VOL 2 No 2
ISSN 0725-069X

November 1982

NEWSLETTER

AT LAST — THE LANDSAT 4 ISSUE!

On Saturday, 17 July 1982 (Australian time), Landsat 4 was successfully launched after a support aircraft delay had put it back from the week before.

The MSS was successfully activated on the following day. A series of orbit adjusts commenced and NASA successfully positioned Landsat 4 in synchronization with its World Reference System on 29 July 1982 with a descending node equatorial crossing at 9.38 am local solar time.

The orbit adjust positioned Landsat 4 initially 4km west of the WRS nominal paths from which point the satellite would drift slowly to the east. Further orbit adjusts were planned to maintain the satellite within ±5km of the nominal WRS paths, but on 17 August 1982 it was announced that higher than anticipated drag precluded routine maintenance of Landsat 4 orbit to within ±5km of WRS paths as originally planned and that NASA had revised the limit to ± 10km as of that date.

Meanwhile, NASA had notified ALS that Landsat 4 MSS acquisition start-up over Australia would be 10 August 1982, following start-up over the USA on 3 August. At present (October 1982) Landsat 4 is still in an engineering test mode; the MSS appears to be satisfactory.

The Thematic Mapper (TM) has also been activated and initial assessment is that all bands have good response, definition and registration. Enclosed with this Newsletter is a band 3 (630-690 nonometre) TM image of the Detroit, USA/Windsor, Canada area at an approximate scale of 1:600 000. Note the definition of highways, urban areas and shipping in the Detroit River. This photograph has been copied from a print and "production" quality would be better.

The Tracking and Data Relay Satellite System (TDRSS) antenna which initially failed to deploy correctly, has now fully deployed and has full movement range. TDRSS antenna manipulation during a special test between 13 and 21 August 1982 had caused attitude perturbation. That test is not expected to be repeated and steps were taken to restore normal spacecraft functioning.

LANDSAT 4 MSS MODIFICATIONS

Station modifications are necessary in order to process Landsat 4 MSS imagery because of changed orbit, changed MSS optics and a completely different telemetry system. A contract was signed late in September 1982 to undertake this modification.

Adequate funding has been provided in the 1982/83 budget to complete the MSS modifications and it is anticipated that Landsat 4 Bulk products will be available by June 1983, with Precision products being available by July 1983.

LANDSAT 4 ORBIT AND COVERAGE

Landsat 4 has assumed a repetitive, circular, Sun-synchronous, near-polar orbit at a nominal altitude of 705km over the Equator. The satellite crosses the Equator in the descending node at approximately 9.38am on each pass. Each orbit takes nearly 99 minutes and the spacecraft completes just over 14½ orbits per day, covering the entire Earth (poles excepted) every 16 days.

This compares to the similar but higher orbits of Landsats 1, 2 and 3, which had altitudes of 920 km, completed each orbit in 103 minutes (14 times a day), and covered the Earth every 18 days.

The lower orbit of Landsat 4 — necessary for the 30m ground resolution of Thematic Mapper data — results in an Earth coverage cycle significantly different from that of the earlier Landsats. For Landsat 4, the adjacent swath to the west of a previous swath is covered 7 days later. This is in contrast to Landsats 1, 2 and 3, where the adjacent swath to the west was established just 1 day later. A convenient way to visualize the Landsat 4 coverage pattern is to remember that the distance between any two consecutive orbits (moving westward) is 2,752 km at the Equator. The rest of the area between these ground tracks fills in over a 16 day period, whereupon the coverage pattern starts repeating itself.

At the Equator, adjacent swaths overlap at the edges by 7.6 per cent. Moving from the Equator toward either pole, this "sidelap" increases because of the fixed swath width of 185 km.

The Landsat 4 16 day ground coverage cycle is accomplished in 233 orbits, making it incompatible with the 251 orbit Worldwide Reference System (WRS) path/row indexing scheme that is used with data from previous Landsats. The WRS path/row system for Landsat 4 is made up of 233 paths numbered from 001 to 233, east to west, with Path 001 crossing the Equator at 64.95° W longitude. The same number of rows, however, are still used. The rows are positioned so that Row 60 coincides with the Equator at the orbit's descending node, there being 248 rows in all.

Successive orbits and framing operations will be carefully controlled to ensure minimal variation to either side from the intended ground track and precise framing from to the bottom so that successive images of a specific scene can be "registered" or overlaid accurately.

The accompanying diagram and calendar (inserts) illustrate the Australian coverage cycle. Further copies of each are available from ALS upon request.

LANDSAT 3

Showing signs of old age, Landsat 3 continues as prime satellite for worldwide coverage as it nears 4½ years of service.

The late line start anomaly is now "solid", and has been since early in 1982. For some months an intermittent end-of-line code loss has resulted in some scenes which will not process. Lately this has become quite severe and recent evidence of jitter in the scan mirror velocity in the order of one or two pixels has been observed.

TURNAROUND TIME

By the middle of this year the Station had worked through the backlog of orders which had previously been as long as six months (and was still being quoted in March 1982 at eight weeks for standard priority).

Now ALS routinely achieves better than two week turnaround on standard priority, with Priority 2 and 1 being better than one week and three days respectively. It has always been the aim to provide two week turnaround for standard priority. Capacity now exists in the processing system to cope with transient demand peaks without significantly affecting these turnaround times.

PRECISION PRODUCTS

Unforeseen difficulties have delayed implementation of the Precision Processing System (PPS) which is now hoped to be operational in November 1982. Independent checking of rectified imagery revealed system errors in both computing and photographic areas and the majority of these have been corrected. It is known that dimensional stability of photographic materials is still a problem.

In the process of checking out the PPS a great deal has been learned about the characteristics of suitable Ground Control Points (GCP's). It is now thought that an iterative process will be most suitable for building the GCP Library.

ALS will provide marked-up images to National Mapping Council (NMC) members, indicating points which can be consistently identified by operators during computer manipulation of data. NMC members will, in turn, provide co-ordinates and descriptions (air photographs, for example) or alternative suggestions. This is expected to commence in November 1982; a similar process suggests itself for private users requiring rectified imagery in areas yet to be co-ordinated by NMC members.

In all cases it is to be expected that GCP's will enter the public domain in the ALS GCP Library and that marked-up images remain the property of ALS, which would require their return for operator guidance.

COLOUR NEGATIVE MASTER EXPERIMENTS

ALS photographic staff have been experimenting using Kodak SO 200 colour negative film in the Photowrite image makers. This appears to give more consistent results with improved resolution and colour discrimination. Comments on examples of colour imagery produced using this method have been sought from some users and NMC members. As yet Kodak have been unable to undertake regular supply of SO 200 but user comment could sway their decision.

SPACECRAFT STATUS

Recent variations in spacecraft operational status (continued from March 1982 Newsletter) have been:

8 February '82	LANDSAT 2	The yaw wheel stuck again and payload operation suspended until further notice.
13 February '82	LANDSAT 3	The ERTS Command Auxiliary Memory (ECAM) halted. Payload operation discontinued until further notice.
24 February '82	LANDSAT 2	Evidence of debris jamming yaw wheel. Prognosis against re-establishing operational capability. Experimenting with magnetic control and continuing attempts to re-start yaw wheel. Spacecraft withdrawn from operational service as from tomorrow.
25 February '82	LANDSAT 2	Landsat 2 will continue to be scheduled according to existing power limitations. Data quality will be assessed from pass to pass.
	LANDSAT 3	Existing problems are: Late line start anomaly which results in loss of western 27% of image; missing end-of-scan line pulse on souce "B" and expected degradation of source "A" in current use; possibility of recurrence of electronic connection failure in multiplexer digitizer circuits which prevented any MSS data transmission; jitter in mirror velocity pseudopulse relationship increasing over past months means variations in mirror position at occurrence of pseudopulse, which are now too large to permit accurate data processing without an end-of-line pulse (variations of 3-7 pixels in uncorrected data). Ability to overcome these problems is minimal and daily cycle will be limited in attempt to prolong life until Landsat D is available.
26 February '82	LANDSAT 2	Observations during Paths 101, 119 today indicated 45° clockwise yaw displacement. Data not recorded.
	LANDSAT 3	Scheduled for Australian acquisition on a reduced basis; generally, reduction in offshore areas. Special acquisition requests will, however, be entertained. In future, consider requirements in terms of 36 day cycle (versus 18 days) to obtain maximum ground coverage.
27 February '82	LANDSAT 2	Yaw appears close to normal. Scene centre shifted approximately 25% to west.
1 March '82	LANDSAT 2	Scene centre displacement and yaw offset approx 25° counter-clockwise observed on successive paths.
2 March '82	LANDSAT 2	Yaw changed from normal to 55° counter-clockwise on successive orbits. Severe image distortion makes scene centre unclear. Low power condition reoccurred. Spacecraft reverted to non-operational mode.
8 March '82	LANDSAT 2	MSS being reactivated today. Yaw wheel still not responding to "ON" command. Pitch bias now being used under more stringent conditions for attitude control. Power stability requirement forces elimination of MSS on four Paths daily between Paths 120-175.
	LANDSAT 3	Intermittent missing end-of-line code occurrence became noticeable.
10 March '82	LANDSAT 2	Yaw appears approximately 20° clockwise from nominal.
13 March '82	LANDSAT 2	Yaw normal, scene centre shifted 20% westward.
15 March '82	LANDSAT 2	No MSS or telemetry pickup. Landsat 2 no longer tracked on routine basis.
Mid June 1982	LANDSAT 3	Missing end-of-line code occurrence became more frequent.
16 July '82	LANDSAT 3	Landsat 3 coverage ceased during Landsat 4 launch for 72 hours to ensure successful support of the launch.
	LANDSAT 4	Landsat 4 launched from Lompoc, California.
19 July '82	LANDSAT 3	Landsat 3 returned to service.
12 August '82	LANDSAT 4	Proposed initial data transmission over Australian (3½ minutes MSS).
14 August '82	LANDSAT 4	High gain antenna manoeuvred free. TM radiative cooler outgassing complete and Bands 5, 6, and 7 allowed to cool down. Test results show that radiative cooler has excellent thermal margin of 10°.
16 August '82	LANDSAT 4	NASA released first quarter scene TM image at Unispace Conference, Vienna (scene of Detroit/Windsor area). TDRSS antenna now fully deployed and operable (had been "stuck").
17 August '82	LANDSAT 4	Higher than anticipated in-orbit drag precludes routine maintenance of orbit path within ± 5km of nominal WRS as originally planned. Proposed to revise limit to ± 10 km. TM Bands 5, 6 and 7 turned on for first time. Initial assessment shows they have good response, definition and registration. A problem detected in on-board GPS Receiver/Processor Assembly and isolated to bad memory chip. Magnavox recompiled GPS software around the 1000 word data bank which contained the bad chip and GPS RPA memory successfully re-loaded.
26 August '82	LANDSAT 4	During special test not expected to be repeated (in course of deploying "sticking" TDRSS antenna) the spacecraft attitude was perturbed. As a result, attitude data for orbits 406 to 522 inclusive is incorrectly referenced; this could cause incorrect map coordinates unless correction is made from known ground control.
30 August '82	LANDSAT 3	Increasingly high incidence of missing end-of-line code occurrence. Many scenes unprocessable.
7 September '82	LANDSAT 4	Moon interference with fixed head star trackers caused slow increase in attitude errors from orbit 753 to error of approximately 1.2° or orbit 773.
9 September '82	LANDSAT 4	High gain antenna program track test performed during orbit 804 over ALS receiver.
14 September '82	LANDSAT 4	Low level of coherent noise at times in various MSS bands. Level is one or two quantum levels. Under investigation by NASA/GSFC.
18 September '82	LANDSAT 4	Spacecraft off normal pointing by 0.3 to 1.0 degrees during orbits 824 to 843 and 881 to 891. Could cause erroneous map coordinates unless referred to ground control.
20 September '82	LANDSAT 4	MSS sensor and USB telemetry temporarily suspended due to anomaly discovered on spacecraft. Expected to be restored in 24 to 48 hours.
30 September '82	LANDSAT 4	Sensor operation not supported during orbit 1109 due to orbit adjust manoeuvre.
5 October '82	LANDSAT 4	Attitude errors apparent in scheduled MSS transmissions during orbits 1169 to 1175.

(Source: operational messages)

NASA TO HAND MSS OPERATIONS TO NOAA

U.S. Government proposals call for the tranfer of Landsat 4 MSS operations from NASA to NOAA (National Oceanographic and Atmospheric Administration) on 31 January 1983. Whilst NASA plans to exercise control over the TM instrument until turnover to NOAA in January 1985, it was recently decided that NOAA will act as NASA's agent in providing TM direct readout to non-US ground stations.

However, TM data will not be transmitted until NASA has characterized TM performance and is ready to place data into the public domain. NASA say that, based on dates of anticipated TM processing capability provided to them by foreign ground stations, in nearly all cases TM data is likely to be characterized before those stations need data to check out their processing systems.

NASA also say that full TM acquisition by foreign ground stations (up to the worldwide budget of 150 scenes per day) will be approved when TM data characterization is sufficiently mature.

Once Landsat 4 is declared operational (spacecraft, MSS instrument and MSS processing system operating satisfactorily to specified standards), it will be given acquisition priority. NASA also expect to place Landsat 3 on standby no later than 31 March 1983, pointing out that it has already exceeded its planned lifetime and could further deteriorate to make use impractical. To a great extent this has already happened, since the missing end-of-line code anomaly which became evident in mid 1982 has increased to the extent that many scenes cannot be processed at ALS.

The US Government has instituted a new pricing structure for all MSS data collected as of 1 October 1982 and NOAA will be responsible for assessment and collection of such fees. In addition to increased annaul access charges, royalties will be collected for imagery. These charges have been taken into account when revising ALS prices.

SPACE ASSOCIATION

Formed almost twelve months ago, the Space Association is aimed at the advancement and expansion of space exploration and is open to all who share that view.

Activities include meetings with speakers and films, sale of space publications (a list of these is included in the Association's September 1982 Newsletter); publication of the Newsletter, at present bi-monthly; and tours of space-related centres (e.g. the Bureau of Meteorology's GMS receiver).

Annual membership subscription is $12 ($6 for students) and many be obtained by writing to:

The Space Association
PO Box 4
THORNBURY, VIC 3071

CENTRE FOR REMOTE SENSING UNIVERSITY OF NEW SOUTH WALES

Courses:

The University of New South Wales' Centre for Remote Sensing offers Master's Degree and Graduate Diploma programmes in Remote Sensing plus Short Courses and Workshop activities.

Master's are offered to four year degree holders in appropriate earth science or relevant environmental disciplines, with Graduate Diploma courses being offered to three year undergraduate degree holders or professionals seeking remote sensing qualifications without needing to complete the requirements of a full Master's programme.

Short courses are designed as modules varying in duration from 2 to 6 days, which can be linked to cover specific needs. Longer workshops of two or more weeks can be organized subject to availability of University facilities and staff.

Short courses will be conducted for staff training of particular organizations and may be held either at the Centre or on the client's premises.

For further details contact:

- Master's and Graduate Diploma programmes
  Dr Tony Milne, Telephone: (02) 662-2904
- Short Course and Workshop programmes
  Dr Bruce Forster, Telephone: (02) 662-3057

Research Assistance and Consultants:

The Centre is also able to provide research services in remote sensing technology and applications to industry and outside organisations; having strong associations with faculties of Applied Science and Engineering provides a reservoir of personnel, equipment and research facilities.

The Centre's activities include collaborative or contract research in fundamental aspects and applications of remote sensing; software development for remote sensing projects involving the Centre's image analysis system or similar facilities; sale of time on its image processing equipment to personnel with the expertise to perform their own data processing.

Details of research and consultant services are available from:

Dr John Richards
Director
Centre for Remote Sensing
The University of NSW
PO Box 1
KENSINGTON NSW 2033
Telephone: (02) 662-3002

NEW ALS IN-DIALLING FACILITIES

Installation of a new PABX at the Belconnen Data Processing Facility will simplify access to staff and customers alike.

In-dialling permits direct access to user services staff. Some regularly called numbers are:

Don Gray	Station Director	(062) 524400
Colin Purbrick	Business Manager	524404
Shirley Crocker	Accounts	524405
Steve Dovey	Product Applications	524406
Ted Donnell	Orders	524407
Bill Hordern	Product Promotions	524409

Switchboard numbers are: (062) 515411 and (062) 524411

THE RUSSIAN EARTH RESOURCES SATELLITE

(The following article was adapted from a TASS report in PRAVDA, 19 June 1980)

In June 1980, the USSR launched a "Meteor" satellite equipped to observe the natural resources and meteorology of the Earth. The vehicle is part of an experiment to develop and optimize a methodology for an operational study of the Earth's surface based on multispectral information.

Three basic sensor packages are carried by Meteor. The first, the BIK-E sensor complex, comprises three subsystems: (1) an MSU-SK medium resolution multispectral sensor with a conical optical-mechanical image scanner; (2) an MSU-E high resolution multispectral solid-state scanner; and (3) a telemetry system.

A second sensor package is an experimental high resolution multi-spectral system known as "Fragment". It consists of an optical mechanical scanning unit, an information encoding and processing system, and telemetry system.

The third part of Meteor's sensor payload is the RTVK operational radio and television complex, which consists of: (1) a duplicate system of multispectral optical mechanical scanning units with low (MSU-M) and medium (MSU-S) resolution capabilities; (2) on-board tape recorders; and (3) two telemetry systems operating in the metre and decimetre bands, both of which are standard equipment on satellites of the Meteor series.

Characteristics of these three sensor packages are given in the table accompanying this article. Some of the orbit characteristics of the spacecraft include:

- Altitude at apogee: 678 km
- Altitude at perigee: 589 km
- Orbit inclination: 98°
- Orbital period: 97.8 minutes

Information from the BIK-E complex passes over a digital radio link to a receiving point in Obninsk. Primary data processing is performed at the State Scientific Research Centre for the Study of Natural Resources. Information from the "Fragment" complex is transmitted over a digital radio link to a receiving point at the Moscow Institute of Power Engineering's Experimental Design Office, where it is recorded. Further processing of the data and generation of images on film are carried out with the help of specialized computer facilities at the USSR Academy of Sciences' Institute of Space Research as well as the Centre for the Study of Natural Resources. Information from the RTVK complex enters another network of receiving points.

The creation of the "Fragment" sensor was assisted by specialists from Karl Zeiss-Jena in the Democratic Republic of Germany (*East Germany*) who developed and manufactured a reflecting telescope with a focal length of 1,000 mm and a diameter of 240 mm.

In addition to the goal of developing an operational method for the study of Earth Resources, the experiment of which Meteor is a part has the following objectives:

- Development of new equipment for obtaining multispectral video information in the visible and near-infrared bands of the spectrum.
- Development of systems and methods for the digital transmission of multispectral video information.
- Investigation and optimization of methods for both machine processing and visual interpretation of multispectral video information.
- Utilization, in a production mode, of multispectral video data in the solution of practical problems of Earth research from space.
- Development of recommendations for the construction of on-board and terrestrial sensing equipment, the organization of surveys, the collection of data, and the development of processing technology for use in prospective systems for studying the Earth from space on an operational basis.

BASIC PARAMETERS OF THE METEOR SATELLITE'S SENSOR COMPLEMENT

Parameter	Instrument Complex				
	BIK-E		"Fragment"	RTVK	
	MSU-E	MSU-SK		MSU-S	MSU-M
Field of view (km) for flight altitude of 650km	30	600	85	1,400	2,000
Size of projection of field diaphragm (of a pixel) on the Earth's surface at nadir (m)	30	170	80	240	1,000
Spectral bands (μm)	0.5.0.7 0.7.0.8 0.8.1.0	0.5.0.6 0.6.0.7 0.7.0.8 0.8.1.0	0.4.0.8 0.5.0.6 0.6.0.7 0.7.0.8 0.7.1.1 1.2.1.3 1.5.1.8 2.1.2.4	0.5.0.7 0.7.1.0	0.5.0.6 0.6.0.7 0.7.0.8 0.8.1.0

ALS TRAVELLERS

Station Director, Don Gray, will be overseas until 16 November attending the Landsat Ground Station Operators Working Group (LGSWOG) meeting in Washington DC, and will also visit France.

Steve Dovey, our Applications Specialist, has just returned from a four week visit to France at a SPOT briefing attended by a number of potential overseas SPOT users.

Programmer Don Lawn is attending the LGSWOG and Landsat Technical Group meetings in the USA plus three weeks familiarization of the Landsat 4 processing software at contractor, MacDonald Dettwiler & Associates Limited, in Vancouver, Canada.

SPOT IMAGE

SPOT IMAGE — the world's first commercial company established specifically to distribute satellite remote sensing data was born on 1 July 1982.

Among the many SPOT IMAGE founders, special mention should be made of the French Space Agency (CNES), the SPOT programme manager, MATRA and SEP (Société Européenne de Propulsion), two French industrial firms that are particularly active in remote sensing, and a number of French government organisations directly involved in the use of satellite imagery. This last group includes: the Bureau de Recherches Géologiques et Minières (BRGM), the Institut Francais du Pétrole (IFP), and the Institut Gé ographique National (IGN). Let us not forget, either, our Belgian and Swedish friends who together hold a ten percent equity in SPOT IMAGE.

I personally am convinced that this mix of producers and users is one of the keys to the success of the SPOT programme on both the French and international markets.

Already, users' reactions are confirming that the technical, institutional and commercial decisions taken thus far have been the right ones.

Until the big day in 1984, let me assure you that SPOT IMAGE will be working steadily towards full operational status.
G. BRACHET
Chairman of SPOT IMAGE
(From "Nouvelles de SPOT")

SPOT NEWS

Launch Date of SPOT 1: October 1984

The mid-point of the system development phase now having been reached, every item of on-board hardware has been fully defined and all the mock-ups required for the different tests and checkout procedures have been completed. Also, a complete model of the SPOT satellite is being integrated so that the actual performance of the different subsystems can be checked.

The reasons for the scheduling of the SPOT 1 launch date for October 1984 are:

- late delivery of certain high-reliability components.
- recent changes in the satellite control system: the new Mission Control Centre-Satellite "dialogue" mode will ensure improved flexibility and reliability during SPOT exploitation.
- new precautions concerning the final development of high speed electronics.
- need of a certain flexibility in the development program.

Component Procurement

- Pushbroom sensors. The optical sensors of the SPOT HRV instruments use CCD (charge-coupled-device) linear arrays, known as pushbroom sensors. All the sensors required for SPOT have been delivered and acceptance tested.
- Electronic components. About 90% of the components required for the SPOT 1 and SPOT 2 flight models have been received and acceptance tested. Further orders have been placed to build up a stock of spares for SPOT 2 because the lead times required for the procurement of the types of high-reliability electronic components used on board satellites are generally very long.

Qualification of Hydrazine Tanks

The SPOT on-board propulsion system is of the monopropellant hydrazine type. Its functions include attitude control, satellite pointing and orbit control. The hydrazine thrusters draw propellant from capillary type tanks which are based on a technology that is new to France. Qualification testing of these tanks was recently completed with success.

Payload Thermal Testing

Thermal testing of the SPOT payload, specifically the HRV instruments and the image data telemetry package, was recently completed.

The response of the pushbroom sensors is a function of their operating temperature. Given that the orbiting satellite will be subject to wide temperature variations due, among other things, to variations in the solar illumination, it is essential, if one is to guarantee the radiometric quality of the images and keep the frequency of calibration to a minimum, to maintain the temperature of the payload within the smallest possible range.

It is for these reasons that tests were recently conducted in the CNES solar simulator at Toulouse on a payload that had been thermally insulated from

the rest of the satellite. The results show that the sensors temperature can be held constant to within ±2°C, in accordance with the specifications.

(From "Nouvelles de SPOT")

SPOT TECHNOLOGY

Radiometric Calibration of Pushbroom Sensors

SPOT will be the first satellite ever to use pushbroom sensors. These consist essentially of CCD (charge-coupled device) linear arrays. With the pushbroom device, the scanning of the successive elements of a line of a scene being imaged is performed electronically by successively measuring the current generated by each detector making up the linear array. Each spectral band will use four linear arrays, each array consisting of 1,728 elementary detectors (or CCD devices).

In the panchromatic mode, each detector will correspond to one pixel, while in the multispectral mode, each pixel will contain the data gathered by a pair of detectors.

Sensor Response Equalization

The SPOT specifications require that the mean dispersion in the responses of the elementary detectors making up the SPOT HRV sensors prior to calibration should be no more than ±7%. The CCD arrays for both SPOT 1 and SPOT 2 have thus been selected with the utmost care.

Tests already conducted reveal that the effective dispersion in responses will definitely be less than that required by the specifications. It should be noted that only 1,500 out of the total of 1,728 detectors forming the array will be used for imaging, which means that those nearest the edges are not required. The resultant dispersion in response, prior to calibration, is of the order of ±1.5% relative to the mean value.

In any case, the signals generated by the individual detectors will be corrected by the pre-processing centre, CRIS, in such a way as to further reduce this dispersion.

On-board calibration procedures should allow calibration parameters to be obtained for detector response equalization This procedure will consit of two phases as follows:

1. Measurement of detector dark current; for this, the steerable mirror at the front end of the HRV instrument will be moved to a position such that no light enters.

2. Measurement of detector response; this will involve the exposing of detectors to incident illumination of known spatial distribution; the light source being a standard lamp located within the instrument housing.

Test results. The various tests and studies conducted to date suggest that it should be possible to achieve sensor response equalization to within ±1%.

Inter-band Calibration (Multispectral images)

The aim of this calibration operation, which uses the detector responses obtained in the three spectral bands, is to re-establish the relative spectral radiances of the observed object in the same channels.

This operation is essential to the success of all image analysis procedures (determination of vegetation indices, multitemporal analysis, etc) involving the quantitative spectral signature concept.

In this case, calibration consists in the directing of sunlight with a bundle of optical fibres, on to certain CCD elements. The spectral energy distribution of sunlight being well known, it will thus be possible to correct for any variations in CCD device responsivity at the wavelengths used.

The SPOT technical specifications stipulate that the maximum rms deviation for inter-band calibration should be 3%.

Absolute Calibration

The aim of this calibration operation is to render the output signal values supplied by the sensors suitable for the quantitative evaluation, in physical units, of the energy reflected by imaged objects in the different spectral bands.

Here, calibration is performed by directing incident solar energy on to the CCD devices by using the same bundle of optical fibres as used for inter-band calibration.

It is also possible to use the energy received from suitably equipped test sites.

The system specifications fix at 10% the rms deviation for this calibration.

(From "Nouvelles de SPOT")

SPOT IMAGE produces a bi-annual publication "Nouvelles de SPOT/SPOT Newsletter" and invites new reader registration to this free publication. Their address is:

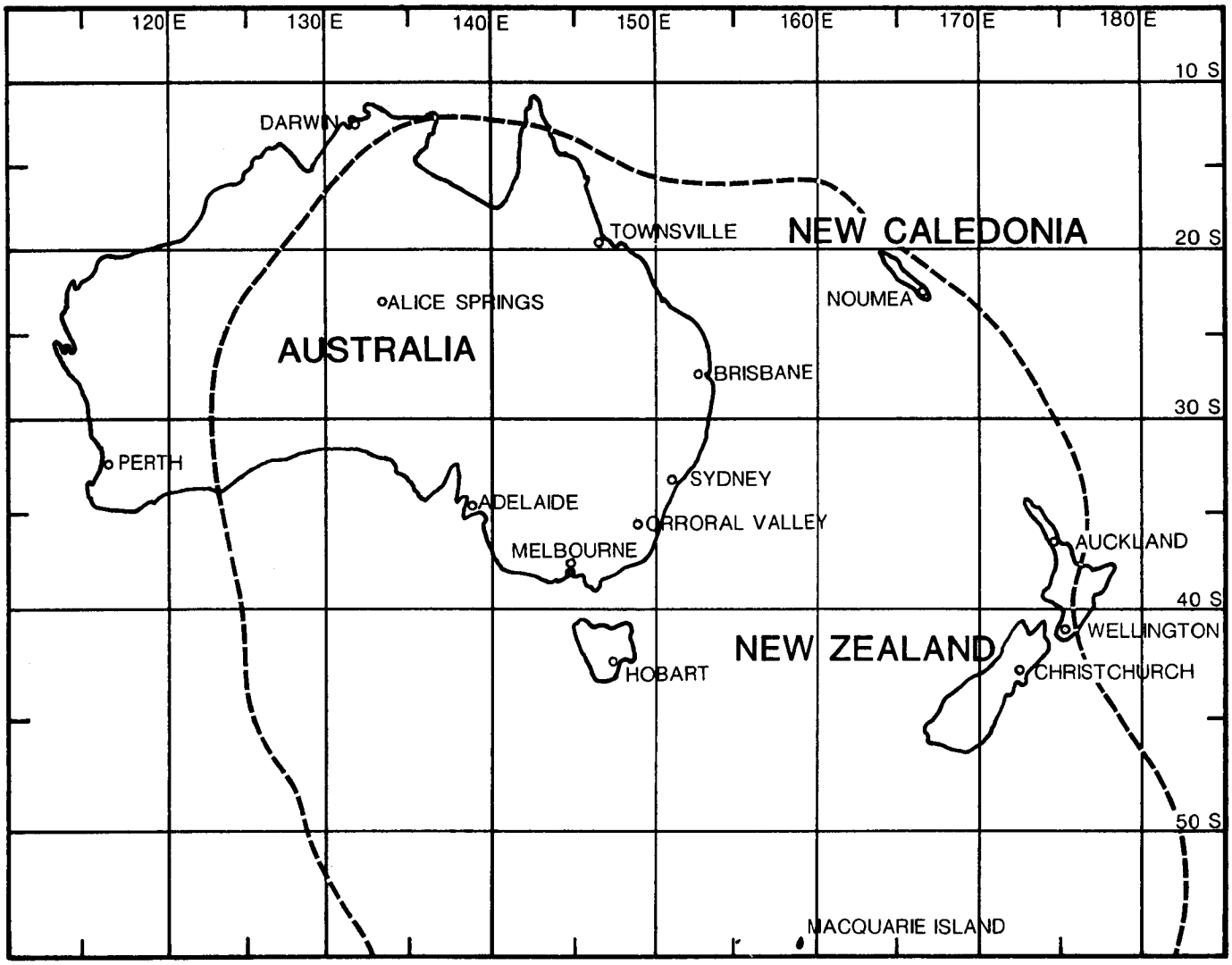
SPOT IMAGE
18 Avenue-Belin
F31055 TOULOUSE CEDEX
France

THE NIMBUS-1 COASTAL ZONE COLOUR SCANNER (CZCS)

Dr David Carpenter Department of Engineering Physics The Australian National University Canberra A.C.T. 2600

The CZCS is a 6-channel multispectral scanner carried on Nimbus-7 launched in October 1978. It was designed to remotely sense ocean colour, from which estimates of phytoplankton concentration may be obtained. Since CZCS became operational many scenes from the Australian region have been obtained and current data acquisition is around 4 Australian scenes per week, each scene covering an area 1,500 km wide by up to 3,000 km long, usually including only a small section of coastline.

The data from the four very narrow bandwidth (20 nm), high sensitivity, visible spectrum channels (1-4) can be processed to remove atmosphere radiance, and the resulting corrected data used to obtain estimates of near-surface ocean plankton pigment concentration — "chlorophyll". The fifth Band, specificially similar to Landsat MSS Band 6, is used to discriminate between land and water, the sixth Band being a co-registered thermal infra-red channel for sea-surface temperature estimation. The pixel size is



Horizon Mask for NIMBUS-7 (altitude 955 km) from Orroral Valley

825 m square at nadir, and the scan line width is 1,560 km. The data are encoded in 8 bits to give 256 levels of radiance.

Unfortunately, the data have only been available from NOAA/EDIS in Washington since no Australian data reception facility was set up to collect local data. The inherent difficulties of accessing such a distant data archive "blind" have been exacerbated by the nearly two year delay in the catalogue and the even longer backlog in processing scenes. It had been hoped that fully processed data, right through to chlorophyll estimates, would be available on a routine basis, but the problems involved in implementing the correction procedures have effectively prevented that.

Some Australian data, from early orbits up to mid-1980, have been obtained in the form of Calibrated Radiance and Temperature (CRT) Tapes, and the atmosphere correction and chlorophyll estimation algorithms have been developed by the Department of Engineering Physics, ANU, using information published by NOAA and members of the Nimbus Experiment Team (NET) for the CZCS.

Recently, it was realised that CZCS data are routinely recorded by the Orroral Valley Satellite Tracking Station, near Canberra, where the data are received for transmission back to NASA Goddard, via land line or via digital data tapes. A joint initiative by the Orroral Valley staff and the Department of Engineering Physics demonstrated the feasibility of accessing the high density analogue station tapes to produce a digital, computer compatible data tape, using the existing station equipment. A sample digital tape was made and upon demonstrating that CZCS image data could be extracted from it, the co-operation of the Department of Science and Technology was enlisted to seek approval from NASA for routine access to these tapes on a non-interference basis. Following approval, the Station is now routinely recording digital computer compatible tapes of all real-time CZCS data collected at Orroral Valley. Most of these data will be for the Australian region, except for the most westerly part which is beyond the range of the Orroral Valley Station, although some will be for New Zealand, which is within that range. The accompanying map shows Nimbus-7 Horizon Mask from Orroral.

The software developed by the Department of Engineering Physics to read the Orroral Valley tapes reformatted into the standard CZCS "ZIP" format, which includes the calibration data as well as the 6-channel image data, is freely available to anyone interested in using it. It is intended that all data collected in this way will be archived by the CSIRO Division of Oceanography, who will attempt to catalogue scenes with some indication of cloud cover, etc. Hopefully the CZCS will continue to operate usefully for some time yet, and this source of near real-time ocean colour data made use of by many Australian oceanographers.

NTIS?

The National Technical Information Service (NTIS) of the US Department of Commerce collates and publishes (on paper, microfiche, microfilm and magnetic tape) technical reports in most disciplines.

Abstracts and newsletters are published regularly. One of value to Remote Sensers is "NASA Earth Resources Survey Program" (bi-monthly). Others are "Current Published Searches" and "Information for Innovators".

NTIS Australia co-operating organization is:
The Australian Financial Review
(Attention: Mr Ken McGregor)
PO Box 506
SYDNEY NSW 2001
Phone: (02) 20944 extension 3052
(Ref. NTIS, Springfield, VA)

FORTHCOMING CONFERENCES FEATURING REMOTE SENSING

30 Nov—3 Dec 1982

URPIS 10; 10th Australian Urban and Remote Information Systems Association, Sydney, NSW.
Conference Committee: GPO Box 4743
SYDNEY NSW 2001
Telephone (02) 270-4021

29 Nov 1982

Workshop "Selected Topics in Computer Cartography"; Prof Waldo Tobler, UC, Santa Barbara.
Information: Prof B J Garner
School of Geography
University of NSW
PO Box 1
KENSINGTON NSW 2033
Telephone (02) 662-3690

4 Dec 1982

Workshop "Recent Developments in Geographic Information Systems"; Prof Duane Marble, SUNY, Buffalo.
Information: Prof B J Garner
School of Geography
University of NSW
PO Box 1
KENSINGTON NSW 2033
Telephone (02) 622-3690

12—16 Aug 1983

9th Annual Conference, Australian Surveying Association, Hobart, TAS.
Conference Committee: Box 38A GPO
HOBART TAS 7001

16—18 May 1983

ASSIA-83; 2nd Australasian Symposium on Stereology and Image Analysis; Monash University, Victoria.

Symposium Secretary: Mr P Pahl
Division of Mathematics & Statistics
C/- PO Box 54
GLEN WAVERLEY VIC 3149
Telephone (03) 235-1355

19—25 March 1983

25th Australian Survey Congress, Institution of Surveyors, Australia; Melbourne, Victoria.
Congress Manager: K M Hogan
18 Guest Road
OAKLEIGH SOUTH VIC 3167
Telephone (03) 669-1222

13—18 May 1984

2nd International Rangeland Conference; Adelaide, SA.
Congress Secretary: C/- CSIRO
Private Bag
DENILIQUIN NSW 2710
Telex AA 55457

28-31 May 1984

International Savanna Symposium; Brisbane, Queensland.
Symposium Secretary: C/- CSIRO
Division of Tropical Crops and Pastures
Cunningham Laboratory
St Lucia
BRISBANE QLD 4067

16—20 May 1983

53rd ANZAAS Conference; Perth, WA.
Hon Organizing Secretary: Mr W S Cooper
School of Social Sciences
WAIT
BENTLEY WA 6102
Telephone (09) 350-7792

CONFERENCE SECRETARIES

We will be pleased to list your conference if it has a remote sensing context. Please send a brochure to ALS Newsletter Editor.

SHORT COURSE

Remote Sensing & Geographic Information Systems
26th and 27th November 1982, University of NSW.
Cost: $230, includes lunch, refreshments and course materials.
Sessions:
1. Remote Sensing Technology
2. Introduction to Geographic Information Systems
3. Remote Sensing and Geographic Information Systems Interface
4. Operational Systems

Further information: Dr Tony Milne
Centre for Remote Sensing
University of New South Wales
PO Box 1
KENSINGTON NSW 2033

WORKSHOP

Computer Aided Resource Analysis and Land Use Planning
13-17 December 1982, Gippsland IAE, Churchill, Victoria.
Cost: $600, includes workshop and computer terminal sessions, field trip, notes, refreshments, lunches and Workshop Dinner.
Accommodation: Gippsland IAE, cost $100 for 4 days full board.
Programme: General overview of computer based land information systems.
Field visits, seminars on local issues.
Hands-on model building using the extensive computer data base.
Land use plan development.
Hands-on plan evaluation.
Further information: Dr Ian Bishop
School of Environmental Planning
The University of Melbourne
PARKVILLE VIC 3052
Telephone: (03) 341-7192

LANDSAT HELPS FIND A NEW WAY THROUGH THE BARRIER REEF

A new deep-water channel through the Great Barrier Reef could save millions of dollars a year on the costs of shipping coal to Japan.

The new channel, charted by Royal Australian Navy hydrographers aboard the survey vessel HMAS Flinders, cuts through the reef off Mackay. Coal ships travelling from Hay Point to Japan could save 1,600 kilometres on the round trip by using the channel.

The deep-water channel will also enable RAN warships to deploy much more quickly into the Coral Sea.

Announcing the discovery of the channel recently, the Minister for Defence, Mr Sinclair, disclosed that the search for such a passage began in 1975 when a patrol boat, HMAS Barbette, was sent to the area to carry out a reconnaissance.

Aerial photographs and satellite imagery had been used to determine the most likely area for such a channel.

In 1976, the Flinders began a preliminary survey and this year completed detailed observations which established the existence of a channel which could take deep-draught vessels. The depth of the passage is reported to be up to 28.5 metres.

Soundings were taken over a route the new route will be approved by the Government for general use.

By reducing costs and delivery time on the Japanese coal run, the new channel, so far named only Hydrographer's Passage, could increase the competitiveness of Australian coal on the Japanese market. It has been under increasing pressure from other supply sources in view of increasing fuel costs and Australian labour charges.

(From "The Canberra Times", 26 October 1982)

TOURISTS!

Station Visits for Student Groups

When the Belconnen, A.C.T., Data Processing Facility was re-modelled earlier this year, visitor facilities were improved by the addition of a meeting room and increased display space. Whilst we have always welcomed visits, they are now made easier.

Groups from senior secondary and tertiary institutions are most welcome. We can arrange after-hours visits if necessary, and handle up to 20 at a time — although smaller groups may be more suitable to ensure good contact.

Audio-visual aids, sample imagery and round-table discussions are used to illustrate our processes and digital processing equipment is displayed in use.

A few days notice is required; we would be happy to send preparatory information to teachers beforehand. Please contact User Services.

Remote Sensing Tours of Canberra for Academics

We at ALS can organize Canberra tours for academics, to the Station and local users of Landsat data. They have been popular for providing familiarization and technical background.

We can pre-arrange visits, for example to the Bureau of Mineral Resources, CSIRO Division of Computing Research or other local users. These can usefully fill a day. To educators we can provide sample imagery or class sets at reduced prices. Please contact User Services if you would like our assistance to set up one of these day tours.

MULTIPLE COPY PHOTO IMAGERY

Great for the Classroom!

ALS can provide multiple copies of the same Bulk processed photo imagery at great savings to you. This is the ideal way to use imagery in the classroom, lecture or workshop, or anywhere that more than two copies are required.

You pay full price for the first two copies but subsequent copies are dramatically reduced in cost.

For example: 10 small colour prints from existing master, $93 — only 23% of single copy price ....
Thirty copies are only $127 or 11% of single copy price ....
Fifty copies are only $161 or 8% of single copy price ....
One hundred copies are $245 or 6% of single copy price!

Similar savings apply to transparencies (30 copies for $313, or 15% of single copy price), medium size prints (30 copies for $320 or 13% of single copy price) and large prints (30 copies for $794 or 16% of single copy price), and for single Band black and white products.

Imagery may be produced from archival material or from specially generated masters. In the latter case, master generation charge is applied (once only) adding $175 for colour or $60 for black and white to the total price.

All ALS photographic products are rigidly quality controlled and multiple copies are produced to the same strict standards. In fact, these prices reflect the lower "run-on" reproduction costs which follow time-consuming setting up.

Because a sliding scale reduction applies, we would be happy to quote you for any specific number of copies — 3 to 3,000. Contact User Services.

THE ALS NEWSLETTER

Published to present information of interest to the user community regarding ALS products, systems, and related remote sensing developments.

There is no subscription charge; individuals and organisations wishing to receive the "Newsletter" should contact the Editor at our ACT address, to whom comments, corrections, brief contributions and other enquiries should be directed.

AUSTRALIAN LANDSAT STATION

"NEWSLETTER"

P.O. BOX 28 BELCONNEN A.C.T. 2616

Canberra Times Print — Telephone 48 0066