety of applications since it began in 1972. With the significant price drop of Landsat 7 data products, it is expected that multispectral imagery will have even more benefits for existing and new applications. The main areas and examples of applications where Landsat data has been used are:

Agriculture, Forestry and Range Resources

- Discriminating vegetative, crop and timber types
- Monitoring and measuring crop and timber harvests
- Precision farming land management
- Determining range biomass & health
- Determining soil conditions & associations
- Monitoring irrigation practices
- Assessing wildlife habitat
- Monitoring and mapping insect infestation

Land Use and Mapping

- Classifying land uses and land capability
- Cartographic mapping and map up-dating
- Monitoring urban growth
- Regional planning
- Mapping transportation networks
- Siting power transmission routes
- Planning waste disposal sites, power plants and other industries
- Mapping and managing flood plains
- Tracking socio-economic impacts on land use

Geology

- Mapping major geological features
- Revising geologic maps
- Classifying rock types
- Mapping volcanic surface deposits
- Identifying indicators of mineral and petroleum resources
- Producing geomorphic maps
- Mapping impact craters

Hydrology

- Mapping land-water boundaries and surface water areas
- Mapping flood plain characteristics
- Determining area extent of snow and ice coverage
- Measuring changes and extent of glacial features
- Measuring turbidity and sediment patterns
- Monitoring lake inventories and health
- Estimating snow-melt run-off
- Mapping watersheds
- Characterising tropical rainfall

Coastal Resources

- Mapping shoreline changes
- Mapping shoals, reefs and shallow areas
- Mapping and monitoring sea-ice shipping lanes
- Tracking beach erosion and flooding
- Monitoring coral reef health
- Measuring sea-surface temperature

Environmental Monitoring

- Monitoring deforestation
- Mapping and monitoring water pollution
- Determining effects of natural disasters
- Tracking oil spills
- Mapping and monitoring lake eutrophication
- Monitoring mine waste pollution
- Monitoring volcanic ash plumes
- Assessing and monitoring grass and forest fires
- Assessing drought impact
- Monitoring volcanic flow activity.

SUCCESSFUL LANDSAT 7 UNDERFLY MANOEUVRE

ACRES Alice Springs Ground Station successfully acquired all passes associated with the Landsat 7 'underfly' of Landsat 5 in early June. The Landsat 5 data was acquired when the satellite was positioned directly over the orbit of Landsat 7. Almost simultaneously, Landsat 7 data of the same area was acquired via the satellite's onboard recorder.

The Landsat 7 underfly project was designed to collect Landsat 5 and Landsat 7 data simultaneously to cross-calibrate the two Landsat systems. Ground station operators in Australia, Argentina, Brazil, Canada, Europe, South Africa and Saudi Arabia collected Landsat 5 data via direct downlink. In addition, Space Imaging, USA, which operates the Landsat 5 spacecraft, collected Landsat 5 data of Canada, USA and Mexico.

The EROS Data Center, USA, which operates the Landsat 7 spacecraft will process and analyse all this data. A large number of scenes will be examined to characterise both the TM and ETM+ sensors. Once a baseline is determined for each sensor the differences in spectral responses will be quantified, the relative gain differences between each sensor will be determined and the calibration parameters adjusted as required. The large quantity of underfly data collected permits multiple techniques to be used in this process.

The NASA Landsat 7 Project Science Office will provide reports of the cross-calibration between the ETM+ and the Landsat 5 TM sensor data. The results will be reported when they become available early in the year 2000.

RADARSAT MEETINGS

The fourth RADARSAT International (RSI) distributors' and network stations' meetings were held in Vancouver, Canada, in June. They were the first meetings to be run by RSI under the new ownership of MacDonald, Dettwiler and Associates (MDA). More than 60 distributors, partners and value added resellers representing 22 countries attended what was the largest distributors' meeting held so far.

Recently appointed RSI President, Mr Roland Knight, welcomed many new Canadian companies to the distributors' meeting which focused on providing more sales tools to develop the future market. At the network stations' meeting, Jim Harpring from Alaska, USA, gave some very good examples of the efficiency and cost effectiveness of RADARSAT for shipping, fishing and environmental monitoring.

Presentations at the distributors' meeting covered selling information and solutions, market analysis, selling strategies, a technical update on the health of the satellite, MDA's future plans for RADARSAT 2 and the likely distribution model that will be adopted in conjunction with ORBIMAGE. The health of the current system is excellent and the satellite has another five years expected life.

John Payne, third from left, with the award he received on behalf of ACRES when he attended the June distributors' meeting. Congratulating John are (L-R) Dr John Hornsby, Shawn Burns and Roland Knight of Radarsat International.

A series of excellent sessions also outlined areas where distributors and partners have worked together to provide solutions for clients. Two strong themes emerged from this year's meeting: the benefits of monitoring programs for distributors and RSI; and the establishment of near-real-time capabilities by many network stations.

A presentation was made to ACRES for achieving the highest total sales in the Asia Pacific area. This award recognized total sales by both ACRES and its Australian and New Zealand distribution network.

John Payne and Mike Pasfield

SAR UPGRADE OPERATIONAL

ACRES synthetic aperture radar (SAR) processing system was upgraded from the DEC Alpha single processor platform to an SGI four processor platform during May. The system now has increased efficiencies, improved file handling during processing, and increased disk space for storage. Consequently, ACRES SAR processing throughput has increased, with data processed up to five times faster which will mean improved delivery times.

The On Site Acceptance Tests (OSAT) are completed for the lower level products for all SAR data sets, so these products are now available.

Products available for RADARSAT-1, ERS-1 & 2 and JERS-1 are:

- Signal Data (Annotated raw);
- Single Look Complex (Phase preserved);
- Path Image (Viewable as an image).

The order forms, price lists and product descriptions are available from ACRES Sales & Marketing and Customer Services or they can be accessed via http://www.auslig.gov.au/acres/index.htm

RADARSAT OPERATIONS TECHNICAL INTERCHANGE WORKING GROUP (OTIWG) MEETING

The Canadian Space Agency (CSA) held the inaugural OTIWG meeting on 10–11 June in St Hubert, Quebec, Canada.

Some 17 international visitors and about 20 CSA/Contractor personnel took part in this informative and valuable workshop. Surendra Parasar and Ken Lord of CSA steered participants through a tight, but comprehensive program. Topics as diverse as operations planning to spacecraft design were covered.

Mike Pasfield (far right) with some of the OTIWG participants near the entrance to CSA's futuristic looking headquarters in St Hubert.

ASEAN EXPERTS MEET IN HANOI

ACRES representatives attended the 12th meeting of the ASEAN Experts Group on Remote Sensing (AEGRS) in Hanoi, Vietnam. Also present were senior officials from remote sensing agencies within the ASEAN countries, and invited guests from satellite operators and international groundstations.

Chaired by Mr Nik Nasruddin Mahmood from Malaysia, AEGRS is an excellent forum to exchange information on remote sensing and an important mechanism for establishing cooperative projects between ASEAN countries and international partners. This year's meeting indicated that a resurgence in remote sensing activity was taking place as the economic situation in countries within the region improved.

Over the last two years, AUSLIG and the Department of Industry Science and Resources have sponsored a cooperative project entitled "Technology for Updating Maps Using Remote Sensing". Participants developed pilot projects in areas of local relevance and exchanged experiences and ideas with other countries. The final seminar was held in Hanoi immediately preceding the AEGRS meeting and was pronounced an outstanding success by all.

Hanoi by day, venue for the meeting of the ASEAN Experts Group on Remote Sensing.

Typical land use around Hanoi.

Delegates attended a performance of Vietnam's internationally famous water puppets while they where in Hanoi.

ASEAN-AUSTRALIA COLLABORATION

The final seminar of the ASEAN-Australia Remote Sensing/Mapping project was held in Hanoi in June.

The ASEAN-Australia project was established following an approach by AEGRS to AUSLIG, and the seminar was the culmination of 18 months collaboration between seven ASEAN countries. Each participating country carried out a pilot project to establish methodologies for map revision using remote sensing data that meet their differing needs.

ASEAN country participants were Brunei, Malaysia, Indonesia, Philippines, Singapore, Thailand and Vietnam. Pilot projects covered the derivation of DEMs, land use/land cover map revision, data fusion techniques, updating national series topographic maps, and satellite image mapping.

AUSLIG's pilot project looked into field validation of maps and data revised using SPOT and TM imagery. Alan Swift and Richard Broers presented this pilot at the final seminar and also recognised the valuable input of other AUSLIG mapping staff.

The assistance provided by ACRES officers, particularly Paul Trezise and Craig Smith, was very much appreciated. The contribution of remote sensing expert, Professor Tony Milne, University of NSW, was also regarded highly by all participants.

Project manager, AUSLIG's Bob Irwin, reported project outcomes to the AEGRS meeting. Some of the major issues that emerged for implementation or further investigation are:

- translation of visual interpretation techniques into information extraction based on set procedures and controlled by map specifications;
- field validation techniques; and
- the role of synthetic aperture radar in map updating and issues of data fusion.

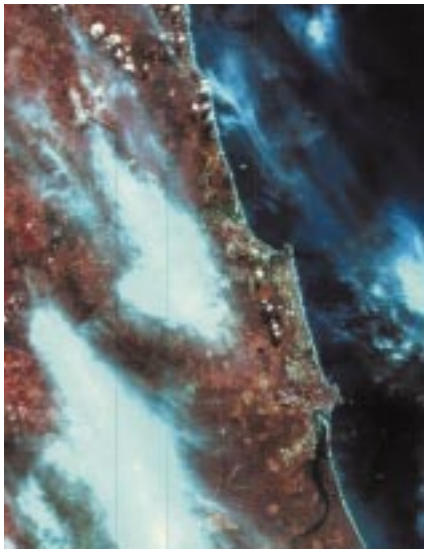
AEGRS members acknowledged the benefits to their organisations stemming from the project. They also expressed the view that future collaboration would build on the learning experiences and good work carried out in the project, and would further strengthen the networking developed during the project and the goodwill between participating countries.

ACRES SUCCESSFULLY ACQUIRES SPOT 4 DATA

ACRES successfully acquired SPOT 4 data from a downlink test on 25 May 1999. The data was then sent to MacDonald Dettwiler and Associates in Vancouver, Canada for test processing on the new ACRES Optical Data Processing System. The SPOT 4 dataset was successfully processed and delivered back to ACRES. The resulting sub-sampled images, generated for the ACRES Catalogue System, are shown in the figure. The examples are not indicative of the image quality from ACRES SPOT data products, but are shown as examples of the sub-sampled "browse" images that will appear in the ACRES Catalogue System.

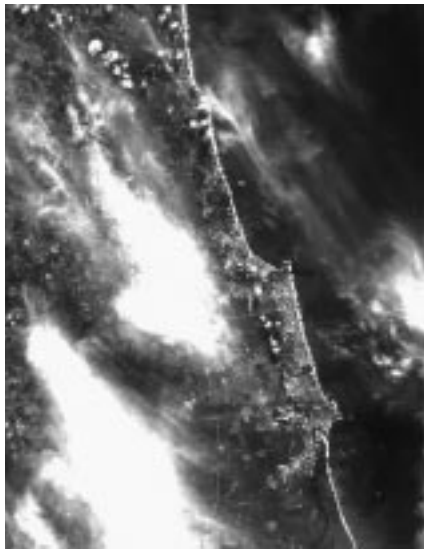
TERSS UPGRADED

The Tasmanian Earth Resource Satellite Station (TERSS) acquisition system in Hobart was upgraded by ACRES in June. A new demodulator now allows the system to obtain Landsat 5, Landsat 7, SPOT 1, 2 and 4 as well as ERS 1 and 2 and RADARSAT 1. This upgrade makes TERSS completely compatible with ACRES Alice Springs site and should allow more reliable operation and simpler maintenance.



SPOT 4 Multispectral Bands 4,2,3 (Note: Band 4 is the short wave infrared band)

SPOT 4 Multispectral Bands 1,2,3



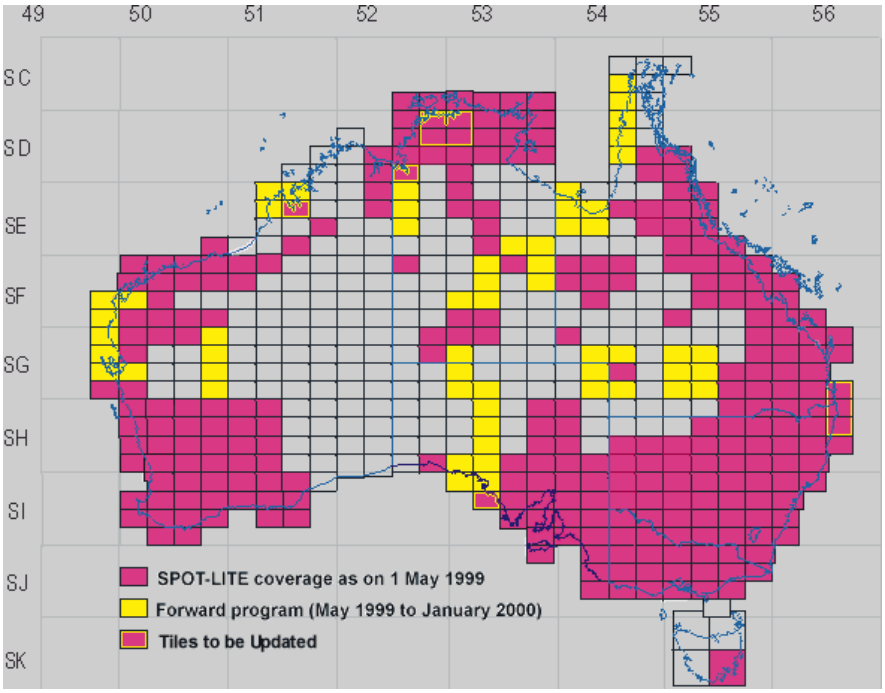
SPOT 4 Monospectral Band

SPOT-LITE UPDATE

The SPOT-LITE Forward Program Map now shows all tiles available as of 1 May 1999 as well as tiles that will be available before the end of the calendar year. On the SPOT-LITE Welcome web page, **www.auslig.gov. au/spotlite/**, users can access this map to view information such as date of acquisition and when a particular sheet will be available as a SPOT-LITE product.

250K tiles recently added to the SPOT-LITE Database

Sheet No.	Sheet Name	Date Acquired
SG5605	MUNDUBBERA	4/98 to 12/98
SG5606	MARYBOROUGH	6/98 to 12/98
SE5513	CLARKE RIVER	10/97 to 8/98
SE5514	TOWNSVILLE	6/98 to 8/98
SF5501	HUGHENDEN	8/98
SH5216	NULLARBOR	11/98 to 1/99
SI5007	DUMBLEYUNG	1/98 to 2/99



Taiwan's satellite receiving facility.

Satellite image showing an approved golf course development in Taipei is outlined in green. The actual development, in yellow, encroaches on a nearby river and surrounding, flatter area.

A delegation from Taiwan's National Science Council visited ACRES during June to benchmark their remote sensing ground station with comparable world class facilities.

TAIWAN GROUND STATION BENCHMARKS WITH ACRES

Led by Professor A J Chen, Director of the Satellite Remote Sensing Laboratory Center for Space and Remote Sensing Research at the National Central University, the delegation spent three days talking with staff at ACRES and visited the ACRES Data Acquisition Facility in Alice Springs.

The Taiwanese Center operates a sophisticated and efficient ground station similar to ACRES, with a focus on SPOT.

'Our ground station has been operating for six years,' said Professor Chen. 'It was time for the reviewers of the project to visit other world class facilities. We need to justify our funding from the National Science Council, which has a strong research and development focus and therefore a small number of users.'

Speaking towards the end of the visit, Professor Chen said the trip had been worthwhile, enabling him to compare his centre with ACRES and to identify future directions. In particular, he was impressed by ACRES total integration, the level of automation in its operations, the support for multiple missions, as well as the rigorous ISO 9002 accredited quality management regime.

'We know what it takes to operate a world class ground station and push us in that direction,' he said.

Despite the different focus between the centres — Taiwan's focus on research and development versus ACRES greater emphasis on operational customers — Professor Chen was also interested in ACRES distribution models, pricing structures, marketing and customer liaison.

But the exchange was not all one way. During a presentation about the Center, Professor Chen explained how satellite imagery was playing a valuable role in preventing the illegal exploitation of natural resources in Taiwan.

In Taipei, Taiwan's capital, golf courses take up about 100 hectares, a relatively large proportion of land for an island nation of 22 million people that is roughly the size of Tasmania. Some developers have exploited nearby water and land supplies through illegal land developments. Satellite imagery has enabled the government to prosecute these illegal developments by comparing the actual development with the approved plans.

'It is better to prevent such illegal development because we can't restore the land,' said Professor Chen. 'From now on, people will be aware they can't do it. This is a most meaningful contribution to protect the land from abuse by the private sector.'

Similarly, a database of cadastral maps, satellite imagery, land use and ownership has provided early reporting of illegal slope-land development in the city. Satellite imagery over time has also revealed dramatic changes in tidal heights and flood prone areas, which has helped to identify areas unsafe for development.

Professor Chen said he had warm memories of working with Don Gray, who 'was instrumental' in helping to set up the Center 10 years ago, along with two other international consultants. Don Gray retired in 1989 as the Manager of ACRES, having nurtured the Australian remote sensing industry from its birth to maturity.

'We really enjoyed his service and he travelled to the site and made valuable comments,' said Professor Chen. 'Shortly after he retired, we had saved more than one million dollars with the consultants' help.'

Pictured at their friendly reunion are (L–R): Don Gray, former Manager of ACRES; Mrs Gray, Professor Chen and Peter Shih.

SAME DAY CATALOGUING FOR ACRES ACQUISITIONS

ACRES is pleased to announce the release of accelerated acquisition cataloguing — the first visible benefit to end-users of the ACRES Data Acquisition Facility (DAF) upgrade.

ACRES staff have monitored the performance and quality of the new catalogue ingest system for several months to ensure that the data is equivalent to the previous system in quality and accuracy.

In addition to the usual datasets for SPOT 1, SPOT 2 and LANDSAT 5, there is also browse imagery and metadata for ERS and RADARSAT. Accelerated cataloguing is available for acquisitions from both our Alice Springs site (DAF) and the TERSS facility in Hobart.

The main features of the upgrade include:

- 90% of acquisitions will have online catalogue images and metadata within four hours of acquisition on the same business day. Weekend and public holiday passes will be available by noon next working day.
- All catalogue results are Quality Assessed before release online (hence the four hour and weekend delays).
- The data in the catalogue will not be cloud cover assessed immediately. The ACRES Digital Catalogue will indicate that cloud assessment is still to be done with a notation of To Do in the cloud cover assessment field.
- Searches of the ACRES Digital Catalogue, regardless of cloud cover criteria selection, will always include these scenes.
- 95% of cloud cover assessments will be completed and online within two working days of acquisitions.

CONFERENCE CALENDAR

1–6 August 1999 — **Brisbane, Australia**

2nd International Conference on Multiple Objective Decision Support Systems for Land Water & Environmental Management and Community Participation Workshop

Contact: Sally Brown Conference Connections, PO Box 108, Kenmore QLD Australia
Tel: +61 7 3201 2808 Fax: +61 7 3201 2809
Email: sally.brown@uq.net.au
Web: www.dnr.qld.gov.au/events/modss99/

16–20 August 1999 — **Enschede, The Netherlands**

2nd International Symposium on the Operationalization of Remote Sensing

Contact: Ms Loes Colenbrander, c/o ITC, PO Box 6, 7500 AA Enschede, The Netherlands
Tel: +31 53 487 4534 Fax: +31 53 487 4466
Email: colenbrander@itc.nl Web: www.itc.nl/ags/symposium.htm

13–15 September 1999 — **Adelaide, Australia**

8th International Aerospace Congress

Contact: Congress Secretariat, ISMS Pty Ltd, 84 Queensbridge St, Southbank, VIC, Australia
Tel: +61 3 9682 0244 Fax: +61 3 9682 0288 Web: www.icms.com.au/iac99

20–24 September 1999 — **Florence, Italy**

EOS/SPIE Symposium on Remote Sensing, EUROPTO Series-Remote Sensing

Contact: Boulevard St Michel 15 B-1040
Tel: +32 2 743 1573 Fax: +32 2 743 1550 Web: www.europto.org

4–8 October 1999 — **Amsterdam, The Netherlands**

The 50th International Astronautical Federation Congress

Contact: Congrex Holland, PO Box 302, 1000AH Amsterdam, The Netherlands
Tel: +31 20 5040200 Fax: +31 20 5040225 Email: iaf@congrex.nl

31 Oct–4 Nov 1999 — **Las Vegas, USA**

International Symposium on Spectral Research (ISSR) Systems and Sensors for the New Millenium

Contact: Ms Connie Gray
Tel: +1 703 428 6735 Fax: +1 703 428 8176 Email: gray@svl.tec.army.mil

1–3 November 1999 — **Canberra, Australia**

Australian Disaster Conference 1999, Australia

Contact: Conference Logistics, PO Box 505, Curtin ACT 2605, Australia
Tel: +61 2 6281 6624 Fax: +61 2 6285 1336
Web: www.ema.gov.au/conference/

22–26 November 1999 — **Leura, NSW, Australia**

AURISA 99

Contact: ACTS, GPO Box 2200, Canberra ACT 2601, Australia
Tel: +61 2 6257 3299 Fax: +61 2 6257 3256
Email: aurisa@acts.ccmail.compuserve.com

22–26 November 1999 — **Hong Kong, Peoples Republic of China**

20th Asian Conference on Remote Sensing

Contact: Prof. Hui Lin
Fax: +852 2603 5006 Email: ngann@shunji.iis.u~tokyo.ac.jp

29 Nov–2 Dec 1999 — **Beijing, Peoples Republic of China**

International Symposium on Digital Earth

Contact: ISDE Secretariat, Dr Chongjun Yang, Institute of Remote Sensing Applications, Chinese Academy of Sciences, PO Box 9718, Beijing 100101 China
Tel: +86 10 6488 9552 Fax: +86 10 6488 9206
Email: de99@digitalearth.net.cn

6–10 December 1999 — **Denver, USA**

ASPRS Pecora 14/Land Satellite in the Next Decade III Conference

Contact: Pecora 14 Conference, 5915 Hollis St, Building B, Emeryville, CA 94608
Tel: 510 654 6980 Fax: 510 654 5774
Web: www.asprs.org/satellite imaging conference

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

ISPRS 2000

Contact: International Society for Photogrammetry and Remote Sensing, ISPRS 2000 Organising Committee, C/- ITC, PO Box 6, 7500AA, Enschede, The Netherlands
Tel: +31 53 487 4358 Fax: +31 53 487 4335
Email: ISPRS@itc.nl Web: www.itc.nl/~isprs

ACRES DISTRIBUTORS

AUSTRALIAN CAPITAL TERRITORY

AGRECON
170 Haydon Drive
Bruce ACT 2617
PO Box 1
Belconnen ACT 2616
Tel: (02) 6201 2565 (BH)
Fax: (02) 6201 5353 (BH)
Tel/Fax: (02) 6227 5021 (AH)
Mobile: 0413 048 863
Email:
buttonb@agrecon.canberra.edu.au
Web: www.agrecon.canberra.edu.au

Environmental Research & Information Consortium (ERIC)
2 Napier Close
PO Box 179
Deakin West ACT 2600
Tel: (02) 6260 5161
Fax: (02) 6260 5162
Email: ericpl@ozemail.com.au
Web: www.eric.com.au

Resource Industry Associates (RIA)
37 Hutchins Street
Yarralumla ACT 2600
Tel: (02) 6260 5377
Fax: (02) 6260 5388
Mobile: 0408 634 471
Email: johnlee@ria.com.au
Web: www.ria.com.au

NEW SOUTH WALES

ENCOM Technology
Level 2, 118 Alfred Street
PO Box 422
Milsons Point NSW 2061
Tel: (02) 9957 4117
Fax: (02) 9922 6141
Email: info@encom.com.au
Web: www.encom.com.au

SPOT Imaging Services (SIS)
Suite 202
156 Pacific Highway
PO Box 197
St Leonards NSW 2065
Tel: (02) 9906 1733
Fax: (02) 9906 5109
Email:
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

NORTHERN TERRITORY

GEOIMAGE
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
Remote Sensing Unit
Cnr Main and Vulture Streets
Woolloongabba QLD 4102
Locked Bag 40
Coorparoo Delivery Cntr 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
Taringa QLD 4068
PO Box 789
Indooroopilly QLD 4068
Tel: (07) 3871 0088
Fax: (07) 3871 0042
Email:
geoimage@geoimage.com.au
Web: www.geoimage.com.au

Geo Mapping Technologies
Suite 2B, 17 Peel Street
PO Box 3857
South Brisbane QLD 4101
Tel: (07) 3846 2992
Fax: (07) 3846 2588
Email: geomap@ozemail.com.au
Web: www.geomap.com.au

SOUTH AUSTRALIA

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 4903
Fax: (08) 8226 4906
Email: jcameron@dehaa.sa.gov.au
Web: www.dehaa.sa.gov.au

TASMANIA

Space Images
Central Science Laboratory
University of Tasmania
Sandy Bay TAS 7005
GPO Box 252-74
Hobart TAS 7001
Tel: (03) 6226 2156
Fax: (03) 6226 2494
Answering Machine:
(03) 6223 3975
Email: enquiries@spaceimages.utas.edu.au
Web: www.spaceimages.utas.edu.au

VICTORIA

Resource Industry Associates (RIA)
538 Brunswick Street
North Fitzroy VIC 3068
Tel: (03) 9482 4945
Fax: (03) 9482 4956
Email: info@ria.com.au
Web: www.ria.com.au

GEODATA SPOT-LITE ONLY
Natural Resource Systems (NRS)
Level 2, 121 William Street
Melbourne VIC 3000
PO Box 20
Collins Street West, VIC 8007
Tel: (03) 9269 4575
Fax: (03) 9269 4500
Email: j.white@nrsc.com.au
Web: www.nrsc.com.au

GEODATA SPOT-LITE ONLY
ERSIS Australia
Level 2, 436 St Kilda Road
South Melbourne VIC 3205
Tel: (03) 9867 7322
Fax: (03) 9867 7422
Email: adriant@ersis.com.au
Web: www.datamall.com.au

WESTERN AUSTRALIA

GEOIMAGE
Unit 1, 66 Mill Point Road
South Perth WA 6151
PO Box 1065
South Perth WA 6951
Tel: (08) 9367 6700
Fax: (08) 9367 6745
Email: perth@geoimage.com.au
Web: www.geoimage.com.au

Satellite Remote Sensing Services
Department of Land Administration
65 Brockway Road
Floreat WA 6014
PO Box 471
Wembley WA 6014
Tel: (08) 9340 9330
Fax: (08) 9383 7142
Email: richard_smith@notes.dola.wa.gov.au
Web: www.rss.dola.wa.gov.au

GEODATA SPOT-LITE ONLY
NGIS Australia
Level 1, 161 Great Eastern HWY
Belmont WA 6104
Tel: (08) 9277 9600
Fax: (08) 9277 9611
Email: ngis@ngis.com.au
Web: www.ngis.com.au

INTERNATIONAL

Landcare Research
Canterbury Agriculture & Science Centre
Gerald Street
PO Box 69
Lincoln 8152
New Zealand
Tel: +64 3 325 6700
Fax: +64 3 325 2418
Email: bellisss@landcare.cri.nz
Web: www.landcare.cri.nz

PT Indica Dharma Consulting Services
Golden Plaza Blok 43-44
Fatmawati No 15, Jakarta
Indonesia
Tel: +62 21 750 8986
Fax: +62 21 750 8985
Email: indica@server.indo.net.id

Space Imaging
International Headquarters
4300 Forbes Boulevard
Lanham Maryland 20706 USA
Tel: +1 301 552 0537
Fax: +1 301 552 3762
Web: www.spaceimaging.com

ACRES

Australian Centre for Remote Sensing
Scrivener Building,
Dunlop Court, Fern Hill Park,
Bruce ACT 2617
PO Box 28
Belconnen ACT 2616
Freecall 1800 800 173
Tel: (02) 6201 4107
Fax: (02) 6201 4240
Email: acres@auslig.gov.au
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

COMMCO – AUGUST 1999