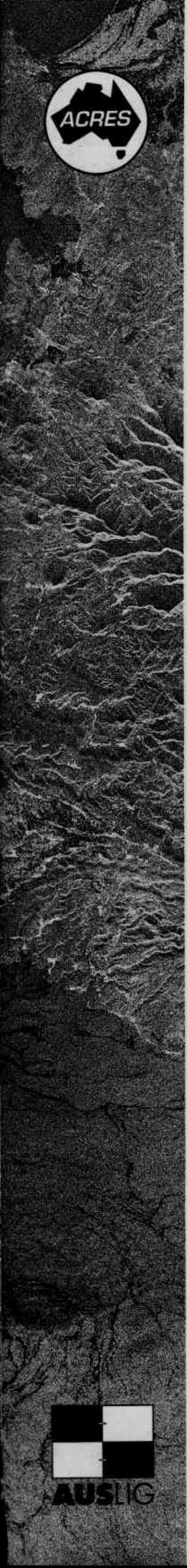


Australian Centre for Remote Sensing

ACRES

UPDATE

Spot satellite captures Sydney bushfires at their height

INSIDE

Detecting salt lands in Victoria

Satellite imagery for environmental health

ACRES distributes Thai data

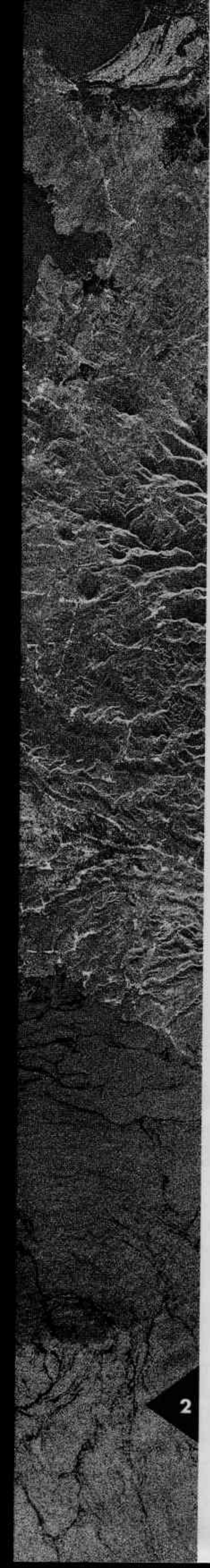
New South African satellite

On Saturday, 8 January, the bushfires to the south of Sydney were at their height. The SPOT satellite passed over Sydney at 10.53am local time on that day and its multispectral sensor captured something of the devastation occurring at that time.

The image above shows graphically the extent of the fires in the Royal National Park. The township of Bundeena on the southern side of Port Hacking had been saved, but the fires were still burning vigorously at the southern end of the park. The fires around Sutherland and Jannali were burning fiercely at the time this image was acquired.

AUSLIG

FEBRUARY 1994



LANDSAT Saga Continues

Since the failure of LANDSAT 6 in October last year, little real progress seems to have been made in 'fast tracking' LANDSAT 7 or building a new LANDSAT 6. In fact, the LANDSAT 7 program seems to have become a bit of a 'hot potato' between departments of the US Government.

At time of writing (early February) NASA and the US Department of Defence, the joint program managers, are not able to agree on funding of the HRMSI sensor or the processing facilities. Meantime, NOAA, the previous program managers, are keen to take the program back again. LANDSAT 7 is presently planned for March 1998 launch. Let's hope LANDSAT 5 can hold on for a while longer yet.

Carl McMaster moves on

The Manager of ACRES for the last four years, Carl McMaster, has left ACRES to take up a position as Managing Director of SPOT IMAGING SERVICES in Sydney. Carl first joined ACRES in 1986 as Assistant Director under Don Gray. When Don retired in 1989 Carl was appointed Manager. Prior to his appointment to ACRES Carl spent many years in the National Mapping organization (AUSLIG's predecessor) in the fields of aerial photography, surveying and mapping. When he resigned in late 1993 he had completed 31 years in the public service in mapping, surveying and remote sensing.

In his time as Manager at ACRES Carl was responsible for many notable achievements, including 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). In Carl's time as Manager ACRES has moved from a single sensor (LANDSAT MSS) facility to a multi sensor, multi processor, world class organization.

We thank Carl for his major contribution to remote sensing in Australia and wish him luck in his future role with SPOT.

ACRES releases its first CD-ROM product

ACRES released its first CD-ROM based product at the AURISA 93 Conference in Adelaide.

THE BASE FROM SPACE – VOLUME 1: URBAN IMAGES

The Urban Images volume comprises a collection of remotely sensed digital images for planners, Geographic Information System (GIS) users and those with an interest in viewing Australia's capital cities from space. The imagery is easily input into a GIS or simply viewed and processed using either the FARMIMAGE software provided on the disc or the software on our own computer.

The Product

- Landsat Thematic Mapper 3 colour images of Canberra, Sydney, Melbourne, Brisbane, Adelaide, Perth, Darwin, Hobart with 25m resolution.
- SPOT panchromatic image of Adelaide at 10m resolution.
- NOAA AVHRR image of the whole of Australia at 1km resolution.
- FARMIMAGE Image Processing software.
- 'Help' files to tell you about the satellites and the software.

The Software

FARMIMAGE is windows based, user friendly, image processing software developed by the University of NSW, which allows you to manipulate the images to their best advantage and also allows the import and processing of other image files and the export of processed files in several formats.

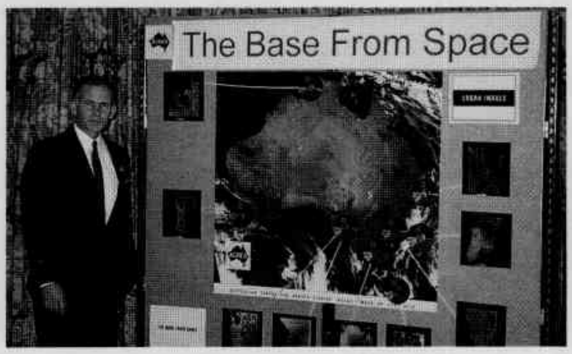
The Value

The total value of the images and software is in excess of $12,000, now available at a special package price of $995.

The Photographic Option

For users not yet able to use CD ROM, the images are available in map scale photographic images for $300 each.

If you have any queries, please telephone John Lee on (06) 252 4431, or any ACRES Distributor.



John Lee with the 'Base' on Display.

Yves Beschaq (SPOT), Dennis Puniard and John Lee deep in discussions.

Tom Tadrowski (SA) and Jeff Bailey (RIA) enjoy some hospitality.

Top end remote sensing users' group

After initial discussions between a number of Darwin based remote sensing users, it was decided that it would be a good idea for a Remote Sensing Users' Group to be established. As such, on 3 February 1994, a meeting facilitated by Bernie Fitzpatrick and with the cooperation of Bill Hazelton and Waqar Ahmad was held at the Northern Territory University, Myilly Point Campus, Darwin.

Twenty people, who represented major remote sensing users, turned up for the meeting, with another eight registering their interest, but unfortunately sending their apologies due to other commitments. An introduction of how the meeting came about, and a quick overview of some issues in relation to what has been going on with respect to some National issues which relate to the Northern Territory, were presented by Bernie Fitzpatrick. All those present then introduced themselves with a short talk on their interest in remote sensing. An open discussion then followed about the likely format of such a users' group and its benefits. The overall feeling of those present was that it should be considered that a users' group was now formed.

It was agreed that a meeting every three months with a rotating venue within the group be the way to go. It was felt by all that it should be kept as informal as possible with a primary focus on applications. As well, it was agreed that the group could become the focal point for contact with respect to remote sensing activities in the Top End of the Northern Territory. The users' group was also seen as a possible forum to work together on joint projects where common interest across users was evident.

The fact that there is an active core of remote sensing people in Alice Springs was also recognised and that those present at the meeting represented primarily Darwin interests. As such, the name of the group agreed on was the Top End Remote Sensing Users' Group. The idea of an annual workshop was floated as a means of getting all those involved in remote sensing within the Northern Territory together to present current work and outcomes, and discuss other issues that may be of common interest.

It was decided that the group should be independent, and that the point of contact for the group should be the Northern Territory University. Also agreed to was the matter that a letter or notice be sent out to other remote sensing groups to advise that the group had been formed and should be seen as a first point of contact for remote sensing activities within the Top End.

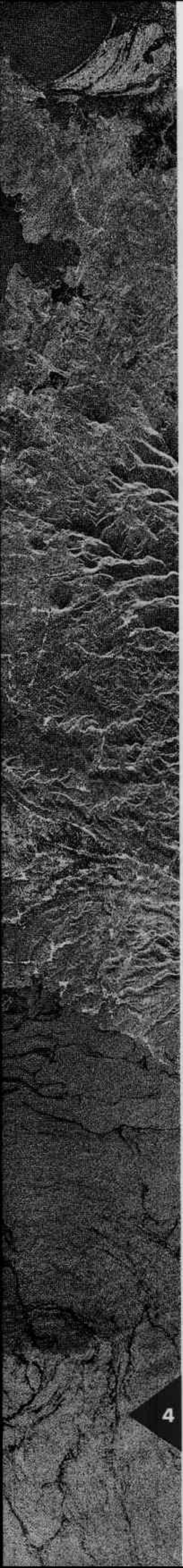
The following are the contact details for the Top End Remote Sensing Users' Group:

Dr Waqar Ahmad
Top End Remote Sensing Users' Group
Northern Territory University
PO Box 40146
Casuarina NT 0811
Tel: (089) 46 6805
Fax: (089) 46 6712

Dr Bill Hazelton
Northern Territory University
Tel: (089) 46 6824
Fax: (089) 46 6712

Paul Frazier
Conservation Commission of the Northern Territory
Tel: (089) 89 4573
Fax: (089) 89 4403

Bernie Fitzpatrick
GEOIMAGE Pty Ltd
Phone: (089) 41 3677
Fax: (089) 41 3670



AGRECON

Agrecon was established in 1992 as a research and development company specialising in the delivery of remotely sensed image products, advisory and consultancy services for primary producers, other rural land holders, private companies and government agencies involved in the development, use and management of natural resources. Agrecon is jointly owned by the University of Canberra with the Vice Chancellor and Dean of the Faculty of Applied Science as co-directors.

PHILOSOPHY, FUNCTION AND MARKET

Agrecon advocates integration of remote sensing with traditional agronomic, engineering and planning techniques for improved decision making and more cost effective mapping, monitoring and management of environmental resources. Agrecon specialises in products and services for client groups including:

- individual farmers and graziers, corporate primary producers, Land Care and Catchment Management Groups
- consulting agronomists, engineers and natural resource managers
- Shires, Municipalities, public utility companies, resource management agencies and government departments
- specially funded research and development projects requiring the supply, customisation, processing or use of remotely sensed imagery

Agrecon ranks amongst the top remote sensing companies in Australia, based on product volume and quality, having supplied more than five hundred products to over 250 clients during the last two years, including family farmers, corporate land holders, land care groups, consultants, resource management agencies, Shire and Municipal Councils, government departments, banks, legal firms, insurance and public utility companies.

AGRECON'S PRODUCTS

Agrecon is a designated distributor of ACRES conventional photographic and digital products. At a small additional cost, many of these standard products are customised to meet particular client requirements – such as photographic enlargement of small subsets to nominated scales. Clients are strongly advised to lodge orders for these products through Agrecon, which provides specialised advice on product selection (including suitable dates, cloud free scenes, relevant spectral band combinations, accurate sub-scene positioning, appropriate levels of computer processing and photographic contrast), and to ensure quality control.

Farmimage is a registered trademark referring to a special range of low cost remotely sensed satellite image products and software developed specifically for primary producers and other rural land holders. A Farmimage depicts the property of any rural land holder and that of adjacent neighbours. It is customised to the particular requirements of individual clients and comes as a geocoded product in false colour photographic form and/or as a digital data set able to be displayed and processed on personal computers. By way of example, a customised photographic farmimage product covering 15km x 15km at 1:25,000 scale (including two page commentary) costs just $310.00. The three band digital data set acquired with the photographic product costs just $250.00 (or $375.00 without the photograph). Products are available using either Landsat or SPOT satellite data. Larger areas up to 900 square km can be supplied as Farmimage products.

Farmimage Software

Agrecon is a franchised distributor of a leading supplier of computers and peripherals, specialising in video controller boards for high resolution SVGA display and large capacity hard disks for data storage. The advent of low cost hardware has been accompanied by a sudden increase in the demand for low cost image processing software for distributed versus centralised image processing. Farmimage software is a low cost package for displaying, manipulating and processing multispectral remotely sensed digital imagery in raster format on IBM compatible PCs under Windows 3.1, under DOS 3 or higher. It was developed as part of the "Remote Sensing Training for Farm Management" project involving ACRES, Agrecon, the Centre for Remote Sensing and GIS (CRS&GIS) at the University of NSW, and the NSW Department of Conservation and Land Management (CALM). The project was sponsored during 1992–3 by the NSW Education and Training Foundation Pty Ltd (ETF). The software is supported by CRS&GIS. Single copies of Farmimage software are available for $250.00. The cost of a site licence for a specified number of copies is subject to negotiation.

The initial version of the software, released in November 1993, runs in 256 colour display mode. Hardware requirements include a SVGA monitor, 256 colour video controller and a hard disk to store the results of image processing. Farmimage is able to load any size file that will fit in RAM. It was designed with image file band sizes in the 0.3 to 5.0 Mb range (requiring 0.9 Mb and 15 Mb of available memory respectively to load a 3 channel colour image). Larger files can be accessed through the enhanced memory handling features supported by Windows by creating virtual memory on the hard disk to emulate RAM.

Farmimage software outperforms other low cost image processing packages. Its user friendliness is enhanced through an extensive system of online Help, Information and Catalogue functions at all levels. This removes the need for an accompanying manual, basic textbook or glossary of remote sensing terms.

Farmimage software supports the following indicative operations:

- import a range of data formats and export in generic .BIL format (no header). Farmimage will display images in Farmimage (.FIM) format and in microBRIAN, ERDAS and ESIPP formats without file conversion. On Screen classifications may be performed using data in any of these formats but the results will be stored in a Farmimage format. There are utilities available to convert from the formats listed above and any other formats that are BIL or separate sequential band files into Farmimage format. BIP formats used by programs such as PC-A-Image are not supported.
- subset, decimate, select channels or mask an image
- select and display in single channel pseudocoloured or grey scale form as well as three channel full colour
- assign any channel combination in any order to red, green and blue colour guns
- interrogate headers to obtain information on user supplied as well as system generated file attributes
- roam, pan, zoom (up to 16 times), read pixel-line coordinate position and obtain 8 bit pixel values (within a 0–255 step range) for any nominated locality
- (automatic) histogram, interactive (linear, logarithmic or power) contrast stretch in preview and final mode
- spatial filtering (to smooth or sharpen)
- calculate a vegetation index or channel ratio
- on-screen digitisation of polygons
- classify an image into user defined thematic classes, user selectable colours
- review and adjust classification parameters
- calculate areas down to single pixel accuracy
- create, save and retrieve image, mask, polygon or classification files
- generate hard copies of resulting imagery using dot matrix, laser or ink-jet printers
- obtain help, information and definitions at all levels through a catalogue system accessible via an alphabetical index, structured page-within-book networked menu or browse mode
- export imagery to PC paintbrush for annotation

Over the next 12 months additional functions will be added along with GPS compatibility and matching vector based GIS software for storage, retrieval and analysis of attribute data for points, lines and area features.

ALTERNATIVE PRODUCTS

For small holdings, or where it is important to obtain more detail than satellite imagery, Agrecon as a designated distributor of the Australian Surveying and Land Information Group (AUSLIG):

- selectively enlarges air photos, either as individual prints or mosaics of multiple prints
- digitises and merges aerial photography with satellite imagery

Agrecon has also developed a range of customised digital and photographic products for Shire and Municipal Councils, other planning bodies and resource management agencies for mapping, monitoring and managing large areas. Clients have the choice of:

- single product coverage for the entire project area, or
- an assemblage of discrete tiles defined by nominated map sheet or AMG boundaries.

By purchasing low cost, uncontrolled digital data from ACRES and rectifying it to a nominated coordinate system, Agrecon is able to deliver precision products in a cost effective manner. The cost of generating photographic products from the same data is substantially lower than purchasing conventional satellite image products.

VALUE ADDED AND PROJECT RELATED IMAGE PROCESSING

Agrecon also undertakes special projects involving more advanced forms of image processing, value adding or data integration. This includes precision forms of geometric and radiometric rectification, mosaicing of imagery acquired on different dates from adjacent orbits, merging of imagery from different satellites, multi-temporal change detection image analysis, land cover classification, inventory and yield estimation. While according priority to rural landholders, Agrecon also specialises in hydrologic applications and riparian and remnant vegetation mapping.

Progress is being made towards a yield estimation bureau service for the Australian cotton industry based on satellite pre-harvest crop monitoring. Date specific correlations between post canopy closure spectral response and lint yields achieved during the last five years for individual fields of selected producers. This information is eagerly sought by growers seeking to compare potential yield with pre-planting contract estimates to minimise exposure and risk associated with the purchase of options on international cotton futures markets. It also has the potential to serve as a basis for refining industry estimates of ginning, transport, warehousing and international shipping requirements to handle likely season product volumes. Preparations are under way for a less ambitious census of rice areas in southern NSW.

All enquiries on Agrecon's products, price lists and services should be directed to:

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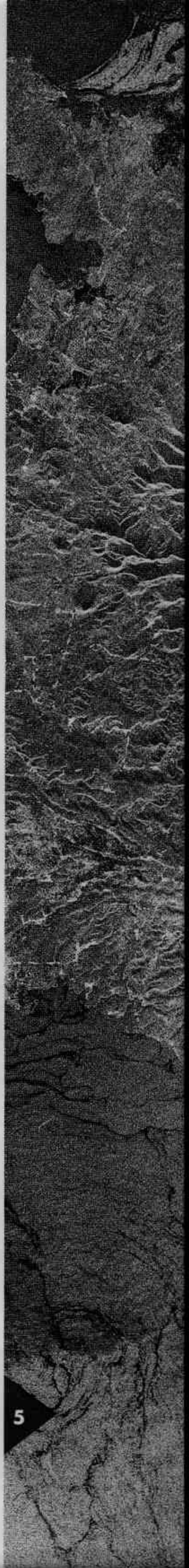

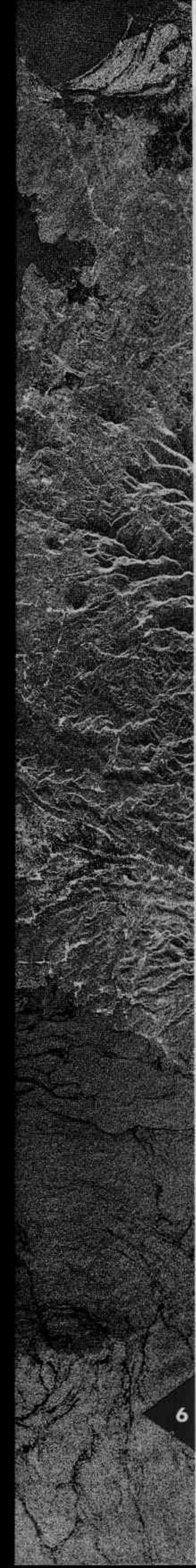

A comparison of microBRIAN and TIGRIS in the detection of salt-effected lands in Victoria

By Somporn Sangawongse-Fordham, Department of Geography, Monash University

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INTRODUCTION

Salinization is a form of land degradation that is now considered to be one of the most serious environmental problems in Australia (Eckersley 1989, Downie 1989). Salinization has destroyed many land and water environments on a large scale (Parliament of Victoria 1984). Also, salinization currently costs Australia $500 million per year in terms of economic and social loss (Soil Conservation Authority 1979). Salinization spreads very quickly (Jenkin 1981); thus, an effective tool is needed to map its extension on a regular basis. The existing data may not be of much use for the future management and evaluation of salinization; therefore, it is necessary to map the spread and extent of salinization on a regular basis in order to obtain updated information for better management and planning.

This paper reports the results of an investigation of the application of Landsat 5 TM digital data and a geographic information (GIS), namely, TIGRIS (Topologically Integrated Geographically Referenced Information System), in the detection of salt-affected land. The integration of remote sensing and a GIS gave cost-effective results. Remote sensing provided a means of regularly collecting and updating information about salinity, while the GIS provided a means to handle large volumes of information relevant to salinity.

MICROBRIAN AND TIGRIS

The microBRIAN (micro-Barrier Reef Image Analysis) system was jointly developed by CSIRO and MPA Pty Ltd between 1980 and 1985. It is used for a wide range of image processing functions, using data from satellite imagery as well as from scan-digitized maps or photos. This system operates on an IBM PC-type micro-computer using the DOS operating system and requires at least 20 Mb of hard disk capacity, 640 Kb RAM and a Vectrix colour card set (CSIRO and MPA 1986).

TIGRIS was developed by the Intergraph Corporation, to be used for vector-based GIS applications. It contains options that can be used to perform different functions. TIGRIS-Imager, for example, is used for a variety of image processing functions, while TIGRIS-Analyst is used for analysing the database in a variety of ways (Intergraph 1989). TIGRIS operates on an Intergraph Interpro 3050 workstation using the UNIX operating system.

LANDSAT 5 TM DATA

Data from Landsat 5 TM (quarter scene), path 94/86, imaged in January 1989, representing the study area, were acquired from the Australian Centre for Remote Sensing (ACRES) via Resource Industry Associates (RIA) in Melbourne. The data were stored on two computer-compatible tapes (CCTs), each of which had 1,600 BPI (bits per inch). Four bands (1, 3, 4 and 7) from this quarter scene were subdivided from the CCTs to four high density floppy diskettes using the ER Mapper (Earth Resource System) at the office of RIA. Each band took up about 262 Kb of disk space and was subdivided by 512 lines and 512 pixels. This subimage scene provides coverage of the study area and represents an area of approximately 225 square kilometres on the ground.

THE STUDY AREA

The study area is part of the Concongella Creek subcatchment in Stawell district of Victoria, Australia. It lies approximately between latitudes 37°00' to 37°10' S and longitudes 142°45' to 142°55' E. It is bordered by Stawell city to the west, Seven Mile Creek to the east, the Bridge Inn township to the north and the Great Western township to the south. The area has undergone substantial dry-land salinity degradation and is experiencing widespread salinization in many parts, especially on farmland.

There are several factors that have contributed to the development of dry-land salinity in the study area, including the climate, geomorphology, soil, land use and vegetation. Each of these factors has played an integral part in developing dry-land salinity. Climatic factors, for example, influence both the rainfall and the evaporation patterns in the study area, which can be used as indicators of salinity, especially when evaporation exceeds rainfall. Also, the occurrence of salt-tolerant plants such as spiney rush (Juncus aucutus) can be used as an indicator of salinity (Duff et al. 1982, Moore 1984). Moreover, the hill topography, together with the grazing land use in the study area, have played a major role in the development of dry-land salinity. Hill topography accelerates the downward movement of rainwater to the lowlands. Grazing helps activate this movement by decreasing the vegetation cover. As a result, groundwater tables are rising continually and bringing salts up to the soil surface.

GIS DATABASE

Data input into a GIS can come from many different sources, including existing maps, field observations, aerial photography, satellites and recording instruments (Jensen 1986, Avery 1985). In this study, the input data were manually digitized from different maps using the Intergraph Microstation. A 1:100,000-scale geological map sheet was used as geological information and a 1:25,000-scale Ararat map sheet was used to identify hydrological features and transportation networks.

This digital map contains five major levels of information altogether, namely, geology, hydrology, road networks, a railway line and a set of ground control points. The vector graphics were cleaned up as much as possible before converting from Interactive Graphic Design System (IGDS) to Integraph Graphic Environment (IGE). They were then topologized using the digitize feature command to be ready for interfacing classified Landsat TM data in TIGRIS. During the building of the topology, unavoidable errors such as node mismatches, overshoots, undershoots and slivers introduced into the graphics had to be reduced or removed so as not to affect the operation.

METHODS

A subset Landsat TM image of 512 by 512 pixels, bands 1, 3, 4 and 7, which covers the entire study area, was processed through the microBRIAN and TIGRIS-Imager image analysis software packages separately. The steps used for the image processing functions on each system are similar in order to avoid having different parameters in the systems, which could affect the accuracy of the results. The major procedures used in the image processing functions followed in this study are described below.

RECTIFICATION OF THE LANDSAT TM IMAGE

The major purpose of rectification is to remove or reduce any radiometric and geometric distortions contained in the image prior to classification. Because the image used in this study was preprocessed at level 5 (systematic georeferencing), the radiometric and geometric distortions were rectified. It was also resampled to a two-dimensional map projection that could be directly related to a specified map scale in the same projection and at the same scale (ACRES 1990). However, when overlaying this image with the digital map on the Intergraph Interpro, it was found that it had not been properly fitted. Therefore, it needed to be registered into the base map in the Australian Map Grid (AMG) reference system in order to be appropriate for interfacing with TIGRIS.

Rectification was applied directly with TIGRIS-Imager using the nearest neighbour resampling method. Four appropriate ground control points (GCP) were used to geometrically rectify the Landsat TM image into the AMG coordinate system, which yielded minimal RMS error (less than half a pixel). Rectification was applied through microBRIAN after classification using the same resampling method.

There were nine GCP used for rectifying the Landsat TM image into the AMG so as to acquire results similar to those from TIGRIS-Imager.

CLASSIFICATION OF THE LANDSAT TM IMAGE

Supervised classification was applied with both systems, as it provides more quantitative results than does the unsupervised classification technique (Curran 1985, Richards 1986). There are three major classifiers that can be used in this process, namely, minimum distance to mean, maximum likelihood and parallelepiped. Each of these classifies unknown pixels in the image data in a different manner and gives different results. For example, the minimum distance to mean classifier is based on the minimum distance (euclidean) of the unknown class pixels to the mean digital number of a class in the training data. Each pixel is assigned to the class to which it is closest (Curran, Intergraph 1989). The minimum distance to mean classifier was used in this study, as it provides classification results similar to those from ground data. Only seven major classes in the microBRIAN system were compared with eleven major classes in TIGRIS-Imager, as forested areas, bare ground areas, urban areas and quarry areas were edited out of the imagery before classification. Salinity is less likely to occur in forested areas and urban areas; therefore, these areas were not significant for this study. Quarry and bare ground areas were deleted because they have spectral reflectances similar to those of salt-affected areas, which confuses the classification process and may reduce the accuracy of the results.

VECTORIZATION OF THE CLASSIFIED LANDSAT TM IMAGE

Vectorization, or the conversion of the classified Landsat TM image from raster to vector format, was performed on the Intergraph Interpro 3050, using the classified image from TIGRIS. The classified image was first smoothed using a modal filter and then converted into vector data using the batch processing function. The output vector data contain salt-affected polygons as well as polygons from other classes. In practice, other polygons were removed from the file with the exception of salt-affected polygons, which need to be incorporated with other levels of information in TIGRIS.

INTEGRATION OF CLASSIFIED LANDSAT TM DATA INTO TIGRIS

In the integration process, salt-affected polygons obtained from vectorization can be placed as an overlay on the rectified Landsat TM image using the move and the move affine transformation commands under the manipulation options in TIGRIS. In this case, the move command was used to bring the points close to the rectified image, while the move affine transformation command was used to transform the file into the same grid base as the rectified image. It was found that all salt-affected polygons could be overlaid quite well on the rectified image. This reflect proper rectification.

Polygons of salt-affected areas were grouped together using the graphics group command and were then topologized in order to put them into one layer of the GIS. At this stage, all levels of information contained in the database can be displayed together in order to extract information relevant to salinity.

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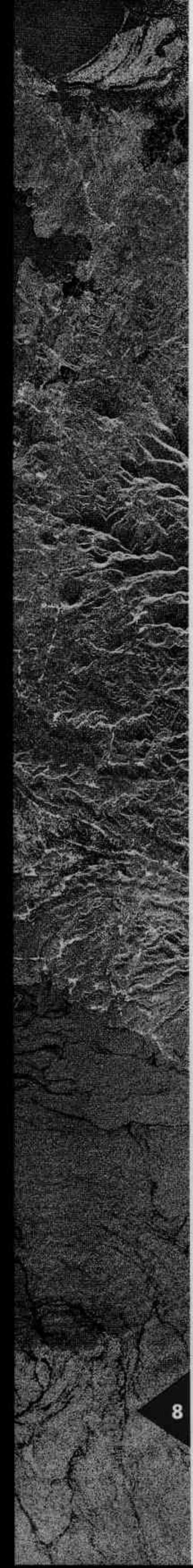


GROUND-TRUTH DATA

Ground-truth data of the study area were derived from the interpretation of black-and-white aerial photography at an approximate scale of 1:25,000 (21 photos), in combination with ground surveys. This photography was taken in December 1986, which is close to the time of the satellite overpass but in a different year. Some 25 salt-affected sites were extracted from this interpretation, and 16 sites were investigated during ground surveys in the study area. The measurement of salt-affected areas on the aerial photography was based on the square grid data created in accordance with the scale of the photography (1 square grid represents about 0.25 hectares). The total salt-affected area as obtained from ground-truth data was 62.28 ha or about 0.27 per cent of the total area of the Landsat TM subimage scene used in this study.

Ground surveys were conducted twice in the study. The preliminary ground survey was carried out in June 1990. This survey had two major aims: to become familiar with the study area and to obtain a general local knowledge of the ground data, as well as to determine the accurate location of the major salt-affected sites within the study area in order to use them as input for the supervised classification. The final field survey was carried out from 2 to 5 October in order to check the classification results obtained from the computer analysis, as well as to investigate other areas classified as being salt-affected. These areas were not investigated during the preliminary field survey.

RESULTS

Results Obtained from Computer Analysis

The salt-affected areas obtained from microBRIAN and TIGRIS were compared with the ground data, as shown in the table below.

Salt-affected areas: a comparison of ground-truth data and computer analysis

		Classified Data	
Cover Type	Ground Data	microBRIAN	TIGRIS-Imager
Salt affected areas	62.28 ha	63.99 ha	64.50 ha

The salt-affected areas obtained from the microBRIAN data totalled 63.99 ha or about 0.29 per cent of the total area. The total salt-affected area obtained from microBRIAN was about 1.71 ha larger than that obtained from the ground-truth data. This is possibly due to two reasons: some salt-affected areas are expanding, while the ground measurement of these areas was based on the 1986 aerial photography, which was taken two years earlier than the satellite imagery used; and some salt-affected areas are still mixed with paddocks, eroded areas and cleared areas, which makes it difficult to get the percentage of purely salt—affected areas in this classification.

Salt-affected areas obtained from TIGRIS-Imager data totalled 97.58 ha or about 33.59 ha more than the total obtained from microBRIAN. This is because these areas are mixed with areas of quarries, bare ground and paddocks (which are not affected by salinity). These areas were not removed from the imagery prior to classification, as was done with microBRIAN, because there is no option in TIGRIS-Imager to do this. However, after the subtraction of bare ground, paddocks and quarries (measured directly from the aerial photography) from the former figure, the new figure is 64.5 ha or about 0.29 per cent of the total area, which is very close to the microBRIAN figure.

RESULTS OBTAINED FROM THE APPLICATION OF TIGRIS

TIGRIS provides not only image processing functions but also many sophisticated GIS functions. Three major GIS functions, namely, integration, calculation of area and query, were used in this study.

Classified Landsat TM data were integrated with GIS data by displaying the topological graphics on top of the classified map. The information contained in the topological database can be displayed as one them at a time or as many themes at one time on the classified Landsat TM image. The classified image acts as one layer of information in this integration process. In the integration function, the use of a GIS provides many advantages over conventional methods, as a GIS allows many layers of information to be displayed at one time (Wilkinson and Zhang 1990). This also allows the objects on the map to be located in terms of the coordinate system types used for setting up the map, as well as to measure their dimensions in terms of distance, area perimeter or height (for a three-dimensional map).

The calculation of salt-affected areas can be done when all features on the map have been integrated. In this study, the measurement function under the analytical options in TIGRIS was used for calculation. The main purpose of this function is to compare salt-affected areas measured from ground data and computer analysis on a site-by-site basis. The classification results gave the totals of all salt-affected areas on the Landsat image, which cannot be used for site-by-site comparisons with the ground data. With the use of the measurement function, each salt-affected area that appears on the Landsat image can be measured.

The comparison of each salt-affected area obtained from computer classification and ground-truth data showed that the two methods are very similar, especially sites 10, 11 and 12. However, the area of some salt-affected areas was different from the ground data measurements due to the effects of classification and vectorization.

The query function was extensively used in this study, as it provided the most effective results for the application of TIGRIS for the detection of salinity. Queries regarding salinity were raised using both the build query command (under the validate attribute options) in TIGRIS-Imager and the create query command in TIGRIS-Analyst. The create query command provides more options than the build query command because it was specifically designed for an analytical function. However, the use of both commands requires the use of the named query and the result set as input before executing each query.

Queries regarding salinity such as "How far are salt-affected areas from the creeks?" or "What type of geology underlies salt-affected areas?" can be raised. As most salt-affected areas in the study area are near creeks, the request "Find all salt-affected areas within 1,000 metres of stream segments" was made.

DISCUSSION

It must be noted here that this comparison of microBRIAN and TIGRIS for salinity detection was not meant to evaluate the effectiveness of their hardware packages because they are totally different in many ways; for example, the hard disk capacity, the operating systems and the machine speeds cannot be compared. This study compared only the results (especially rectification and classification) obtained from each system. The results obtained from the application of a GIS were derived from TIGRIS only. In fact, it is possible to incorporate a vector map with microBRIAN, which can then be used to stratify or enhance the image for many image processing functions, as well as for integration. However, with microBRIAN some analytical functions such as query cannot be done because this option is not available. For this reason, the classified image obtained from TIGRIS-Imager was selected for direct integration with TIGRIS GIS.

CONCLUSIONS

The improved spatial resolution of Landsat TM imagery provides higher accuracy than Landsat MSS (Chou Chen et al. 1986, USGS-NOAA 1984). Also, Landsat TM can supply up to 7 wavebands, which can be selected for a variety of image processing functions. According to the rectification results, especially from TIGRIS, it is obvious that Landsat TM is a steady platform that needs only a few GCP to be registered into a base map. However, the use of Landsat TM imagery for salinity detection is still limited by its resolution because most salt-affected areas are small and have a long, narrow shape. Some are smaller than 1 pixel (0.09 ha) and thus cannot be accurately located by Landsat TM. Therefore, they do not appear on the classified Landsat TM image. This results in the loss of salt-affected polygons after vectorization.

The development of dry-land salinity in the study area has been greatly influenced by cultural factors. For example, land-use activities have activated the development of salinity to a varying degree. Because of the hilly topography of the study area, the development of salinity is strongly associated with erosion. Gully erosion and tunnel erosion are the major types of erosion that have occurred in the study area. The bare ground appearing on the classified image may be caused by either salinization or erosion, which should be separated from each other. However, this study concentrated on salinization rather than erosion; thus, bare ground caused by erosional processes is still mixed with some salt-affected areas, as can be seen on the classified images obtained from both microBRIAN and TIGRIS. This also indicates why salt-affected areas obtained from computer analysis are larger than those from ground data.

REFERENCES

Avery, T.E. and G.L. Berlin. Geographic information systems and land-use/land-cover mapping. Interpretation of Aerial Photographs, Macmillan, New York, 1985. p. 235-250.

Chou Chen, Sherry, Getulio Teixeira Batista and Antonio Tebaldi Tardin. Landsat TM band combinations for crop discrimination. Remote Sensing for Resources Development and Environmental Management, AA. Balkema/Rotterdam/Boston, 1986. p. 211-214.

Curran, P.J. Principles of Remote Sensing. Longman, London, U.K., 1985.

Downie, P. Farmers stop being the salt of the earth. The Weekend Australian, 16 and 17 September 1989.

Duff, J.S., J.J. Jenkin, and G.A. David. The Axe Creek Salinity Study (a) – catchment characteristics for salinity control. Axe Creek, Victoria, Soil Conservation Authority, 1982.

Eckersley, R. Regressing Australia: The Environmental, Economic and Social Benefits of Reforestation. CSIRO occasional paper No. 3, 1989.

Intergraph. TIGRIS-Imager Reference Manual. Intergraph Corporation, Huntsville, Alabama, U.S.A., 1989.

Jenkin, J.J. Terrain, groundwater and secondary salinity in Victoria, Australia. Agricultural Water Management, No. 4, 1981. p. 143-171.

Jensen, J.R. The interface of remote sensing and geographic information systems. Photogrammetric Engineering and Remote Sensing, Vol. 52, 1986. p. 840-847.

Moore, G. A Survey of Dryland Salting in the Willaura District. Soil Conservation Authority, 1984.

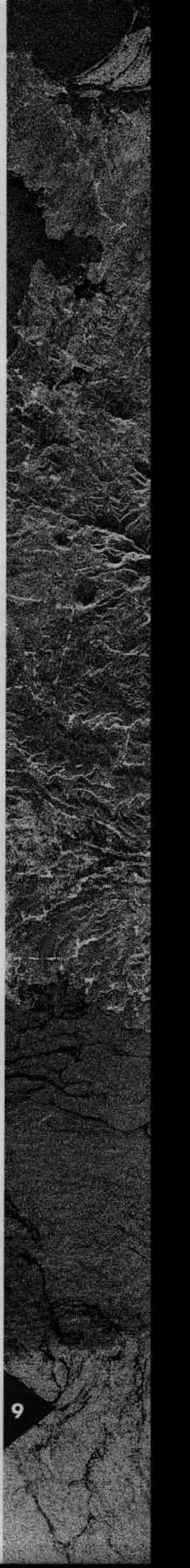
Parliament of Victoria. Salt of the Earth: Final Report on the Causes, Effects and Control of Land and River Salinity of Victoria. Melbourne, Government Printer, 1984.

Richards, J.A. Remote Sensing Digital Image Analysis: An Introduction. Berlin, Springer-Verlag, 1986.

Soil Conservation Authority. Bibliography of Dryland Salting Problem and Guidelines for Salt-Affected Site Revegetation in Victoria. Agronomy Section, Research and Investigations Division, Melbourne, 1979.

USGS-NOAA. Data Users Handbook. U.S. Geological Survey and National Oceanic and Atmospheric Administration, 1984.

Wilkinson, S. and G. Zhang. Simultaneous multi-layer spatial overlay. The Proceedings of the 1990 GIS/LIS, Anaheim, California, November 1990. p. 506-515.



Remote sensing students at Canberra University learn with microBRIAN

Undergraduate and postgraduate students at Canberra University enjoy excellent facilities in their microBRIAN equipped laboratory. Jim Mollison, ACRES agricultural specialist, recently visited the laboratory and observed students at work.

Dr Brian Button has an enthusiastic group of students working on many projects in the Applied Science Department at the University.

Singapore is committed to a new ground station

The Singapore National Science and Technology Board recently approved funding to establish the Centre for Remote Imaging, Sensing and Processing (CRISP) at the National University of Singapore. The funding totals S $31.65 million for four years.

CRISP's missions are the development of remote sensing capabilities, the promotion of research and development in remote sensing technology, the provision of post-graduate training in remote sensing, the provision of consulting services and the general coordination of remote sensing activities in Singapore.

CRISP is headed by Associate Professor Lim Hock of the Department of Physics, National University of Singapore. CRISP has called for bids to provide remote sensing facilities and is in the process of recruiting administrative, operational and research staff members. Its priority is to set up a research section, which will have 15 staff members (research fellows and research assistants).

Australia is one of the bidders for a consultancy to help establish the new facility.

Satellite imagery for environmental health management

Prepared by Rob Gourlay, Director

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ENVIRONMENTAL ISSUES

Environmental mapping is traditionally conducted using air photo interpretation and extensive field survey, however this approach is no longer cost efficient or effective. Aerial photography has high spatial resolution, which is useful when examining local features, but spectral and spatial distortions in the images limit its application at regional scales. Also, the acquisition of photography for regional areas is limited due to spatial or temporal gaps, and the high cost of spatial data per square km compared to satellite imagery.

There are increasing signals appearing in the environment that degraded ecological systems are impacting on public health, eg. algae blooms, soil contamination and air pollution. These signals are the consequences of complex environmental changes caused by water, land and air uses. However, the environmental associations of these changes can only be properly understood within a regional context, eg. catchment or bioregion. Also, the issues of water, soil, vegetation and land use management can only be properly addressed at this level. This requires the environmental information to have a spatial context, with the natural resources information being mapped along with the cultural information.

Overall, the range of environmental data required for environmental planning and management could involve considerable effort to acquire at corresponding levels of resolution for a region. The question is how this need can be met by providing integrated and cohesive landscape data sets in the most efficient and effective manner, and establishing a base for environmental monitoring. The efficiency of the approach is critical because environmental conditions can vary considerably in time and space.

APPLICATION OF SATELLITE IMAGERY

There is a very good chance that if an environmental planner places a satellite image on the table of a local government Council meeting the discussion will be more pragmatic about land use planning. The data have a high potential for planners to assess the overall environmental health of a town or city, such as nutrient pathways to drainage systems, waste disposal impacts, and weed infestation of nature or recreation areas. The urban community may also use the imagery to more fully participate in land use decision making, particularly regarding the reuse of space, water catchment protection, and residential development near sensitive areas, eg. wetlands and estuaries.

However ,the major users of satellite imagery in Australia are geologists, academic and research organisations, and Commonwealth and State Government resource management agencies. Local government and community groups represent a very small percentage of users. This situation arises in part because there is a perception that satellite imagery is too coarse in spatial resolution, inappropriate for land use management, spatially inaccurate and too costly. The other major reasons include inadequate research and technology transfer to community groups and the limited use of satellite data for land management purposes.

SPATIAL PATTERN VS OBJECT RESOLUTION

The landscape comprises complex spatial patterns which are influenced by many factors, including soil conditions, vegetation structure and type, climate and past land use practices. Many of these patterns are not detectable in the visible wavelengths of aerial photography or observable in the field, but are recorded in the reflected and emitted energy wavebands of satellite imagery, which extend beyond the visible. The spatial patterns in a satellite image land cover classification provide the base for efficient field survey design.

Land cover mapping or classification is by definition, spatial. It is therefore reasonable to use techniques or technology which provide the best representation of spatial pattern. It is the nature of the distribution and repeated spatial patterns of landscape conditions which determines land capability, suitability, environmental health and the management regimes. The resolution of landscape objects and cultural features are only relevant in providing context to spatial pattern, rather then defining the pattern.

SPATIAL ACCURACY

The satellite is a very stable platform and consequently provides a level of spatial accuracy superior to aerial photography which is affected by aircraft tilt, yaw and variation in altitude. Spatial accuracy of less than 30m can be achieved with Landsat TM. The geo-referencing of satellite imagery is a far less onerous task compared to aerial photography. Also, the satellite image is continuous and cohesive over large areas, which cannot be readily achieved through mosaicing aerial photography to achieve a regional view. However, the spatial resolution in aerial photography can be a useful aid in object recognition during ground-truthing, particularly when other geographic data are not available.

A key advantage in the use of satellite imagery is the time saving achieved in the ground-truthing and interpretation on landscape information. This is because the computer classification process provides a map where the spatial distribution of each class is defined for the whole scene and statistical data are available to assist in determining the spatial and spectral relationships between classes. This information provides the basis for developing a field survey plan and the questions to be answered by field observation or measurement. Wherever possible, the client or land user should be involved in the ground-truthing of land cover classes so that the final mapping products are understood and reflect the user's requirements.

BASIS FOR LAND MANAGEMENT

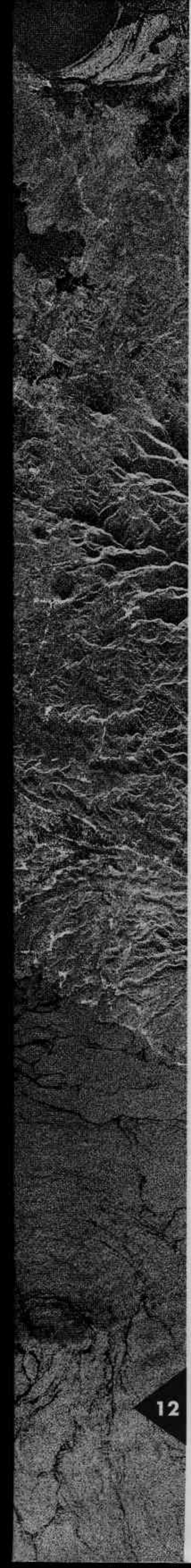
A land cover classification should provide the basis for analysing spatial and temporal change in the landscape, including the causes and consequences of the change. The capacity of satellite imagery to detect surface temperature and moisture differences, varying vegetation characteristics and past land use effects (eg. due to different grazing pressures, nutrient fluxes and soil disturbances), provides an interpretive base for environmental health assessment which may not otherwise be achieved with aerial photography.

Environmental health managers need access to reliable and comprehensive landscape information. Where the land cover classification is used as a base for overlaying other land data, eg. soils and cadastral mappings, the spatial patterns can be readily related to the environmental factors which influence land conditions. Repeated classifications over time provide an efficient means of numerically mapping spatial and spectral change and monitoring conditions.

Mapping and Monitoring is expanding

Mapping and Monitoring Technology, ACRES Townsville based Distributor, has recently expanded its office facilities at its Tully Street offices. When space used by the Department of Environment and Heritage was no longer required, Dr Debbie Kuchler took the opportunity to expand into a more friendly work environment. Debbie has recently been joined by Michele Townsend who has extensive marketing experience in North Queensland.

Michele and Debbie in the expanded MMT offices.



New Australian book on space

"Space Australia: The Story of Australia's Involvement in Space"

Kerrie Dougherty and Matthew James. Published by Powerhouse Publishing, November 1993. 144 pp, A4, paperback. RRP $29.95. ISBN 1 86317 034 0.

"Space Australia: The Story of Australia's Involvement in Space" is the first publication to cover this neglected, but significant part of Australia's contribution to one of the frontiers of science and technology. It shows that Australia has played a vital role in numerous major space programs.

The first images from the APOLLO 11 moon landing in 1969 were received in Australian tracking stations; in the 1960s the Woomera Rocket Range in South Australia was the most heavily used space launching facility in the world, apart from Cape Canaveral, and our own extensive use of satellites has placed Australia as a world leader in the development of software programs for manipulating satellite supplied data.

"Space Australia" is the first popular, illustrated book to tell the exciting story of Australia's technological and human endeavours in one of the most exciting quests of this century. Its 144 pages and more than 40 colour and 60 black and white images capture the vision, hopes and achievements of professional space scientists and inspired amateurs.

"Space Australia" covers over four decades of space activities – from the excitement of the pioneers at the Woomera test range, that saw the launch of the nation's first satellite in 1967 (making Australia only the fourth country in the world to launch its own satellite), through to more recent space applications in communications, remote sensing, military programs, spacecraft tracking and space industry expertise.

A unique feature of the book is the series of commentaries from leading scientists, engineers and industrialists in the Australian space scene, that include Mike Dinn, Director of the Canberra Deep Space Communications Complex, Dr Ken McCracken, founding Director of the CSIRO Office of Space Science and Applications, and Mary Whitehead, one of the few professional women employed on the staff of the Weapons Research Establishment in the 1950s. Their comments give us an insight into the personal side of the space story.

"Space Australia" is available in all good book stores, the Powerhouse Museum shop and by mail order.

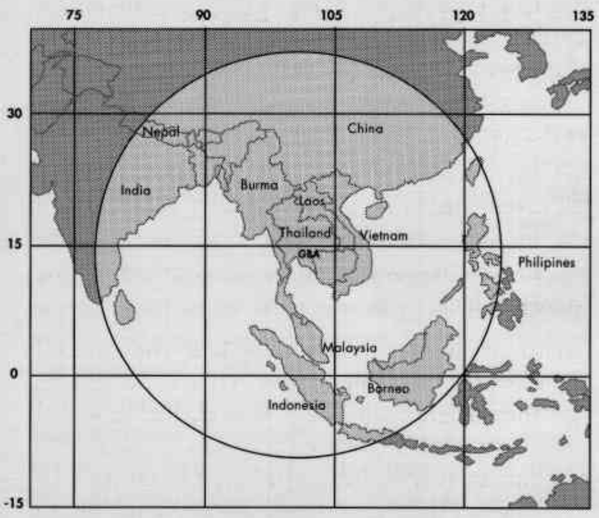
The Authors

Kerrie Dougherty is the only curator of space technology in Australia and has a substantial breadth of knowledge in her field. Matthew L James has long been a space advocate and has served in several local and international space organisations. He is based in Canberra.

ACRES becomes Australian agent for Thailand National Remote Sensing Centre (NRCT) data

ACRES has signed an agreement with NRCT to distribute to Australian customers LANDSAT data from the Thailand receiving station. NRCT has a similar processing system to ACRES and offers a range of digital and photographic products. Prices are competitive ($4000 US for 7 Band Full Scene), searches can be obtained quickly and delivery is prompt (about two weeks).

The diagram below shows the coverage of the station, which includes all of Indo China, Western Indonesia and a large part of the Philippines. Madeleine Clark is the ACRES Sales Representative with responsibility for sales from NRCT. For more details contact Maddy or any of ACRES Distributors.



RMIT Colloquia '94

Sessions will be held on the last Friday of each month between 3.30pm and 5.30pm in the Department of Land Information, at RMIT, building 12, level 11, room 31.

March 25 – *Georgina Race*: Development of remote sensing techniques for use in conservation management of native grasslands in western Victoria.

May 27 – *Nick Rollings*: Development of operational models for the determination of chlorophyll concentrations in Port Phillip Bay using remote sensing.

July 29 – *Rod Allan*: An error management strategy for layer based GIS using remotely sensed data.

August 26 – *Nicholas Coops*: A methodology for atypical data sets and applications using PC based image analysis procedures.

September 30 – *Steven Airey*: The development of methodologies and techniques to improve the accuracy and effectiveness of current remotely sensed grassland fire fuel models.

SPOT*news*

SPOT 3 now fully operational

SPOT 3 reached its final orbital position after just one week in space, which is quite a performance given that this can take up to three weeks. This was achieved as a direct result of the highly favourable time and date of launch. The CNES orbit correction team fine-tuned the orbit inclination by just 0.06°. Final orbit acquisition was also very economical, requiring just 17 kg of thruster propellant out of a total load of 158 kg. Ample propellant reserves are the first step towards a long orbital life, hopefully one that will rival those of SPOT 1 and 2.

The youngest member of the SPOT family is now on orbit and in phase with elder brothers, SPOT 1 and 2 ... precisely as intended by its designer-parents who are now both happy and proud. Its temperature is also just right, as all onboard sensors report around 20°C and stable. The solar array is operating nominally and generating precisely the anticipated amount of power. The payload telemetry package is also operating perfectly. As reported earlier, SPOT 3 features design improvements to its travelling-wave tubes, which amplify radio signals for transmission to ground, to extend their useful lifetime, and hence that of the entire satellite.

Important changes were also made to the onboard recorders for the same reason. These now feature hardened magnetic heads, a new type of tape and active tape guides. Here too the news is good since to date no errors have been attributed to either tape recording or playback, and there are ample margins in the error detection and correction system which points to a long working life for SPOT 3.

EXCELLENT IMAGE QUALITY

Like its predecessors, SPOT 3 is returning images of the highest quality. They are, so far, closely comparable to those returned by SPOT 2 at the start of its life. In addition, SPOT 3 is free of some minor deficiencies in SPOT 1 and 2. These included slight instability in sensor dark current, low responsivity in band B2 and some small defects in the solar array. The main difference between the quality of SPOT 3 images compared to those returned by SPOT 2 is due to the higher responsivity and wider spectral response of band B2. These improvements have significantly increased the signal-to-noise ratio which now meets the original specification. These refinements yield imagery with greater visual appeal in which different types of vegetation can be discriminated more finely (see figure).

The coefficients required for image radiometric detectors equalization have been determined and were made available on 1 December.

The images are of high geometric quality and in full compliance with the specifications. Following geometric calibration, the location accuracy was around 400 m, or about the same as for SPOT 2. SPOT 3 imagery will be free of both scale distortion and anisomorphosis.

SPOT 3 was formally declared operational on 29 November 1993. At present SPOT 2 is still the operational satellite for foreign ground stations, including ACRES. ACRES has received images from SPOT 3 and we are presently fine tuning our production system to process the data. Some minor modifications are still needed before SPOT 3 products can be released in Australia.

SPOT special offer announced at 7th Australasian remote sensing conference

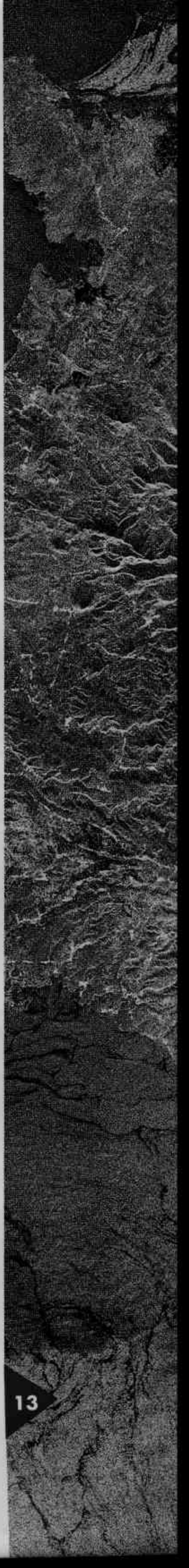
ACRES and SPOT Imaging Services have announced a Special Offer for SPOT digital data purchased between 1 March and 30 June 1994.

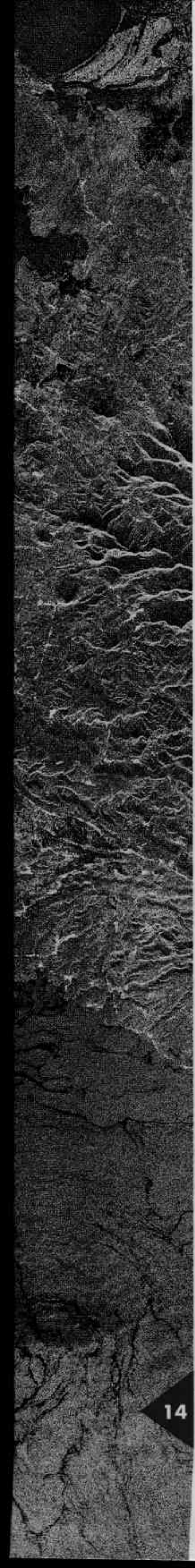
The offer is to encourage users to look at SPOT data for time series studies or to create merged data sets (SPOT PAN plus SPOT Multispectral) at a reasonable cost. Also stereo pairs will be available through this offer.

The offer is "buy one SPOT digital image and the second and subsequent images of the same area are half price".

If ACRES does not have a second image of your area of interest, the offer includes a free programming request valid for 12 months.

For more information contact ACRES Sales, SIS, or any of our Distributors.





South Africa to launch remote sensing satellite

HOUWTEQ, a space systems integration company of Grabouw, South Africa, has released details of its proposed new satellite, GREENSAT.

GREENSAT is a low cost optical observation satellite system comprising a lightweight, autonomous low earth orbit satellite, a dedicated ground station, and image processing system. This integrated system can be tailored to specific needs. It is possible, for example, to provide operators with multiple satellites and additional image-receiving and processing stations that will allow optimal use of the system's capabilities.

The system is designed for panchromatic high resolution observation and multispectral medium resolution observation, monitoring and data acquisition for a wide variety of end uses, including:

- Town and Regional Planning
- Pollution Control and Monitoring
- Coastal Management
- Forestry Management
- Nature Conservation
- Agricultural Management
- Surveillance
- Cartography
- Disaster Management

GREENSAT is equipped with two optical sensors. With a resolution of better than 2.5 metres at an orbit height of 400 km, the main camera provides images more than four times more detailed than others currently available commercially. It covers a ground swath of 8 km. The second camera has a resolution of 16 metres, giving a ground swath width of 120 km at an orbit height of 400 km. The two cameras operate independently. To meet specific mission requirements, the satellite can be manoeuvred up to 45° from nadir angle to allow the main camera to capture the required images.

In order to keep the mass of the satellite as low as possible, it does not carry any data recording equipment. Instead, it downloads the information in real-time to a ground station within a 2000 km radius, depending on communication links and orbit height. Additional receiving stations can be provided in order to maximise the amount of information received.

THE GROUND STATION

The ground station handles satellite command and control (SCC) and telecommand, tracking and communication (TT&C) and image reception functions. The system has a multi-mission capability within a 2000 km radius of the ground station. A single SCC system can control up to three satellites in a constellation. Each satellite is fully autonomous during cruise mission, while orbit correction and imaging missions are planned and controlled by the SCC. Raw image data received from the satellite is processed by the image processing system to the required format.

MAJOR SYSTEM SPECIFICATIONS

Design Life	2–5 years nominal
Reliability	0.9 over 2 years
Mass Satellite (dry)	215 kg
Payload	45 kg
Total	320 kg
Orbit Height	200–700 km

Communications

S-Band Command Uplink Frequency:	2095 MHz
S-band Telemetry Downlink Frequency:	2295 MHz
X-band Data Link:	8150/8250 MHz
Maximum Data Rate:	70 Mbits/sec
Off-nadir Angle:	30°max. for optical sensor temperature control (in cruise mode), 45°max. during imaging missions

Optical Payload

The payload consists of two independent observation cameras for terrestrial mapping and high resolution imaging of pre-defined areas using state-of-the-art CCD detector technology. A customizable interface is provided by a signal processing unit.

Observation Payload Characteristics

High Resolution Camera

Image Resolution (Pixel footprint at nadir angle):	Better than 2.5 metres at 400 km(nominal) orbit height
Swath Width	8 km at 400 km orbit height
Spectral Range	Panchromatic (0.5–0.9μm)
Mass	25 kg
Power Consumption	54 W
Optical Aperture	300 mm
Focal Length	3.47 m

Multispectral Mapping Camera

Image Resolution (Pixel footprint at nadir angle):	16 m at 400 km orbit height
Swath Width:	120 km at 400 km
Multispectral Bands:	Band 1: 0.63–0.69μm Band 2: 0.76–0.90μm
Mass:	7.5 kg
Power Consumption:	44 W
Optical Aperture:	60 mm
Focal Length:	320 mm

For more information contact:

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Phone: (024) 50 5911 Int. + 27 24 50 5911
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Taiwan ground station now operational

Taiwan joined the worldwide network of international receiving stations in June 1993 with the opening of the new Chung-Li station. The government of Taiwan first decided to look into a data receiving station in 1986. In 1987 a feasibility study was presented to the National Science Council. In 1989 a government agency known as the Scientific Technology Advisory Group (STAG) brought nine deputy ministers together to finalize project details. All government agencies involved were in favour of a go-ahead. The construction of the station building was funded by the Ministry of Education and the purchase of station equipment by the National Science Council.

At the same time, the station was made an integral component of the 15-year space program voted by the government the following year. Construction work began in June 1991. Later that year the Taiwanese authorities selected MDA to supply station equipment. By March 1993 the station was ready for on-site acceptance testing. On 25 May it received its first image, a SPOT panchromatic scene of Siberia. Tests continued until late June when the facility was declared ready for operational service. A data reception contract signed by the National Central University and SPOT Image in April came into effect in July.

The Chung-Li station is located on the university campus and has an annual operating budget of FF 20 million. It employs 27 people divided into shifts to keep the station running 22 hours a day. At any one time ten or so part-time employees are engaged in project work while five professors head as many laboratories specializing in digital image processing, imagery for digital photogrammetry, geographic information systems (GISs), standard products and value-added products. Image acquisition, image processing, applications development and the creation of added-value products are all provided for on the same campus, so ensuring close cooperation among all parties.

Users came forward almost as soon as Chung-Li went operational. They now receive their data more quickly than before and are pleased with the improved service. Fast turnaround is particularly important for agricultural projects. Apart from agriculture, the leading applications are planning and development, environmental management and coastal development.

The Centre for Space and Remote Sensing Research is one of SPOT Image's longest standing distributors. The experience acquired by this organization since 1987 in data processing and applications management is an important advantage that is being turned to good account now that data can be supplied more readily.

Professor A. J. Chen is the Centre's leader. Early last year ACRES conducted a four week training program for the new station's operators. The coverage from the station includes the eastern half of mainland China, Japan, Indo China and part of the Philippines.

New Satellite remote sensing kit released

The Geography Teachers' Association of Victoria (GTAV) has now released a classroom education kit for teachers on remote sensing. The kit is an exciting new resource written and produced by GTAV in association with the Australian Centre for Remote Sensing (ACRES).

The kit has:

- Australia-wide applicability, relevant to years 7–12
- comprehensive and innovative classroom activities which introduce students to satellite images and the technology that produces them
- 40 page student activity and teacher resource booklet
- class sets of full colour satellite images of Cairns and Adelaide, topographic and regional maps corresponding to image areas and acetate overlays for use in student activities
- the kit also includes full colour overhead transparencies displaying the images and a variety of geographic activities relating to image areas

The cost of the kit is $100 plus $15 postage and handling. To order the kit, complete the order form below and fax or mail to GTAV. Any enquiries should be addressed to Ellen Finlay at GTAV on:
Tel: (03) 824 8355
Fax: (03) 824 8295

OFFICIAL ORDER FORM

Please supply .... copy/copies of the educational resource kit on Satellite Remote Sensing at a cost of $100.00 plus $15.00 postage and handling.

Name ....

School or Location ....

Postal Address ....

....

....

.... Postcode ....

Phone .... Fax ....

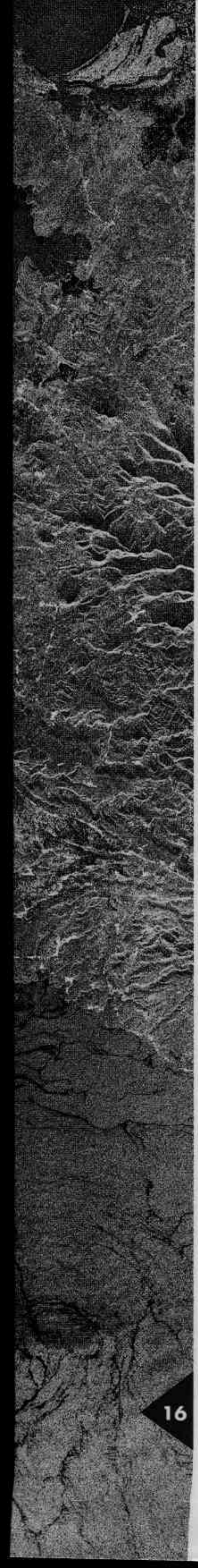
Please find attached my/our confirmation of payment

☐ Official school order number ....

☐ Cheque number ....

Confirmation of payment must accompany all orders

Fax your order to GTAV on (03) 824 8295, or post to: 503 Bourke Road, Camberwell South, Victoria, 3124.



SPACESCAPES™: merged and geocoded satellite poster maps

Spacescapes are a new concept in high precision and high definition satellite image poster maps. Production of these posters involves the use of a wide range of modern technologies and innovative techniques for acquiring, processing and printing the imagery. Because of their accuracy, detail and colour, Spacescapes products satisfy the requirements of a range of uses and users, including members of the public seeking aesthetic display material, tourists wanting a memento of their visit, private companies in search of promotional media, educators requiring material for curricula, local councils and non/government agencies involved in specialised projects. The Spacescapes company involves three separate parties. Image processing is undertaken by Agrecon Pty Ltd. Posters are printed in Canberra by Pirie Printers Pty Ltd and distributed by Spacescapes Distributors Pty Ltd, a Sydney based company formed specifically to market Spacescapes products under contract.

Spacescapes of Sydney is the first in a series of merged and geocoded satellite poster maps planned for production. Three spectral bands (3, 4 and 5 corresponding to visible red, middle infrared and near infrared) comprising a quarter scene of cloud free Landsat 5 TM data (path 89, row 84 – 25 July 1993) were selected to highlight differences in land use, biophysical and cultural features within the Sydney area. Spectral bands were assigned to blue, green and red colours respectively to generate a pseudo-natural appearance. High resolution panchromatic data from SPOT 2, comprising two full scenes acquired from adjacent satellite orbits on different dates (path 389, row 418 – 24 June 1993, and path 390, row 418 – 11 September 1992), was used to present spatial detail of urban features.

More than 80 ground control points were defined in image and map coordinates to generate a precision geocoded product for each of the three images used. This involved removal of scale distortions, rectification to a (Universal Transverse Mercator) map projection, realignment of pixels and scan lines from satellite path orientation to accord with (Australian Map Grid) grid lines on conventional maps, and resampling of data to a pixel size of 10 metres (down from 30 metres for Landsat data). Positional accuracy of the resulting imagery is better than 10 metres.

A smoothing filter was applied to the Landsat image to remove any anomalies created during registration and resampling. The pair of SPOT panchromatic images was matched to eliminate the presence of a join mark after mosaicing. Thereafter, an edge detection high pass filter was used to extract cultural detail from the SPOT panchromatic mosaic. This was then added to digital data comprising each of the three selected Landsat spectral bands to incorporate the best elements of spatial and spectral resolution from imagery acquired by different satellites. An edge enhancement spatial filter was applied to the merged, geocoded image to further sharpen the final product.

Two different areas were selected for presentation at 1:50,000 and 1:100,000 scales, with each subset being individually rescaled for maximum contrast and colour balance. The 1:50,000 image was framed to focus on Sydney Harbour and Botany Bay while the 1:100,000 image was positioned to include the entire metropolitan area between Broken Bay to the north, the Royal National Park to the south, and the Hawkesbury/Nepean River to the west. The AMG coordinates for neat lines defining the borders of the 1:50,000 image map are 297,050 343,350 6,260,100 and 6,231,000 for west, east, north and south map edges respectively. The AMG coordinates for neat lines defining the borders of the 1:100,000 image map are 275,000 367,000 6,284,000 and 6,226,000 for west, east, north and south map edges respectively. Every major commercial and industrial building in Sydney is able to be discriminated in the resulting merged and geocoded images. Recreational and transportation features are equally apparent. Although landscaping and trees preclude identification of every house, most dwellings are able to be located while every street is readily able to be identified.

Image processing was undertaken on 486 PCs using microBRIAN software. Total computer processing time exceeded 500 hours and involved more than 20 billion separate calculations. The final 1:50,000 three channel image comprises a total of 4630 pixels and 2890 lines, giving a file size of more than 40 megabytes, while the final 1:100,000 three channel image comprises a total of 9260 pixels and 5800 lines, giving a file size of more than 161 megabytes. Merged and unmerged geocoded digital data sets generated during production of the poster are available for sale to government agencies, local councils and companies for incorporation into GIS systems.

Instead of scanning a photographic product to generate colour separates for printing, image quality was maximised by converting red, green and blue (RGB) primary colours from digital format directly into colour subtractive cyan, magenta, yellow and black (CMYK) film ready for printing. Image contrast and colour balance was further adjusted during this process. The resulting product was printed on Royal Impression 200 gsm paper using a Komori Lithrone 540 5 unit 40" printing press. Two printing runs were required to generate each side of the final image product. The first print run laid down the image using an Under Colour Removal system. Black, cyan, magenta and yellow colour subtractives were printed sequentially with a fifth printing unit being used to double up the density of the black border. Ink densities were set to enhance contrast and visual appearance. The job was not run to the proof. A fine dust was applied to the underside of each print to prevent individual sheets sticking together during drying. During the second print run the first two printing units were used for dedusting, silver ink was applied to the Spacescapes logo on the third printing unit, while the last two units were used to apply spot gloss and matt varnish to the image and border respectively. The same printing sequence was used for the reverse side of the product after several days had elapsed to allow the ink and varnish to dry.

Double sided printing of the poster at different scales represents exceptionally good value for money with a recommended retail price of $19.95. Class sets and multiple purchases (of 25 or more) are being offered at a unit price of $13.99. Following an initial print run of 10,000, plans are in hand for short reruns, especially for clients wishing to 'badge' the poster with their own logo for advertising purposes.

The Sydney Spacescapes poster has been entered in the technology and innovation category of the 1994 Australasian Printing Awards.

Orders for copies of Spacescape posters or precision geocoded merged digital data sets of Sydney, as well as enquiries for production of satellite posters over other areas should be directed to:

Dr Brian Button
Managing Director
Agrecon Pty Ltd
University of Canberra
PO Box 1
Belconnen ACT 2616
Tel: (06) 201 2565
Fax: (06) 201 5353
Mobile: 015 264623

NGIS joins ACRES network

A new Western Australian based company, National Geographic Information Systems (NGIS), has recently joined the ACRES network of Specialist Consultants.

NGIS is managed by Paul Harris who has over seven years experience using GIS and remote sensing in a variety of applications both in Australia and the US. Paul also has an engineering and training background. Support staff include Olsen Dias, Mike Forde and Rupert Crowe, who have backgrounds in computing, biology and geology.

NGIS is a total GIS services consulting bureau. They provide complete solutions to the Mining, Natural Resource, Land Management and Business communities. Their services include user needs assessment, systems analysis, customisation, database development, data conversion, geo-coding, training and bureau work. NGIS can provide independent advice regarding the most cost-effective GIS option for your organisation.

NGIS has also been recently appointed the Western Australian distributor for ER Mapper. Commenting on this appointment, Paul Harris says "We are very pleased to be associated with ER Mapper, not only because they are Australian, but ER Mapper is a world leader in image processing software and it will complement our many other products and services".

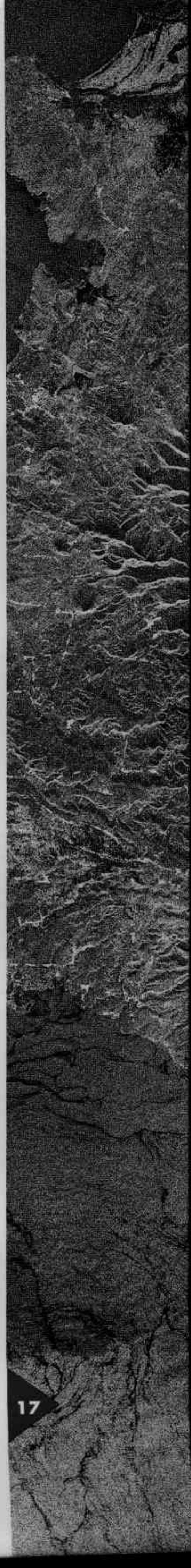
For further information about NGIS products and services contact:

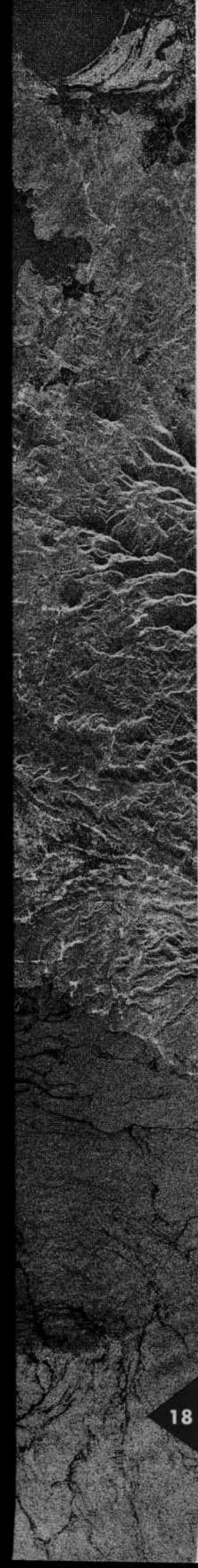
Paul Harris
Managing Director
NGIS (Australia) Pty Ltd (ACN 061 264 793)
Suite 4 Kishorn Court
58 Kishorn Road
Mount Pleasant WA 6153
Phone: (09) 364 3878
Fax: (09) 364 9200

ACRES production team begins to benefit from new systems

The upgrades that took place to ACRES production system last year are now delivering many of the benefits expected. With the upcoming release of variable window products and the full range of MSS products (both to be released at the Melbourne Remote Sensing Conference), the system is now delivering most of the benefits expected. Turnaround time for orders is also being reduced significantly. After some further testing in the next few months, we expect to be able to deliver otho-corrected products.

Loree Aalders, Lien Ly and Bill Howard keep things on the move in the computer room.





CALENDAR

Remote Sensing and Associated Events

28 Feb – 4 Mar Melbourne, Victoria, Australia

Seventh Australasian Remote Sensing Conference
Contact: Secretariat
Tel: (03) 387 9955
Fax: (03) 387 3120

5 – 12 Mar Melbourne, Victoria, Australia

FIG XX International Congress
Contact: ICMS
Phone: (03) 387 9955
Fax: (03) 387 3120

11 – 15 April Adelaide, SA

Photogeology and Image Interpretation for Mineral and Petroleum Exploration
Presented by Tim Wilson, Australian Photogeological Consultants
Contact: Australian Mineral Foundation Inc
Phone: (08) 379 0444
Fax: (08) 379 4634

16 – 19 May Dunedin, NZ

SIRC '94 for Estuary to Forestry
6th Annual Colloquium of the Spatial Information Research Centre
Contact: Ms Kitty Ko
Colloquium Coordinator
Spatial Information Research Centre
University of Otago
PO Box 56
Dunedin
New Zealand
Tel: 64 3 479 8153
Fax: 64 3 479 8311

16 – 20 May Williamsburg, USA

International Symposium on the Spatial Accuracy of Natural Resource Databases
Contact: Dr James L. Smith
Department of Forestry
Virginia Tech University
Blacksburg
Virginia 24061-0324
USA

June Cardiff, Wales, UK

Education & Remote Sensing '94
The second conference of its kind aims to bring together educators, industry and space companies to provide a sensible approach to space education and remote sensing in particular.
Contact: Annette Temple
Director
The Satellite Project
Dyfed LEA Satellite Centre
Newcastle
Emlyn
Dyfed SA38 9DB
UK
Tel: 44 239 710 662
Fax: 44 239 710 985

13 – 24 June Canberra, ACT

GIS and Environmental Modelling Course; Basic GIS principles and practical skills by Dr Brian Lees, Geography Department, Australian National University
Contact: George Collett
ANUTECH
Tel: (06) 249 5671
Fax: (06) 249 5875

28 – 30 June Orange, NSW

Remote Sensing in Agriculture Symposium
University of Sydney
Orange Agricultural College (date tentative)
Contact: Mr Graeme Tupper
NSW Agriculture
Locked Bag 21
Orange NSW 2800
Tel: (063) 91 3143
Fax: (063) 91 3206

29 June – 2 July Hobart, Tasmania, Australia

Coast to Coast '94 – A National Coastal Management Conference
Contact: Penelope Archer
GPO Box 844
Hobart
Tasmania 7011
Tel: (002) 31 3223
Fax: (002) 31 3224

11 – 14 July Melbourne, Victoria

Remote Sensing Short Courses at RMIT
11 July Remote Sensing; Mapping the Farm
12 – 13 July Image Processing using MicroBRIAN
14 July Introduction to Remote Sensing
Contact: Department of Land Information, RMIT
Tel: (03) 660 2213
Fax: (03) 663 2517

14 Aug – 3 Sep Dundee, UK

The Determination of Geophysical Parameters from Remotely-Sensed Data

Contact: 8th Dundee Summer School on
Remote Sensing
Robin Vaughan
Department of APEME
University of Dundee
Dundee
UK

4 – 8 September Gold Coast, Qld

Mapping Sciences '94, Australian Institute of Cartographers

Contact: Conference Secretariat
Tel: (07) 369 7866

6 – 9 September Hobart, Tasmania

1994 Australian Landcare Conference
"Landcare in the Balance"

Contact: Mike Temple-Smith
Tel: (003) 36 5264
Fax: (003) 36 5365

11 – 15 September Strasbourg, France

1st International Airborne Remote Sensing Conference

Contact: ERIM/Airborne Conference
PO Box 134001
Ann Arbor MI 48113-4001
USA
Tel: 0011 1 313 994 1200, Ext 3334
Fax: 0011 1 313 994 5123

26 – 30 September Melbourne, Victoria

Resource Technology '94; New Opportunities, Best Practice

Contact: Dr. Ian Bishop
Tel: (03) 334 6944
Fax: (03) 347 2916

4 – 6 October **Fremantle, WA**

1994 National Greening Australia Conference
"A Vision for a Greener City"

Contact: Motive Conventions
GPO Box M973
Perth WA 6001
Tel: (09) 322 2666
Fax: (09) 322 1417

23 – 25 November Sydney, NSW

AURISA 94 Conference, Darling Harbour, Sydney

Contact: AURISA Executive Office
Tel: (06) 285 2301
Fax: (06) 285 2320

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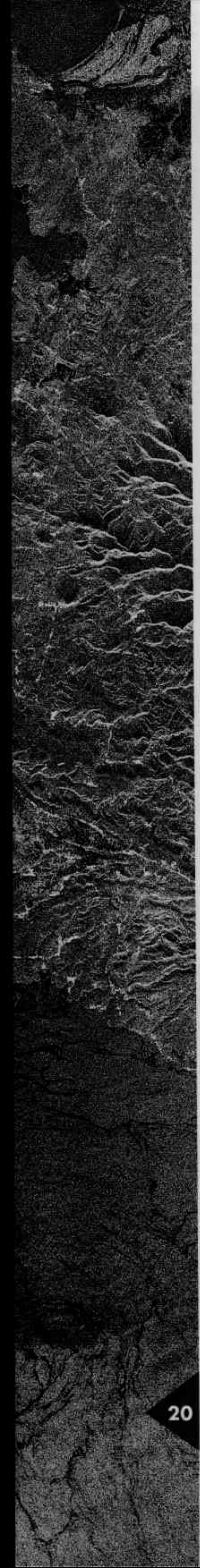

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PO Box 761
Herdsman WA 6017
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Fax: 0015 1 301 552 3762

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Indonesia
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0011 62 21 32 6781
Fax: 0015 62 21 32 3133
0015 62 21 32 1406

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Holt ACT 2615
Tel: (06) 255 1398
Fax: (06) 255 2460

Southern Remote Sensing
24 Curtis Street
North Adelaide SA 5006
Tel/Fax:
(08) 267 3983

Technical and Field Surveys Pty Ltd (TFS)
Building 3
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30 Delhi Road
North Ryde NSW 2113
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Fax: (02) 887 8647

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Wembley WA 6014
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Fax: (09) 387 8400

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