TWO SHARE PECORA AWARD

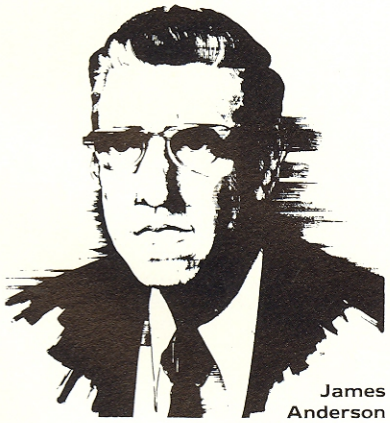
Nearly 300 geographers, natural resource managers, and cartographic, computer, and Earth scientists attended the 7th Annual William T. Pecora Symposium, in Sioux Falls, S. Dak., October 18-21, 1981. The theme of the symposium was "Remote Sensing: An Input to Geographic Information Systems in the 1980's." The Association of American Geographers (AAG), the National Council for Geographic Education (NCGE), and the American Society of Photogrammetry (ASP), sponsored the symposium in cooperation with the U.S. Geological Survey and the National Aeronautics and Space Administration (NASA). Proceedings will be available from the ASP in early 1982.

The symposia were instituted in 1975 in memory of the late Dr. Pecora to foster the exchange of scientific and resource management findings resulting from the use of remotely sensed data. A special Pecora Award is presented jointly every year by the Department of the Interior and NASA to honor the memory of Dr. Pecora who was Under Secretary of the Interior, Director of the Survey, and a leading figure in the establishment of the Earth Resources Observation Systems (EROS) Program and the EROS Data Center (EDC).

Two scientists credited with "outstanding contributions to the understanding of the Earth by means of remote sensing" shared the 1981 Pecora Award:

Dr. James R. Anderson, who died in December 1980, was honored posthumously for his work, which resulted in the first practical application of remote sensing technology to a national land use classification system. Prior to his service with the U.S. Geological Survey, where he was Chief Geographer and scientific advisor to the Director, Dr. Anderson performed landmark research with the Department of Agriculture and was a highly regarded university teacher and administrator. Until his untimely death, he was a leading figure in the planning of the 1981 symposium.

Leonard Jaffe, who held key positions for more than 30 years with NASA and its predecessors, was honored for being instrumental in the development of the Landsat Program. Under his direction, the "open to the public" data policy of the U.S. program was established. From 1969 through 1971, he held the NASA position of Deputy Associate Administrator for Space Science and Applications. He is currently vice president of Computer Science Corporation, Falls Church, Va.



James Anderson

Leonard Jaffe

NOTICE TO READERS

Because of problems encountered during production, the November 1981 issue of the Landsat Data Users NOTES was cancelled, causing a departure from our bimonthly publication schedule. Most of the articles that would have appeared in November are included in this issue. This is issue no. 21, and it is the next in sequence after last September's issue.

Landsat Data Users NOTES

ISSUE NO. 21
JANUARY 1982

NASA

U.S. GEOLOGICAL SURVEY
EROS DATA CENTER
Sioux Falls, S. Dak. 57198

PUBLICATION ON SPACE OBLIQUE MERCATOR AVAILABLE

U.S. Geological Survey Bulletin 1518, **Space Oblique Mercator Projection–Mathematical Development,** by John P. Snyder, was recently published. It contains refined and improved equations that can be applied to Landsat and other near-polar-orbiting satellite parameters to describe a continuous true-to-scale groundtrack. The equations will contribute to the automated production of image-base maps. The 108-page book is available through the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Refer to Stock No. 024-001-03441-7 when ordering. The price is $4.75.

REMOTE SENSING TRAINING FILMS

Two remote sensing training films have been released by the American Society of Photogrammetry (ASP). Entitled "Vegetation Mapping: The Use of Remotely Sensed Data," and "Mineral Exploration: The Use of Remotely Sensed Data," the films use case examples to illustrate the use of satellite imagery, aerial photography, computer-assisted analysis, and ground sampling methods in solving resource problems.

Each 28-minute, color-and-sound film can be purchased in 16-mm film format for $250, or as ½-inch (Beta or VHS) or ¾-inch video cassettes for $100. Contact the ASP Foundation, 105 N. Virginia Ave., Falls Church, VA 22046, telephone: (703) 534-6617, for further information.

The EROS Data Center has a limited number of copies that are available on a short-term loan basis. For information on these copies, contact the Technical Communications Section, U.S. Geological Survey, EROS Data Center, Sioux Falls, SD 57198, telephone: (605) 594-6171.

REMOTE SENSING PROGRAM IN INDIA

The Indian Photo-Interpretation Institute (IPI), a part of India's National Remote Sensing Agency (NRSA), each year offers a variety of courses within its "Training Programme in Aerial Photo-Interpretation and Remote Sensing Techniques." IPI was established in 1966 at Dehra Dun, India, in collaboration with The Netherlands' International Institute for Aerial Survey and Earth Sciences. Courses range in length from 4 days to 12 months and emphasize the use of photointerpretation and remote sensing techniques for surveying, mapping, and assessing resources in many disciplines, including forestry, geology, hydrogeology, geomorphology, and soils. Introductory photogrammetry, photointerpretation, and remote sensing courses are also offered. For information about this training, contact The Dean, Indian Photo-Interpretation Institute (NRSA), 4 Kalidas Road, Post Box No. 135, Dehra Dun-248001, India.

SYMPOSIA

A **Symposium on Remote Sensing and Mineral Exploration** will be held as part of the 24th COSPAR (Committee on Space Research) Conference this May, 1982, in Ottawa, Canada. COSPAR is an organization within the International Council of Scientific Unions. The symposium's organizers, W. D. Carter and L. C. Rowan, both of the U.S. Geological Survey, have solicited papers documenting case histories on the use of Landsat data in mineral and energy resource exploration. The 11 sessions planned will run from May 17 to 22. Details on the COSPAR Conference may be obtained from the Executive Member, LOC XXIV COSPAR, Conference Secretariat, National Research Council, Ottawa, Ontario K1A OR6, Canada.

The **16th International Symposium on Remote Sensing of Environment** will be held in Buenos Aires, Argentina, June 2-9, 1982. Organized and conducted jointly by the Environmental Research Institute of Michigan (ERIM) and the Argentine National Commission on Space Research (CNIE), this symposium will stress the application of remote sensing technology to problems in developing countries, emphasizing topics of regional importance. Simultaneous interpretations in English or Spanish, as appropriate, will be provided at the formal-paper sessions. Registration information and other details about the symposium are available from Dorothy M. Humphrey, Environmental Research Institute of Michigan, P.O. Box 8618, Ann Arbor, MI 48107, telephone: (313) 994-1220.

The **8th International Symposium on Machine Processing of Remotely Sensed Data** will be held July 7-9, 1982, at Purdue University in West Lafayette, Ind. Crop inventory will be emphasized, and topics will include research results in digital modeling of remotely sensed scenes, information extraction from digital remotely sensed and ancillary data, and utilization of digitally processed data related to Earth resources. A call for papers has been issued. For more information, contact D. B. Morrison, Symposium Coordinator, Purdue University/LARS, 1220 Potter Drive, West Lafayette, IN 47906, telephone: (317) 749-2052.

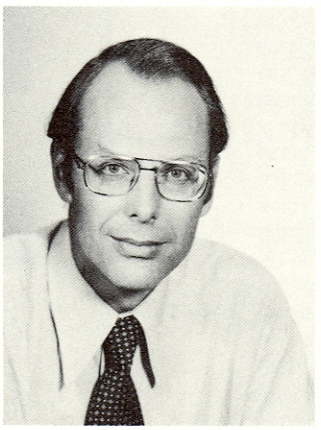
A symposium entitled **Advances in Instrumentation of Processing and Analysis of Photogrammetric and Remote Sensing Data** will take place August 30 to September 3, 1982, in Ottawa, Canada. It is sponsored by Commission II of the International Society of Photogrammetry and Remote Sensing. A call for papers has been issued. For further information, contact Z. Jaksic, President, Commission II (ISPRS), Division of Physics, National Research Council of Canada, Bldg. M-36, Montreal Road, Ottawa, Ontario K1A OR6, Canada, telephone: (613) 993-2074.

The **International Society for Photogrammetry and Remote Sensing** will host a symposium in Toulouse, France, September 13-17, 1982. The symposium will present the activities of the Society's Commission VII working groups relevant to two main subjects: (1) the methodologies for joint

NEW CHIEF AT EROS OFFICE

John W. Salisbury was recently named the new Chief of the EROS Office. Dr. Salisbury comes from the Department of Energy where he was most recently the Acting Director of the Division of Geothermal Energy. Before his move to the Department of Energy 5 years ago, he spent 17 years with the United States Air Force Cambridge Research Laboratories. He achieved international recognition there as an expert in lunar and planetary research and remote sensing techniques. A geologist by training, Dr. Salisbury has authored more than 80 publications and received numerous awards for distinguished service throughout his career.

We extend him a warm welcome.



JOHN SALISBURY

PROPOSED FEE SCHEDULE FOR LANDSAT MSS DATA

The National Aeronautics and Space Administration (NASA) and the EROS Data Center (EDC) now recover only the cost of certain near-real-time services provided by NASA and the direct and indirect costs of data reproduction by EDC. This approach will change after the launch of Landsat D. The National Oceanic and Atmospheric Administration (NOAA), who will assume managerial responsibility for the U.S. civil land remote sensing system in fiscal year (FY) 1983, will recover the full cost of operating and maintaining the Landsat D program.

NOAA's goal of full recovery of the operating and maintenance costs of the Landsat D multispectral scanner (MSS) program includes meeting the direct, and associated indirect, costs of the following activities:

- Satellite command and control.
- Data acquisition and preprocessing at the NASA Goddard Space Flight Center (GSFC).
- Transmission of data to EDC or to those users who elect to use preprocessed data.
- Data processing and preparation of digital and imagery products for archiving.
- Retrieval of data from the archives and preparation of products for retrospective sale to users.

Thus, NOAA's costs will include all activities at GSFC, whether performed by NOAA personnel or support contractor staff; all direct and indirect costs at EDC; and all associated satellite communications costs.

Proposed Fee Schedule

NOAA has established fees for Landsat MSS data and data products, effective October 1, 1982, as follows:

- Data retrieved from the existing archives, or acquired by NOAA, as part of a Basic Data Set of worldwide MSS data:
  - Digital data at $650 per scene.
  - Imagery at an average of $47 per frame.
- Special acquisitions made at the request of the users:
  - Delivery of preprocessed digital data from GSFC via a communication satellite at $790 per scene.
  - Delivery of a frame of imagery from EDC at $880 per scene.
  - Delivery of a computer-compatible tape (CCT) or high-density data tape (HDT) from EDC at $1,000 per scene.
- Foreign ground station fees:
  - Annual access fee of $600,000 per station.
  - Distribution fee of $65 for each CCT and $5 for each photographic product sold or otherwise distributed by the station to customers.

A breakdown of prices for specific products and services is presented in tabular form below. Except where noted, the prices will apply to U.S.-produced data from all Landsat-series satellites (Landsats 1, 2, 3, and D).

LANDSAT PRICE LIST
(TO BE EFFECTIVE OCTOBER 1, 1982)

ARCHIVAL PRODUCTS:	Price
Photographic Products:	
70-mm Film Positive (B/W)	$ 26
70-mm Film Negative (B/W)	32
10-in. Film Positive (B/W)	30
10-in. Film Negative (B/W)	35
10-in. Paper (B/W)	30
20-in. Paper (B/W)	58
40-in. Paper (B/W)	95
10-in. Film Positive (color)	74
10-in. Paper (color)	45
20-in. Paper (color)	90
40-in. Paper (color)	175
16-mm Microfilm (B/W)	60
35-mm Slide (color), from existing collection	4
16-mm Microfilm (color, 100-ft roll)	150
Digital Products:	
9-track, 800-bpi CCT (MSS scene--all avail. bands)	650
9-track, 1600-bpi CCT (MSS scene--all avail. bands)	650
9-track, 6250-bpi CCT (MSS scene--all avail. bands)	650
9-track, 800-bpi CCT (RBV single subscene)	650
9-track, 1600-bpi CCT (RBV single subscene)	650
9-track, 800-bpi CCT (RBV set of 4 subscenes)	1300
9-track, 1600-bpi CCT (RBV set of 4 subscenes)	1300
14-track, High-Density Tape (variable content)	Variable
Generation of Color Composite (false-color infrared):	
Surcharge on product price	$ 195

SPECIAL ACQUISITIONS:

(Special acquisitions signify Landsat D MSS scene data that are not scheduled for routine collection, but which are provided upon user request.)

Delivery of preprocessed digital data to the requestor's site via communication satellite; per MSS scene collected at a time and place specified by the requester	$ 790

	Price
Delivery to the requester of a frame of standard MSS imagery (not a color composite); per MSS scene collected at a time and place specified by the requester	$ 880
Delivery to the requester of a CCT or HDT; per MSS scene collected at a time and place specified by the requester	$ 1000
Surcharge for delivery of a color composite to the user originally requesting the special acquisition of an MSS scene; per scene	$ 150
Surcharge applied when the requester establishes a maximum allowable cloud cover condition for the collection of an MSS scene; per scene	$ 250

SUBSCRIPTION SERVICES:

Landsat MicroCATALOG:

Annual:

World (monthly update)	$1088
North Zone (monthly update)	508
South Zone (quarterly update)	290
Polar Zone (quarterly update)	290
Region 1 (monthly update	139
Region 2 (monthly update	139
Region 3 (quarterly update)	52
Region 4 (quarterly update)	29
Region 5 (quarterly update)	36
Region 6 (quarterly update)	36
Region 7 (quarterly update)	65
Region 8 (quarterly update)	52
Region 9 (quarterly update)	58
Region 10 (quarterly update)	131

Current Edition:

World	377
North Zone	203
South Zone	102
Polar Zone	73
Region 1	58
Region 2	58
Region 3	17
Region 4	14
Region 5	14
Region 6	10
Region 7	14
Region 8	14
Region 9	14
Region 10	$ 36

Landsat MicroIMAGE Fiche (Landsat D): Annual by World, Zones, and Regions	Price to be announced
Landsat MicroCATALOG/MicroIMAGE Fiche (Landsat D) combination: Annual by World, Zones, and Regions	Price to be announced

NOTES:
1. 1 inch = 254 mm
2. B/W = for "black and white"
3. bpi = bits per inch
4. CCT = computer-compatible tape
5. HDT = high-density digital tape

INTERNATIONAL CCT STANDARD

Concurrent with the launch of Landsat D, a standard worldwide format for computer-compatible tapes (CCT's) will become available.

This new format, adopted in 1978 by the Landsat Ground Station Operators Working Group (LGSOWG), was designed to facilitate the interchange of data between countries and to help lower overall software complexity and cost. It differs from current formats in that it carries an internationally recognized "superstructure" which provides comprehensive location and data description information on the tape itself. The superstructure concept allows the development of a "family" of formats which can include tape formats for a variety of data types, for example, image, polygon, profile, or point data. Once a user becomes familiar with the superstructure, it is possible, with any family member, to identify the data type and source, locate and read the desired data and support information, and in most cases directly apply the data to a given analysis requirement without software modification.

Formats adopt the superstructure through the addition of:

- A Volume Directory File, which generally describes the data configuration (in a Volume Descriptor Record) and provides pointers to each data file (File Pointer Records).
- A File Descriptor Record for each data file, which describes the data structure within that file.

The general format and content of these three records is similar; the purpose of each is to identify, describe, and locate data in the files to which they apply. The records of the Volume Directory File always equal 360 bytes in length; the File Descriptor Record assumes the same length as the records within the file it introduces.

The records within the data files themselves will be very similar in format to those of the current Landsat CCT format, but some minor differences will exist. One difference is that the record length for MSS data will be 3,600 bytes instead of 3,596 bytes. Another is that the location of some fields in the Landsat header record will be changed in order to have these fields fall on 4-byte boundaries. The actual content of the data records, however, will not change between the two formats.

The advantages of ready access to multisource data have encouraged the various organizations represented in LGSOWG, including EDC, to adopt the superstructure conventions for Landsat CCT's and to bring the formats of other Landsat processing centers into this family. Examples of data type formats other than Landsat which are already within the family include synthetic aperture radar data, imagery to be obtained from the French SPOT satellite, and Canadian geocoded polygonal data on natural resources.

An additional advantage of the superstructure convention is that it may be employed by users in recording reprocessed imagery, data resulting from image analysis (such as coded clusters), and associated information on the same (or a companion) tape. These kinds of secondary information are both documented and made accessible through the same superstructure conventions and software as in the original digital imagery.

To aid users in making the transition to the new International CCT Format, EDC has detailed documentation available on both the new format and on the philosophy of the superstructure approach. Requests for this documentation may be addressed to the User Services Section, U.S. Geological Survey, EROS Data Center, Sioux Falls, SD 57198, telephone: (605) 594-6151.

LATE PAYMENT POLICY

As directed by the Department of the Interior, the U.S. Geological Survey is required to charge interest on customer accounts not paid within 30 days of the billing date. Interest rates are determined by the U.S. Department of the Treasury on a quarterly basis. The annual rate for the period of January 1, 1982, through March 31, 1982, was set at 14.39 percent.

This policy will go into effect on April 1, 1982. EDC customers should be aware of it if they are currently carrying a delinquent bill for any products purchased. Questions can be directed to the User Services Section, U.S. Geological Survey, EROS Data Center, Sioux Falls, SD 57198, telephone: (605) 594-6509.

Notice of any changes in the interest rate will be published in this newsletter.

REMOTE SENSING EXPERIMENTS ABOARD SHUTTLE

When the second Space Shuttle mission was carried out last November, a scientific payload known as OSTA-1 was aboard. This payload was developed by NASA's Office of Space and Terrestrial Applications (OSTA) to conduct experiments concerning the remote sensing of land resources, environmental quality, ocean conditions, and meteorological phenomena. Although the second Shuttle flight had to be cut back to a 54-hour minimum mission, most of the experiments obtained a sufficient number of observations to warrant terming the results successful. These are summarized here.

The **Shuttle Imaging Radar-A** (SIR-A) experiment used a side-looking, synthetic-aperture, imaging radar (the first to fly in space) to create two-dimensional images of the Earth's surface. An SIR-A type of sensor not only provides relief information but can also penetrate cloud cover and to some extent vegetation canopies as well. It thus holds much promise for geologic exploration.

All objectives of the SIR-A experiment on the second Shuttle were met. The radar equipment worked perfectly, and excellent image data (about 8 hours) were obtained over North and South America, Africa, Europe, and Asia. Several long passes over both the Atlantic and Pacific Oceans were also collected. The radar images gathered by SIR-A will be compared with other data, particularly Landsat images, to develop geologic information for locating hydrocarbons and mineral deposits. Radar imagery records differences in surface roughness and terrain attitude and therefore can be used to delineate faults, folds, domes, and drainage patterns. Landsat multispectral imagery will provide the supplementary information needed to identify rock and vegetation types.

The **Shuttle Multispectral Infrared Radiometer** (SMIRR) was also successful. This experiment was designed to evaluate the effectiveness of 10 spectral bands in the 0.5-μm to 2.5μm range for discriminating geological units (rock types, for example) when the data are gathered from space. About 108 minutes of cloud-free observations were acquired. Although not yet analyzed, extremely good data are believed to have been acquired over Mexico and Spain; data acquired over the United States were of lower quality due to cloud cover.

SMIRR data will be correlated with field spectrometer data and with existing Landsat data to help determine spectral bands suitable for future orbiting multispectral scanners designed for geologic mapping. The variability in reflectance signatures of similar geologic units in different climatic environments will be assessed, and the effects of atmospheric absorption on the quality of the data will also be analyzed.

The **Feature Identification and Location Experiment** (FILE) was part of an effort to develop an onboard capacity to select scenes at the data gathering stage. Measuring spectral reflectances at the red (0.65 μm) and near-infrared (0.85 μm) wavelengths, it used a ratioing technique to determine whether given scenes contained vegetation, water, barren land, or clouds and snow. From the data gathered, a proof-of-concept for future "smart" Landsat-type satellites could be developed. The possibilities include automatic acquisition of data on certain surface features as well as automatic suppression of acquisitions when scientific objectives are not in view.

FILE acquired 32 hours of data. Some of these data, however, may have been lost because of marginal performance on the part of the sensor's tape recorder.

The **Measurement of Air Pollution from Satellite** (MAPS) experiment used a carbon monoxide detector to measure the relative amount of CO in the middle and upper troposphere. It also included an aerial camera to record cloud cover and terrain data. The performance of MAPS under various temperatures and other orbital conditions is expected to indicate the potential effectiveness of using orbiting spacecraft to measure environmental quality.

The experiment acquired 32 hours of data, including excellent sightings over Virginia, Florida, and California.

The **Ocean Color Experiment** (OCE) was designed to test the ability of a sensor to automatically map chlorophyll concentrations in the world's oceans as a means of locating plankton and the schools of fish that feed on them. This information would be useful to commercial fisheries as well as to the marine science community.

The OCE acquired 78 minutes of cloud-free data, nearly twice the minimum mission requirement. It is anticipated that some of the ocean color data will be degraded because of the low relative Sun angle. However, excellent data are believed to have been acquired over the Mediterranean Sea, where concurrent ground data are also available for comparison.

The **Night/Day Optical Survey of Lightning** (NOSL) experiment consisted of a crew-operated, handheld instrument which took motion pictures and photocell readings of lightning and thunderstorms. The techniques involved in gathering and analyzing such data may be useful in the identifica-

tion of severe weather situations from meteorological satellites.

The data from the NOSL experiment were generally of low quality.

Reduction of the data acquired by the various sensors making up the OSTA-1 package is in progress, and image products are expected to be available sometime this spring from the National Space Science Data Center located at the Goddard Space Flight Center in Greenbelt, Md.

THE RUSSIAN EARTH RESOURCES SATELLITE

[The following article was adapted from a TASS report in PRAVDA, June 19, 1980.]

In June 1980, the U.S.S.R. 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 multispectral 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) onboard tape recorders; and (3) two telemetry systems operating in the meter and decimeter 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 Center 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 U.S.S.R. Academy of Sciences' Institute of Space Research as well as the Center 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 Federal Republic of 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 onboard 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 650 km	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

DATA SALES REACH RECORD HIGH IN FY 1981

EDC's satellite and aircraft data sales for FY 1981 totaled $4,368,000. This figure is about 20 percent more than sales for FY 1980. Deliveries were rather evenly spread over all four quarters.

Landsat data accounted for 57 percent of the net shipped sales, aircraft data accounted for 33 percent, and miscellaneous data products accounted for about 10 percent. Sales of Landsat images increased 4 percent over the previous year's sales, while aircraft data sales increased 55 percent.

Non-U.S., industrial, and Federal agencies were the biggest users of Landsat imagery, with oil/gas and mineral exploration users being the most active group of consumers. Non-U.S. users accounted for 34 percent, industrial users for 27 percent, and Federal agencies for 20 percent of all dollar sales.

The increase in aircraft data sales was primarily due to a high level of interest in the National High-Altitude Photography (NHAP) Program and in photography acquired by the Bureau of Land Management. NHAP is a consortium of 13 U.S. Federal agencies which is collecting black-and-white and color-infrared photographic data over the 48 States during a 5-year period. The demand for these data is growing rapidly and is expected to increase as more coverage becomes available. User demand for older aircraft data is also growing and these continue to be valuable archive asset.

EDC received about 45,000 inquiries concerning satellite and aircraft data in FY 81. These inquiries generated approximately 25,000 orders. The average order turnaround time for the year was under 2 weeks for all orders.

Remotely sensed data analysis methods are undergoing rapid advancement in both the photographic and digital technique areas. The data needs of resource managers, coupled with new analysis developments, should result in a continued strong demand for the types of Earth resources data that are available from EDC.

FY '81 EROS DATA CENTER DATA DELIVERIES $4,367,785 *

LANDSAT IMAGERY & CCT'S 133,126 Items $2,495,268			AIRCRAFT IMAGERY 259,824 Frames $1,429,994	
% By Items	% By Dollars	Customer Category	% By Items	% By Dollars
22%	19%	Federal Government	48%	41%
3%	4%	State/Local Government	3%	4%
9%	8%	Academia	8%	8%
22%	31%	Industrial	30%	34%
7%	5%	Individual	9%	12%
37%	33%	Non-U.S.	2%	1%

*Includes $442,523 in miscellaneous deliveries

LANDSAT D SCHEDULE

The launch of Landsat D is expected to take place early in the third quarter of 1982 (calendar year). All activities leading to the launch are on or ahead of schedule. All flight segment hardware has been integrated, and the acceptance test cycle has been initiated. Ground segment hardware and software development are on schedule for an operational readiness test to be initiated in May 1982.

The second spacecraft in the series, Landsat D', will be available 12-15 months later and will be launched when Landsat D fails. Spacecraft lifetimes are projected to be 3 years.

Current plans call for the National Oceanic and Atmospheric Administration (NOAA) to become the operator and manager of the operational part of the Landsat D program early in 1983. NOAA will assume responsibility at that time for preprocessing of Landsat D MSS data and for services related to both archived and real-time Landsat data.

NOAA's recently established Landsat operations activity group is engaged in projects leading to the 1983 transfer of system management to NOAA. The group is working with NASA on implementation tasks.

LANDSAT 2 AND 3 STATUS REPORT

During a 9-week period starting late last August, a major adjustment was made to the **Landsat 2** orbit. This was the first major adjustment in 3 years. It should allow for continued operations through 1983.

In conjunction with the start of preliminary acquisition testing by Thailand in November, Landsat 2's power limitations were investigated further. All ground station operators are being advised as necessary regarding the acquisition capability of this platform.

Landsat 3 return beam vidicon (RBV) operations were constrained to a real-time mode when the onboard tape recorder being used for RBV data failed on October 15, 1981. Because of the problems involved in using the one remaining recorder in multiple modes, its use is now restricted primarily to MSS data acquisition. Small quantities of

recorded RBV data may still be acquired, but only on special request.

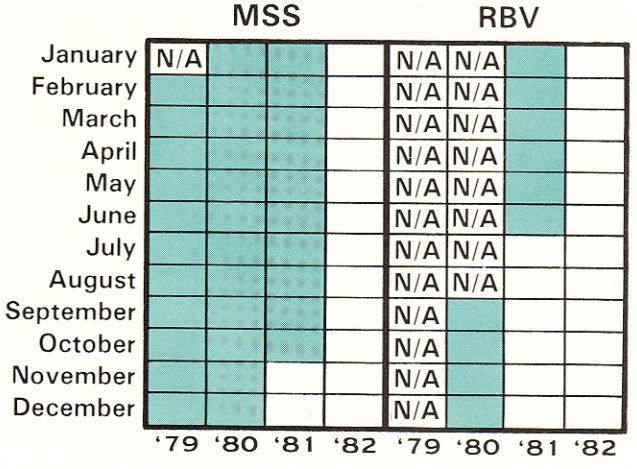
Current plans are to operate both Landsats through March 1983, after which their use may be gradually phased out as Landsat D assumes the role of primary user spacecraft.

Indonesia has signed a Memorandum of Understanding with NASA, making it the most recent member of the group of countries operating Landsat ground stations worldwide.

STATUS OF GSFC DIGITAL PROCESSING

Because of various ground system problems that occurred after the commencement of digital operations between GSFC and EDC in 1979, the flow of Landsat data to EDC suffered frequent interruptions even though acquisitions by the satellites were continuing. This situation resulted in a significant backlog of data waiting to be processed at GSFC, and it was not until recently that any substantial progress could be made toward eliminating it.

In the past year, significant reductions in the Landsat digital processing backlog have been accomplished which have allowed certain monthly increments of data to be "closed out." These are shown in the chart below. Where a month is closed out, it means that all processable Landsat MSS and RBV scenes acquired during that month have been processed and sent to EDC. The chart is current as of February 1, 1982. It should be noted that digital processing of RBV data did not start until September 1980.



RBV WORLDWIDE COVERAGE PROJECT CONSTRAINED

A project to systematically acquire Landsat 3 return beam vidicon (RBV) imagery of all the land masses of the world may soon be constrained after little more than a year in operation. The reason is that Landsat 3 RBV operations are restricted primarily to real-time mode since failure of one of the onboard tape recorders October 15, 1981. The remaining recorder is being used mainly for MSS data at this time.

The RBV Worldwide Coverage project began as an effort to acquire at least one good scene for every path-row location falling over a land mass. Scenes with 30 percent cloud cover or less, and which met overall quality standards, were to be selected to create a permanent digital archive of one-time RBV coverage.

Unfortunately, only 17 percent of the total number of scenes possible under this project had been acquired when the tape recorder failed last October. This figure equates to about 1,800 scenes out of a possible 10,554.

North America and Africa have the most coverage at this point in the project, with about 35 percent of the total number of acquisitions planned for these continents having actually been obtained. Other major land masses, such as Eurasia and South America, have received significantly less coverage—around 10 percent.

All scenes that have been acquired under the RBV Worldwide Coverage project are available in either photographic or digital form from EDC. Contact the User Services Section at EDC for specific information on which path-row points are available.

6250-BPI CCT'S AVAILABLE

Computer-compatible tapes (CCT's) of Landsat imagery are now available at a packing density of 6250 bits per inch (bpi). The 9-track, 6250-bpi tapes cost the same as CCT's reproduced at other densities (1600-bpi and 800-bpi, for example). The only difference is that more data can be packed on the new tapes, reducing the storage requirements of those who maintain extensive CCT libraries.

In the past, CCT's have generally been sold as tape sets. A customer ordering all four bands of an MSS scene, for instance, received two 1600-bpi tapes or three 800-bpi tapes depending on the density requested. The new 6250-bpi CCT's, however, can contain the same amount of data on a single tape.

MSS tape sets at the lower densities will still be available, and RBV data will still be sold on a tape-per-subscene basis.

Customers should ensure that their equipment can handle 6250-bpi data before ordering CCT's at this density. Tape drives having such a capability are widely available from commercial sources. Any questions concerning the production of 6250-bpi CCT data at EDC should be directed to the User Services Section, U.S. Geological Survey, EROS Data Center, Sioux Falls, SD 57198, telephone: (605) 594-6151.

STANDING REQUEST SYSTEM CHANGED

EDC recently eliminated the "Report Only" option from its Standing Request System. Under this option, customers had been able to automatically receive computer printouts describing new Landsat acquisitions over their areas of interest.

The reason for dropping the "Report Only" option was that customer interest had fallen in re-

cent years. Too few requests were being received to justify the expense of maintaining the service.

A second option in the Standing Request System, the "Auto Order" option, is being continued. This option allows the customer to maintain a standing order for any specific data products meeting his criteria. As soon as the source data are received at EDC, the order is filled and shipped automatically.

To place an "Auto Order" standing request, users should contact the User Services Section, U.S. Geological Survey, EROS Data Center, Sioux Falls, SD 57198, telephone: (605) 594-6151.

NEW MEDIA FOR DIGITAL PRODUCTS

The EROS Data Center plans to start offering full Landsat scenes in tape cartridge format soon. The price of each cassette will be $300, the same as currently charged for CCT's. Production capacity will be limited initially, but plans have been made to expand production quickly if user demand indicates a need.

Also, 8-inch floppy disks containing Landsat data will be offered. These will be single-sided, single-density, CP/M-compatible disks containing subsets of Landsat scenes which will be selectable by area.

The techniques used to format Landsat data on tape cartridges and floppy disk media were developed in conjunction with the designing of the EDC Remote Image Processing System (RIPS). This is a microprocessor-based image analysis system whose primary advantages are low cost and portability. Its use of advanced data storage techniques had obvious implications for new product development.

Readers may direct any questions to the Computer Services Branch, U.S. Geological Survey, EROS Data Center, Sioux Falls, SD 57198, telephone: (605) 594-6555.

LANDSAT HISTORICAL MSS DIGITAL DATA BANK PROJECT

Since the launch of Landsat 1 in July 1972, the three Landsat satellites have collected more than 1 million scenes of MSS data throughout the world. Of this total, more than 350,000 scenes were recorded on wideband video tape at one of the three NASA receiving stations.

Until 1979 the wideband video tape data were routinely converted to analog images at the Goddard Space Flight Center by electron-beam recorder (EBR). Very few scenes were converted to digital form in response to specific customer orders. Therefore, the vast majority of Landsat data collected from 1972 until 1979 existed only as wideband video tape recordings or as EBR-generated 70-mm film. Because wideband video tape data can deteriorate with age, it became desirable to upgrade this data archive by creating a permanent archive of digital data. The wideband video tapes could then be destroyed or reused for other purposes. The EROS Data Center started a project to select scenes of highest historical value while minimizing the number of scenes that would have to be reprocessed through the ground data handling system.

It was recognized that certain areas of the world are subject to more seasonal variations than other areas. It was felt that for those areas where there are four distinct seasons of the year, it would be desirable to archive a sample of data taken during each of the four seasons in each year of satellite operations. For areas where seasonal variation was minimal, only one scene from each year of operation would be required.

A review of the current status of this project shows that EDC has completed scene selection for the years 1972 through 1976 (approximately 30,000 scenes) and that GSFC has converted approximately 4,000 of these scenes to digital form. These have been added to the 12,000 scenes (approx.) that were already in the EDC digital archive as a result of customer-generated requests for pre-1979 data in past years.

CCT USERS PLEASE NOTE: The conversion of selected 1972 data from wideband video tape to CCT's will be completed within the next few months. Starting on August 1, 1982, all 1972-acquired wideband video tapes will be retired from the GSFC archive. No further conversion of those data to CCT's will be possible after that date, although the film archive will remain intact. Therefore, if you need to order CCT's of any of these 1972 data, your order must be placed with EDC before July 1, 1982.

A brief review of the scene selection procedure used in the project is provided below for the benefit of users who may be ordering from the MSS Data Bank.

Selection Plan Design

The world climate map by Strahler and Strahler[1] partitions the global landscape into 14 major climate categories, a level of detail deemed appropriate for the purposes of this project. The climate categories were considered along with information about their associated vegetation types in order to estimate the number of Landsat scenes which would be required to capture significant variations in landscape appearance due to seasonality.

The boundaries of the climatic categories were then transferred from the original small-scale world climate map to their respective Worldwide Reference System (WRS) Landsat Coverage Index Sheets. Notations of local seasonality (expressed as astronomic seasons related to local Sun position) were made in the margin of each index sheet to help locate the correct selection data, or dates, as specified in the guidelines.

After the relevant data had been added to the Landsat Coverage Index Sheets, general summaries of the number of scenes required for each sheet were prepared.

Although the phenology-related criteria provided a specific target date for scene selection, a candidate scene also had to meet strict quality standards in order to be included in the Data Bank. The maximum acceptable cloud cover, for example,

[1]Strahler, A.N., and H.H. Strahler, 1978. Modern Physical Geography. John Wiley and Sons, New York.

was established at 30 percent. In addition, the digital tape containing the scene could not have missing bands or other such defects which could detract from its usefulness as a historical record.

Strategy for Implementation

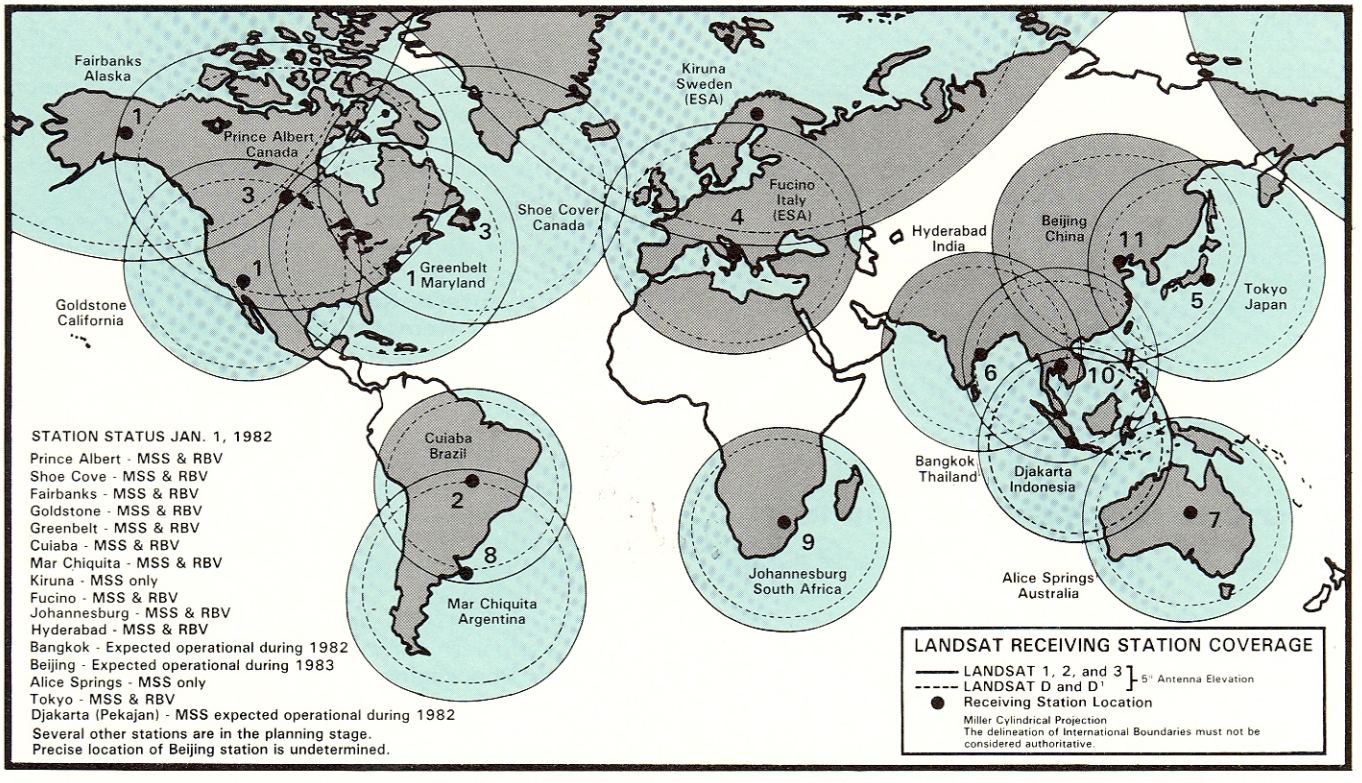
Use of the index sheets with climatic zone boundary and seasonality requirements allowed a specific date (or dates) to be suggested for each Landsat MSS scene center point (path-row designation) worldwide. Ideally, a scene would be available which would not only fall on the required date, but which would satisfy the cloud cover and technical quality requirements as well. However, it was expected that exact matches would be rare. Therefore, in practical use, the selection dates were considered as target dates only. Each target date thus represented the center of a selection "window" from which scenes were to be chosen. Relatively minor deviations from the target dates did not negate the logic and rationale of the selection criteria.

Additional information regarding this project can be obtained by contacting the User Services Section, U.S. Geological Survey, EROS Data Center, Sioux Falls, SD 57198, telephone: (605) 594-6151.

ERRATA

In the September 1981 issue of this newsletter (no. 20), a map depicting the real-time coverage areas of Landsat ground stations worldwide appeared on page 3. This map, as printed, carried no legend defining the significance of the broken-line and solid-line patterns used, and it bore no annotation describing the current reception capabilities of the stations shown (MSS, RBV, or both).

A second version of the map in this issue (below) contains that information.



INTERNATIONAL LANDSAT DATA DISTRIBUTION CENTERS

1 User Services Section
EROS Data Center
U.S. Geological Survey
Sioux Falls, South Dakota 57198

2 Instituto de Pesquisas Espacias (INPE)
Departamento de Producao de Imagens
ATUS-Banco de Imagens Terrestres
Rodovia Presidente Dutra, Km 210
Cachoeira Paulista-CEP 12.630
Sao Paulo, Brazil

3 Canadian Centre for Remote Sensing (CCRS)
User Assistance and Marketing Unit
717 Belfast Road
Ottawa, Ontario K1A OY7
Canada

4 European Space Agency (ESA)
Earthnet User Services
Via Galileo Galilei
000 44 Frascati, Italy

5 Remote Sensing Technology Center (RESTEC)
7-15-17 Roppongi, Minato-Ku
Tokyo 106, Japan

6 Director, National Remote Sensing Agency
No. 4 Sardar Patel Road
Hyderabad-500 003
Andhra Pradesh, India

7 Australian Landsat Station
14-16 Oatley Court
P.O. Box 28
Belconnen, A.C.T. 2616
Australia

8 Comision Nacional de Investigaciones Espaciales (CNIE)
Centro de Procesamiento
Dorrego 4010
(1425) Buenos Aires, Argentina

9 Director, National Institute for Telecommunications Research
ATTN: Satellite Remote Sensing Centre
P.O. Box 3718
Johannesburg 2000
Republic of South Africa

10 Remote Sensing Division
National Research Council
Bangkok 9
Thailand

11 Academia Sinica
Landsat Ground Station
Beijing
People's Republic of China

operational use of photogrammetry and remotely sensed data and (2) the use of a new generation of operational satellites that should be available in the 1980's. An international exhibition will be held concurrently with the symposium. For further information, contact:

Groupement pour le Developement
de la Teledection Aerospatiale
18, avenue Edouard-Belin
31055 Toulouse Cedex, FRANCE
Tel: (61) 53.11.12

The American Congress on Surveying and Mapping (ACSM) and the American Society of Photogrammetry (ASP) will hold their 1982 Fall Convention in Fort Lauderdale-Hollywood, Florida, September 19-23, 1982. In conjunction with this conference, a **National Symposium on the Profession in Private Practice** will be presented. Organized by the ASP Florida Region and the Florida Society of Professional Land Surveyors, this special symposium will focus on the business problems, legislative affairs, legal matters, and Governmental contracting practices that face the professional photogrammetrist and surveyor today. Further information on this symposium can be obtained from Janet D. Degner, Department of Civil Engineering, University of Florida, Gainesville, FA 32611, telephone: (904) 392-1436.

EDC TRAINING SCHEDULE

The EROS Data Center's Applications Branch will conduct or assist in presenting several training courses and workshops in the coming months:

April 26 - May 28 **International Remote Sensing Workshop: Applications in Geologic and Hydrologic Exploration and Planning** (Sioux Falls, S. Dak.) Open to non-U.S. scientists only. Contact: Office of International Geology, U.S. Geological Survey, National Center, Mail Stop 917, Reston, VA 22092.

June 7-11 **Digital Land Cover Classification Techniques** (Sioux Falls, S. Dak.) Advanced. Contact: Chief, Training and Assistance, U.S. Geological Survey, EROS Data Center, Sioux Falls, SD 57198, telephone: (605) 594-6114.

Aug. 30 - Oct. 1 **International Remote Sensing Workshop: Applications in Vegetation Assessment and Land Use Planning** (Sioux Falls, S. Dak.) Open to non-U.S. scientists only. Contact: Office of International Geology, U.S. Geological Survey, National Center, Mail Stop 917, Reston, VA 22092.

LANDSAT PRODUCTION STATISTICS

	June '81		July '81		Aug. '81		Sept. '81		Oct. '81		Nov. '81		6-Month Total	
	MSS	RBV	MSS	RBV	MSS	RBV	MSS	RBV	MSS	RBV	MSS	RBV	MSS	RBV
Landsat scenes acquired (satellite acquisitions)*	3,339	946	2,884	561	3,311	504	2,764	898	2,585	534	1,813	170	16,696	3,613
Landsat MSS scenes/RBV subscenes received at EDC	3,420	2,678	4,611	2,640	3,519	2,672	4,036	1,132	3,486	2,403	3,620	1,081	22,692	12,606
Average time in days from EDC receipt to archive availability	7.2	5.2	13.5	13.8	19.8	21.9	20.6	18.1	9.3	35.4	32.6	13.9	–	–
Average delivery time from receipt of order at EDC to shipment:														
Standard photographic products	15		15		12		13		17		20		–	
Standard digital products**	13		13		8		9		15		14		–	
Landsat photographic frames sold	11,594		11,958		10,187		7,654		16,678		7,991		66,062	
Landsat digital scenes sold	301		280		430		363		940		542		2,856	
TOTAL LANDSAT DOLLAR VOLUME	$205,060		$225,385		$219,857		$160,268		$374,922		$224,486		$1,409,978	

*Figures are revised periodically to reflect updated information received from NASA.

**Standard digital products average 3 days in production – balance of turnaround is for the 9-in. prints shipped with the tapes.

EDC HISTORICAL LANDSAT STATISTICS (FY 1973 - FY 1981)

	FY '73	FY '74	FY '75	FY '76	FY '77	FY '78	FY '79	FY '80	FY 81
Landsat 1 MSS Scenes Acq'd	46,354	11,764	55,284	14,109	12,286	4,964	51	0	0
Landsat 2 MSS Scenes Acq'd	–	–	10,962	53,704	25,282	44,715	12,886	8,325	20,457
Landsat 3 MSS Scenes Acq'd	–	–	–	–	–	12,350	22,452	18,032	13,237
TOTAL LANDSAT MSS SCENES ACQUIRED	46,354	11,764	66,246	67,813	37,568	62,029	35,389	26,357	33,694
Landsat 2 RBV Scenes Acq'd	–	–	575	479	949	64	24	11	46
Landsat 3 RBV Scenes Acq'd	–	–	–	–	–	3,221	4,234	16,684	15,112
TOTAL LANDSAT RBV SCENES ACQUIRED	–	–	575	479	949	3,285	4,258	16,695	15,158
Landsat Photographic Frames Sold	81,071	157,178	197,654	297,253	130,100	110,723	134,482	128,433	128,775
Landsat Digital Scenes Sold	10	228	729	3,299	1,887	2,853	2,982	4,139	4,351
Dollar Volume of Total Landsat Sales	$229,642	$564,994	$909,009	$2,093,664	$1,453,837	$1,976,068	$2,131,813	$2,388,567	$2,495,268
Customer Profile of Total Landsat Data (by $ value):									
Federal Government	27%	16%	21%	34%	26%	31%	23%	16%	19%
State/Local Government	5%	2%	2%	1%	1%	1%	1%	3%	4%
Academic	13%	12%	16%	11%	10%	8%	11%	9%	8%
Industrial	30%	22%	24%	21%	28%	24%	24%	26%	31%
Individual	7%	13%	11%	8%	5%	4%	5%	4%	5%
Non-U.S.	12%	23%	19%	25%	30%	32%	36%	42%	33%
Non-Identified	6%	12%	7%	0%	0%	0%	0%	0%	0%

*Fiscal years 1973-1975 lasted from July to June, FY 1976 lasted from July 1975 to September 1976, FY 1977-1981 lasted from October to September.

The Landsat Data Users NOTES is published bimonthly in order to present information of interest to the user community regarding Landsat products, systems, and related remote sensing developments. There is no subscription charge; individuals and organizations wishing to receive the NOTES should contact the User Services Section, U.S. Geological Survey, EROS Data Center, Sioux Falls, SD 57198, U.S.A., telephone: (605)594-6151.

Comments, corrections, and other inquiries should be directed to:

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