



ACRES

UPDATE



Graham Bashford (AUSLIG GM) discusses the APEC map with Bob McMullan and Vice President Tri Sutrisno.

Indonesia Vice President inspects ACRES

Indonesian Vice President Tri Sutrisno included a visit to inspect Australia's Remote Sensing capabilities at ACRES in his recent visit to Canberra. On 23 September 1994 Vice President Tri was accompanied on a briefing and tour of ACRES facilities at Belconnen by the Australian Trade Minister, Senator Bob McMullan, the Secretary of the Department of Administrative Services, John Mellors and AUSLIG General Manager, Graham Bashford.

With the recent completion of the new Indonesian ground station and processing facilities, Australia and Indonesia now use similar systems to access earth resources satellites and have overlapping reception areas. There are cooperative opportunities to learn from each other's experiences and to provide back-up capabilities if break downs or satellite conflicts occur.

The Vice President was given a briefing on ACRES capabilities and demonstrations of project work using imagery of Indonesia acquired by ACRES. A demonstration of the use of satellite imagery for updating AUSLIG's topographic maps was also presented.

AUSLIG has recently signed a MOU with its Indonesian counterpart, Bakosurtanal, and in a joint project produced a map of the APEC countries for distribution at the recent APEC leaders forum in

INDONESIA SPECIAL

Australian-Indonesian RS project

P.T. Indica Dharma leads the way

Trochus shell mapping with TM



Manager's message

My first 6 months as ACRES Manager have been both interesting and challenging. I have been fortunate to have been able to meet many of the key players in the industry both within Australia and overseas. I feel that I now have a good understanding of the major challenges that lie ahead.

As you will quickly gather from this newsletter, our relationship with our Indonesian colleagues at LAPAN has been very active recently. We believe this will result in long term benefits for ACRES and indeed the whole Australian remote sensing industry.

In October I attended the SPOT GOSS 9 meeting in Ottawa, Canada. The list of initiatives unveiled by SPOT Image was very impressive. The new Managing Director, Jacques Mouysset, also impressed all present with his enthusiasm and expertise. Jacques subsequently visited Australia and we held useful discussions regarding strengthening even further the excellent working relationship between SPOT and ACRES. During the GOSS meeting the French Government announced approval of funding for 2 further SPOT satellites, termed 5A and 5B. This welcome announcement virtually guarantees continuity of the SPOT program until the year 2010.

While in Canada I had the opportunity to visit the Canada Centre for Remote Sensing and to observe the Canadian industry at close quarters. The grouping of large government and private sector monopolies provides an interesting contrast to the more devolved model that is in place in Australia.

In October I also attended the inaugural meeting of the Australian Space Council's Remote Sensing Board. The Board will certainly be busy. Its initial priorities have been agreed as the development of plans for an Australian Earth Observation Network, development of the value added services sector, development of an education and training program and the review of the organisation of remote sensing in Australia. Besides that there's always the minor matter of establishing the expected data requirements of the Australian remote sensing user community!

The year ended fittingly with the ACRES data distributors' meeting where we reviewed our performance and discussed plans for the year ahead. I can promise you that 1995 will be an exciting year in terms of new data sources, new marketing initiatives and even higher levels of customer service from ACRES.

Paul Trezise

Editorial

ACRES Update is still alive! Due to a number of factors, including my absence overseas in the latter part of 1994, the September/October edition did not see the light of day. With this first edition for 1995, quarterly publications will resume in earnest.

This edition has a strong Indonesian flavour reflecting our growing closer ties with that country as a nation and more specifically in the remote sensing industry. Recent activity has included Ministerial visits to Australia by the Vice President of Indonesia, Tri Sutrisno; our own minister Frank Walker, in Indonesia; a number of exchange visits between our ground stations and successful business activity by P.T. Indica Dharma, ACRES Indonesian agent. A number of articles in this edition provide some detail of these activities. The seeds have been sown; we look forward to the development of a mature and mutually rewarding relationship.

Dennis Puniard

Variable Window Products provides flexibility

The recent introduction of Variable Window Products for both Landsat and SPOT provides ACRES customers with more flexible options when ordering images other than full scenes. Variable window products are now available in both photographic and digital format and allow data sets to be ordered based on a customer's needs rather than the limitations of quarter scenes or map sheets.

The variable window products are only available for map oriented products with either systematic or precision correction, depending on accuracy requirements. The pixels are resampled and oriented to the North-South Australian Map Grid (AMG). For Landsat TM the smallest data set is 2025 sq km and the largest 60,000 sq km. For SPOT the smallest is 900 sq km and the largest 10,000 sq km. Prices are based on the area covered by the product ordered so that the customer only pays for the amount of data needed for their application. Product ordering has also been simplified with a central coordinate (latitude and longitude) nominated and N-S and E-W dimensions in kilometres of the area required.

For more details on product specifications and prices contact:

John Lee

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Jakarta. The Vice President viewed a draft version of this map during his visit.

A large media contingent accompanied the Vice President on his tour and high profile coverage on both television and written media was accorded the visit in Indonesia. With such high level interest in remote sensing in Indonesia there would appear to be many opportunities for cooperative ventures.



Top right: Paul Trezise, ACRES Manager shows the Vice President and Senator Bob McMullan the ACRES operations. Merv Trubee is the ACRES operator.

Below right: Vice President Sutrisno accompanied by Senator McMullan departs ACRES The Indonesian Ambassador to Australia, Mr Sabam Saigian, is on Senator McMullan's left.



Below: John Mellors (Secretary DAS) welcomes Vice President Tri Sutrisno and Senator Bob McMullan to ACRES.



Senator McMullan presents a framed image of Seram to the Vice President.

P.T. Indica Dharma leads the way in Indonesia

ACRES distributor in Indonesia P.T. Indica Dharma has experienced its most successful year yet in its remote sensing business. In only their third year of operations they have become ACRES second biggest distributor taking out the silver award at the recent distributor's meeting held in Canberra. Mr G. Haryuatmanto (Anto) received the award from AUSLIG General Manager, Graham Bashford (below).



Since its establishment in 1991, the company has developed its capabilities, expanded staff numbers and added to its product range. Staff include Mr Mohammed Isnaini as Director, Mr G. Haryuatmanto and Ms Lissa Rakmi Utari as applications experts and sales representatives. In addition to being an ACRES distributor they also distribute data from the Thailand Ground Station and are distributors for MicroBrian and ER Mapper software. More recently the company has been appointed a distributor for the new LAPAN Station.

Much of the success of the business is due to support from the company's President Director Dr Syarifuddin Harahap and its focus on the mapping of forestry concession areas.

The company has recently moved to new office premises in a new business area in the South Jakarta area of Fatmawati. Future projects include continued development of new markets and a lead role in the Australian Indonesia Visible Inferred Scanner (AIVRIS) project in conjunction with Trippett-Sheddon and CSIRO.

Left to right: Mohammed Isnaini, Dennis Puniard, Lissa Rakmi Utari, G. (Anto) Haryuatmanto outside P.T. Indica Dharma Consulting Services office in Jakarta.



Australia - Indonesia project paves the way

ACRES and its Indonesian counterpart, LAPAN, have recently been working together in a joint project aiming to make data exchange and communications between the two organisations functional. The project, known as the Remote Sensing Ground Station Cooperation Project was funded by the Australian Department of Industry Science and Technology (DIST) as part of its International Industry Collaboration Programme.

The projects objectives included:

- Understanding limitations and opportunities through agreements by the parties with satellite operators;
- The exchange of catalogue information;
- Development and testing of data exchange mechanisms;
- Understanding satellite scheduling and archiving policies;
- Technical assessment of each others systems;
- Training of Indonesian operators in photographic techniques and TQM procedures;
- A marketing and sales workshop in Indonesia; and
- Investigation of SAR processing capabilities.

The project commenced in earnest in July 1994 with a visit by the Project Manager, Dennis Puniard and the ACRES Business Manager, Tim Shirley to Jakarta.

Activities during the project have included:

- A visit to Canberra, Alice Springs and Darwin by LAPAN managers, Mr Dijardjana, Mr Mawardi Nur and Mr Bambang Tedjasukamana;
- A visit to Canberra for on site experience by LAPAN production managers Mr Mohammed Natsir, Mr Ignatius Arisdio and Mr Nurdinsyah Mokobombang;
- A visit to LAPAN's Jakarta Facilities by Dennis Puniard, Mike Pasfield, Anton Albina and Madeleine Clark;
- A visit to LAPAN's facilities at Pare Pare and Jakarta by Dennis Puniard and Robert Denize; and
- A visit to Jakarta by Peter Radonyi.

The project was completed in early December with the successful achievement of all objectives. Data from all satellites can now be successfully exchanged between the two stations.

Left to right: Bambang Tedjasukmana, Tim Shirley, Dr Mahdi Kartasmita, Mawardi Nur.





LAPAN headquarters at Pare Pare.



Operations Room at Pekayon.



LAPAN Processing Centre, Pekayon, Jakarta.

Australian minister tours Indonesia

In November 1994 the Honorable Frank Walker, Australian Minister for Administrative Services, visited Indonesia. He was accompanied by the DAS secretary, John Mellors. The tour included Eastern Indonesia and Jakarta where a reception was held to mark the opening of a new DAS office in Jakarta. The minister met with Vice President Tri Sutrisno and other national and provincial government representatives.

The reception in Jakarta was attended by several prominent Indonesians involved in remote sensing activities from both government and private industry. The minister's speech made prominent mention of remote sensing and GIS technologies and business opportunities especially in relation to the development of Eastern Indonesia. He said in part:

"Australia thinks (the region) is important because it is closest to Australia.. It is also where development is most needed and where some of the country's poorest people live."

"Feasibility studies for a large hydropower plant were currently being carried out in the Mamberamo Valley in Irian Jaya and for low-cost housing in Kupang, East Nusa Tenggara."

"Other projects currently being studied include those related to satellite remote sensing and aero-mapping surveys."

Australia, he said, was also interested in the tourism industry and plans to assist in the expansion of the smaller airports in many parts of the region.

The visit has continued to build relationships at the highest level and provides a stepping stone for further cooperative projects.



Left: Antenna at Pare Pare, Sulawesi.

Right: Robert Denize, ACRES Chief Engineer and LAPAN Station Manager Nur Hidayat at Pare Pare.

A classification strategy for mapping trochus shell habitat in Torres Strait, Australia

Waqar Ahmad and Greg J.E. Hill
Northern Territory University
Darwin, Australia

INTRODUCTION

The large marine gastropod, *Trochus niloticus*, has been used for thousands of years by the island peoples of the South Pacific as a source of food, craft material and trade. In the 1800s it formed the basis of the mother-of-pearl, shell trade that was controlled from Europe. While the extent of harvesting that characterized these times is not found today, the annual world harvest is still over 5 million kg and trochus remains an important cash crop and food source (Bouchet and Bour 1980). With increasing human populations and technological advances that facilitate the gathering of trochus, there is concern over current levels of harvesting and degradation of the reef habitats that support trochus (e.g. Glucksman and Ludholm 1982, Nash 1985, Yen 1985, Catterall and Poiner 1987, Honma 1988).

However, the tropical coral reefs where trochus shell is found are remote and in many cases, uncharted. As well, it is only certain sections of the reefs that are prime trochus habitat. As *T. niloticus* feeds mainly on algae, the best locations are the high energy sections of the reefs. These generally form narrow zones along the windward edges of the formations. Trochus are found in both intertidal and subtidal reef areas. Most inhabit water depths of between 5 and 6m although the larger commercial sizes often occupy deeper water (e.g. Heslinga et al. 1984, Hahn 1989). The task of estimating the abundance of trochus and the distribution of suitable habitat is a difficult one. This is the reason few surveys have been conducted for the commercial fishery areas (Long et al. 1993).

Remote sensing is a suitable base for mapping trochus habitat. However, mapping the habitat requirements of trochus demands high spatial resolution in a sensor system. For this reason satellite remote sensing has not made a contribution to mapping trochus habitat until comparatively recent times. Bour et al. (1986) and Loubersac and Populus (1986), working in New Caledonia, demonstrated that simulated SPOT imagery was capable of mapping the reef areas used by trochus with high accuracy. These results were confirmed after the launch of SPOT (Bour 1988). In the Australian region, Long et al. (1993) used Landsat TM imagery and a relatively simple classification technique as a means of rapidly estimating the trochus stocks of the eastern Torres Strait.

Work by the current team made use of the field data and air phot derived maps of Long et al. to establish the level of detail possible with Landsat TM imagery if more sophisticated processing approaches were tried. This commenced with the successful classification of the reef surrounding Yorke Island in Torres Strait (Hill and Ahmad 1992). In attempting to extend this process to surrounding reefs, it became clear that they displayed different patterns of trochus habitat. One practical problem, from the image analysis point of view, is that the islands and reefs which support trochus, are distributed patchily across broad areas. Because of differences in the size, location and geomorphology of the islands/reefs, they exhibit a diverse range of spectral classes for classification. As well, water depth alone, is not necessarily a good indicator of prime habitat. This state of affairs may lead to long and involved image processing sessions before a satisfactory classification of the full range of classes is successfully achieved.

The general aim of this paper is to assess the usefulness of Landsat TM data for mapping of trochus shell habitat for the reefs of the Bourke Isles in Torres Strait, which separates Australia and Papua New Guinea. In specific terms, however, emphasis is given to the description of a methodology that stream-lines the process of classifying prime habitat for commercial sized trochus across a group of reefs. It relies on transfer of a classification mask generated from an intensively surveyed reef to similar but unsurveyed areas.

STUDY AREA

The location of the study area is Torres Strait, being roughly 100 km from north to south and 250 km east to west, occupies an area of approximately 8,000 km between Papua New Guinea and Australia. It is a shallow zone, up to approximately 50 m in depth, that features a host of reefs, islands and shoals (e.g. Harris 1989). The Bourke Isles are located in the eastern Torres Strait. These islands are coral cays surrounded by elongated, platform reefs. The major reef flats face the prevailing south east trade winds and it is along the windward edge of these that most large trochus are found.

Climate of the area is mild for a tropical region being dominated by the south east trade winds that blow from June to November and the north west monsoon that brings heavy rains between January and May. Maximum, annual average temperatures range from 24°C to 30°C with average, annual precipitation of 1,750 mm (Thursday Island). The dry season provides good conditions for the capture of satellite data with little cloud cover. During the monsoon season, however, there is little likelihood of usable imagery.

METHODS

Research was based on a Landsat TM scene (path 98, row 67) recorded on 31 October 1988. Channel 1 (.45 - .52 μ m), channel 2 (.52 - .60 μ m) and channel 3 (.63 - .69 μ m) were selected because of their water penetration characteristics. As each reef was associated with an island, channel 4 (.76 - .90 μ m) was included to assist with separation of land and water environments.

The project was carried out in two stages. In Stage 1, trochus habitat for the largest island in the Group (Yorke Island) was successfully achieved (Hill and Ahmad 1992). Stage 2 involved the transfer of the classification mask generated for Yorke Island to the remaining three reefs of the study area (Marsden, Kabbikane and Keats Islands). Initial classification runs of these reefs using the Yorke Island classification file indicated that the sub-classes involved were not directly transferable and adjustments were required.

Work began with the contrast enhancement of the images for Marsden, Kabbikane and Keats reefs. The data were visually inspected on a high resolution colour monitor and a few homogeneous training areas were selected from the more distinct colour patches visible on the screen. The training areas were added to the previously created classification file for Yorke Island.

To ensure that the spectral variation in the data was sampled and incorporated in the classification procedure, a sequence suggested by Ahmad (1986) was adopted. This procedure relied on the independent sampling and inclusion of themes (spectral classes) based on the use of two dimensional spectral histograms of the least correlated input channels. Implementation was achieved by defining boundaries that corresponded to the 1-95% values of the individual histograms. By overlaying these boundaries on the two dimensional cross-plots of the least correlated channels, different boxes were formed and their central values (mean) calculated. These values (additional themes) were then added to the composite classification file.

As the next step, the composite classification file was used as an input to the minimum distance classifier using the microBRIAN image processing system (MPA 1988, Harrison and Jupp 1990). The three islands were classified separately using the composite classification file noted above. The resultant classified and residual images for the three islands were then evaluated (Jupp and Mayo 1982). In the classified image each pixel's value (per band) is replaced by the mean value for the class to which it belongs. The residual image is the difference between the classified and original data. The more closely the classified image resembles the original data and the more random the appearance of the residual image, the better the classification. This procedure resulted in optimally classified images which did not require any iterative classification.

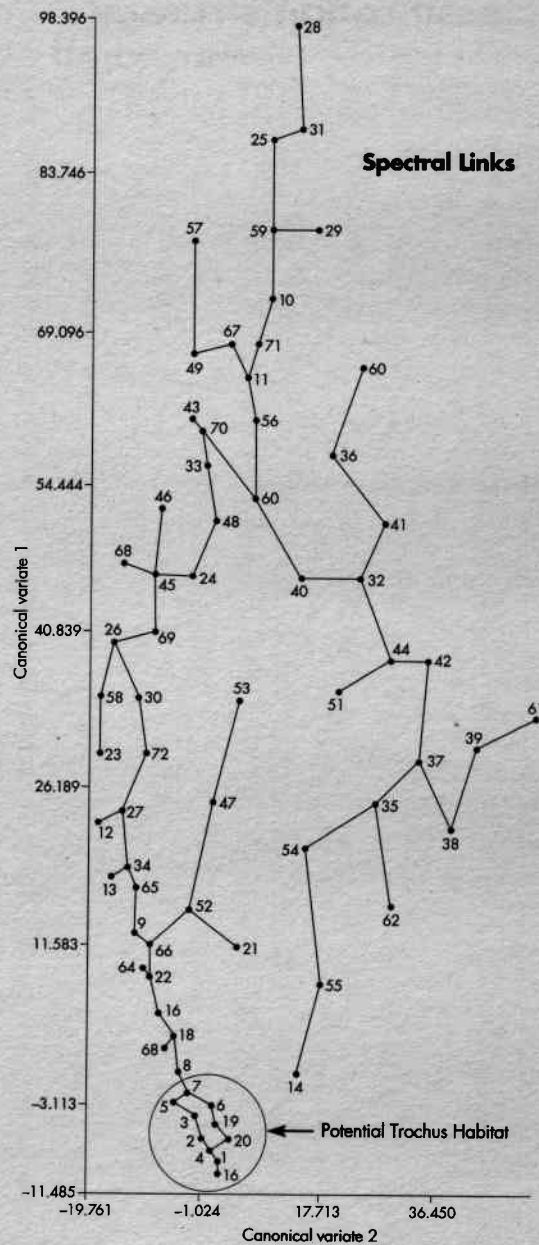


Figure 1: Canonical variates analysis illustrating the spectral links between classification classes for the Bourke Isles reefs.

The resultant spectral classes were edited and aggregated according to the respective Mahalanobis Distance (Hope 1968) between spectral classes. This was performed by evaluating the Mahalanobis Distance value of the generated spectral classes. The technique calculated the difference between the mid-point values of the original themes and the mean values of the pixels assigned to each of the themes weighted by the within class inverse covariance matrix. The classes were then labelled using additional analytical techniques provided by the microBRIAN software. This phase involved the aggregation of classes which were spatially contiguous as well as spectrally similar. These techniques included Canonical Variates Analysis (Hope 1968) and Minimum Spanning Tree (Gower and Ross 1969). A Canonical Variates Plot of the data showing spectral class means of the classified Landsat TM scene, together with its associated Minimum Spanning Tree is illustrated in Figure 1.

To finalise the spectral classes which defined trochus habitat, the class amalgamations were fine-tuned by displaying each sub-class separately until the optimum stratification for trochus habitat had been achieved. Areas not on the windward side of the reefs were then trimmed manually (Long et al. 1993), the final maps plotted and area of prime trochus habitat per reef calculated. Ground truth maps prepared by the Commonwealth Scientific and Industrial Research Organisation (CSIRO), from fieldwork and interpretation of black and white aerial photography were available for each of the reefs under study (Long et al. 1993). These were used to assess the accuracy of the Landsat based classifications.

RESULTS

Table 1 provides a summary of the areas of trochus habitat estimated for each of the Bourke Isles and how these varied from the groundtruth maps prepared by the CSIRO.

Figure 2

Island	CSIRO map (hectares)	Landsat map (hectares)
Yorke	168.6	165.8
Keats	20.7	18.2
Kabbikane	17.4	16.9
Marsden	13.1	12.1

As can be seen in Figure 2, the reef edge classes potentially representing trochus habitat form a distinctive cluster in spectral space. In the present study, one group (classes 6, 19 and 20) formed the required zone on the larger, Yorke Island while a separate grouping (classes 2, 3, 4 and 20) represented the smaller islands. Spectral classes 2, 3 and 4 were in the appropriate reef zone on Yorke Island. However, they were located on either the leeward side of the reef, or submerged shoals, neither of which are preferred by trochus (Long et al. 1993). It is likely that other classes associated with the ones selected for the Yorke Isles would form optimum trochus habitat in other situations (e.g. classes 1, 15, 5 and 7). Further research will be required to assess this. It is clear, however, that for the Yorke Isles the key reef zone associated with prime trochus habitat and the sub-classes which apply to each island are well defined by the Landsat TM imagery.

The Landsat TM based classification produced estimates that were between 1.7% (Yorke Island) and 12.1% (Keats Island) below those produced from the air photos and fieldwork. The results compare favourably with the Landsat based estimates produced by Long et al. (1993) from density slicing of a green on red (TM2/TM3) ratio channel. These varied from a 12% overestimate for Keates island to a 29% underestimate for Marsden Island.

DISCUSSION

The consistent, but small, underestimates of the Landsat classification, compared to the photo interpretation / field survey methods of the CSIRO, are due in part to the generalisation that typifies maps produced by photo-interpreters. In the Landsat based approach, large coral bommies and isolated patches of coral (in the trochus zone) were classified as a different habitat. On the existing maps these had been included (as major noise) within the surrounding trochus habitat.

Textural problems of this nature are common to all remote sensing classifications that rely on spectral information alone. As pointed out by Long et al. (1993), the narrowness of the key habitat areas for large trochus (down to 30 m wide) must also create classification errors for imagery that features 30 m pixels. They also attribute some of the error in their work to reliance on aerial photography that was recorded 17 years before the satellite imagery. Problems of this sort aside, the results achieved in the current study demonstrate a quite acceptable level of accuracy.

Trochus prefer sections of reefs where wave action deposit rubble, retards coral growth and scours fine sediments. Because of variation in reef size, position and structure there is variation in where this prime trochus habitat is located from reef to reef. It follows, therefore, that the spectral signatures of these areas are not completely transferable. In particular, it means that water depth is not the only factor of importance in mapping exercises. This would appear to be borne out by the results of Long et al. (1993) for the same area. However, the research completed here demonstrates that the methodology developed allows modification of spectral classes to suit each reef system providing field data are available. Mapping and monitoring of large areas can therefore be performed relatively quickly once the initial classification phase has been completed.

The island nations and communities of the South Pacific where trochus is exploited for economic and traditional uses are currently becoming more actively involved in remote sensing technology (e.g. ESCAP/UNDP 1989, 1991). One difficulty they face, however, is that the standard applications of satellite based remote sensing are not particularly useful in these environments because of the tiny land areas involved. It is in the assessment of coastal and marine resources that remote sensing offers the greatest scope for useful applications. These resources offer great potential for development and conversely, over exploitation. To date little progress has been made in mapping reef resources. As pointed out by Quinn et al. (1985:549), "Developing countries do not generally have a satisfactory enough inventory of their shallow water habitats to develop and manage them effectively."

While research based on Landsat MSS imagery has indicated some success in this field, it was not until the advent of the higher resolution systems that detailed assessments became possible (e.g. Loubersac and Populus 1986, Loubersac et al. 1988, Bour 1988, Vercelli et al. 1988). The results of the current work provide a basis for high resolution mapping of an important, traditional resource that is under considerable pressure. For many sections of its range there is no data base on distribution of suitable habitat or abundance of trochus.

Acknowledgments

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Obituary – Frank Ientile

Peter Radonyi

It is always sad to report the death of a friend and colleague. It's even sadder when it happens to one so young with such a zest for life. Frank was in the bathroom when he slipped and broke his neck on the floor and died instantly, on the 23 August 1994. He had just turned 29 in June.

Frank had a very successful past and a promising future. He had a distinguished academic record. He enrolled in UNSW studying geology in 1984. He was one of two graduates with first class Honours in the faculty of Science in 1988. He then worked for 2 years with Petro Consulting. Having gained the respect of his employer he was given leave without pay and returned to full time study under Dr. Ian Jones at the Ocean Technology Group (OTG) at Sydney University completing a Master of Engineering Research in 1992. He worked with Tony Szeto from Canada on a more efficient method of calculating satellite wave spectra and travelled twice to Europe to present his work in international forums. His work was about to bring him the recognition of Doctor of Philosophy.

His private life was rich and fulfilling. His calendar was full of significant events for the next 18 months. He was recently engaged to Angela and they were due to marry in January 1995. He has an uncle called Frank living in Canberra also completing a PhD. The two Franks were in friendly competition as to who would complete their PhD first. His extracurricular activities involved him in the army reserves where he was highly regarded; he had already reached the rank of Captain and had excellent prospects for further advancement. Later this year he was due to come to Canberra for further army training and we had planned to meet and share some pleasant time together. Unfortunately this never eventuated.

In such a small community as remote sensing, one develops working relationships with other members of the community. When I came to write this obituary I was surprised by how many people had dealings with Frank in some way or another. Two members of the Satellite Operations (SO) Group had been regularly exchanging snippets of technical information. Frank always had plenty of time for people and it didn't have to be work related. Steve Alder who works in SO was looking for information for his son about the army reserves and Frank of course was more than happy to help. He sent a lot of information to Rosalie Booth on how SAR data is used for detecting ocean oil spills.

Frank and I had been corresponding for about a year when we met in Hamburg in October 1994 for the ERS-1 symposium. He had a wonderful sense of humour and took it in his stride my ribbing him about his Italian background. He had a quick wit, the conference finished on Thursday and on Friday we went sightseeing around Hamburg. The city lockup is

in the centre of the city in a neoclassical building, flanked by two parks. We tried to work out what the building was, Frank guessed that it was a very prestigious hotel for very important persons because of the high security walls and turrets with armed guards. Finally when we did work out what it was he said, "like I said, it's a hotel... if you try to leave without paying your bill they shoot you." When we met in Frascati at ESRIN (ESA Research Institute) and I pointed out the ordered chaos of the city traffic, he was quick to respond telling me not to be deceived, the Italians build Ferraris and Lamborghinis. He had been in regular contact with the ERS-1 help desk in Frascati, so he was warmly greeted in the familiar form (like most European languages, except English, Italian has the familiar and formal form, of address) like an old friend.

He was a gifted presenter able to reduce complex ideas to a form that could be grasped by many, often in anecdotal form. He could just as easily switch his technical level of presentation when talking with his peers as he did from Italian to English. One evening in Hamburg after the conference we were joined by Prof. Fabio Rocco from Politecnico di Milano. Fabio is well known in the SAR community for his pioneering work on fringes and SAR interferometry. Fabio's background is also in geophysics and listening to these two intellects talk was quite an experience – it was difficult to discern whether they were still speaking in English.

Ralph Waldo Emerson summed up what life is about, rather well in the following poem:

To laugh often and much,
To win the respect of intelligent people
And the affection of children,
To earn the appreciation of honest critics
And to endure the betrayal of false friends,
To appreciate beauty
To find the best in others,
To leave the world a bit better,
Whether by a healthy child, or garden patch
Or redeemed social condition,
To know even one life has breathed easier
Because you lived,
This is to have succeeded.

Frank's life measures up well to what life's about, and those who knew him will miss him very much.

Radiometric correction of Landsat TM imagery

Radiometric corrections are applied to all Landsat data supplied to users. This article explains some technical background to radiometric corrections. Without radiometric correction, the data appears striped because the detectors are not perfectly balanced. This does not mean that the data is incorrect; it just makes the data unusable.

First, some background about the Thematic Mapper sensor. Bands 1, 2, 3, 4, 5 and 7 each have 16 detectors and measure reflected energy. The thermal band, 6, has four detectors, and measures emitted energy. Each of these detectors within each band read Earth radiance in specific frequency ranges. For example, band 1 records data between .45 – .52 μ m; band 2 records data between .52 – .60 μ m. Within each band, each of the detectors has a job to do: record data. Because no two detectors and their accompanying electronics are identical (the size of the detectors may vary slightly, the heating and cooling conditions may be different, or the lengths of the wires may be longer or shorter), each detector records a slightly different value. The values are within a specified percentage of one another, but they are, nevertheless different.

Thematic mapper Band Wavelength Ranges

Band	Wavelength	Description	Resolution (meters)
Band-1	0.45 – 0.52	Visible blue	30
Band-2	0.52 – 0.60	Visible green	30
Band-3	0.63 – 0.69	Visible red	30
Band-4	0.76 – 0.90	near-IR	30
Band-5	1.55 – 1.75	mid-IR	30
Band-6	10.4 – 12.5	Thermal	120
Band-7	2.08 – 2.35	mid-IR	30

The purpose of the radiometric calibration is to relate the digital readout to input radiance. Radiometric correction calibrates the sensor to account for the independent behaviour of each detector so that all detectors use the same data number for the same input radiance. The purpose of the radiometric correction is to produce an output Digital Number (DN), which normalizes the response of each individual detector to some common radiance range. The internal radiometric calibration system for the TM reflective bands consists of three calibration lamps and a shutter, all of which are seen by the detectors at the end of each scan. The raw calibration data consists of up to 1,024 bytes of calibration data starting at the end of a TM image scan.

Nominal Maximum and Minimal Radiance Values for Landsats 4 and 5 in milliwatts/cm steradian

Landsat 4			Landsat 5	
Maximum	Minimum		Maximum	Minimum
1.104547	-0.022181	Band 1	1.059476	-0.016946
2.455621	-0.049292	Band 2	2.611919	-0.041805
1.402240	-0.033929	Band 3	1.639666	-0.026226
3.128049	-0.128175	Band 4	2.949823	-0.059251
0.643351	-0.015569	Band 5	0.683888	-0.016548
1.524310	0.123780	Band 6	1.568666	0.125240
0.457179	-0.009181	Band 7	0.424707	-0.008528

The radiometric calibration process involves analysing the calibration data to determine the gains and biases such that the new value 'Y' equals the gain times the old value 'X', plus the bias.

Before applying the gains and biases, a histogram equalization process adjusts the gains and biases for each detector such that each detector's histogram will have the same average value and standard deviation as the overall band histogram. The histogram equalization process improves the overall radiometric correction process by reducing detector striping that may occur between individual detector lines. These gains and biases are then transformed back to the world of data numbers. Now, all the detectors are on the same scale.

Although this radiometric process improves the appearance of most scenes, there are scenes where unwanted image effects are still visible. In scenes with high radiance features such as bright deserts or bright clouds, the detectors become 'saturated' and are unable to unload quickly all of the electrons caused by the bright light. Evidence of scan banding may be visible, particularly if viewed using large contrast stretches. The primary cause of scan banding is a slow change in the true bias of the detectors during a scan. There are no reliable automatic remedies available for alleviating either the scan banding effects of the scan line droop or bright target saturation phenomena. These can be removed by manual intervention techniques.

Very few analysis techniques require the use of actual radiances values. Thus, generally it is not critical to know the relationship between the digital number and radiance. However, it is extremely critical that all detectors within a given band for any optical sensor, such as TM, MSS, IRS, or Spot, use the same scale within a given scene; that any given digital number means the same radiance, regardless of which detector made the measurement.

For information, contact:

EOSAT's Technical Services Department
Tel: (301) 552 0716 or 1 800 344 9933, ext. 716

Source: EOSAT Notes – Summer 1994

Remote sensing news briefs

ERS2 LAUNCH DELAYED

ERS2 was scheduled to be launched on an Ariane rocket from French Guiana on 25 January 1995. Following the recent failure of the 70th Ariane launch and the loss of a communications satellite, Ariane launches have been suspended and the ERS2 launch postponed to a date yet to be identified.

The launch delay means that the current 168 day revisit phase of ERS1 will be extended until at least 15 March 1995. ERS2 has identical instruments to ERS1 and is planned to operate in tandem with ERS1 for a short period after launch. Just prior to launch of ERS2, ERS1 will be placed in a 35 day cycle orbit and after launch ERS2 will also operate in a 35 day cycle either 1 day ahead or behind ERS1 (depending on launch window). This will give an opportunity for the acquisition of SAR imagery 24 hours apart for a short period, giving opportunities for interferometry acquisition of high quality.

OCEAN COLOUR MONITOR ABANDONED FROM LANDSAT 7

The Ocean Colour Instrument planned to be included in the Landsat 7 configuration for launch in December 1998 has been cancelled. NASA has dropped the instrument due to finance and scheduling difficulties, but plans to still develop the instrument for another launch platform. The Ocean Colour Instrument is planned to follow up the SEASTAR satellite being built and launched by Orbital Sciences for launch in May 1995.

RADARSAT LAUNCH DELAYED

The RADARSAT launch originally planned for March 1995 has been delayed until at least August 1995. An extension to satellite testing is being quoted by Canadian officials as the reason for the delay. RADARSAT is being built in Canada but will be launched by the USA using a Delta 2 launch vehicle.

INDIA LAUNCHES IRS - P2

On 15th October 1994 the Indian Space Research Agency (ISRO) successfully launched its IRS-P2 satellite. The satellite was launched by India's first indigenous launch vehicle the Polar Satellite Launch Vehicle (PSLV). IRS-P2 has identical instruments to IRS 1A and 1B, with multi spectral imagery with 36 metre resolution.

EOSAT'S CONTRACT FOR LANDSAT OPERATIONS UNDER REVIEW

The current US Government contract for the maintenance and operation of Landsat 4 and 5 with EOSAT was due to expire on 31 December 1994. At least two other US organisations, E-Systems and the Environmental Research Institute of Michigan (ERIM), have been lobbying for the right to take over the operations. Bids were due to close with the US Commerce Department on 21 December 1994.

EOSAT has made considerable investment in its Landsat systems and market development and it is difficult to envisage a change in this late stage of Landsat 4 and 5 operations, however, it is interesting that E-Systems, who are major partners with Lockheed in the Space Imaging Company planning to build a 1 metre resolution satellite, would be so keen to take over Landsat operations.

Digital catalogue on the way

The days of searching through endless microfiche for that perfect image are almost at an end. By mid 1995, ACRES plans to replace microfiche catalogues with an on line digital catalogue.

ACRES Manager, Paul Trezise, recently outlined the major features of the new system to the ACRES Distributor's meeting. The major aims are to:

- Improve on line search facilities for distributors;
- Make information on remote sensing data more widely accessible;
- Improve search facilities for major customers; and
- Improve interfaces with international catalogue systems.

The major attributes of the new system will include:

- A central system accessed through existing telecommunications networks;
- Interface through common IT interfaces such as Internet and World Wide Web;
- Interactive client viewing of images with textual, image enhancement and mapping tools built in;
- Availability of images within days of acquisition; and
- On line auxiliary data such as format documents and price lists.

Tender responses will be assessed in early 1995 with the initial system operational by July 1995. For more information contact:

Karl Nissen at ACRES
Tel: (06) 201 4113

Highlights from the ERS Newsletter

This newsletter is available via e-mail from ERS-1 help desk. To obtain this newsletter electronically on the internet write to:

helpdesk@ersus.esrin400.esa.it

ERS-1 1ST PILOT PROJECT WORKSHOP

The first ERS-1 Pilot Project Workshop took place in Toledo, Spain, from the 22-24 of June '94 and was attended by 225 persons.

Results in various fields of application were presented. The trends emerging from these presentations included:

- About 10% of the applications have an operational status or pre-operational status, one at a very advanced stage.
 - Ice Monitoring (Particularly navigation through ice)
 - Marine Applications (particularly sea state forecasting including ship routing and sea climate state climatology)
 - Flood monitoring and assessment
 - Mosaicking.
- About 20% show good potential towards becoming operational in the medium term:
 - Bathymetry using SAR
 - Detection of oil slicks
 - Flood monitoring and assessment
 - Mosaicking.
- About 30% are more linked to applied research rather than to operational or commercial applications, but nevertheless present a very good future potential:
 - Crop yielding monitoring
 - DEM generation
 - Tropical Forest
 - Oil Mineral exploration.

The significance of ERS-1 to the improvement of existing models, or to the development of new models was underlined, in particular for wave forecasting, ocean circulation and atmospheric circulation models.

DOCUMENTATION

NEW ERS-1 Interferometric Baseline Algorithm Verification.

ERS-1 Interferometric Baseline Algorithm Verification to determine the accuracy of the Interferometric Baseline Algorithm used in the generation of the ERS-1 INSAR Baseline Listing. Beside the verification itself, description of the algorithm and an analysis of the interferometric potential of ERS-1 mission is presented. Document reference number is ES-TN-DPE-OM-GS02.

From ERS-1 to ERS-2 Destination Earth.

A brochure on the three years of life of ERS-1, showing the more promising application examples, with a view towards the ERS-2 launch, the ERS-2 payload and the tandem scenario of the ERS-1 and ERS-2 operation plan.

SERVICES

ESA has now implemented its own Earth Remote Sensing User Services Home Page on the World Wide Web which contains information on services and systems offered to the Earth Observation user community by ESRIN, ESA establishment in Frascati (Italy).

The World Wide Web e-mail is:
<http://services.esrin.esa.it/>

Conference reports:

RESOURCE TECHNOLOGY '94

This conference was held at the University of Melbourne from 26–30 September 1994 and concentrated on Resource Technologies and Resource Applications with the theme "New Opportunities – Best Practice". Coordinator was Dr Ian Bishop of the University's Centre for GIS and Modelling.

Conference papers and presentations addressed a range of technology and applications themes including:

- GIS Technology Trends
- Using GIS
- Visualisation
- Modelling
- Expert Systems
- Airborne Video
- Remote Sensing
- Digital Photogrammetry
- Wildlife Applications
- Land use, change and sustainability
- Salinity
- Heritage
- Coastal Resources; and
- Resources, Economics and the Law.

Proceedings with introductions by session chairs are now available for \$50. plus postage from:

Centre for GIS and Modelling
University of Melbourne
Parkville VIC 3052
Tel: (03) 344 6944
Fax: (03) 347 2916

AURISA '94

The AURISA '94 conference, workshops and technical exhibition was held at Darling Harbour in Sydney from 21–25 November 1994. The conference, with over 500 attendees, 60 presented papers, 40 exhibitors and 14 workshops is easily the biggest event in the region addressing spatial information issues.

Awards at the conference were given for:

- *AURISA Eminent Individual*
Bill Robertson, DG DOSLI, NZ
- *AURISA Achievement Award*
Ben Kemp, Hurunui District Council, NZ
- *Gerald McCalden Award for best research paper*
Gary Hunter, M.Robey and M.Goodchild –
University of Melbourne
- *AISIST Academic Award*
Professor Graeme Hugo, University of Adelaide

- *ACKLIS Student Award*
Brett Davis, UNSW
- *Best Presented Paper*
Lisa Buckleton, WA Fires Board
- *Best Booth and Delegates Choice of Best Booth*
Intergraph
- *AURISA/GIS User Desktop Mapping Award*
John Black, Optus.

Proceedings are available from the AURISA office at a cost of \$60 (non-members) or \$40 (members). Contact:

Tel: (06) 285 2301
Fax: (06) 285 2320

AURISA '95 will be held in Melbourne from 22–24 November 1995. The call for papers has been announced with abstracts due by 3 March 1995.

For more information contact:

Australian Convention and Travel Services (ACTS)
Tel: (06) 257 3256
Fax: (06) 257 3299

HORIZONS OF SCIENCE FORUM

On 23 August 1994 a unique event was held at the University of Technology, Sydney. The Horizons of Science Forums are events put together by the Centre for Science Communication at the University specifically as "media" events. Topics and speakers are chosen for their topicality and general 'science' interest and the day is structured to meet the media's (TV, radio & press) needs. The event on 23 August was focused on remote sensing.

Two page written summaries were provided by each speaker who had 10 minutes to communicate his/her message and they had to be available for interview throughout the day. Ten invited speakers presented their topics and a discussion panel of an additional 7 participants took place in the afternoon.

Presenters and their topics were:

- Dennis Puniard, ACRES
Observing Earth from Space – Today and Tomorrow
- Dr Jon Huntington, CSIRO Exploration and Mining
Airborne Mineralogy – a New Exploration Method
- Bruce Neal, Bureau of Meteorology
More Pieces for the Weather Jigsaw Puzzle
- Dr Ian Barton, CSIRO Atmospheric Research
Camera Eyes see Temperature Change
- Dr Kim Bryceson, Byte-Ideas
Predicting Drought and Monitoring Locust Plagues

- Michael Aubrey, Technical Field Surveys
Global Problems, Local Solutions
- Dr Deborah Kuchler, Mapping and Monitoring
Technology
Satellite Focus on Offenders
- Dr David Cartwright, DSTO
Sharing Military and Civil uses of Remote Sensing

Discussion panel participants included: Carl McMaster (SIS), Dr John Gaudin (Privacy Committee NSW), Dr Alison Betts (Archaeology, Uni of Sydney), Professor Bruce Forster (UNSW), Dr Keith McCloy (UTS), Donn Corcoran (ASO), Ken McCracken (Jellore Technologies) and Craig Wood (DIO).

The convenor was Dr Peter Pockley, assisted by Susannah Elliott of UTS. The media response was extensive with 27 representatives in attendance and many reporting from a distance with interviews and written articles. TV coverage included news reports on Channels 7, and 10, ABC, and SBS national news. A 7:30 report was also as a result of the forum. Over 25 radio interviews went to air and over 25 press articles were published.

The issues that achieved most attention (not surprisingly!) were 'Mystery Lines' on the Nullabor, detection of illegal activities and privacy issues from high resolution systems.

Copies of the papers are available from the authors or the convenors. Contact:

Susannah Elliott
Tel: (02) 330 2580
Fax: (02) 330 2583

SPOT news

New chairman appointed to Spot Image

Jacques Mouysset has been appointed Chief Executive Officer (CEO) of Spot Image, effective 1 September 1994. Gerard Brachet, Chairman and CEO since Spot Image was first set up in 1982, leaves his post to head the Programmes Directorate of CNES, the French Space Agency, and will be based at the Agency's head office in Paris. Mr Brachet will, however, continue as Chairman of the Spot Image Board of Administration for another year.

Jacques Mouysset, 42, is a graduate of France's renowned Ecole Polytechnique school of engineering. In 1979 he was seconded to the naval shipbuilding arm of French defence procurement agency DGA, part of the Ministry of Defence. His next move, in 1985, was the Scientific & Technical Mission section of the Ministry of Research and Technology as head of its space department.

Jacques Mouysset joined CNES in 1987 as head of the planning division within the Programmes Directorate. From there, he was appointed assistant director for strategy and planning, then deputy director of the Programmes Directorate.

Since 1985, Jacques Mouysset has contributed to the framing of French space policy and more particularly to planning civil space programs. He played an active role in the preparation and launching of several major programmes at the European Space Agency level (Ariane-5, ERS-2, DRS, etc.) and national level (Spot 3, 4 and 5, Topex/Poseidon in collaboration with NASA, etc.). He also contributed to the preparation of the ESA ministerial conferences on space held at The Hague, Munich and Granada.

SPOT 5 commitment made by French Government

Following a French Government ministerial meeting on 4th October 1994, France has announced it will give priority to Earth Observation in its national space programme and has given approval for the funding and development of the SPOT 5 satellites. SPOT 5 with its 5 metre resolution instruments and in track stereo capability will now proceed in development with 2 satellites to be built, the first for launch in the year 2000.

NARGIS '95

Second North Australian Remote Sensing and
Geographic Information Systems Forum
Darwin, 18-20 July 1995

Call for papers and registration of interest

FOCUS

The forum will promote the exchange of information and discussion about the application of remote sensing and geographic information systems technology in the management and development of the vast and sparsely populated north Australian region. Participation will benefit practitioners, managers and researchers whose interests and responsibilities in northern Australia include a need for spatial information acquisition and analysis. Presentation of applications in the fields of land and environmental management, biophysical and geological sciences, and anthropology in northern Australia are expected.

FORMAT

NARGIS '95 will broadly follow the format of the successful NARGIS '93 forum with the presentation of papers followed by questions and discussions. In addition, there will be addresses by invited experts as well as sessions for shorter poster papers, research bites and student presentations. The program will be complemented by workshops, seminars and social events.

PAPERS

Contributions are invited from all interested parties. Abstracts of up to 250 words should be submitted before 15 March and authors will be advised of acceptance by 30 March (short paper abstracts are due by 15 June). Papers of up to 3,000 words will be due at the time of the forum. Proceedings of the forum, including short presentations will be published and distributed to all participants shortly after the event.

INFORMATION

Register your interest if you wish to receive further information regarding the forum or facilities in Darwin and the Top End. Participants requiring accommodation during the forum are advised to make arrangements well in advance.

NARGIS '95

Tel: (089) 81 8818
Fax: (089) 41 1530
E-mail: nargis@oss.erin.gov.au

PO Box 4011
Darwin NT 0801

Sales success celebrated at ACRES distributors' meeting

In early December representatives of ACRES distributors gathered in Canberra for their annual meeting. The meeting reviewed sales performance for 1993/4 and addressed a number of policy and marketing issues.

Awards for sales performance in 1993/4 were presented by AUSLIG General Manager, Graham Bashford. The awards are:

- Gold Award for best sales performance in the year
GEOIMAGE PTY LTD
- Silver Award for second best sales
P.T. INDICA DHARMA
- Bronze Award for third best sales
SPOT IMAGING SERVICES



Sylvia Michael of GEOIMAGE presented with Gold Award by Graham Bashford



Carl McMaster presented with Bronze Award



Melissa Rowe (ACRES) and Kate Brian (SIS) in celebration mood.

SALES RESULTS 1993/94

Dennis Puniard presented the following summary of sales results for 1993/94 to the meeting.

Overall Sales Summary (Nett Sales) – Financial Year 1993/94

Year	Quantity	\$
1992/93	3800	1.72M
1993/94	4171	1.87M
Change	+371	+0.15M
% change	+9.8%	+8.7%

Summary (Gross Sales) – Financial Year 1993/94 (1)

	Quantity	\$
LANDSAT		
MSS	902	252,360 (10%)
TM	1272	1,400,010 (54%)
EOSAT	55	193,338 (7.5%)
EROS	5	490
Total	2234	1,846,198 (72%)
SPOT		
PAN	210	263,298 (10%)
MS	136	94,141 (4%)
Total	346	357,439 (14%)
ERSI	75	22,820 (1%)
AVHRR	46	14,027 (0.5%)
IMAGE WRITING	1334	185,020 (7%)
THAILAND	24	87,757 (3%)
CATALOGUE	37	7,600
ROYALTIES	13	31,527
MISC	62	8,376

Sales through ACRES distributors in 1993/94 accounted for 67% of total sales up from 54% the previous year.



Paul Trezise, assisted by John Payne addresses the meeting.

New organisational structure

ACRES Manager, Paul Trezise outlined the new organization structure and responsibilities introduced in late 1994, where sales, marketing and customer service functions have been re-arranged. These are outlined below:

The revised structure:

AUSLIG Graham Bashford

National Data Centre

Keith Bell
Sales and
Distribution

ACRES

Paul Trezise
Production and
Customer Service

Product Management

Dennis Puniard
Marketing and
Product Development

National Data Centre

- *Role – Sales and Data Distribution*
 - appointment of distributors and management of the distribution network
 - distribution policy (including licensing)
 - promotion and sales
- *Key Contacts*
 - John Payne, Keith Bell, John Lee, Jim Mollison, Maddi Clark

ACRES

- *Role – Customer Service and Production*
 - order entry
 - day-to-day distributor/customer support
 - remote sensing product generation
 - international agreements, long term strategy
- *Key Contacts*
 - Paul Trezise, Mike Pasfield, Sandy Browne, Mike Linney, Melissa Rowe, Cheryl Monahan

Product Management

- *Role – Marketing and Product Development*
 - Remote Sensing Marketing Plan
 - marketing strategy implementation
 - new product development
 - sales monitoring and support
 - coordination with related product strategies
- *Key Contacts*
 - Dennis Puniard

CEOS working group on calibration and validation

P.J. Wise

*Terrain Mapping Sub-group
4th Meeting, Canberra, Australia
4-5 December*

BACKGROUND

This sub group was formed to bring together geoscientists working on methods of determining terrain height from a range of satellite borne sensors to discuss common interests. Other Calibration and Validation (CAL/VAL) sub groups are Infrared and Optical Sensor Systems and Passive Microwave Systems.

The sub group has set a long term plan with its mission being to provide opportunities for validation and comparison of Digital Elevation Models (DEM) from satellite borne sensors; to support ground campaigns by provision of test data; to provide a forum for discussion of results and future developments.

The sub group's objectives are:

- To provide test data sets of DEMs and other relevant material over a number of test sites covering different terrain, land cover and climatic conditions;
- To provide guidelines for the use of the test data to allow evaluation and comparison of DEMs from different sensors and as a means of validating data from such sensors; and
- To provide a forum for discussion of matters related to DEMs derived from satellite data.

STATUS OF GROUP ACTIVITIES

In opening the meeting the sub group's convener Dr Ian Dowman of the University College London reported on the current status of the group's activities.

The working group was established in 1992 and has since held 3 meetings. The group currently has 34 active members and each of the meetings held so far has been attended by about 20 people.

The group has had discussions on the qualities required in test sites, suitable sites and methods of evaluating the data obtained from measurements made over the sites. A dossier of test sites has been compiled and at present data is available for distribution to members of the working group from one of the sites and data is being prepared for distribution from two other sites.

A guide to evaluating the data is being prepared as a result of discussions at the 3rd meeting and this will be refined at this meeting.

The working group has also discussed the requirements for DEMs and how future spaceborne sensors can satisfy these. Recommendations on this topic have been sent to the CEOS Plenary through the WGCV.

The activities of the working group have been presented to international meetings such as the International Society of Photogrammetry and Remote Sensing (ISPRS) and the Science Teams on new sensors have been encouraged to collaborate with the group.

The group has worked closely with the GLOBE project (A WG Data exercise) and has had contact with the CEOS WG Data, a CEOS Auxiliary Data sub group. The group is also in contact with the ESA FRINGE Group.

ACTION PLAN

Update the current dossier of test sites and identify new sites, particularly to satisfy the cal/val requirements of future missions (this is necessary to ensure that data from a wide range of test sites is available to users to conduct cal/val work in a wide range of conditions to satisfy the user community and the technological developments in new sensors).

Prepare data of suitable test sites for distribution to ensure that suitable data is available to a large number of users.

Prepare guidelines for evaluation of the data and reporting of the results (in order to enable different sensors and data obtained in different conditions to be compared it is necessary that results are presented in similar formats using comparable statistical methods).

Disseminate information about the working group and encourage new members to join and participate to ensure that the test sites are used as much as possible by as many sensors as possible.

Collaborate with other groups to ensure that common activities are coordinated and enhanced by collaboration.

Liaise with CEOS affiliates in order to determine the requirements of the user community to ensure that cal/val procedures are in place to satisfy that need.

Consider the data requirements of future missions and develop guidelines for ground segment requirements to support generation and use of DEMs.

Hold one meeting a year to review progress, plan future action and review results.

NOTES OF MEETING

The meeting was attended by 30 members of which five were from overseas. The Australian representatives were from AUSLIG, Academia, Defence, CSIRO, and DSTO. These overseas members were Dr Ian Dowman (UCL), Frederic Adragna (CNES), Laurent Renouard (ISTAR), Wolfgang Naode (DLR, German RS Data Centre), Yoshinori Miyazaki (MITI/Geological Survey of Japan). Because of the ERS-2 launch no representative from ESA attended.

The meeting was split into three sessions. The first morning was given to SAR Interferometry and the afternoon to optical sensors. Test sites were then discussed in the third session.

The SAR Interferometry session heard about the results from Frederic Adragna's (CNES) research into interferometric SAR from JERS and SIR-C. Unfortunately this research appeared to raise more questions than it answered. In short, operational SAR interferometry and subsequent DEM generation still has a way to go. Laurent Renouard reinforced this view in a presentation to AUSLIG staff. He suggests 2-5 years.

John Homer (University of Queensland) then over-viewed his research using the Lake Frome Test site which has 30 corner reflectors surveyed in. John has only been going for some 6 months so his work is mainly theoretical but is exciting in that he proposes to use several interferometric fringes to generate the DEM and so get over some of the operational problems.

David Bruce (University of South Australia) reported that he had been concentrating in getting his DEMs of his study site right and had not progressed into the SAR Interferometry stage. Dave's test site in the Adelaide hills has a DEM from 1:100 000 scale maps, NASA AirSAR when it comes, and two small areas of high resolution DEM from GPS methods.

Ian Dowman compared DEMs generated from SPOT stereo-pairs and ERS SAR Interferometry. He stated that the most accurate DEM was generated by extracting, photogrammetrically, spot heights from aerial photographs. A less accurate method was generating a DEM from photogrammetrically produced contours followed by DEMs from map contours.

Three DEMs were automatically produced from SPOT by ISTAR and UCL's software at 30m and 20m respectively. ISTAR also generated a 40m DEM from ERS SAR. The DEM from SPOT proved to be the most accurate when compared with the test DEM having a RMSE of about 7m. The SAR DEM RMSE was about 15m.

John Trinder (University of New South Wales) opened the afternoon session on optical sensors reporting the results of his research into five software packages able to automatically generate a DEM from SPOT stereo-pairs. The packages were the UNSW's own package, the UCL package, Helava, ERDAS Orthomax and the Joanneum Institute (Austria) package.

The results were that no package was superior overall and nearly all gave acceptable results ($dZ = 5-10m$) in all but the most severe terrain. Those using the image pyramid technique were a little superior in the severe terrain. Error detection was poor overall.

Yoshinori Miyazaki (MITI) stated that he had generated an OPS DEM with dZ of some 30m due to the poor 0.6 b/H ratio. He then went on to talk about ASTER and the Japanese wanting to set up an Asian GCP data base and the problems of security and its impact of getting maps in most countries of the region.

Frederic Adragna (CNES) overviewed CNES's plans for SPOT 5.

Graham Freeman (Australian Defence Force Academy) then spoke of the progress he had made with using patch based matching of stereo images. No definitive results have emerged as yet.

Vittal Shettigara then discussed his work on using tree shadows to determine building height. Interesting!

The last two papers were given by Damian Carroll, AUSLIG and Jim Mitchell, CALM, NSW as possible suppliers of DEM information for test sites.

The third session discussed the test site dossiers. I was unable to attend this session but believe it added little to the above.

CONCLUSIONS

- An excellent meeting which summarised a lot of national and international activity into automated DEM generation and compared the current packages for automated DEM generation.
- While everyone sees that SAR interferometry may be the way of generating cost effective DEMs an operational package is as far away as ever. TOPSAR may be the answer?
- Automated DEMs from SPOT are accurate but are still very expensive.
- Airborne TOPSAR and AuSAR are capable of providing high resolution DEMs but their airborne nature makes them expensive.

Remote Sensing Board appointed

The Australian Space Council (ASC) has appointed its first advisory Board, the ASC Remote Sensing Board. After a national call for interest which attracted over 90 nominations a board of 13 has been appointed. The members are:

Neil Williams (Bureau of Resource Sciences, DPIE)
Chair

Mike Aubrey (Tech and Field Surveys)

David Cartwright (DSTO)

Brian Embleton (COSSA)

Doug Gauntlett (Bureau of Meteorology)

Frank Honey (SpecTerra)

Henry Houghton (WA Lands)

Gail Kelly (Qld Lands)

Debbie Kuchler (Mapping and Monitoring Technology)

Brian Milliken (BHP)

Kerry O'Sullivan (CRA)

John Richards (ADFA)

Paul Trezise (ACRES)

The mission of the Board includes:

- The development of commercial opportunities for remote sensing;
- To represent to government the views of the remote sensing community;
- To focus Australian expertise on key initiatives;
- To ensure Australia is adequately represented at peak international forums; and
- To develop strategies to maximise the economic and social benefits of remote sensing.

Book review

Remote Sensing use in Tree Cover Mapping and Pasture Management;
ABARE Research Report 94-11; RRP \$25.

This booklet, published by the Australian Bureau of Agricultural and Resource Economics, contains two papers which are economic analyses of remote sensing applications in resource management. The project was assisted with funding from the Australian Space Office.

The two studies were:

- Using satellite imagery to map tree cover across Victoria; and
- Using remote sensing information to monitor pasture fertilizer status.

In the first study comparisons are made between the costs of a project to map tree cover of the whole of the state of Victoria using traditional aerial photography in the first instance and then using Landsat TM data. The costing models used include data acquisition, processing, ground, all materials and overhead costs including capital equipment needs. The total cost of the project using Landsat TM data and remote sensing techniques was estimated at \$393,880. The identical project using aerial photography techniques was costed at \$2,564,943. The report also estimates the net present value of the TM data set at \$1.5 million, a cost benefit ratio of 5 to 1.

The second study examines the use of SPOT and Landsat imagery to determine the best targeted use of fertilizer in pasture lands. The imagery is used to produce pasture maps at specific times in the growing cycle and the results used to modify fertilizer application. The study compares potential stocking rates with and without the use of these techniques and coordinates that net benefits would accrue to the land holder of some \$25,000 over a 20 year period by using the pasture maps. Extrapolations of this methodology to all properties in the high rainfall zone of Australia (adoption rate of 27% assumed) net benefits of \$66 million over a ten year period are estimated.

Both studies are a 'first' using the skills of economists and ABARE agricultural skills. The publication is highly recommended for those involved in forestry and agricultural applications of remote sensing.

Contact:

Bill Watson at ABARE

Book available from:

ABARE
GPO Box 1563
Canberra, ACT 2601
Tel: (06) 272 2000
Fax: (06) 272 2001

Remote Sensing Association expands its base

The Remote Sensing and Photogrammetry Association of Australasia is now firmly established as the Association for remote sensing professionals in Australasia. Recently the NSW branch of the Australasian Photogrammetry and Remote Sensing Society (APRSS) affiliated with RSPAA and the Victorian Society for Photogrammetry and Remote Sensing is also merging with RSPAA.

Recent elections saw Dr Norm Campbell returned as Chairman with other board members being Peter Woodgate, Alex Wyllie, Mark Shortis, Dennis Puniard, Don DeVries, Greg Ellis, Chris Bellman, John Trinders, Brian Donnelly and Bruce King.

RSPAA will now be the contact organisation for the International Society for Photogrammetry and Remote Sensing (ISPRS) and provide support for Australia participation in ISPRS commissions.

The 8th Australasian Remote Sensing Conference is to be held under the auspices of RSPAA in Canberra from 22-26 March 1996. A call for papers will be issued soon.

Contact ACTS for details on:

Tel: (06) 257 3299

Membership of RSPAA is open to any professionals with an interest at \$15 students, \$25 individual and \$50 corporate.

For details contact:

Norm Campbell or Alex Wyllie

Tel: (09) 387 0305 or (09) 340 9341

National Science Award for Frank Honey

One of the "gurus" of remote sensing in Australia has recently been rewarded for his outstanding service to science. Dr Frank Honey, who is now the Managing Director of SpecTerra systems, was recently awarded the Clunies Ross National Science and Technology Award for his work as a pioneer in remote sensing instrumentation particularly in mineral exploration and environmental mapping applications.

Frank has been responsible for the development of the world renown Geoscan airborne scanner and more recently the Digital Multispectral Video (DMSV) system. He was one of the first CSIRO scientists in Australia working in the field of remote sensing and was one of a small group of scientists responsible for the introduction of the technology to Australia.

Frank moved to the private sector to develop and market the Geoscan system and has recently established the SpecTerra company to market the DMSV technology. Both of these systems have been accepted internationally and have a wide range of users and applications. DMSV is now being used to study such phenomena as algal blooms and for mineral exploration and to monitor mine site rehabilitation.

ACRES and the remote sensing community congratulate Frank on his well deserved recognition.

ACRES User Group to be established

Paul Trezise the ACRES Manager, has announced that an ACRES User Reference Group is to be set up in early 1995. The User Group will provide a forum for a representative selection of ACRES customers to have input to policy decisions in relation to:

- Future data needs; (new satellites and sensors)
- The delivery performance of ACRES and its distribution network; and
- Product improvements, including formats and media.

Membership of the group will be by invitation, however, those with an interest in participation should contact:

Paul Trezise

Tel: (06) 201 4100

1995 CALENDAR

Remote sensing and associated events

14-16 February

Adelaide SA

Short course on Fundamentals of High Resolution Radar.
Fee \$700.00. Organized by Cooperative Research Centre for Sensor, Signal and Information Processing.
Contact: Mary Ayre
Tel: (08) 302 3528
Fax: (08) 302 3124

February 27 - March 1 North Carolina, USA

Auto-Carto Twelve, Twelfth International Symposium on Computer-Assisted Cartography
Charlotte, North Carolina, USA.
Contact: Donna J. Pequet, Auto-Carto 12, Department of Geography, 302 Walker Building, Pennsylvania State University University Park, PA 16802
Tel: +1 814 863 8017
Fax: +1 814 863 8018
Internet: AC12@gis.psu.edu

13-17 March Melbourne, VIC

WMO International Symposium on Assimilation of Observations in Meteorology and Oceanography
Contact: Phil Parker
Bureau of Meteorology
150 Lonsdale Street
Melbourne VIC 3000
Tel: (03) 669 4000
Fax: (03) 669 4699

14-18 March Chicago, USA

91st Annual Association of American Geographers (AAG) Meeting
Chicago Marriott Downtown, Chicago, Illinois, USA
Contact: AAG, 1710 16th Street N.W Washington, DC 200093198
Tel: +1 202 234 1450
Fax: +1 202 234 2744

19-22 March Atlanta, Georgia, USA

1995 ERDAS Users' Group Meeting
Colony Square Hotel, Atlanta, Georgia, USA
Contact: ERDAS, 2801 Buford Highway, Suite 300 Atlanta, GA 30329, USA
Tel: +1 404 248 9000
Fax: +1 404 248 9400

20-23 March Darwin, NT

Short Course on Integrated Image Interpretation for Mineral Exploration run by Colin Nash of World Geoscience. Fee \$1150.
Contact: Australian Mineral Foundation 63 Conyagh Street, GLENSIDE SA 5065
Tel: (08) 379 0444
Fax: (08) 379 4634

27-29 March

Kuala Lumpur, Malaysia

Seminar on Integration of Remote Sensing and GIS for Applications in SE ASIA.
Contact: Assoc Prof Dr Mohd Ibrahim Seeni Mohd Faculty of Surveying and Real Estate Universiti Teknologi Malaysia
Tel: +60 7 557 6160 Ext 2940
Fax: +60 7 556 6163

27-30 March

Vancouver, Canada

9th Annual Symposium on GIS with workshop and technical exhibition.
Contact: GIS World
Tel: (604) 688 0188
Fax: (604) 688 1573

27-31 March

The Hague, The Netherlands

Joint European Conference and Exhibition on Geographical Information
Netherlands Congress Center, The Hague, The Netherlands
Contact: AKM Congress Service, Clarastrasse 57 PO BOX CH-4005, Basel, Switzerland
Tel: +41 61 691 51 11
Fax: +41 61 691 81 89

17-21 April

Orlando, Florida, USA

Commercialization of High Resolution Satellite Imagery for Dual Use Applications
Contact: International Society for Optical Engineering (SPIE) PO Box 10 Bellingham, WA 98227-0010, USA
Tel: +1 206 676 3290

13-19 May

San Antonio, Texas, USA

ASPRS/ACSM Annual Convention
Contact:
Fax: +1 301 493 8245

22-26 May

Palm Springs, California, USA

ESRI 15th Annual User Conference
Wyndham Hotel and Palm Springs Convention Center. Palm Springs, California, USA.
Contact: Environmental Systems Research Institute (ESRI), User Conference Registration, 380 New York Street, Redlands, CA 92373 USA
Tel: +1 909 793 2853, +1 909 793 5953
E-mail: ucregis@esri.com

18-20 July

Adelaide SA

3rd National Geoscience Information and Data Management Conference
Contact: AMF
Tel: (08) 379 0444
Fax: (08) 379 4634

12-16 June Budapest, Hungary

GIS '95: Central Europe, conference and exhibition on GIS/LIS

Budapest, Hungary.

Contact: International Secretariat, GIS '95
PO Box 5738, Bethesda, MD 20814, USA

Tel: +1 301 951 0480

Fax: +1 301 951 0499

13-15 June Saskatoon, Canada

17th Canadian Symposium on Remote Sensing
Sheraton Cavalier Hotel, Saskatoon, Saskatchewan,
Canada.

Contact: Jeff Whiting, Saskatchewan Research
Council, 15 Innovation Boulevard
Saskatoon, Saskatchewan S7N 2X8, Canada

Tel: +1 306 933 5423

Fax: +1 306 933 7817

E-mail: whij@src4330.src.sk.ca

16-20 July San Antonio, Texas, USA

URISA '95, Urban and Regional Information Systems
Association conference

San Antonio Convention Center, San Antonio,
Texas, USA.

Contact: URISA, 900 Second Street N.E., Suite 304
Washington, DC 20002

Tel: (202) 289-1685

E-mail: urisa@macc.wise.edu

18-20 July 1995 Darwin, NT

2nd North Australian Remote Sensing & Geographic
Information Systems Forum

Papers & Registration of interest:

NARGIS 95 PO Box 4011

Darwin Northern Territory 0801

Tel: (089) 81 8818

Fax: (089) 411 530

E-mail: nargis@oss.erin.gov.au

18-20 September Seattle, Washington, USA

Third Thematic Conference on Remote Sensing for Marine
and Coastal Environment

Westin Hotel, Seattle, Washington, USA

Contact: ERIM Conference,
PO Box 134001, Ann Arbor
MI 48113-4001, USA

Tel: +1 313 994-1200, ext 453

Fax: +1 313 994-5123

14-16 November Nashville, Tennessee, USA

GIS/LIS '95,
Nashville Convention Center, Nashville, Tennessee, USA

Contact: GIS/LIS '95 14456 East Evans Avenue
Aurora, CO 80014, USA

Tel: +1 303 337-0513

Fax: +1 303 337-1001

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St Leonards NSW 2065
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South Townsville QLD 4810
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Adelaide SA 5001
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PO Box 471
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24 Curtis Street
North Adelaide SA 5006
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(08) 267 3983

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North Ryde NSW 2113
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