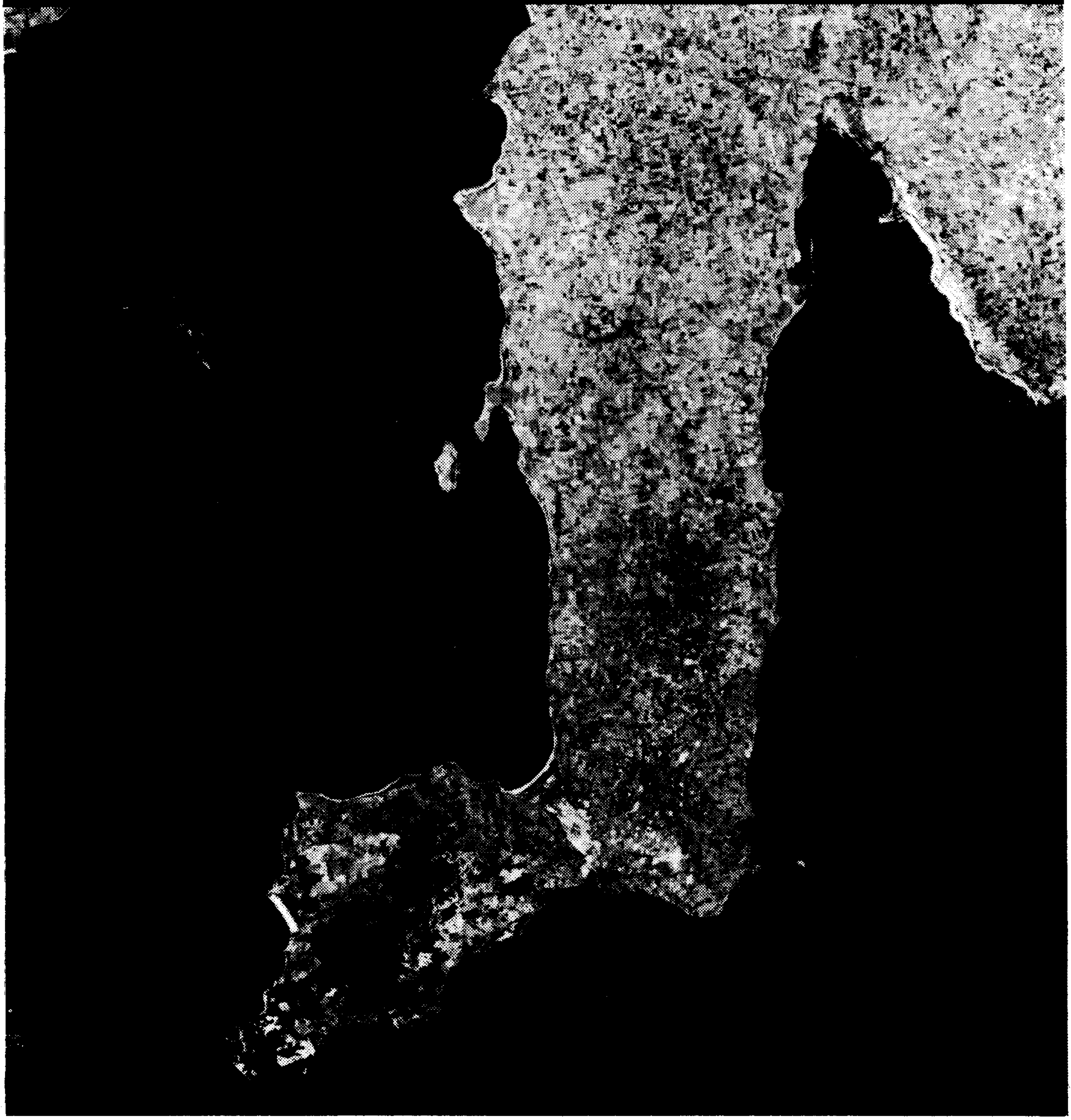
NEWSLETTER

FOR THE REMOTE SENSING INDUSTRY



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FRONT COVER STORY

No, it's not Italy!

After a successful launch from the Vandenberg Air Force Base in California on 1 March 1984, the approximately 1950kg LANDSAT-D prime spacecraft was put through orbit-adjust manouvres before reaching its 705km near-polar orbit. Since then, NASA engineers have checked out all computer, communications, telemetry and other spacecraft systems before declaring it operationally 'green' and handing it over to NOAA on 6 April 1984.

The front cover shows the first of many LANDSAT-5 MSS images acquired and processed by ALS; it was ordered by our digital engineer Mr Robert Denize, for evaluation and testing of LANDSAT-5 data — it is the Yorke Peninsula near Adelaide, on path 98, row 84 of the Worldwide Reference System (WRS) on 11 April 1984.

After thorough testing of the data and spacecraft specific modifications to our computer software we were able to start cataloguing LANDSAT-5 data at the start of cycle 3 on 9 April 1984.

We continued to support both spacecrafts until the end of LANDSAT-4 catalogue cycle 42 on 2 May 1984. As the two satellites are 8 days (half cycle) apart, we are fortunate to have 8 day coverage of most of Australia for the period 9 April to 2 May.

ALS now supports the spacecraft designated as prime spacecraft, LANDSAT-5.

The Multi Spectral Scanner (MSS) data quality is high and all instruments perform to specification. Only one minor hitch occured on 29 March, when after progressive failure in the coil of one of the two thruster valves some fuses were blown in the valve driver of the Rocket Engine Module-D Thruster. The result is the loss of the thruster and a consequent loss of redundancy. Other Stations report that the Thematic Mapper (TM) too is performing nominally; it currently provides up to 100 US scenes and 225 international scenes per day to a maximum of 52 scenes per orbit.

The Tracking and Data Relay Satellite System (TDRSS) is functioning well, but is currently not available on a routine basis as acquisitions must be manually edited into the Schedule with a limit of two LANDSA-5 scenes per day.

Naturally this does not apply to data from the Pacific region until after the TDRS-B launch which is scheduled for February 1985. The launch will be with a newly designed USAF/Boeing initial upper stage (IUS) from the Space Shuttle, following the first test of the IUS on mission 51-C scheduled for launch on 9 December, 1984 (AW&ST 24/9).

John Bruyn (User Services)

We have not moved

However, the local authorities have revised the street addresses of all the blocks in Oatley Court and we have been given a new number. Our address now is:

Australian Landsat Station
22-36 Oatley Court
BELCONNEN ACT 2616
OR
PO Box 28
BELCONNEN ACT 2616

Our telephone (PABX) numbers are (062) 51-5411 or 52-4411.

Dear Reader

Have you ever read an article or paper in which acronyms were used repeatedly while you forgot or never knew the meaning of it? Well, many of use have.

In the remote sensing industry a large range of acronyms are used. To save you the frustration that many of us have felt in the past, we have borrowed Dr John Richard's (University of NSW — Centre for Remote Sensing) list of acronyms and abreviations, and expanded it somewhat.

We hope that you will find it useful!

If you do have any queries or you find that some of your pet RS — acronyms are missing, we would love to hear from you.

John Bruyn (User Services)

A	Angstrom (10^{-10}m)
AARS	Asian Association on Remote Sensing
ACS	Attitude Control System
ACT	Australian Capital Territory
AESIS	Australian Earth Sciences Information System
AFB	Air Force Base (USA)
AgRISTARS	Agriculture and Resources Inventory Surveys through Aerospace Remote Sensing (USA)
ALCORSS	Australian Liaison Committee on Remote Sensing by Satelite
ALS	Australian Landsat Station
AMG	Australian Map Grid
AMF	Australian Mineral Foundation
AO	Announcement of Opportunity
APRSS	Australian Photogrammetric and Remote Sensing Society
APS	(former APRSS) Australian Photogrammetry Society
AS	Academia Sinica (China)
ASP	American Society of Photogrammetry
ASTEC	Australian Science and Technology Council
AVHRR	Advance Very High Resolution Radiometry (NOAA)
AW&ST	Aviation Week and Space Technology (weekly by McGraw-Hill)
BGR	Blue, Green, Red — Order in which bands are assigned to a colour in image processing
BMOE	Brouwer Mean Orbital Elements
bps	bits per second
BPS	Bulk Processing System (ALS)
B&W	Black and white
CAS	Chinese Academy of Sciences
CCD	Charge Coupled Device
CCIR	International Radio Consultative Committee (ITU)
CCITT	International Telegraph and Telephone Consultative Committee (ITU)
CCRS	Canada Centre of Remote Sensing
CCT	Computer-compatible Tape
CIR	Colour Infrared
CNES	Centre National d'Etudes Spatiales (France)
CNIE	Commision Nacional de Investagaciones Espaciais (Argentina)
CNR	National Research Council (Italy)
COSPAR	Committee on Space Research
CPU	Central Processing Unit (Computer)
CRT	Cathode Ray Tube
CSC	Computer Sciences Corporation (USA)
CSIR	Council for Scientific and Industrial Research (S.Africa)
CSIRO	Commonwealth Scientific and Industrial Research Organisation (Australia)
CUCRS	Commonwealth Users Committee on Remote Sensing
CZCS	Coastal Zone Colour Scanner (NOAA)
DAF	Data Acquisition Facility (ALS — Alice Springs)
dB	Decibel
DEMUX	Demultiplexer
Domsat	Domestic Communications Satellite
DPF	Data Processing Facility (ALS — Canberra)
DRE	Department of Resources & Energy (Australia)
D/SBD	Defence Space Business Daily (USA)
DSIR	Department of Scientific & Industrial Research (New Zealand)
DST	Department of Science & Technology (Australia)
EBR	Electron Beam Recorder
ECI	Earth Centre Inertial
EDC	Eros Data Centre (USA)
EM	Electro-magnetic
EMR	Electro-magnetic Radiation
EOC	Earth Observation Centre (Japan)
EOSAT	Earth Observing Satellite Co. (RCA Astro Electronics Div. and Hughes Aircraft Co.)
ERIM	Environmental Research Institute of Michigan (USA)
ERS	Earth Resources Satellite (Japan)
ERTS	Earth Resources Technology Satellite (first in the LANDSAT series of Satellites and was renamed just before LANDSAT-2 was launched)
ESA	European Space Agency
ESRO	European Space Research Organisation
EVA	Extra Vehicular Activity (Manned space flights)
FOV	Field of View
GARP	Global Atmospheric Research Program
GCP	Ground Control Point
GE	General Electric Co. (USA)
GEMS	Global Environment Monitoring System
GHz	Giga Hertz (10^9 cycles per second)
GOES	Geostationary Operational Environmental Satellite
GMS	Geostationary Meteorological Satellite
GMT	Greenwich Mean Time
GPS	Global Postioning System
GSFC	Goddard Space Flight Center (USA)
GSTDN	Ground Space flight Tracking and Data Network
HCMM	Heat Capacity Mapper Mission
HDDT	High Density Digital Tape
HDTR	High Density Tape Recorder
HRV	High Resolution Visible (SPOT)
ICE	International Cometary Explorer
IEEE	Institute of Electrical and Electronics Engineers
IFOV	Instantaneous Field of View
I^2S	International Imaging Systems (USA)
INPE	Instituto de Pesquisas Espaciais (Brazil)
INTA	Instituto Nacional de Technica Aeroespacial (Spain)
IPF	Image Processing Facility (GSFC)
IR	Infrared
ISPRS	International Society for Photogrammetry & Remote Sensing
ISRO	Indian Space Research Organisation
ITU	International Telecommunications Union
IUS	Inertial Upper Stage (Space Shuttle Launch of Satellites)
JPL	Jet Propulsion Laboratory
JSC	Johnson Space Centre (USA)
Kbps	Kilo bits per second (10^3 cycles per second)
KSC	Kennedy Space Centre (USA)
LACIE	Large Area Crop Inventory Experiment
LAGEOS	Laser Geodynamic Satellite
LARS	Laboratory for Applications of Remote Sensing
LAPAN	Indonesian National Institute of Aeronautics and Space
LBR	Laser Beam Recorder
LGSOWG	Landsat Ground Station Operations Working Group
LS	Landsat
LTWG	Landsat Technical Working Group
Mbps	Mega bits per second (10^6)
MDA	MacDonald-Dettweiler and Associates Ltd (Canada)
METSAT	Meteorological Satellite
MHz	Mega Hertz(10^6 cycles per second)
MOMS	Modular Optoelectronic Multispectral Scanner System
MOS	Marine Observation Satellite
MOSAICS	Multi Observational Satellite Image Correction System (CCRS)
MOU	Memorandum of Understanding
MSFC	Marshall Space Flight Centre (USA)
MSS	Multi Spectral Scanner
MTF	Modular Transfer Function
MUX	Multiplexer
NASA	National Aeronautics and Space Administration (USA)
NASDA	National Space Development Agency (Japan)
NATMAP	Division of National Mapping (DRE-Australia)
NEp	Noise Equivalence Reflectance
NESDIS	National Environmental Satellite, Data, and Information Service (NOAA, USA)
NETD	Noise Equivalence Temperature Difference
NIR	Near Infra-Red
NITR	National Institute for Telecommunications Research (S-Africa)
nm	Nanometer (10^{-9}m) used for wavelengths smaller than visible light (also known as millimicron)
NOAA	National Oceanic and Atmospheric Administration
NRCT	National Research Council of Thailand
NRSA	National Remote Sensing Agency (India)
NSCA	National Safety Council of Australia
NSTL	National Space Technology Laboratories (USA)
NT	Northern Territory (Australia)
OBC	On board computer
OCC	Operations Control Centre
OSTA	Office of Space and Terrestrial Applications (USA)
OTV	Orbital Transfer Vehicle
PAM	Payload assist module
PDU	Power Distribution Unit
Pixel	Picture Element
POF	Product Order Form (ALS)
PPS	Precission Processing System
PST	Pacific Standard Time
QLP	Quick Look Print
RBV	Return Beam Vidicon
RFP	Request for Proposal
RESTEC	Remote Sensing Technology Centre (Japan)
RMS (rms)	Root Mean Square
RS	Remote Sensing
RSAA	Remote Sensing Association of Australia
RSC	Remote Sensing Committee
RTPB	Real Time Play Back
SAA	Space Association of Australia
SAM	Stratospheric Aerosol Measurement
SAR	Synthetic Aperture Radar
SARSAT	Search and Rescue Satellite Aided Tracking
SEP	Societe Europeenne de Propulsion (France)
SEL	Space Environment Laboratory (NOAA)
SESC	Space Environment Services Centre (NOAA)
SFC	Space Flight Centre
SG	Surveyor General
SIR	Shuttle Imaging Radar
SLAR	Side Looking Airborne Radar
SMA	Scan Mirror Assembly
S/N (SNR)	Signal to Noise Ratio
SOM	Space Oblique Mercator (map projection)
SPAS	Shuttle Pallet Satellite System
SPARRSO	Space Research and Remote Sensing Organisation (Bangladesh)
SPB	Space Projects Branch (DST)
SPOT	Systeme Probatoire d'Observation de la Terre (France)
SRS	Statistical Reporting Service
SRSC	Satellite Remote Sensing Centre (S-Africa)
SSC	Swedish Space Corporation
STI	Space Tracking Industry
STS	Space Transportation System (Shuttle)
TDRS(S)	Tracking and Data Relay Satellite (System)
TIR	Thermal Infra-Red
TM	Thematic Mapper
um(μm)	Micrometer (10^{-6}m, used in wavelengths of visible light and IR)
UOSAT	University of Surrey Satellite (UK)
USDA	US Department of Agriculture
USDC	US Department of Commerce
USDI	US Department of the Interior
USGS	US Geological Survey
UTC	Universal Time (Coordinated)
UTM	Universal Transverse Mercator (map projection)
VICAR	Video Image communication and Retrieval
VLBI	Very Long Baseling Interferometry
WRS	World-wide Reference System

Privatisation — Commercialisation

Following the success of earlier Landsat satellites and the recognition that the information acquired this way would benefit both the public and private sector, it was concluded in the late 1970's that the system could be financed and managed on commercial terms, albeit with heavy reliance on 'value-added' products.

Following the transfer from R&D status of the Landsat program under NASA to an operational status under NOAA, the Reagan Administration decided to limit the funding of the program to operational cost and processing of Multi Spectral Scanner (MSS) data, while maintaining funds to launch LANDSAT-5 and the Thematic Mapper (TM) data processing system.

A large US firm made a bid for both the land and weather satallite systems and proposed that the government would enter into a long term agreement to purchase the data. While government officials concluded that this would not significantly reduce cost and lead to 'privatisation' rather than 'commercialisation', the firm's proposal focussed government and public attention on the issue.

Following the Reagan Administration's proposal in March 1983 to sell the satellites, the Commerce Department issued draft Requests for Proposal (RFP) to industry, that allowed them to bid on any combination of land and satellite systems.

That same October however, following criticism from several sources, the US Senate adopted an amendment to the $US 10.5 billion State, Commerce and Justice Departments spending bill, that forbade the Commerce Department to spend any more public money on the sale of the weather satellites.

This still left the over $US 1 billion Landsat system (nett expenditure around $US 20 million pa); the assests include the Landsat 4 and 5 spacecraft, their command and control capabilities and the MSS and TM processing facilities.

On 3 January 1984, the Commerce Department released new RFP's for the sale of LANDSAT only.

After an extension on the deadline by the Commerce Department to 19 March 1984 there were seven bidders. One of these, Geospectra Corp, was disqualified for lack of financial strength, but was reported to be involved in forming a partnership with 10 mining and petroleum companies to design, launch and operate a geological remote sensing satellite called Geostar (AW&ST 25/6). Eastman Kodak, leading a team including TRW, Fairchild and the Environmental Research Institute of Ann Arbor (Michigan), found the conditions and terms set by the Commerce Department unacceptable.

In its 24 July letter to the department, Kodak ruled out participation as long as the condition of a $250 million ceiling on government investment and contractor matching of that amount or more, remained in force (AW&ST 6/8).

EOSAT, an expressly formed joint venture for the LANDSAT initiative by the RCA — Astro Electronics Division and the Hughes Aircraft Co., planned to proceed under the $250 million ceiling. EOSAT would take over the LANDSAT 4/5 operation immediately on a cost reimbursement basis and build and launch LANDSAT 6 and 7 in 1988 and 1991 respectively, to maintain data continuity.

Malcom Baldridge, Secretary of the Department of Commerce announced last September that EOSAT would be the designated commercial operator of LANDSAT 5 (AW&ST 23/9). Its proposal called for a twelve year program to operate the existing LANDSAT-5 facilities at NASA and to build and launch four more satellites. Landsat-6 would carry a Thematic Mapper similar to that of LANDSAT-5 but it would be fitted with the improved Emulator Multi Spectral Scanner (EMSS), with four spectral bands at 60m resolution. In the proposal, it was further planned that LANDSAT-7 and subsequent spacecraft would be fitted with 10/20 metre resolution multispectral linear array sensors (D/SBD 9/7/84).

John Bruyn (User Services)

NASA Plans Landsat — 4 Orbital Repair

Mission could involve space shuttle in tanker role; repair or retrieval would first use maneuvering unit in polar orbit

Washington — The National Aeronautics and Space Adminstration's Landsat Program Office has asked space shuttle managers to plan for an April, 1986, repair or retrieval of the cripple $60-million General Electric Landsat 4 Earth resources spacecraft.

The mission could result in the first demonstration of space shuttle tanker capabilities and manned maneuvering unit operations in polar orbit.

The flight would be a follow-on to the Solar Maximum satellite repair earlier this year and the successful rescue of the Indonesian Palapa satellite during Space Shuttle Mission 51-A, last November. Both are part of a growing move to exploit the shuttle's satellite repair capabilities (AW&ST Apr. 2, p. 18).

The landsat repair/retrieval mission would involve an astronaut in the Martin Marietta manned maneuvering unit docking with the Landsat 4 spacecraft at 285-naut-mi. altitute in polar orbit, following launch of the orbiter Discovery from Vandenberg AFB, Calif.

Selection of the repair option would provide a demonstration of space shuttle tanker capabilities. Following Landsat's repair, Discovery would refuel the satellite so that it could propel itself back to a 380-naut-mi. operational orbit.

If only the retrieval is planned, the same manned maneuvering unit pickup would be flown, but Landsat 4 would be returned to Earth for ground refurbishment instead of being repaired in space.

NASA managers said the successful Solar Max repair provides an important boost to the even more difficult Landsat repair plan.

Second Polar Flight

The Landsat 4 retrieval/repair mission is scheduled as the second shuttle polar orbit flight to be launched from Vandenberg AFB. Depending upon Vandenberg launch site readiness, however, the mission could be the first U.S. manned flight launched into polar orbit, shuttle officials said.

The first Vandenberg mission is scheduled for October, 1985, based on launch site readiness, although questions remain on whether NASA or the U.S. Air Force has a requirement for a polar orbit payload for launch at that time. There is increasing doubt about whether there will be a Vandenberg — launched shuttle mission in October, 1985,

Landsat 4 has lost 50% of its solar array electrical power and is likely to lose more. Its thematic mapper direct ground link has failed, as has its prime command and data-handling computer (AW&ST Aug. 1, 1983, p. 12).

The spacecraft's condition over the 'next several months will be an important factor in determining whether the satellite is to be repaired in orbit or retreived for repair on Earth.

Retrieval Logistics

Landsat 4 is in a 380-naut-mi-high circular polar orbit, too high for space shuttle retrieval. A further loss of electrical power in that high orbit could leave Landsat 4 stranded with no chance of shuttle retrieval.

To protect against this, the Goddard Space Flight Center has loaded its ground computers with special software so that within 2 hr. of an additional failure, Goddard could command Landsat 4 to maneuver 100 mi. lower to an altitute where a loss of satellite control would not preclude the shuttle retrieval and repair.

NOAA was forced to launch the Landsat 5/D-prime spacecraft Mar. 1 to back up the failing Landsat 4.

Landsat 4 was launched July 16, 1982, and was to have functioned for at least three years. Its problems reduced utilization of the spacecraft, however, after only one year of operation.

Under the repair option, the primary Landsat 4 task would involve the replacement of the spacecraft's failing 19.6-ft-long solar arry with a new array. Landsat 4 then would be refueled.

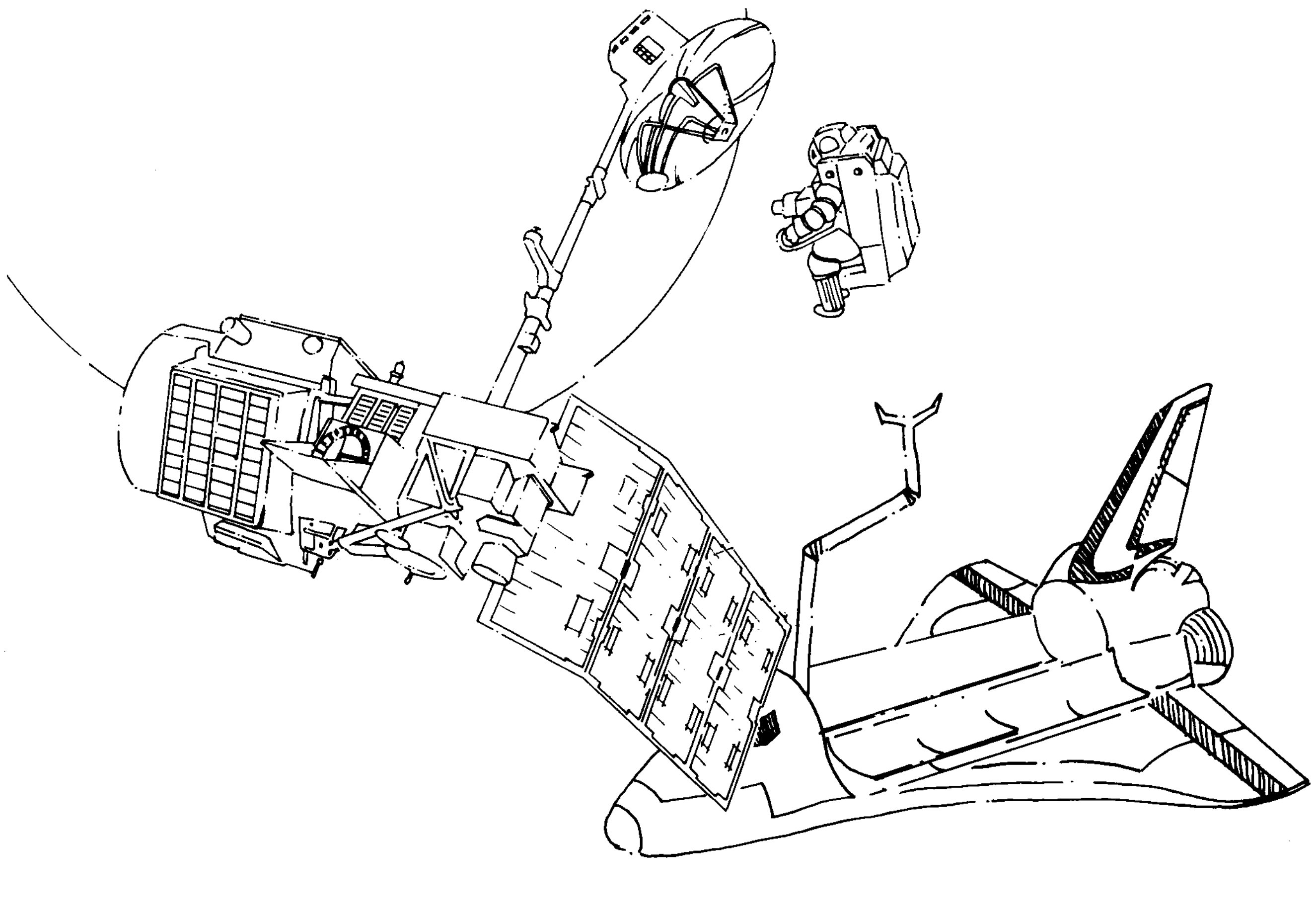
The mission plan for either the repair or just retreival would first involve the use of the Landsat hydrazine system to lower the satellite to about a 285-naut-mi. orbit where the spacecraft can be reached by the space shuttle.

Whether this altitude reduction will be done as part of a comfortably space routine or as an emergency maneuver will depend on the satellite's condition, especially any further solar array degradation.

It is desirable to keep Landsat 4 at its operational altitude for as long as possible because it is providing NOAA some thematic mapper and multispectral scanner data through the TRW/Spacecom tracking and data relay satellite, although only on a limited basis.

About 180 lb. of the spacecraft's hydrazine load would be burned to achieve the altitude reduction, according to Frank Cepollina, manager for Goddard Space Flight Center's satellite servicing project.

Once Landsat achieves the lower altitude, Discovery would be launched from Vandenberg on a direct orbit



Artist impression of astronaut aiding in recovering the ailing Landsat-4 spacecraft.

insertion trajectory to achieve a rendezvous with Landsat 4.

With Discovery flying 200 ft. away from Landsat, an astronaut in a manned maneuvering unit would be deployed to dock with Landsat 4 to insure spacecraft stabilization for the shuttle retrieval phase of the mission.

Payload Bay

The orbiter would maneuver close to Landsat 4, attach the arm to the spacecraft and place the satellite in the aft payload bay while maneuvering unit crewman undocked and parked the Martin Marietta unit back in the forward bay.

Landsat 4 is a stable spacecraft and would not necessarily require use of the manned maneuvering unit as part of the operation. However, use of the maneuvering unit in the plan is expected because it provides an extra element of control over the retrieval operation.

In addition, depending on the Landsat's future condition, the spacecraft may need to be placed in a slow spin-stablized mode if additional solar panel degradation causes a loss of three-axis control. A slow spin-stablization motion would need to be stopped before shuttle pickup, and the maneuvering unit provides a means to do that.

Under the repair option, the maneuvering unit crewman and teammate in the bay would use the Grumman work platform on the end of the shuttle arm to detach the failed solar array and attach a new panel to the spacecraft.

Other repairs requiring penetration of the side of the vehicle or removal of modular multimission spacecraft boxes also could be undertaken.

Refueling of the spacecraft would be a critical operation in the repair option.

The Landsat 4 thematic mapper and the multispectral scanner imaging systems need to operate at about the 380-naut-mi. altitude, and the spacecraft would have to propel itself from the shuttle retrieval altitude back to the operational altitude. To do this its hydrazine tank would have to be refilled by the orbiter crew. Landsat 4 was designed to be retrieved in space and returned to Earth for refurbishment. It was not, however, designed for in-orbit refueling.

The crew on the April, 1986, mission would have to penetrate hydrazine fuel receptacles designed only for groundbased servicing of the vehicle.

Astronaut Army Lt. Col. Robert L. Stewart demonstrated this could be done safely in a Landsat hydrazine tool and hardware extravehicular activity test on shuttle Mission 10.

Astronaut Kathyrn D. Sullivan demonstrated the technique further using actual hydrazine fuel during an extravehicular activity on shuttle mission 41-G last October.

Hydrazine Burnoff

Because the polar orbit crew would be penetrating a potentially hazardous hydrazine system, the plan is to burn off about 140 lb. of hydrazine that would be left in the spacecraft after its altitude descent maneuver.

Just how and when this should be done is being assesed because use of hydrazine could be a factor both in controlling spacecraft attitude and in maintaining proper spacecraft thermal condition.

The hydrazine is on board primarily for large orbital adjustment maneuvers, while attitude control is handled by momentum wheels.

Landsat's imaging systems have to be maintained at a proper temperature. If solar arry power fails further it may be necessary to shut down the momentum wheel attitude control to allow remaining electrical power to flow to instrument heaters, forcing the hydrazine system into attitude control.

NASA is assessing engineering questions involving the role of the hydrazine system to determine how best to operate the satellite from a retrieval safety and instrument survival standpoint. it also is assessing hydrazine system implications for returning the satellite to Earth if that option is pursued.

Retrieval Altitude

NASA also is examining the implications of whether or not a repair and refueling would allow enough fuel to remain on Landsat 4 to return again to a shuttle retrieval altitude if that were to become necessary.

The solar panels' electrical power problems have occurred because of the potting material used with the wiring in the arrays. The potting material has had the effect of breaking wires leading from the panel to the spacecraft during the course of day/night thermal cycles on the satellite.

There are four segments in the panel. The power from only two of those segments is reaching the spacecraft, limiting satellite operations. Analysis shows it is likely that a third panel will eventually have the same problem, leaving only 25% power — a situation that could result in a loss of spacecraft control.

Goddard controllers are prepared to lower the Landsat's altitude immediately if the third panel shows signs of imminent failure.

General Electric Landsat managers said the company provided hardware specifications to Hughes for the wiring system but did not provide adequate thermal cycle data. The General Electric specifications and lack of thermal data are to blame in the loss of Landsat 4 power, the company's Landsat managers said (AW&ST Aug. 1. 1984, p. 13)/

Ground controllers at Goddard have maintained the Landsat 4 panel at an angle to the Sun that minimizes heating to reduce the severity of the thermal cycles, a change that also further limited spacecraft power.

Acknowledgement

The Australian Landsat Station gratefully acknowledges the author of most of this article, Mr Craig Covault, and the publishers of Aviation Week & Space Technology (April 9, 1984), McGraw Hill.

Delta Launch Ends An Era

When Delta 174/Landsat 5 was launched from Space Launch Complex 2 West at Vandenberg Air Force Base on March 1, it marked the end of two closely related eras. The prime payload aboard was Landsat 5, the latest spacecraft in that revolutionary earth resources observation series.

For Kennedy Space Center's Expendable Launch Directorate, the launch of Delta 174 was the final pearl in an 18-year, 39-mission string of successes from the west coast site. The mission also marked the 40th straight success for the workhorse Delta.

An hour after its 9.59 a.m. PST liftoff, with the Delta second stage passing to the west of the island of Madagascar, a 13-second reignition of that stage circularized the polar orbit at an altitude of 440 miles. Minutes later, the two-ton Landsat spacecraft was separated, followed by the 133-pound UOSAT-B, a 'hitchhiker' payload. UOSAT-B is an amateur radio and scientific research satellite designed and built by Britain's University of Surrey.

Delta launches from NASA facilities near Purisma Point on Vandenberg began with the Delta 41 ESSA-3 weather satellite mission in October 1966. They have continued at the rate of one or two each year since that time.

'We obviously hate to see launch activites at that pad end,' commented Charles D. Gay, expendable vehicles director 'It's been a highly successful and rewarding program conducted by a highly motivated team — and we're pleased that our last shot from SLC-2W was a success.

We've conducted six Delta launches from Vandenberg in the past three years using the KSC team rotated out here on temporary duty. Now we plan to finish the Delta program at KSC with the same degree of succcess and professional pride as we saw with the Delta program on the west coast.'

NASA's Delta program currently has five remaining missions set, three in 1984, and the final two in the summer of 1986.

NASA ACTIVITIES

Landsat 5 Orbit Drift

Towards the end of ALS catalogue cycle 9 on 30 July 1984, Landsat 5 exceeded the 10 km limit of the Worldwide Reference System (WRS) in a westerly direction.

Predictions of the drift were made earlier by NOAA, based on a solar flux average. It is expected that at current solar flux levels the spacecraft would have continued to drift westward if no orbit adjustment was made. By 23 August 1984 the satellite had reached 22km west of WRS before thrusters were fired to steer the spacecraft slowly back onto WRS. (See Fig 2.) A

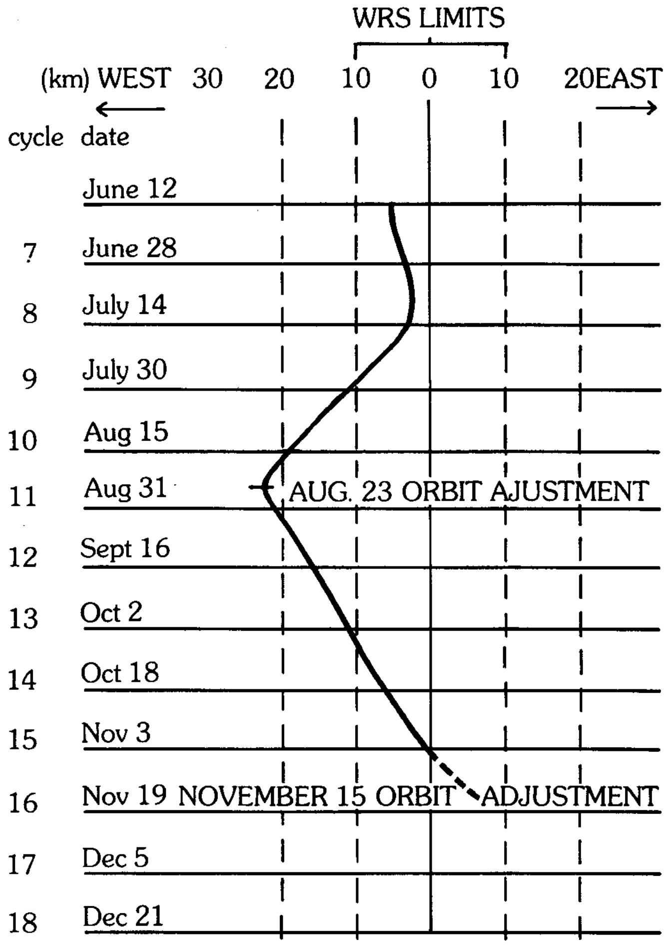


Fig. 2 **Landsat 5 Distance from WRS**

John Bruyn (User Services)

procedure to perform retrograde orbit adjustments to prevent Landsat 5 from drifting outside the 10km limit is under review.

This is the first time a Landsat satellite was allowed to drift outside WRS before adjustment was made. Particularly the extent of the drift is most unusual — as yet, NOAA has not given an explanation as to why they allowed the satellite to drift this far. Speculation that the backup-thruster malfunction may be the reason has not yet been confirmed.

Figure 2 shows that following the 23 August orbit correction, the spacecraft began drifting eastward at an almost linear rate of 4.25km per cycle. By the start of cycle 15 however, the eastward drift had increased to around 7.5km per cycle. Drifting at this rate would again take the spacecraft outside the 10km WRS limit, but this time in the opposite direction. To prevent this from happening, an orbit adjust was made on 15 November 1984 towards the end of catalogue cycle 16.

It is hoped that following this last orbit adjustment, Landsat 5 will maintain a more steady WRS path. ALS will continue to monitor the spacecraft's movements and keep you up to date in the colour micro-image catalogue newsletter.

ALS News

Image quality reduction for path 089 on 27 April 1984

Landsat 5 scenes of path 089 on 27 April 1984 have their data catalogue quality flag reduced form 7777 to 4444 for each of the four MSS bands.

The cause of this reduction in quality is a discontinuity of about one pixel on line to line registration between pairs of lines. The problem occurs about once every swath and is probably due to spacecraft perturbations caused by a bad ephemeris load (orbit parameters transmitted to the spacecraft) to Landsat 5.

Landsat 5 was entered into a safe hold condition at the end of path 89 to correct for the bad load, and subsequent passes have not shown a repeat of the problem.

Robert Denise (ALS, Digital Engineer)

$100,000 for TM-SPOT upgrade study

An allocation of $100,000 was made in the 1984/85 Federal Budget for the Australian Landsat Station (ALS) upgrade preliminaries.

The upgrade is to enable ALS to receive and process image data from the Landsat Thematic Mapper (TM) at 30 metres resolution and the French SPOT satellite with stereo capability on 20 and 10 metre resolution.

Current rough estimates are that such an upgrade would cost in the vicinity of $13.2 million over three years and includes:

a. An upgrade of the Data Acquisition Facility (DAF) at Alice Springs to receive image data from TM and SPOT on X-Band, at a rate of up to 120 mega bits per second and store this at high density on a suitable rapid access medium.
b. An upgrade of the Data Processing Facility (DPF) in Canberra, which involes the acquisition of new computer hardware and software to cope with the aroud 230 million pixel values of a TM scene, and new film writing and processing equipment to cope with the|less than 10um image pixels and the expected increase in demand.

In otherwords, at both facilities, the ALS needs to be able to handle much greater volumes of data at much higher rates.

The supply of $100,000 allows a team of ALS specialists to complete most of the necessary preliminary action to let an upgrade contract; the work is expected to be completed during the current financial year.

A further approach by members of the Australian Remote Sensing Industry will be made to the Government early in 1985, seeking an estimated 13.2 million over three years. Once these funds have been allocated, upgrade contracts can be negotiated.

John Bruyn (ALS, User Services)

Natmap News

Natmap digital elevation data programs

Digital contours

Availability of full-cover digital contours is linked to two events: completion of the NTMS 1:100 000 and 1:250 000 scale compilation programs, and acquisition of a scan digitizing system.

Current estimates are for the 1:100 000 scale compilation program (20 metre contours) to be completed by 1986, and the 1:250 000 scale program (50 metre contours) during 1987. Acquisition of a scan digitizing system is currently under consideration, and subject to the necessary approvals the scanner would be purchased during 1985/86.

However, some digitizing of contours has already commenced as part of the on-going Natmap and Royal Australian Survey map compilation programs. Currently, digital contouring has commenced or has been completed in some 15% of 1:100 000 scale map areas, although this percentage may be expected to rapidly rise after acquisition of a scanner.

Digital elevation models (DEM)

A three-level Natmap DEM program is proposed:

Level One (1:1 million scale)

The level one DEM (DEM 1-is to be produced from irregularly distributed spot heights and the digitized coastline. The computed DEM 1 elevations will be on a latitude-longitude grid with a spacing of 0.01 degree (approximately 1 Km).

Level Two (1:250 000 scale)

The level two DEM (DEM 2) is to be produced primarily from scan digitized 50 metre contours, and will also provide national coverage, at an anticipated latitude-longitude grid spacing of 10 seconds (approx 300 metres).

Level Three (1:100 000 and larger scales)

Level three DEMs are to be produced on a project basis to satisfy other-agency and Natmap requirements for more accurate models. Data sources will include 20 and 10 metre digitized contours, photogrammetric spot heights, streams and other topographic data. With 1:100 000 scale data (20m contours), an appropriate grid spacing would be 100 meter AMG eastings and northings, while individual elevations would have an accuracy of approximately 10 metres.

DEM Production program

Development work for DEM 1 has now commenced, with the objective of completing national coverage during 1985. Production of DEM 2 is linked to acquisition of a scan digitizer, while the capacity to produce DEM 3 models is dependant on software development.

The Natmap contact officer for the DEM 1 project is Mr Andrew Clarke (062) 525991.

Andrew Clarke (Natmap)

Australian News

Australian monitor Rabaoul volcanoes

A team from the National Safety Council of Australia (Victorian Division) earlier this year returned from a successful mission to Rabaul in Papua New Guinea. They assisted the staff of the government's Vulcanological Observatory and the Natural Disasters Organisation in their efforts to gain a better understanding of the imminent volcanic eruption.

Rabaoul is located at the junction of two major continental plates on the so called 'Ring of Fire' which circles the Pacific Ocean. It has a deep, enclosed harbour, which itself is the partly drowned caldera of earlier volcanic eruptions. The last major eruption in 1937 caused 500 deaths and much destruction. A new mountain was then formed from the sea in just three days — and appropriately named Vulcan.

Geologists at the Rabaul Vulcanological Observatory know that another eruption is inevitible and is likely to occur within the next few months.

Tension in the earth's crust, and in the lives of otherwise friendly people of Rabaul, is building daily. The most recent crisis involved 1800 earth tremors on a single day — Easter Sunday. The staff of the Observatory are monitoring the activity of the mass of magma under them by measuring seismic responses, ground deformation and the temperature of the land and sea.

The Papua New Guinea government requested the assistance of the NSCA to determine the extent and temperature of thermal sources across the whole caldera, about 10km across. The team from Morwell responded quickly with their aircraft equipped with a thermal infrared scanner. Previously, this has been used mainly for bushfire detection and mapping during our critical summer months, to assist the Country Fire Authority and the Forests Commission Victoria.

Thermal mapping of volcanoes is an ideal application for the sophisticated equipment, and conforms to NSCA's concern for public safety. The image produced by the instrument in the aircraft is a calibrated temperature response of the active craters and nearby thermal springs.

The team of four spent a week in Rabaul, and conducted missions over the volcanoes on most days. A field check of ground temperature involved a climb by one of the members, Markus Walther, into an active crater.

Vulcanologists at the Observatory were thankful for the support provided and enthusiastic about the value of the survey showing the extent of thermal areas and providing an accurate baseline for the anticipated changes.

Graeme Lacy (NSCA)

Space Races to Tasmania

For four hours next April, Tasmania will be the location for a major international scientific experiment. NASA's Space Shuttle Columbia will push through the Earth's ionosphere, and the hole it leaves will be the focus of scientists from around the world. The Tasmanian experiment will be run by Professor Graeme Ellis, former professor of physics at the University of Tasmania.

Professor Ellis says, study of the hole will provide information which could plan the maps future astronauts will use to travel the universe. He will use a telescope to be built near Hobart to monitor radio waves that penetrate the hole. He said the experiment was likely to benefit Man's understanding of plasma physics, which is behind the burning of hydrogen at high temperature to produce electricity.

The Herald.

The University of New South Wales Centre for Remote Sensing

The Centre wishes to advise that from the 1st October, 1984, their new phone numbers will be:

Dr John A. Richards, Director	697-4964
Dr Bruche Forster, Associate Dir.	697-4183
Dr Tony Milne	697-4397
Ms Leanne Bischof	
(Image Analysis Laboratory)	697-4962
Mr Rosie Garth	697-4391
University Switchboard	697-2222

RSAA Sponsors APRSS

Following negotiations during 1983/1984 between the executives of the Remote Sensing Association of Australia (RSAA) and the Australian Photogrammetric and Remote Sensing Society (APRSS), the Association has now joined APRSS as a sponsoring member.

Until recently the Australian Photogrammetric Society (APS) has operated under the auspices of the Institution of Surveyors and the Australian Institute of Cartographers, with each group contributing three members to a federal executive. In 1982 APS changed its name to include the words 'Remote Sensing' in its title. This was in line with the earlier action taken by the international body, the International Society for Photogrammetry and Remote Sensing (ISPRS) of which APRSS is an affiliate member.

By becoming a sponsoring body of APRSS along with the Australian Institute of Cartographers and the Institute of Surveyors, the Remote Sensing Association of Australia retains its national identity and can still service the needs of its members who come from a broad spectrum ranging from technical specialists in computing and earth science research to executives in private companies involved in environmental consultancy work. In addition it now has official links with the international remote sensing community through ISPRS.

Tony Milne (Chairman RSAA)

International News

CANADA

Huge Increase in Canadian Space Expenditure

The Canadian Minister of Space who is responsible for Space Policy, the honourable D J Johnston announced a new Space Expenditure Plan of a huge $122.2 million or 38 per cent increase to bring the total federal government's committment to space to almost $446 million for the next two financial years.

While making the announcement, Mr Johnston pointed out that the Canadian space industry sells more than the government spends on space. The industry employs over 3,200 people and it is anticipated that over 500 jobs will be created as a result of this initiative.

The funds allocated under the new Space Plan will be used to enhance application of space technology to most Canadian needs in communications, remote sensing and space science.

New Space Plan Expenditures — 1984-85 to 1986-87

	$ Million
ERS-1 phases C/D: Canadian participation in the construction and use of the European Remote Sensing satellite of the European Space Agency. The satellite will be launched in 1988. Canadian industry will provide part of the satellite radar system and the ground-base processing system.	29.7
RADARSAT phase B: engineering and economic studies for the detailed definition of a remote sensing satellite system capable of providing day or night, all weather, map-like images of the earth. The system would meet unique Canadian needs for offshore and land resource information.	21.1
Ground System: development of a ground system in Canada to receive, process, and extract information from ERS-1 and RADARSAT	21.5
Space Science: continuation of a co-operative international Space Science program.	18.9
MSAT Bridging Phase: the proposed MSAT program will provide communications services in the future to mobile users in vehicles, ships and aeroplanes.	23.9
Space Station Studies: the commissioning of a one-year study to define possible Canadian participation in the American Space Station Program.	2.4
Technology Development: expansion of the David Florida Laboratory to provide the additional satellite assembly and environmental test facilities required by the Canadian aerospace industry.	5.5
Other Items: projects to enhance the usefulness of remote sensing data, development of the Fluorescence Line Imager, communications satellite applications, environmental monitoring, and the space counsellor in Europe	

REMOTE SENSING IN CANADA.

Canadian Centre for Remote Sensing Receives $10 million for upgrade

MDA (MacDonald, Dettwiler and Associates) of Canada has been awarded a $10 million, 31 month contract to develop, design, install and test the Multi Observational Satellite Image Correction System (MOSAICS) for the Canada Centre for Remote Sensing (CCRS). The MOSAICS technology will improve the accuracy of data gathered from satellite images and allows this data to be integrated with topographic maps and geographic data bases. The system is to be installed at the Prince Albert Satellite Station by June 1986.

MOSAICS will be designed to process images from the LANDSAT and SPOT series of earth resource observation satellites as well as from new generations of this type of satellites planned through to 1995.

REMOTE SENSING IN CANADA.

USA

Nasa Announcements of Opportunity

Thematic Mapper Research in the Earth Sciences

i. Description of the Opportunity

The National Aeronautics and Space Administration (NASA) announces the opportunity to conduct basic scientific studies of the Earth employing the unique observational capabilities of the Landsat Thematic Mapper (TM). The TM is an advanced remote sensing system designed to measure the intensity of Earth raditation within selected portions of the electromagnetic spectrum. The TM is able to conduct multispectral surveys of Earth radiation at a level of resolution and sensitivity that surpasses all previous sensor systems placed in Earth orbit.

Research to be initiated under the auspices of the Announcement is expected to build upon the results of earlier MSS investigations but to differ substantially in intent and scope. The purpose of this research program is to develop improved understanding of surface conditions and processes on the Earth through the analysis and interpretation of TM data. It is anticipated that proposals submitted in response to this Announcement will identify topical problems in various aspects of the Earth sciences that can be addressed in new and innovative ways through the analysis of TM imagery. Proposals are specifically sought for investigations in the fields of botany, ecology, geology, hydrology, and related Earth science disciplines.

Earlier Landsat research programs have provided considerable insight into the general types of Earth science studies that can potentially be conducted with multispectral Earth imagery collected at synoptic scales on a repetitive, global basis. In addition, a variety of experiments have been conducted during the past eight years employing multispectral imagery acquired by airborne sensors that stimulate the general measurement capabilities of the TM. The results of earlier MSS data analysis projects and TM simulator studies are available in the open scientific and technical literature. (A bibliography of key references to relevant publications are available to prospective proposers).

The research program described in this Announcement will be initiated in 1985 and continued through 1987. Proposals may be submitted for investigations ranging from one to three years in duration. Two types of proposals will be considered: (1) those requesting NASA funds to support the analysis and interpretation of TM and (2) those that require TM data but do not require financial support by NASA. The latter type of proposal may be submitted by foreign (non-US) research institutions or by private organizations which could potentially benefit from participating in this type of data analysis activity.

A total of approximately five million dollars is available to conduct this research program. However, this Announcement does not constitute an obligation on the part of the US government to provide such funds for this purpose. It is anticipated that a total of 20-30 proposals will be approved, depending on the scope and complexity of individual investigations. The results of these investigations will subsequently be published in the open scientific literature.

Each proposal should identify a single individual who will serve as the Principal Investigator for the proposed study. The Principal Investigators of those proposals selected by NASA will be appointed to a Thematic Mapper Science Working Group (TMSWG). The TMSWG will meet periodically in whole or in part to review the results of ongoing research activities. The TMSWG will receive routine briefings on TM sensor performance, TM image quality, and the status of the TM data collection. In addition, the TMSWG will provide a forum for the discussion of data analysis techniques and approaches among investigators with diverse disciplinary backgrounds. This working group will be headed by the Landsat Project Scientist. Dr Vincent Salomonson of NASA's Goddard Space Flight Center currently serves as the Landsat Project Scientist.

It is currently anticipated that Landsat 5 will be the principal source of TM data for the scientific investigations conducted under the auspices of the Announcement of Opportunity. However, prospective investigators may include requests for previously acquired Landsat 4 TM data in their proposals.

The National Oceanic and Atmospheric Administration (NOAA) within the US Department of Commerce will assume responsibility for TM operations and data processing in January 1985. However, the investigators selected to participate in this research program will submit their requests for TM data acquisition and processing to NASA. These requests will be compiled and centrally co-ordinated by the Landsat Project Scientist at NASA's Goddard Space Flight Center. NASA will assume all responsibility for providing TM data to the domestic and foreign scientists selected to participate in this research program.

ii. Announcement Objectives

To be selected, proposals submitted in response to this Announcement must identify a topical problem in one or more Earth science disciplines that can be addressed in an innovative fashion employing the Landsat TM. The overall objective of this Announcement is to develop improved understanding of surface conditions and processes on the Earth through the analysis and interpretation of space acquired TM data. It is anticipated that successful proposals will address scientific objectives of the following nature:

- To develop an improved understanding of the factors influencing the growth, health, condition, and distribution of vegetation on the Earth.
- to develop an improved understanding of the processes controlling the structural and chemical evolution of the Earth's crust, and the geological history of specific crustal provinces.
- to develop an improved understanding of the Earth's water budget and and hydrologic processes that operate at local, regional and global scales.
- to develop an improved understanding of the physical and chemical interaction between different types of surficial materials such as rocks, soils, vegetation and water
- to develop an improved understanding of the interaction between the earths surface and its atmosphere over a variety of temporal and spatial scales

These objectives are presented here in a very generalized fashion. It is expected that individual proposals will identify specific topical problems that can be addressed in a meaningful fashion during a one-to three-year period of investigation.

PLEASE NOTE:

The above Announcement is only a small part of the original NASA document. For more details please write to NASA in Washington DC, 20546 and request a copy of the 'Announcement of Opportunity', A.O.NO.OSSA — 3 — 84 of 27 July 1984 'Thematic Mapper Research in the Earth Sciences'.

The Planetary Geology and Geophysics program

The Planetary Geology and Geophysics Program supports scientific investigations which contribute to understanding the geological and geophysical evolution of the planets, their satellites (including the Earth's Moon and planetary ring systems), and such smaller solar system bodies as asteroids and comets. These investigations involve several types of research efforts generation of new basic data; analysis and synthesis of existing data; or combinations of both kinds of activities. The goals of this program are to foster the gathering, synthesis, and comparative study of data that will improve the understanding of planetary geological and geophysical processes, their extent, and the results of their interactions through time; the origin and evolution of the solar system; the nature of Earth in comparison with other planets; and the origin and distribution of life in the universe. Examples of the kinds of research supported by this program include: studies of the surfaces and interiors of planetary bodies; and the dynamical evolution of the planets, satellites, small solar system bodies, and ring systems. The program includes, without limitation, laboratory experimentation; photointerpretation; theoretical, analytical, field and comparative studies; and cartographic compilation. Planetary cartography and geologic mapping are also supported by this program.

The Planetary Geology and Geophysics Program is an open program in which unsolicited proposals may be submitted at any time. However, it is contemplated that proposals will be reviewed by a scientific peer group on a periodic basis. Proposals received by NASA before September 1984 will be reviewed in October-November 1984, but before January 1985, will be reviewed in March 1985 by a peer panel. Thus, to receive funding starting in early FY 1985, your proposal must be received by the end of August 1984, and to receive funding starting in late FY 1985, your proposal must be received by January 1985. Selection of proposals for participation in the Planetary Geology and Geophysics Program will be made by NASA based on the reviews, program needs, and availability of funds.

If you have questions regarding data availability, proposal format, evaluation procedures, etc., you should contact Mr. Joseph M. Boyce, Discipline Scientist, Planetary Geology and Geophysics Program, Solar System Exploration division, Code EL, NASA Headquarters, Washington, DC 20546, telephone (202) 453-1597.

Exploring Jupiter's Atmosphere

The Galileo Project, America's next major unmanned planetary exploration mission continues on schedule for launch in May 1986.

The project was named in honour of the Italian astronomer who, over 350 years ago, contributed much to man's knowledge of the planet Jupiter, and follows earlier investigation by Voyagers 1 and 2 in 1979.

The Galileo spacecraft is stated to make a minimum of 11 circuits of Jupiter over 20 months and release an entry probe into the planet's turbulent atmosphere as man's first incussion into the atmosphere of an outer planet.

The spacecraft will be placed into earth orbit by the Space shuttle, after which a newly designed Centaur G' upper stage rocket will boost it towards Jupiter, some 800 million kilometers away, where it is expected to arrive 26 months later, around August 1988,

NASA ACTIVITIES

Orbital Transfer Vehicle Study

A space vehicle to move payloads from low Earth orbits to higher Earth orbits will be the subject of new study contracts awarded by NASA to both Martin Marietta Aerospace Co. and Boeing Aerospace Co.

The contracts call for parellel studies (concurrent but independent on same topic) for an Orbital Transfer Vehicle (OTV) and cost $1 million each over 15 months.

The initial concept is to transfer payloads from one orbit to another by a space or ground based upper stage rocket to be deployed by the Space Shuttle as payload or as aft cargo on the Shuttle's external tank.

The OTV could even be assembled in space and be larger than a ground base unit and carry more payload to and from its space station.

Marshall Space Flight Centre Engineers conceived as ultimate goal to develop a vehicle capable of ferrying a crew to and from geostationary orbits at around 36000km above the Earth.

NASA ACTIVITIES

Sam II Provides Environmental Information

Stratospheric Aerosol Measurement II (SAM II) is a NASA satellite instrument shich has been methodically measuring the earth's atmosphere for five years. It provides scientists with large amounts of information about the stratosphere and clearly shows the build-up of aerosols in the polar regions. Particularly the climatic effects of volcanic eruptions is manifested in the data.

Volcanic activity puts huge amounts of sulphur dioxide into the stratosphere, which opposes the 'green house effect' of carbon dioxide by reflecting some of the sun's radiation back into space.

A most surprising finding is the effect on acrylic windows on aircraft which cruise at 30 000 feet in the polar regions, where the stratosphere dips closest to the earth's surface. SAM II evidence showed that the interaction of volcanically produced sulphur dioxide and the atmosphere produces sulpuric acid which subsequently causes clouding with minute cracks called 'window crazing' on acrylic aircraft windows.

SAM II also provides scientists with data on stratospheric volcanic debris transport, velocity and dispersion as well as vortex activity in the polar regions.

The instrument further provides NASA-Langley researchers with evidence of Polar Stratospheric ice clouds (PSC's) (Dr PM Mc Cormick), which are believed to be associated with the nacreous (pearl-hued) clouds, initially thought to occur at around 70 000 feet under specific meteorological conditions. In its first two years of operation, SAM II measured more than 1 000 PSC's and since launch it has sensed, collected and dispatched to earth over 50 000 profiles on aerosol concentrations in the lower atmosphere.

The instrument is one of nine aboard the Nimbus 7 satellite which was launched on 24 October 1978.

NASA ACTIVITIES

Space Bargain

The five years old International Sun-Earth Explorer (ISEE-3) was directed on a new mission after it swooped the moon's surface at an altitude on 120km. The lunar swing-by catapulted the spacecraft towards the oncoming comet Giocobini-Zinner.

Renamed International Cometary Explorer (ICE) it is scheduled to pass through the tail of the comet on 11 September 1985 at about 15 000km from the comet's head.

The low cost exploration of the comet's tail and its relation to solar wind, is followed by the visit of five probes from the USSR, the European space Agency and Japan to Halley's comet, six months later.

The new mission for ISEE-3/ICE was conceived by Dr Robert Farquhar, the Goddard flight director. The additional cost of $3-5 million compares very favourably with an estimated $200 million for a new dedicated spacecraft.

The close fly-by of the moon on 22 December was essential to pick up sufficient speed and direction to reach Giacobini-Zinner almost 21 months later at almost 70 million km from the earth (155 million km from the Sun).

The comet was discovered in 1900 and makes an orbit around the sun every 6½ years.

In flight directional changes of the spacecraft may be necessary to accommodate the comet's orbital deviations due to gravitational tugs from planets and due to jets of evaporating gas from the comets nucleus.

ICE's new mission comes after five years of interplanetary space research with instruments such as a magnetometer, a plasma electron analyser, an ion-mass spectrometer, a set of three charged particle detectors, a plasma wave detector and a radio-wave spectrometer.

After its launch in August 1978 the spacecraft became the first to orbit a libration point (the point between planets where an object would remain gravitationally fixed). ICE was near L1, between the sun and the earth-moon system.

In June 1982 ICE was redirected to a four year study of the earth's magnetic tail which required repeated orbit changes for sampling at varying distances from the earth.

After intercepting Giacobini-Zinner, ICE will continue through interplanetary space to investigate solar wind disturbances upsream of Halley's Comet (between the sun and the comet) of 138 million kilometres on October 13, 1985 and from a distance of 30 million kilometres on March 26, 1986.

By the time the comet exploration mission ends, ICE will have completed the most complex set of trajectory modifications ever attempted by a NASA spacecraft.

NASA ACTIVITIES

EUROPE

Metric Camera on Esa's Spacelab-1

The first European Space Agency (ESA) Spacelab pay load included a remote sensing experiment called the Metric Camera. The German build instrument was composed of a standard Zeiss RMK A 30/23 aerial survey camera, with a Zeiss Topar A305mm f 15.6 lens and two interchangable cassettes, each loaded with 150m of 23cm wide film, one is black and white and the other is a false colour infrared.

The objective of the experiment was to test the mapping capability of high resolution space photography for:

- the compilation of topographic and thematic maps, especially in unpopulated and less developed regions of the world
- the updating and revision of topographic and thematic maps in populated and developed areas of the world.

Despite a lower than initially expected sun-angle in some areas due to a delay in the launch of Spacelab-1 until 28 November 1983, high quality stereo-photos over parts of Africa, Europe, North and South America, Saudi-Arabia and South-west China were obtained. All camera operations were initially ground controlled by ESA and German specialist at the Johnson Space Centre in Houston, until a film jam occurred just after loading the second (B&W) film. The film was unjammed after astronauts rigged a darkroom from a sleeping bag aboard the Space Shuttle permitting further operations, albeit with manual assistance for film take-up after each exposure.

Despite this inconvenience, at the end of all preprogrammed operations, approximately 80% of the available film was exposed. The remaining film was used on a target of opportunity basis by the crew and allowed for additional coverage of the North American continent and Western Europe. A total of 1000 images were obtained of which about 70% are relatively cloud free and suitable for mapping applications. A re-flight is tentatively planned for mid 1985.

EARTH OBSERVATION QUARTERLY

ITALY

Italy joins US in Development of Tethered Satellite

The concept of the Tethered Satellite System, the 'satellite on a string' expected to be in orbit by 1987, took a giant step closer to reality when NASA's James M Beggs and Professor Ernesto Quagliarello, President of the Italian National Research Council — CNR, signed a Memorandum of Understanding (MOU) in Rome earlier this year.

The tethered Satellite System (TSS) is a data gathering satellite that will be carried in to orbit by the Space Shuttle and released from the payload-bay on a tether — a super strong approximately 1½mm thick synthetic cord of up to 100km in length.

NASA will be responsible for the development of the deployment system and perform the system level engineering and integration, and launch TSS from the Shuttle. CNR will develop the two module (science-service) satellite and provide system level support to NASA for technical aspects of the satellite.

NASA and CNR will jointly plan and implement the initial TSS mission to verify system engineering and conduct electrodynamic and plasma-interaction investigations. This initial flight, which is planned for late 1987, calls for an upward deployment of the satellite. Once the shuttle is in orbit, the satellite will be moved out about 12 metres by an extendible boom to be checked out before release.

As it moves upward, away from the Shuttle, the reel will unwind until the satellite is at its required distance for conducting electrodynamic experiments, e.g. as the shuttle passes through the space plasma (ionised gas particles which surround the earth) the satellite with its conducting tether becomes a generator of electricity similar to a coil moving past a magnet. By drawing off the electric energy from the tether and releasing it into space, scientists will be able to study magnetic flux lines surrounding the earth.

A similar situation exists between Jupiter and one of its moons — Io. While moving through Jupiter's magnetic field, Io sometimes has volcanic activity that causes an ionosphere like the Earth's to be formed. Io then becomes a conductor and caused the flow of an electric current from Io to Jupiter.

By deploying the Tethered Satellite (TS) upward, it is hoped to simulate these conditions and learn more about electrodynamics as it pertains to our sister planets.

Future missions also call for the downward deployment of the TS for upper atmosphere studies which are usually limited to short periods of sampling by rockets. The upper atmosphere (approx 100-150km up) is a 'fringe' area — it is too high for aircrafts and balloons, and too low for ordinary satellites, due to the rapid orbit decay of around a few hours.

The TS however, could be pulled through extremely low orbits of perhaps 130km above the Earth, to study the upper atmosphere continuously for several days. This would allow scientists to map the global electric current systems known to exist, and permit experiments to map magnetic fields and gravity at higher resolution.

After conclusion of an experiment the satellite will be reeled back in the Space Shuttle and returned to Earth to be reused on another date, possibly by a different instrument package on board.

NASA ACTIVITIES

Italy to Build Second Laser Geodynamics Satellite

In Rome earlier this year, the Italian National Research Council — CNR represented by its president, Professor Ernesto Quagliarello, signed a Memorandum of Understanding (MOU) with NASA's James M Beggs for the development of a new Laser Geodynamic Satellite (Lageos).

Currently, eleven countries are conducting laser ranging activities in twenty locations using the first of the laser geodynamics satellite (Lageos-1) which was launched by NASA in 1976.

The agreement signed by CNR and NASA outlines the terms for the development of the second one in this series of satellites. Lageos-2 will significantly enhance study and understanding of the solid Earth and its dynamic processes and will be identical in configuration to Lageos-1. It will be placed in an orbit of similar altitude but with a different inclination (51-53 degrees prograde, instead of 70 degrees retrograde).

Lageos-2 will also be a spherical satellite with a diameter of 60 centimetres and weighing approximately 411 kilograms and will be launched by the Space Shuttle.

The satellite will contribute to the study of plate tectonics and the accumulation of crustal strain in areas of high seismicity through very accurate measurements of baseline changes due to crustal motion. The two satellites, in essentially opposite orbits, will improve the precision of current laser determined baselines by a factor of two and will make possible achievements of a precision of one centimetre for baselines of several thousand kilometres.

These improvements will particularly benefit studies of regional crustal deformation associated with the occurrence of earthquakes in the Mediterranean area undertaken by the United States and a consortium of European countries. Similarly, studies of the San Andreas Fault System will benefit from Lageos-2 and from the Mediterranean studies.

CNR is responsible for the fabrication of the Lageos-2 satellite, integration of the apogee stage and the Italian Research Interim Stage. NASA will provide existing ground support equipment, hardware and software remaining from the Lageos-1 mission, technical consultation and launch of the Space Shuttle as a payload of opportunity with a planned launch in 1987.

NASA ACTIVITIES

UK

University Satellite — Co-Passenger to Landsat-5

UOSAT-B, an experimental scientific and educational satellite, designed at the University of Surrey (UK) was launched as secondary payload to LANDSAT-D prime on a Delta 3920 rocket from the Vandenberg Wester Test Range on 1 March 1984. The offer to launch the 60kg satellite free of charge was made in September 1983 and left Dr Martin Sweetings team only five months to design and build the satellite before transporting it to the US.

The spacecraft will join its sister satellite Uosat 1, launched on September 1981, in a 700km polar-synchronous orbit. Uosat 2 is both different and smaller than its sister craft and carries a range of scientific and engineering experiments for scientists, radio buffs and schools.

NEW SCIENTIST

FEATURES

Soviet Space Technology Helps Agriculture

By Valery Andronnikov, Chief, Laboratory of Aerospace Cartography of Soils, V.V. Dokuchayev soil Institute

Methods of the automated collection and processing of information from space vehicles have opened a qualitatively new stage in studies of the Earth's cover. this has made it possible to get a more exact picture of the USSR's natural, soil and agricultural resources by analysing information obtained from space vehicles. In developing agriculture use is made of space photography and the transmission of prompt photoelectronic television information from space vehicles.

Pictures of the Earth's surface from outer space are taken by the KATE-140 photographic camera on black-and-white, colour and multispectral film on a varying scale. The new type of the multispectral photography for the agricultural deciphering of areas under crops in the Salsk steppes was used for the first time in the USSR in 1973 from the Soyuz-12 and Soyuz-13 spaceships. Subsequently under the Intercosmos programme specialists of the USSR and the GDR worked out and manufactured (at the Carl Zeiss-Jena enterprise) the MKF-6 multispectral camera which today is widely used for photographing farmlands from space vehicles and planes in six regions of the spectrum.

Small-scale and medium-scale photography from space vehicles has made it possible to produce qualitatively new soil maps. For the territories of the USSR's dry steppe and desert zone the accuracy and completeness of the content of the soil cover on these maps is 1.5 to 2 times higher than on old topographic maps. For instance, it has been established for the Kalmyk Autonomous Republic that the use of space pictures for the needs of soil and soil-erosion mapping has permitted to attain saving 5 to 6 times higher than in cases when only ground-based methods are used. Pictures taken from space vehicles have allowed for the first time to clearly determine the zonal, subzonal and provincial boundaries of forest, forest-steppe and dry steppe soils, to reveal more accurately zones in the mountains and to determine soils of ancient deltas and ancient fluvial valleys.

For example, on the photo of a territory in Central Asia taken from the Salyut orbiting station scientists have seen for the first time the ancient delta of the Amudarya near the presentday delta of the river. On all existing soil maps of this region of Central Asia it has not been indicated since visually it has been impossible to spot it due to centuries-old alluvium. Now this region will be reclaimed and put to agricultural use.

By tonality, the small-contour texture of fields and sharp contrast the irrigated lands of the semi-desert and desert zone amidst dry bogharic soils are easily spotted on pictures taken from space vehicles.

On early spring pictures taken from outer space before beginning of field-work the different character of moistening reveals itself depending on the autumn tillage of fields. One can easily discern excessively moistened autumn-fallow fields, fields with autumn ploughing and fields in which stubbles of farm crops have remained since autumn. This information handed over on time to agronomists of collective and state farms makes it possible to determine the time of the start of the sowing campaign. Satellites of the Meteor type (the first such vehicle was launched in 1967) are used mainly for meteorological studies, but they are also partly applied for these purposes too. Promptly delivered data ensure the high efficiency of control over the state of farmlands, the estimate of the degree of humidity of soils, their readiness for tillage, the yield-capacity of crops and the productivity of hayfields and pastures.

On June 18, 1980, the Soviet Union launched the Meteor of the second generation. It carried three optical-electronic devices with low, medium and high resolution. For instance, from a picture of medium resolution contours of podzolized and leached black soils, and the degree of their erosion were determined for the forest-steppe zone and also the contours of grey soils on ploughlands and in forests. The Fragment multispectral scanning highresolution system is successfully used for the needs of agriculture. For instance, soils with differing fertility have been detected from the pictures of the steppe zone.

The determination of the type of soils and their erosion on the basis of high-resolution photographs of different times and regions of the spectrum has shown that the picture of the infrared region taken in spring provided the fullest information. As far as the information value is concerned, it was 4 to 8 times higher than the pictures taken in summertime.

The ALS and its Staff

by John Bruyn (ALS, User Services)

The Australian Landsat Station (ALS) began active operations in 1979 under the auspices of the Space Projects Branch of the Department of Science and the Environment which in November 1980 became the Department of Science and Technology.

On 1 March 1984 the responsibility for the Station was transferred to the Department of Resources and Energy as part of the Division of National Mapping. Since its inception, management of the Station has been effected by the Station Director, Mr Don Gray, with day to day operational activities being carried out under an Operations and Maintenance Contract by Fairey Australasia Pty Ltd.

Through their Field Services Division, Fairey employs personnel especially for the Australian Landsat Station contract, similar to their Defence related contracts. Fairey has a long history of Defence Industry involvement through its Operations Division in Adelaide. Activities include the design, manufacture and assembly of a wide range of precision mechanical, electronic and electro-optical devices such as structural components for aircraft, radar units, multispectral scanners, laser and night vision equipment.

The Australian Landsat Station operates on two locations, the Data Acquisition Facility (DAF) at Alice Springs and the Data Processing Facility (DPF) at Belconnen, in the ACT.

The DAF is located just south of Alice Springs in the CSIRO compound, and consists of a 9.2m steerable parabolic dish antenna and receiving, recording, maintenance and administrative facilities. The officer in charge is Mr Ian Lee of the Department of Resources and Energy while the Supervising Technician on the operations side is Mr Ben Douglas, who is assisted in operations and maintenance of the equipment by Wally Steckis, Warren Serone and Rainer Holdinghausen. Administrative support to the Alice Springs operation is provided by Jenny Heintze. The DAF receives the Landsat data direct from the spacecraft and records the information on High Density Digital Tape. The tapes are forwarded by commercial courier to Canberra on a daily basis for processing at the Data Processing Facility. The very high reliability of data acquisition is a credit to the DAF staff.

The Data Processing Facility (DPF) in Belconnen, ACT incorporates the headquarters of the Australian Landsat Station, its Director is Mr Don Gray and his Executive Officer is Mr Paul Jolly (acting). In charge of all contractor staff at the ALS is the Chief Engineer, Mr Bill Kempees.

Within the DPF, the contractor staff perform a number of functions. The computer area is run by the digital Engineer, Mr Robert Denize, his software specialist Mr Bruce Williams and his hardware specialist Mr Peter Pistoor. Assisting Bruce with software are the programmers Don Lawn and Peter Pianella, while Peter Pistoor is assisted in hardware maintenance by technicians Ces Langdown and Bill Howard. The ALS Interdata 832 and peripheral equipment are very skillfully operated by Mike Linney, David Brill and David Baily.

The photographic laboratory is run by Mr Tony Chiles, who is assisted by Mike Pasfield, Lindsay Piggott, Anton Albina and Joe Kucharski; all are experienced photographers and photo processing operators.

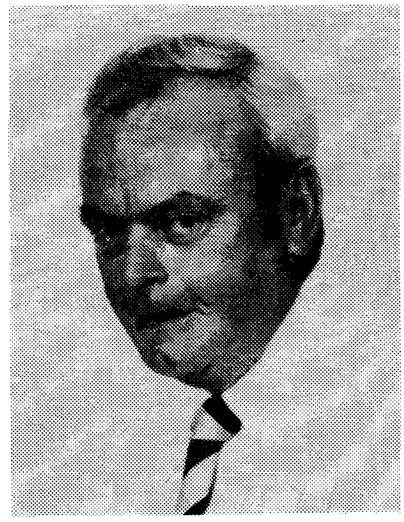
In the special applications area Mr Steve Dovey is assisted by promotions officer John Bruyn. The user services and administration/logistics sections are the responsibility of Colin Purbrick with Ted donnell and Sandra Browne looking after user services, while Bob Jones and Kevan McKenzie take care of administration and logistics. Secretarial and administrative assistance to the Station is very skillfully provided by Jill Rees, Linda Parker, Anne Brennan and Lynda Smith. To enable you to put faces to our names, have provided a current photograph of each of us on the next page.

The distribution of ALS products is achieved through a network of distribution centres (see page 31). All distributors provide browse facilities and have staff available to assist with scene selection and ordering and are able to help you with your enquiries.

Currently in progress is the establishment of Reference Centres (see back page) where advice in relation to the use of remotely sensed data, processing techniques and data interpretation techniques are available from experienced and highly qualified consultants.

Visits to the ALS facilities may be arranged through contacting Ian Lee (Alice Springs) on 089-523353 or John Bruyn (Belconnen) on 062-524409.

In Memoriam
Guy T Sherman



With much regret we advise of the passing away of our friend and colleague, Guy Sherman, on 25 September 1984.

Guy had been involved with the Space Tracking Industry for many years. He joined the Department of Science and Consumer Affairs in 1975 and was involved with the Australian Landsat Station since its inception.

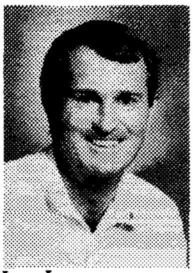
In 1981 Guy joined the Station as Executive Officer to the Director and became an important link between the Station's staff and the Public Service.

His passing is a loss to his family, his friends, the Station and to the remote sensing industry.

Don't Laugh–Our Faces!

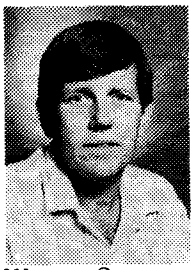
Australian Landsat Station staff as at 1 December 1984. Please read the preceeding text to see where we are and what we do.

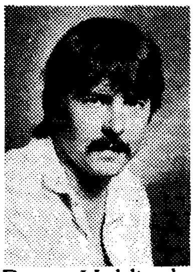
ALICE SPRINGS (DAF)


Ian Lee


Ben Douglas

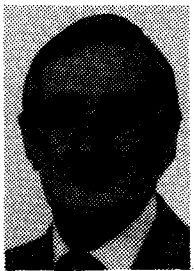

Wally Steckis

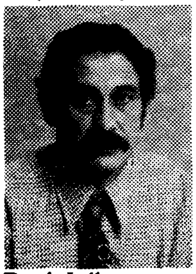

Warren Serone


Rainer Holdinghausen


Jenny Heintze

BELCONNEN (DPF)

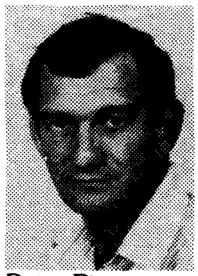

Don Gray


Paul Jolly

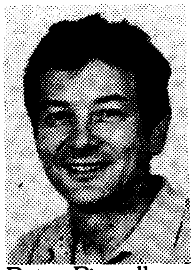

Bill Kempees


Robert Denize


Bruce Williams


Peter Pistoor


Don Lawn


Peter Pianella


Ces Langdown


Bill Howard


Mike Linney


David Brill


Tony Chiles


Mike Pasfield


Lindsay Piggott

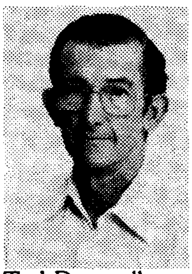

Anton Albina


Joe Kucharski


Steve Dovey

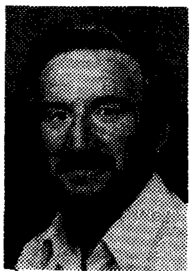

John Bruyn


Col Purbrick


Ted Donnell


Sandra Browne


Bob Jones

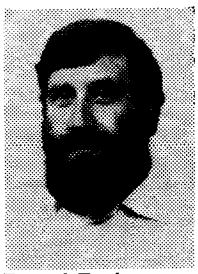

Kevan McKenzie

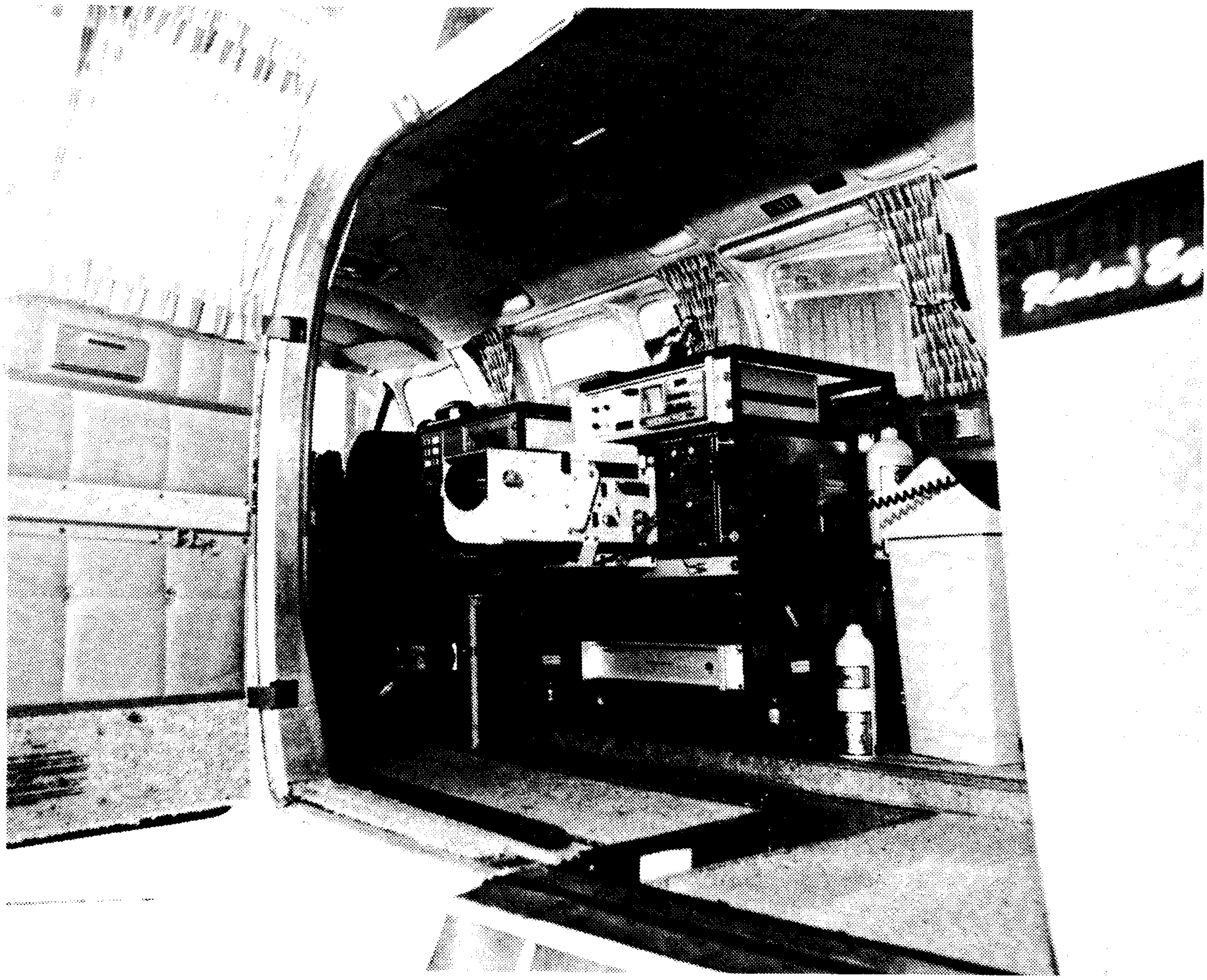

Linda Parker


Anne Brennan


Lynda Smith


Jill Rees


David Baily



NSCA (National Safety Council of Australia)

Remote Sensing Unit By Graeme Lacey (NSCA — Victorian Division)

During the past year, the Victorian Division of the National Safety Council of Australia has expanded their Remote Sensing Unit to provide improved logistic and tactical support in emergencies. The NSCA has also developed the first real-time application of remote sensing in Australia, through its Fire Detection and Mapping Program.

Aircraft fitted with multispectral line scanners fly missions over active fires, during day or night and through the thick smoke which usually accompanies forest fires. The key to the success of the program is the infrared detectors in the airborne scanners. They permit the thermal response from the ground to be imaged from elevations up to 5000m. the terrain covered by the track of the aircraft is printed immediately onboard the aircraft, showing the active fire front and burnt areas as well as accurate terrain detail; roads, ridges, watercourses and houses. These 'quick look' prints are dropped immediately to waiting firefighters. The image is also recorded on magnetic tape in the aircraft and relayed via a telemetry link to the Morwell headquarters. The recorded or transmitted signals can be further enhanced using an interactive image processor. The Council also has a digital mapping system to produce cartographic quality maps from generated imagery.

Other public safety applications that have involved the Remote Sensing Unit include search and rescue, locating boats and aircraft, and support for the Papua New Guinea Disasters Organisation. A scanner aircraft was flown over the Rabaul region to characterise the thermal patterns in the active volcanic craters.

The two Daedalus multispectral scanners in use can be fitted with detectors sensitive to wavelengths from ultraviolet, through visible wavebands and reflected infrared to the emitted infrared. The spatial resolution is determined by the flying altitude of the aircraft. Pixel dimensions from less than one metre to greater than 20 metres are possible. The airborne scanners can therefore be used for many remote sensing applications, especially for resource surveys in agriculture, forestry and mineral exploration. The spatial, spectral and radiometric resolution offered by the system permits the user to determine the optimum parameters in the multilevel sampling strategy, involving detailed ground survey and synoptic analysis using LANDSAT.

Satellites aid fish-finding in WA, possibly beyond

By D.G. Myers Satellite Technology Unit, School of Electric and Electronic Engineering, Western Australian Institute of Technology.

Fishermen in Western Australia are now receiving photographs indicating sea surface temperatures that have been prepared from satellite information.

It is a service that could be extended to include fishermen elsewhere, particularly in South Australia, if they are interested.

The maps at present are being sent to fishermen in Albany and Esperance, and of course are used mainly to indicate areas likely to attract schools of southern bluefin tuna. They should make the task of finding tuna schools — for both spotter planes and fishing boats — considerably easier and more efficient than in the past.

These photographs are the product of a three-year joint study between the Satellite Technology Unit of the WAIT School of Electrical and Electronic Engineering and the CSIRO Division of Groundwater Research.

The project's principal objective has been to find a correlation between sea-surface temperatures as detected by satellites, and fish catches, so that optimum fishing zones can be predicted.

The benefits expected of the research are significantly reduced operating costs for fishermen.

The project makes use of data broadcast by NOAA satellites. These satellites are named after their sponsoring agency — the National Oceanic and Atmospheric Administration of the US Department of Commerce.

They are general environmental monitoring satellites designed to complement US weather satellites. They sense reflected and emitted surface radiation, principally infrared radiation; some properties of the atmosphere immediately below the satellite; and the general state of the near space region.

The sensors measuring surface radiation give a result easily converted to temperature. In theory these results give surface temperature to a resolution of 0.2°C, but in practice various perturbations make it only 0.5°C. Nevertheless, that is well within the accuracy range of surface-based instruments.

NOAA has been able to ensure two satellites are always in orbit. Currently, NOAA-7 and NOAA-8 are the active pair, and while NOAA-6 still orbits, it has been placed on standby. the two satellites orbit about six hours apart. Their orbits are sunsynchronous, meaning they are fixed with respect to the sun, and so each scans every point of the earth once every 12 hours. Then four times a day it is possible to gain information on the temperature of the ocean.

Each satellite scans an area about 2500 km wide. Its resolution is one kilometre, as that is all that is needed in oceanographic and atmospheric studies. At any one receiving site the satellite is in view for about 16 minutes. Information collected in this period covers a vertical strip on the earth about 5000 km in length.

Thus four times a day it is possible to assess the oceans around the entire state of Western Australia, as well as the Southern Ocean down almost to the Antartic icepack, and northern waters to Indonesia.

The joint project uses a receiving system designed and built at the School of Electrical and Electronic Engineering under the direction of Dr Bill Carroll. Located on the WAIT campus at Bentley, a site about four km from the centre of Perth, the system can not only receive data from NOAA satellites passing over Western Australia, but also over eastern Australia. In fact as part of the project one pass a day over both Western Australia and the eastern States is archived.

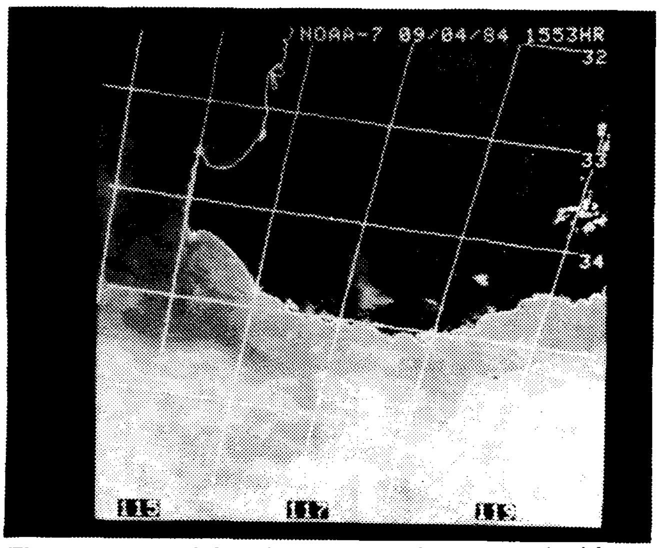
As a result the project now has a tape library of data collected for more than a year of the entire ocean area, from Bass Strait round to the Gulf of Carpenteria. Technical and siting difficulties make any regular reception of data on the eastern seaboard impossible.

Therefore, although the current project is aimed at the fishing areas off Albany and Esperance in the west, there is no reason why this work could not be extended to South Australia, or to help the establishment of new fishing industries on the west coast and in northern waters.

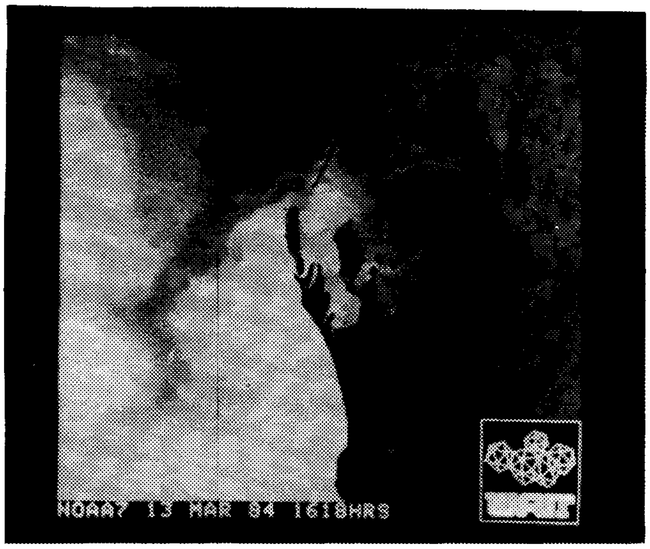
The joint project began in mid 1981. At that time WAIT had a satellite data acquisition system, and the elements of a processing system. CSIRO had a developed processing system and some years' experience in remote-sensing.

Overseas a number of successful projects had established the value of satellites in aiding the fishing industry, and it seemed to the joint co-ordinators, Dr Bill Carroll of WAIT and Dr Frank Honey of CSIRO, that this should be true for Australia as well. A proposal was put to the Fishing Industry Research Committee, (FIRC) and was accepted. FIRC agreed to pay for research from FIRTA funds over a period pf three years to prove the value of satellite data. (*Editor's note:* In late 1982 Dr Carroll left the prject, and his position is now occupied by the author.)

The project has been divided into three separate programs. The first year concentrated on developing some necessary equipment and the computer programs needed to process the data. Also, fishermen were visited to explain the project and the need for accurate catch data.



This is typical of the photo images being supplied by WAIT to fishermen in Esperance and Albany



This is a NOAA 7 image of the Shark Bay area, just south of the North-West Cape.

The second year concentrated on examining satellite imagery and the collected fish catch data to see if any definite pattern emerged. This proved to be more difficult than imagined and has been extended into the third year.

Finally the last phase will be to supply fishermen with satellite data and to determine if this leads to the benefits expected.

A crucial question here is — why sea-surface temperatures? How does knowing these aid the fishing industry? The answer lies in the behaviour of certain fish species. They congregate along the temperature gradients within the ocean, taking advantage of both the warmer and colder waters, where the latter are (presumed to be) nutrient-rich.

One example is tuna, although in Western Australia the situation is a little more complex than this description suggests.

Tuna are swept south by the warm Leeuwin current of the west coast from their breeding areas in the north. The boundary of this current tends to conform with the continental shelf; thus upwelling is notable along this boundary, and certainly tuna congregate here. Eddies also spin off from the current, trapping tuna within them. These eddies are frequently found to be valuable fishing sites. (One eddy discovered from a satellite photograph earlier this year produced 150 tonnes of southern bluefin tuna.)

While this relationship between ocean temperature and fish populations has long been known, it has been difficult to take advantage of it. Simply criss-crossing an area by boat is very expensive, and really quite out of the question. Using spotter aircraft is a possibility, and is certainly used both within Australia and elsewhere, but it, too, is expensive.

On the other hand satellites cost the fishermen nothing, they can examine an enormous area of the ocean, and they do so several times a day (and of course at night).

The only problem, if it can be called that, is that the equipment needed to process the data can be quite expensive. It is not at all unusual for $250 000 or more to be spent on facilities for this sort of work.

Like all research projects of this nature there have been both pluses and minuses from this work.

Some naive estimates were made initially on how much work could be done. It was thought that tuna, pilchards and salmon could be studied. However the value of work and the limited catch data avilable on the latter, has meant the major focus of the project has gravitated towards tuna.

Also on the negative side not enough effort was made to explain to fishermen this was a scientific research project with commercial implications, not the other way round. Coupled with the distance between the research teams in Perth and the fishing ports in the south, this lead to some discouragement amongst fishermen.

A hindrance to the project has been the truly staggering extent of cloud cover in southern waters. In winter months it has been almost impossible to view the ocean.

However, while at first this was considered a major impediment to the project, recent work has strongly hinted at a correlation between cloud structure and water temperature below. This is being closely investigated, and it may prove possible to identify warm features in the ocean by searching for particular cloud types.

On the plus side, there is no question of a successful outcome, although it will probably not be the outcome anticipated.

It has been found that just showing satellite photos to fishermen can benefit them enormously. Their own experience enables them to accurately assess probable fishing sites, and this seems to be as good as, or better than any analysis procedure likely to be developed.

Consequently a conclusion of the project is likely to be that the major 'problem' encountered was the difficulty in supplying information to fishermen.

Further to this, it has been found that a simple verbal description of sea conditions is of considerable value.

Thus a follow-up project proposal is most likely to cover the range of information services possible, and how to distribute that information quickly and efficiently.

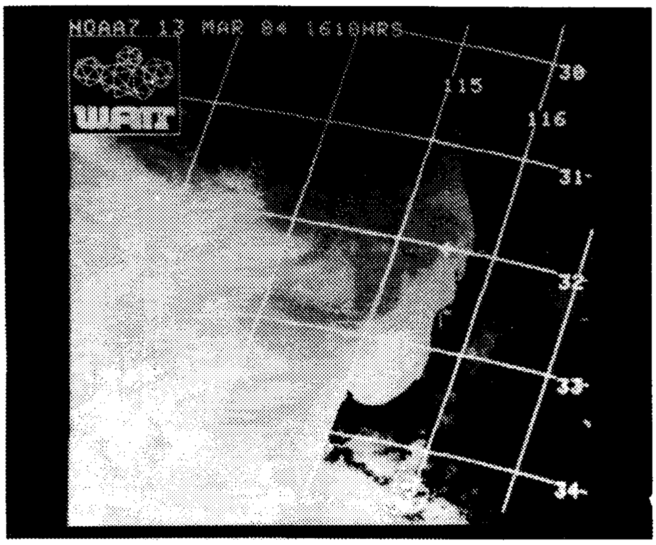
When the project began it was though a simple relationship between fish catches and sea surface temperatures should be found. That was what overseas experience implied.

It is not, however, what has been found. On the contrary, the correlation is proving to be rather complex and there appear to be numerous influences. Understanding these will require a closer investigation of the weather at the time, of the ocean as a whole, and of the behaviour of the fish. This problem will probably require many more years of study before it is completely understood.

At present, only two sites in Australia are capable of receiving NOAA data for such a service, namely WAIT and the CSIRO Division of Atmospheric Research in Victoria.

WAIT's current facilities are limited, being largely constructed by students over a period of several years. A major upgrade is needed, and that is very expensive. In fact, it is beyond the resources of the Institute.

Nevertheless WAIT is keen to maintain a strong presence in this area, and hopes to demonstrate the



A satellite view of south-western Western Australia.

effectiveness of satellite imagery to as many fishing groups as possible in the coming year.

I would welcome inquiries from fishermen in South Australia and elsewhere about any aspect of our satellite program, and how we might be able to help them. Write to me at the School of Electrical and Electronic Engineering, Western Australian Institute of Technology, Kent Street, Bentley, WA 6102, or telephone (09) 350 7700.

Framing Accuracy — A History

By Robert Denize (ALS Digital Engineer)

The accuracy of the centre of a standard Landsat bulk product scene has been of concern to both users and the Australian Landsat Station (ALS).

A look at the history of methods used and steps taken to get a reliable framing procedure brings together some interesting factors and explains why some of the earlier scenes made by the bulk Processing System (BPS) were so badly framed.

The scene centre of the Bulk Products are given in Latitude-Longitude; these centres are scattered about a nominal centre defined on the Worldwide Reference System (WRS).

To derive the actual scene centre for a Path-Row-Date, the BPS uses an orbital model of the spacecraft to calculate its position and hence the Lat-Long of the scene.

The inputs to this orbital model are:

i. Orbital elements referenced to a time or epoch
ii. Time

It is around these two inputs that most of the errors arise in framing of the BPS products and it is of interest to look at them in the context of the two Landsat types of spacecraft, Landsat 2/3 and Landsat 4/5.

Landsat 2/3

Input of Orbital Elements for these spacecraft were in the form of telexed Brouwer Mean Orbital Elements (BMOE's).

The telexed copy of the BMOE was received at ALS on a regular (sometimes daily and sometimes every second day) basis and contain the elements for the spacecraft orbit which were true at a particular time or epoch.

A number of errors arose from the use of telexed BMOE's, two major errors experienced were:

a. A transcribing error due to an operator reading the data off the telex and keying it into the input of the orbital program. Methods were devised to minimize this error but nevertheless errors did occur from time to time that were not gross (errors in the least significant bits of an orbital element number) but did distort the framing position.
b. The time from BMOE epoch to the time of the spacecraft orbit. This could be 24 hours and even on occasions approach 3 days, which meant that the orbital model was framing from a reference epoch of up to forty orbits in the past, although the usual case was around fifteen orbits.

LS 2/3 Time

The on-board clocks for these spacecrafts were allowed to drift up to four seconds before being reset.

To reduce this error in time, ALS, at its Alice Springs receiving site, records a separate timecode alongside the recorded MSS data. This timecode is held within 100 milliseconds of UTC, and so reduces time contribution to along track error to less than one kilometre.

For LS 2/3 we could not reliably get a framing accuracy much below about 20 kilometres, with occasional errors of up to 70 kilometres.

This was to change with the Landsats 4/5.

Landsat 4/5

A major change in the input of the orbital elements occurred when ALS was modified to process LS 4/5. These spacecraft continued as part of their telemetry downlink, to transmit orbital elements in the form of orbital state vectors. These vectors are uplinked to the spacecraft as predicted ephemeris data. As far as ALS is concerned, these orbital state vectors are read into the BPS on playback and so bypass the need for an operator to transfer BMOE's from telex. The orbital vectors provided by the spacecraft telemetry, and directly input to the orbital model of the BPS.

Another change with LS 4/5 was that the on-board clock is held within $\pm$ 20 milliseconds.

Both these factors have given the BPS more confidence in framing the scene centre to an accuracy better than 5 kilometres.

Sample measurements from recent LS 5 products gave measured framing errors less than 2 kilometres. This error is considered normal whenever good telemetered orbit vectors are used from the spacecraft. On the few occasions where telemetry is not available for one reason or another, BMOE's are used for the framing of the pass. The worst measured framing error for LS 5 for such passes is 8 kilometres.

Information on the spacecraft attitude especially in relation to the pointing of the MSS instrument at nadir is not used in framing of the scenes, the assumption is made that the spacecraft platform is very stable.

This assumption seems to be justified for the LS 4/5 series.

By Robert Denize
(ALS Digital Engineer)

Space Geology in the USSR

By V. Volkov, Deputy Minister of Geology of the USSR

Since its early years cosmonautics has opened up new and ample opportunities for many economic branches of the country. The country's geological service has become the principal customer for space information. Space photos, which cover vast areas, clearly show major geological structures, the study of which by conventional methods is hardly possible. Very often photographs of the Earth's surface, taken from outer space, show the structures which do not outcrop at the surface.

Prospecting work, based on the analysis of space photos, is divided into several stages. At the initial stage specialists compile comparatively small-scale specialised cosmogeological and mineragenic prognostication maps showing the elements of the Earth's crust structure which can be associated with the likely mineral deposits. At the second stage, geologists check on the spot the results of land observation from outer space. Completing the cycle is the purposeful prospecting for minerals.

Space geological mapping has been carried out in a planned manner with the aim of covering the entire territory of the country. For the first time in the history of geology, specialists compiled maps which show major structural elements detected by space technology. They include a cosmogeological map of linear and circular structures in the Soviet territory and the cosmophototectonic map of the Aral-Caspian region. In the course of the Tenth Five-Year Plan period cosmogeological maps with a scale of 1:1,000,000 and a 1:500,000 were compiled for vast regions of the country. The first of such maps was made for the BAM project zone and has helped to accelerate its geological survey. Cosmogeological maps have been compiled for vast areas of the Krasnoyarsk Territory, Yakutia, the north-eastern region of the USSR, Western Siberia, Western Kazakhastan and some other regions. This work helped specify the structural scheme of many regions, determine new regularities in the distribution of minerals. Specialists have recommended concrete directions of geological prospecting. It is planned to complete the mapping of the entire territory of the USSR by 1990.

In the process of regional mineral explorations, based on information obtained by space technology, specialists analyse, first of all, in detail the known ore and mineralised zones and regions. They have succeeded in specifying the size of early discovered ore zones and outlining them on maps. In the course of further processing specialists compare the known zones to similar structures on space images. The results of space image analyses and information on the composition and age of rock masses and manifestations of mineral resources, geochemical and geophysical anomalies are processed in a computer which gives the most promising regions for detailed survey.

On-the-spot examination of information supplied by deciphered space images has been completed in many regions and yielded important results. Information supplied by space technology has been confirmed by the discoveries of ancient igneous-tectonic rocks which are most promising for deposits of rare and noble metals in the Soviet Far East, copper-rich structures in the BAM zone, sectors of concentration of promising tin manifestations in Yakutia. This information has made it possible to make effective use of space images for prospecting for new deposits on the Siberian platform. Many of them follow the extensive web of fractures which are hard to detect by aerial photography or ground survey. Space images clearly show those fractures. This has made it possible to narrow the zone of geological prospecting. Specialists have made use of the latest technical facilities for thoroughly studying the materials of multi-zonal space photography on those zones. They determined first of all specific photo-anomalies and planned the flights of helicopters with aerogeophysical materials helped pinpoint the most promising sites for mines and boreholes. As a result, several highly promising deposits have already been discovered.

Manifestations of certain minerals are known to cause anomalies in landscapes clearly visible on space photos. Proceeding from this, scientists develop methods of direct explorations. It will not be feasible even in a more distant future to detect, and even less so, to reconnoitre a deposit by the means of space technology alone. Orbital land observation systems, which detect hitherto unknown structural regularities in mineralisation placement, facilitate the discovery of new deposits. This ensures a higher degree of geological prognostication authenticity and a well-substantiated choice of promising areas for purposeful geological survey and prospecting. Specialists of the industry have experimented with the quantitative evaluation of the likely efficiency of space geological mapping. Estimates have proved that the expected annual economic effect from the exploitation of the results of this type of work in planning the regional geological survey of the country's territory reaches 36 million roubles.

A network of specialised organisations and departments has been set up in the country to practically apply geological information, acquired by space technology and to ensure a material outcome. Space and aerogeological groups have been set up within the framework of regional geological associations. The development of remote sensing methods is coordinated by the Aerogeological association.

Other countries of the world also actively engage in the development of the remote sensing methods as a means for studying their mineral wealth. According to foreign experts approximately 70 percent of information supplied by space technology on the natural resources of the planet are utilised by geology.

Lately, several new and promising directions of geological explorations based on space technology have been developed, including the specifying of the material composition of rocks by the materials of aerial and space survey, the detection of anomalies which are associated with highly concentrated deposits of minerals, the determination of geophysical field characteristics required for the study of plutonic structures.

Scientists of the Ministry of Geology of the USSR in cooperation with specialists from other Ministries and departments have been designing new remote sensing instruments to be placed aboard planes. The inventions introduced over the past few years include the Vulkan IR imager, multispectral camera, side view radar system, on-board spectrometer and so on. They are all tested at special space and aerial geological proving grounds for the purpose of establishing the value of information supplied by remote sensing instruments. Specialists have designed special systems for introducing images of the planet surface into a computer for their further automated processing. They have also developed a complex of algorithms and programmes.

Geologists have grown accustomed to the use of space photos which ensure the further development of space geology, a new and important field of mineral wealth study.

(Izvestia, Abridged.)

Fourier filtering of Landsat 4 noise

By Don Lawn (ALS — Software)

A noise pattern was noticed by ALS staff on some LANDSAT-4 imagery. The fact that the noise did form a regular, ripple-like pattern indicated that it was coherent noise, and therefore subject to mathematical analysis and perhaps removable.

ALS staff undertook this analysis and attempted removal using Fourier transformation techniques.

The spectral signature of the noise showed clearly as a group of up to 30 narrow spikes in the frequency domain. The central and largest spike was found to lie in the vicinity of 28.5 KHz. the others appeared symetrically about this centre and appear to be harmonics of the main noise frequency, indicating non-sinusoidal noise.

By placing a gaussian notch at the centre of each noise spike, all noise and some image information is removed.

Mathematically, this is the same as multiplying the frequency spectrum by a filter function. The result in the image domain (after re-transforming back) is to convolve the image with the fourier transform of the filter function. This does remove the noise, but also introduces 'ghosting or ringing', especially in areas of high contrast i.e. beaches tend to repeat out into the ocean.

The method in implementation is as follows:

1. Collect magnitude frequency spectra of a number of lines
2. Design a filter function having notches at all noise spikes
3. For each line of data:
    a. Fourier transform it
    b. Multiply by the filter function (both real and imaginary components)
    c. Transform back to image space.

In practice, it was found that the noise characteristics vary slightly over an image, resulting in broadening of the lines, wider filter notches and hence more intense ringing (the magnitude of ringing is related to the loss of image data due to filtering).

An adaptive system was developed which redesigns the filter every 150 lines automatically. This greatly reduces the amount of data lost through filtering by using only the minimum necessary notch width.

The amplitude of the noise in raw data is slightly less than on quantum level.

Filtering of contrast stretched data results in pixel values being changed to fill in the unused quantum levels. Few pixel values are change beyond the next 'raw' pixel bin.

Effects for users

Photo interpretation

On unfiltered imagery, the noise is most visible on low contrast scenes and subscenes. Fortunately the filter works best on low contrast scenes (better automatic filter design and less convolution ringing).

Noise usually presents problems for photo interpreters only when fine, low contrast detail is being studied. In this case filtering can be a definite assest.

Digital processing/classification

If filtered imagery is used, several problems may arise.

a. ringing from adjacent areas may change the classification of an area arbitrarily
b. variations in filter function every 150 lines may change the classification of areas down the image.

Aesthetics

Providing that no problems areas such as beaches and ocean are present, a filtered image is generally more pleasing to the eye than an unfiltered one.

Official Opening of Landsat 84 Conference, Chevron Hotel, Surfers Paradise, Monday, May 21, 1984.

By Hon. Martin Tenni, Minister for Environment, Valuation and Administrative Services, and Chairman of the Queensland Remote Sensing Committee.

Mr. Rob Melloy (Conference Chairman)

Conference hosts, the Queensland Remote Sensing Committee our distinguished overseas and inter-state guests the Queensland Surveyor-General, Mr. Kevin Davies ladies and gentlemen it is a great pleasure to welcome you to Queensland.

I hope that your visit confirms the accuracy of all those magnificient cloud free images of Queensland we get from the Australian Landsat Station each winter.

I congratulate your hosts, the Queensland Remote Sensing Committee, for their hard work and good organisation, and the sponsors for their generous assistance in making this conference possible.

I am not too sure of the significance of George Orwell's thoughts on 1984, but am assured by the committee that the timing of this conference is purely coincidental.

Certainly, Mr. Chairman, your conference follows the very successful Landsat 81 held in Canberra and Landsat 79 held in Sydney.

It is very appropriate too that your conference is being held in Queensland.

Without such an information tool as remote sensing, we would be hard pressed indeed to provide all of the data needed to research and manage a state the size of Queensland.

It also happens to be the 60th anniversary of the first government use of aerial photography in the Mt Isa region, the official birthplace of remote sensing technology in this state.

Appropriately, remote sensing with satellites is today playing a very important part in the discovery of new mineral finds in the Mt. Isa region.

A great deal has happened in those 60 years.

There are many benchkmarks on which to gauge our progress in satellite technology but it is worth noting that since Sputnik 1 went into orbit in 1957, there have been some 14,000 man-made objects put into space.

Although scientific knowledge has gone ahead in leaps and bounds, it is sadly true that we are still in a world torn by many of the religious and racial differences, national fervour and jealousies of a century ago.

Faced with such a world of strife and turmoil, it is well worth recalling that remarkable view of our earth which only satellite cameras or astronauts have seen.

From the vantage point of space, none of the tensions and rivalries and national boundaries that divide us are visible.

All we see is a fragile blue planet surrounded by oceans of darkness.

Such a remarkable view draws our attention to the point that we live in a world finely balanced between development and prosperity on the one hand and over exploitation, misuse and pollution on the other hand.

In the sixties and seventies, the debate about the future management of our planet, certainly in many western countries, often came down to an argument between two rival lobbies — the developers who said 'if it's there, dig it up' and the conservationists who said 'if it's there, lock it up, don't touch it.'

It was not surprising then that governments faced a difficult choice trying to strike a balance in ensuring prosperity and employment while preserving unique and beautiful areas of our natural environment.

The arguments go on although I hope in a more mature fashion today.

I believe that in making rational judgements about our future land use and management today we now have the opportunity to reach more informed conclusions on environmental issues thanks to the technology of remote sensing.

Queensland, like other Australian states, has been quick to use this new technology in a wide variety of applications ... from bushfire, flood and drought research, estimating crop yields, wetlands research, mineral and oil exploration to land use planning.

It is to the credit of Queensland's Surveyor-General, Mr. Kevin Davies that the State Mapping Authority, the Departments of Mapping and Surveying, has invested so heavily in Landsat research.

You will forgive me for being just a little parochial in saying that I am proud of the fact that the department's Sunmap Centres currently have the highest sales figures in Landsat data, of any Australian state.

Sadly, at a time when State Governments are seeking *more* not less resources information, we find ourselves in a situation where we cannot realise the full potential of such an important remote sensing tool as Landsat.

It is a tragedy that Federal Government short-sightedness, in refusing to honour the Fraser government's commitment to upgrade the Australian Landsat Station, has denied us access to the more accurate and detailed data avialable from the lastest generation of earth resources satellites, Landsat 4 and 5.

Such a technological 'cringe' by the Federal Labour Government is even the more surprising given their publicly stated commitment to the environment.

In recent years, Australia has had a well deserved reputation for being at the forefront of new technology ... the progress in radio astronomy, the development of the Jindalee over-the-horizon radar and the revolutionary automatic landing system for aircraft are three examples.

The America's cup victory showed the world that given the dedication and research, we can come up with the technology to match even the very best of American 'know how'.

It is a sad commentary that the full benefits of using Remote Sensing over such a vast continent as Australia are being lost because we cannot receive the better quality data from satellites which at this very moment are transmitting such data to other nations of the world.

In short, we find ourselves in a situation where other countries can know more about us then we do ourselves.

Rather than allow Australia to slip further into a 'technological backwater', I would like to see this conference move strongly to seek a commitment from the federal government in their August budget to outlay the estimated $13.5 million needed to upgrade the Australian Landsat Station.

I can assure you that in such a move you will have the full support of this government.

Despite this present dispute, I feel confident that most governments recognise the importance of remote sensing technology to Australia's future land use management, planning and mineral exploration.

However, while governments are prepared to listen, I believe that you, as leaders in your various fields, also must share some responsibility in getting your message across more effectively to the policy makers.

To do this, I believe that priority needs to be given to the development of a national policy on space, including the very important aspect of remote sensing.

Such a policy will ensure that both the Commonwealth and State Governments are clearly aware of the vital role space technology can play in the management of our natural and man-made resources.

The public controversy about Australia's communication satellite Aussat and the deplorable failure of the Federal Government to upgrade the Australian Landsat Station are symptomatic of the fact that there is currently no co-ordinated national policy on the use of the important resource of space.

Unfortunately, issues such as the ownership of Aussat and the presence of the American space facilities have overshadwoed the more basic priority of establishing a credible space and remote sensing industry to service Australia's needs and create new export markets.

One of the best examples of Australia's leadership in remote sensing technology has been the development of the airborne laser depth sounder which promises to revolutionise the charting of our coastal seabed.

I believe this technology presently languishes somewhere in the defence 'ivory towers'.

It would be a tragedy if the commercial potential of such a development was left to another nation.

There is the distinct danger that unless the present fragmented approach to the research and development of space is not changed, we will become a 'technological backwater' when compared with our rapidly developing Asian neighbours.

Faced with such an unhappy future, where do we begin.

The Chinese have a quotation that is most apt.

It says that the longest journey begins with the shortest step.

May I suggest that the long journey towards the creation of a co-ordinated policy on space could be assisted by a first step — the development of a more unified policy on remote sensing.

This conference could play an important part in that process by the circulation to Federal and State Governments of resolutions seeking such a move.

The development of such a policy will ensure that all governments are clearly aware of the advances and advantages of remote sensing technology.

Most importantly, as professionals scattered widely across the nation, you will be speaking to governments with greater unity and clarity.

Thank you, Mr Chairman, for giving me this opportunity to speak at your conference.

I wish your discussions over the next five days every success.

I do hope you will take back to your respective states and countries some fond memories of your stay in Queensland ... not to mention some happy memories of one of our major resort areas.

It gives me great pleasure, ladies and gentlemen, to declare Landsat 84 officially open.

Landsat 84 — Keynote Address

Dr Ken McCracken, Chief of the CSIRO Division of Mineral Physics, delivered the Keynote Address at the LANDSAT 84 Conference at Surfers Paradise.

The following is a summary of what he said.

Space technology was God's gift to Australia in its war against the tyranny of distance, he said. 'Calamitous inertia had allowed the first 27 years of the Space Age to pass without national recognition of the vital role of space in resources management, economics and employment.'

The primary objective of a national space policy should be the development of an Australian space industry that would both satisfy part of Australia's space needs, and also export selected space technology throughout the world, he said.

By 2000 AD, Australia would own satellites and associated ground equipment worth $4 billion (1984 Dollars). A national space policy is urgently required to provide the environment in which Australian industry would have the opportunity to supply part of this equipment.'

'The absence of a space policy over the past two decades has resulted in virtually the whole of the three AUSSAT spacecraft being purchased from overseas, with the loss of at least 5,000 man-years of employment.'

As a prime example of the damage being caused to the whole Australian economy by the absence of a space policy, he cited the delay in the upgrading of the Australian Landsat Station.

While countries such as India, Brazil, China and Sweden have upgraded their receiving stations to receive the high resolution images now being transmitted by the latest of the LANDSAT satellites, LANDSAT 5, the Australian government had repeatedly deferred such modernisation.

'As a consequence, the Australian Landsat Station will be inoperable after 1986.'

'From that date, other countries will be able to receive the LANDSAT pictures of Australia, but we will not.'

'From that date, Australian resource managers will not have the LANDSAT images they need for agricultural, hydrological, environmental, engineering, and geological purposes.'

'Trade officials, and commodity managers in foreign countries would know more about Australia's future supply of wheat and other grains than would our own officials.'

Dr McCracken said this situation was due to the fragmented Australian approach to space technology, and to a lack of vision and understanding of the manner in which space technologies are changing the whole world.

He called for a national space policy that would lead to

- provision of the new space technologies that Australia will need, in a timely and cost-effective manner
- provision of an environment in which Australian industry would acquire the skills and facilities to supply Australia's future needs
- Australian participation in international spacecraft consortia thereby reducing the costs of space technology to the nation
- technological spin-off to other important parts of the Australian economy, such as communications, computing, scientific instrumentation, and mining
- direct and indirect employment that could reach 30,000 by the year 2000.

Landsat 84 Technical Exhibition

Opening Address by Mr Con Veenstra, Director, Division of National Mapping, Department of Resources and Energy.

Mr Chairman, distinguished guests, ladies and gentlemen, thank you, Mr. Chairman for your introductory remarks

I feel honoured to have been invited to open the technical exhibition at this prestigious conference and I thank the Minister for Environment, Valuation and Administrative Services, the honourable Martin Tenni, for his invitation and the privilege afforded to me.

As most of you will be aware, responsibility for the Australian Landsat Station was transferred on 1 March this year from the Department of Science and Technology to the Department of Resources and Energy, and specifically to my division, the Division of National Mapping.

This does not mean that National Mapping is a newcomer to the field. Prior to the establishment of the ALS, the division was responsible for holding Landsat data of Australia obtained from the USA, and our land use mapping programs have made extensive use of satellite data for a number of years.

We feel that having the ALS within our area of responsibility is an eminently sensible arrangement since it has the advantage of closely associating data acquisitions and dissemination with a section of the user community where the requirements and problems are well understood and I am referring to resource assessment, land use and topographic mapping.

It is my intention that, within the limits of the resources provided, the ALS will continue to provide, improve and expand on the services and products it offers to the user community.

Technical exhibitions are an important adjunct to conferences and symposia as they provide the practitioners of the disciplines concerned with an opportunity to see the latest and best that is available in their 'tools of trade'.

This particular exhibition is indicative of the state to which Satellite Remote Sensing has matured.

On display is information on subjects ranging from upcoming satellites through data acquisition, dissemination, research, analysis and interpretation.

There is international representation from the USA, Canada, France and Australia.

Remote Sensing relies heavily on the computer and photographic industries. It is not surprising therefore to see recognised expert companies well represented with the latest in equipment and services.

Consultant services are now a well established part of the Remote Sensing scene in Australia and these too are represented in the exhibition.

I believe that it is incumbent on both the delegates to the conference and the exhibitors to take advantage of the opportunity this technical exhibition offers for exchange of information:

- for industry to make known what equipment and services are available
- for people working in the field to make their needs and problems known to industry
- and for people working in the field to note and consider the possible application, of research and the work of their colleagues, to their own situations.

Accordingly, I highly commend the technical exhibition to all attending this Landsat 84 Conference, and have much pleasure in formally declaring it *open*.

Landsat 84 Conference Dinner, Surfers Paradise, 24 May 1984
Remote Sensing and the Future

Extracts from speech by *Dr Mortimer Tracy,* M.Sc., Ph.D.(Lon.), F.R.C.O.P.(Hon.), Principal Scientific Officer in the Officer of the Commissioner of the Metropolitan Police, London.

'Given my background with the force, I'm tempted to begin by saying 'Hullo-hullo-hullo-; but we've had our departmental budget cut by about 83% recently, so I'll abbreviate it to 'Hi'. I'm further attracted by the idea of opening tonight's lecture with the rather plodding old line: 'I was proceeding in a northerly direction'. But, of course, I was not. I was *supposed* to be, but the pilot was holding his satellite photograph up the wrong way . . .

The main problem (in relation to applying remote sensing techniques to the discovery of buried bodies) occurs where . . . the buried body is not in fact dead. One solution to this might be a system of *human colour-coding* which would give a clear indication . . . as to the state of health of the person under surveillance. Now, much needless searching could be eliminated if, on dying (or, preferably, just prior to it), the subject were able to paint himself, say, *black.*

But then, why not follow it through? Why not help us to distinguish, not just between dead and alive, but between different stages of life: brown for infants, green for students, red for adults, yellow for pensioners and the unemployed, cerise or plum for homosexuals, half of each for transvestites, blue for sex offenders, white for virgins, and clear for politicians. (It wouldn't matter if they *had* a colour: you'd see straight through them *anyway.*)

'With the clever use of multiple spectrographic filters, we could thus determine not only what citizens were up to but also what *priority* we should then attach to tracking down a particular wrongdoer. For instance, a remote-sensing result of clear on yellow would not rate very highly on our scale of urgency, since politicians are always doing something to either pensioners or the unemployed. And an all-brown reading is similarly harmless, because babies are always doing . . . ah, well, doing something similar.

'But a green/cerise/plum/blue/white exposure would seem to indicate that something very untoward is going on between students, homosexuals, transvestites, sex offenders and virgins, or, at the very least, that it's a ruddy good orgy and we (as custodians of the community) ought to be jolly well represented, if not as participants then certainly as immensely interested observers . . .

'As we all know, if it's green or wiggles, it's geology; if it stinks, it's chemistry; if it doesn't work, it's physics; and if you can't work out *what* the blazes you're looking at, it's that bleedin' *remote sensing!*'

☆ ☆ ☆

With the emergence of 'Dr Tracy's' alter ego, the title of his learned address ('Remote Sensing and the Future: Is What We See Really What We Get?') took on an even more ambiguous dimension!

☆ ☆ ☆

Dr Mortimer Tracy was later revealed to be the 425th character of Melbourne comic speechmaker Campbell McComas.

Landsat 84 — Looking Back

By Rob Melloy
Conference Chairman

In early 1982, the Department of Mapping and Surveying decided to support the holding of a Third Australasian Remote Sensing Conference. The proposal was to follow up the successful conferences in Sydney and Canberra by holding Landsat 83 in Queensland.

Some important decisions were taken very early. A conference committe was formed from members of the Queensland Remote Sensing Committee and a Chairman elected. Possible locations were surveyed and the Great Barrier Reef, Sunshine Coast and Brisbane were rejected in favour of the Chevron Paradise Centre on the Gold Coast. Finally the date of the conference was fixed, not in 1983 as proposed but in May 1984.

Early planning produced constitutions for the conference committee, final dates for important actions and a list of activities to be held prior to, and during the conference.

All of this early planning was forgotten, however, as the time got closer and issues began to emerge, the thematic mapper was not going to be available, ALS changed Departments, meteorological data became more important. Delegates would want more involvement than just listening to papers, sponsors needed to be found and the proceedings printed early.

As with most conferences, the original estimates of attendances looked as though they would not be realised, mining companies had no money and financial disaster seemed assured. None the less, the committee prepared 450 satchels and printed 600 proceedings while praying that there would be a last minute rush of registrations.

The committee members, by the opening session, were almost physical wrecks — would the last of the major speakers arrive on time? Would the Minister's helicopter be called to rescue a lost mountaineer, or the lost conference committee? The course of action set in motion 24 months earlier was not to end in disaster, the conference opened on time, all the speakers were there, and the final run on registrations had actually happened.

Did the conference committee relax?

Relax? — not on your life — not with 400 delegates from 10 countries to look after of which 280 were not even from Queensland.

There was more to worry about — Presented Papers, Poster Papers, Workshops, Think Tanks, Exhibition, Meetings, Dinners, Boat Trips, Lunches — how would they run? Would the delegates technical appetite be satisfied? Had enough been allowed for food? Would they fall asleep during 11.00 a.m. overseas speakers 'Keynote Address' spot, after a heavy night of 'Surfers Paradising'.

Much to the relief of the committee, everyone seemed to know where they were going, there weren't too many frowning faces (even when suffering from an excess of the night before) and most activities were well attended.

In particular, it was most gratifying to see that delegates were relaxing and exchanging ideas, information and experiences. The committe had aimed at creating an environment where this would happen, but even our wildest hopes were exceeded. The only strained looks came from committee members when it was suggested that Queensland should host the next conference.

By Friday night the committe members were either flat on their backs or deep in the account books. No thoughts would be given for some weeks to the high points of the conference — Dr. Mortimer Tracy, Dean Graetz's 'guru waddle', Think Tank discussions, the Booze Cruise, the Technical Exhibition and the making of many friends.

Call for Papers and Newsworthy Articles

John Bruyn (ALS User Services)

The LANDSAT '84 conference showed that the remote sensing industry is a hive of activity. Many of you are so busy in fact that you can hardly find the time to 'write up' your projects and thus limit your communication to those few that you have close contact with.

The Australian scientific community is often accused of not being vocal enough and so have poor public relations.

Comments by a number of speakers and the lack of TM-SPOT receiving and processing facilities in Australia clearly indicate that our remote sensing industry is no exception.

The current Canadian position (see articles p. 10) illustrates that things can be different for those who get their act together.

Many enquiries directed to the ALS staff during the LANDSAT '84 conference and elsewhere demonstrate the need for publication of both the successes and limitations of various remote sensing instruments.

In an attempt to bridge the gap between those that are actively using remotely sensed data and those that do not, we would like you to communicate your experience by publishing in this newsletter.

Several of our remote sensing 'Gurus' have promised their contribution to our next issue, in which we hope to feature some more colour. So, don't leave to the Gurus what you can do today!

Let us have your contribution before 31 March 1985.

AUSTRALIAN LANDSAT STATION

LANDSAT 5 ACQUISITION CALENDAR

1985 PATH SEQUENCE

PATH / MONTH	84 100 116	85 101 117*	86 102 118*	87 103 119*	88 104 120*	89 105	90 106	91 107	92 108	93 109	94 110	95 111	96 112	97 113	98 114	99 115 83*
January	6 22	13 29	4 20	11 27	2 18	9 25	16	7 23	14 30	5 21	12 28	3 19	10 26	1 17	8 24	15 31
February	7 23	14	5 21	12 28	3 19	10 26	1 17	8 24	15	6 22	13	4 20	11 27	2 18	9 25	16
March	11 27	2 18	9 25	16	7 23	14 30	5 21	12 28	3 19	10 26	1 17	8 24	15 31	6 22	13 29	4 20
April	12 28	3 19	10 26	1 17	8 24	15	6 22	13 29	4 20	11 27	2 18	9 25	16	7 23	14 30	5 21
May	14 30	5 21	12 28	3 19	10 26	1 17	8 24	15 31	6 22	13 29	4 20	11 27	2 18	9 25	16	7 23
June	15	6 22	13 29	4 20	11 27	2 18	9 25	16	7 23	14 30	5 21	12 28	3 19	10 26	1 17	8 24
July	1 17	8 24	15 31	6 22	13 29	4 20	11 27	2 18	9 25	16	7 23	14 30	5 21	12 28	3 19	10 26
August	2 18	9 25	16	7 23	14 30	5 21	12 28	3 19	10 26	1 17	8 24	15 31	6 22	13 29	4 20	11 27
September	3 19	10 26	1 17	8 24	15	6 22	13 29	4 20	11 27	2 18	9 25	16	7 23	14 30	5 21	12 28
October	5 21	12 28	3 19	10 26	1 17	8 24	15 31	6 22	13 29	4 20	11 27	2 18	9 25	16	7 23	14 30
November	6 22	13 29	4 20	11 27	2 18	9 25	16	7 23	14 30	5 21	12 28	3 19	10 26	1 17	8 24	15
December	8 24	15 31	6 22	13 29	4 20	11 27	2 18	9 25	16	7 23	14 30	5 21	12 28	3 19	10 26	1 17

* PATH NOT NORMALLY ACQUIRED

DATES SHOWN ARE LOCAL (GREENWICH DATES ARE INDICATED ON IMAGES)

AUSTRALIAN LANDSAT STATION

LANDSAT 5 ACQUISITION CALENDAR

1985 DATE SEQUENCE

PATH / MONTH	84 100 116	91 107	98 114	89 105	96 112	87 103 119*	94 110	85 101 117*	92 108	99 115 83	90 106	97 113	88 104 120*	95 111	86 102 118*	93 109
January	6 22	7 23	8 24	9 25	10 26	11 27	12 28	13 29	14 30	15 31	16	1 17	2 18	3 19	4 20	5 21
February	7 23	8 24	9 25	10 26	11 27	12 28	13	14	15	16	1 17	2 18	3 19	4 20	5 21	6 22
March	11 27	12 28	13 29	14 30	15 31	16	1 17	2 18	3 19	4 20	5 21	6 22	7 23	8 24	9 25	10 26
April	12 28	13 29	14 30	15	16	1 17	2 18	3 19	4 20	5 21	6 22	7 23	8 24	9 25	10 26	11 27
May	14 30	15 31	16	1 17	2 18	3 19	4 20	5 21	6 22	7 23	8 24	9 25	10 26	11 27	12 28	13 29
June	15	16	1 17	2 18	3 19	4 20	5 21	6 22	7 23	8 24	9 25	10 26	11 27	12 28	13 29	14 30
July	1 17	2 18	3 19	4 20	5 21	6 22	7 23	8 24	9 25	10 26	11 27	12 28	13 29	14 30	15 31	16
August	2 18	3 19	4 20	5 21	6 22	7 23	8 24	9 25	10 26	11 27	12 28	13 29	14 30	15 31	16	1 17
September	3 19	4 20	5 21	6 22	7 23	8 24	9 25	10 26	11 27	12 28	13 29	14 30	15	16	1 17	2 18
October	5 21	6 22	7 23	8 24	9 25	10 26	11 27	12 28	13 29	14 30	15 31	16	1 17	2 18	3 19	4 20
November	6 22	7 23	8 24	9 25	10 26	11 27	12 28	13 29	14 30	15	16	1 17	2 18	3 19	4 20	5 21
December	8 24	9 25	10 26	11 27	12 28	13 29	14 30	15 31	16	1 17	2 18	3 19	4 20	5 21	6 22	7 23

* PATH NOT NORMALLY ACQUIRED

DATES SHOWN ARE LOCAL (GREENWICH DATES ARE INDICATED ON IMAGES)

Landsat Reference Centres

A new concept in dissemination of information on LANDSAT data was announced with the introduction of designated Reference Centres.

With the recent additions of one centre in Sydney and two in Perth there are now five such Reference Centres.

Each centre will hold a full range of ALS image samples and a complete set of the micro image and data catalogues. In addition, each centre will hold a range of other reference and promotion material, and will establish a comprehensive library of images covering the whole of the ALS acquisition area.

To qualify to become a designated Reference Centre, centres must have the necessary expertise and facility to be able to demonstrate, give advice and provide guidance in analytical and interpretive techniques of LANDSAT data.

The following centres have been selected to be ALS designated Reference Centres:

BRISBANE
Department of Mapping
and Surveying
Research and Development Branch
Watkins Place
288 Edward Street
Brisbane QLD 4000
Phone: 07-2244881
Contact: Ms Linda Collins
Ms Gail Kelly

TOWNSVILLE
James Cook University
Economic Geology Research Unit
C/- Geology Department
James Cook University of North
Queensland
Townsville QLD 4811
Phone: 077-814726
Contact: Professor John Stephenson

SYDNEY
University of New South Wales
Centre for Remote Sensing
Geography and Surveying Building
Barker Street
Kensington NSW 2033
Phone: 02-6974964
Contact: Dr John Richards
Dr Bruce Forster
Dr Tony Milne

PERTH
University of Western Australia
Department of Geography
Nedlands WA 6009
Phone: 09-3802696
Contact: Dr David Murray
Mr Vivian Forbes

PERTH
WA Institute of Technology
Surveying and Mapping Department
Kent Street
Bentley WA 6102
Phone: 09-3507566
Contact: Dr Claude Collet
Mr Graeme Wright

Newsletter

The Australian Landsat Station Newsletter is published and distributed free of charge and in the interest of exchange of information related to the ALS product user community and the remote sensing industry.

Comment concerning ALS products, services, systems and related remote sensing activities are the responsibility of this Station and is subject to change with changes in its operational status. Reference to other publications, to data applications and interpretations to services and systems, to research programs and notices is made at the discretion of the ALS and is published in good faith.

The Australian Landsat Station welcomes contributions and comments from readers with a genuine interest in remote sensing or remotely sensed data.

Interested persons/organisations are kindly requested to complete the application slip.

If you have moved please let us know your new address so we may amend our mailing list.

All correspondence should be directed to:

ALS Newsletter
PO Box 28
BELCONNEN ACT 2616
AUSTRALIA

ALS Newsletter

SEND TO: Australian Landsat Station,
PO Box 28, Belconnen, ACT
Australia, 2616

Please amend your mailing list for future issues as folows:

NAME: ....
Please use block letters

ORGANISATION: ....

ADDRESS: ....

.... Postcode ....

PREVIOUS MAIL ADDRESS: ....

.... Postcode ....

INTEREST: General ☐ Professional ☐
Please tick appropriate box

APPLICATIONS: ....

DATE: ....

Landsat Products

Processed satellite images and related products are available from the Australian Landsat Station. Bulk images are available as monochrome and colour photo transparencies or photographic prints in various scale formats; and as image data on Computer Compatible Tapes (CCTs) for user manipulation. Precision images are available in the same forms with some user selected enhancements, or non-routine radiometric/geometric corrections.

Image and data catalogues are both available in microfiche form. Catalogues may be viewed at State Browse Centres, at the ALS Data Acquisition Facility (DAF), and at the ALS Data Processing Facility (DPF). Acquisition calendars, satellite coverage diagrams, and product price lists are available free on request from the Australian Landsat Station — or from the Browse Centres listed below. Orders for products can also be made through these Centres.

CANBERRA

Australian Landsat Station
22-36 Oatley Court
Belconnen ACT 2617
Phone 062-515411
Telex AA61510 LANSAT

MELBOURNE

Map Sales
Dept of Conservation, Forests & Lands
25 Spring Street
Melbourne VIC.
Phone 03-6513024

BRISBANE

Sunmap
Aerial Photography Section
Dept of Mapping & Surveying
11th Floor, Watkins Place
288 Edwards Street
Brisbane QLD
Phone 07-2247876

ALICE SPRINGS

Australian Landsat Station
CSIRO Compound
Heath Road
Alice Springs NT
Phone 089-523353

MELBOURNE

Air Photographs Pty Limited
625 Burwood Road
Auburn VIC.
Phone 03-821966

ADELAIDE

Mapland
Department of Lands
12 Pirie Street
Adelaide SA
Phone 08-2272675

SYDNEY

Map Sales
Lands Department Building
23-33 Bridge Street
Sydney NSW
Phone 02-20579

HOBART

Tasmanian Government Publications Centre
134 Macquarie Street
Hobart TAS.
Phone 002-303382

PERTH

Central Map Agency
Dept of Lands & Surveys
Cathedral Avenue
Perth WA
Phone 09-3231349

SYDNEY

Technical & Field Surveys Pty Ltd
250 Pacific Highway
Crows Nest NSW
Phone 02-4383700

DARWIN

Survey Mapping Division
Dept Lands & Housing
Moonta House, Mitchell Street
Darwin NT
Phone 089-897572