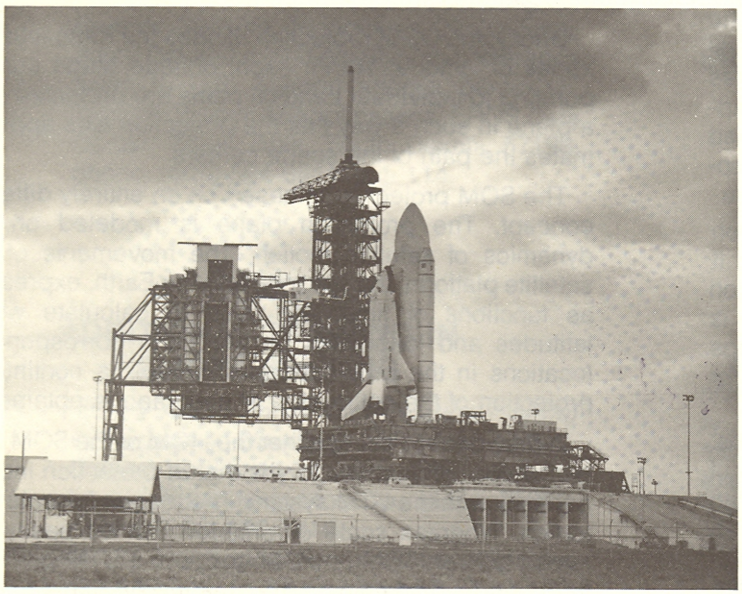
LANDSAT D AND THE SPACE SHUTTLE

It is planned for Landsat D and follow-on Earth resources satellites to be retrievable by the space shuttle, as opposed to the one-shot, nonretrievable Landsat missions sent up in the past.

To be retrievable by the shuttle, Landsat D will have to carry about 160 kg of extra propellant, the amount needed to conduct in-orbit maneuvers for rendezvous. The standard Delta launch vehicle, an expendable rocket used for Landsat and other missions, cannot currently handle this extra weight. NASA is therefore participating in the development of an improved Delta launcher which could place a heavier payload in orbit.

Such an added launch capability could be provided for relatively low additional cost, certainly much less than the cost of sending up a nonretrievable Landsat D satellite. The new Delta launcher could also be used for other satellite missions (communications satellites, weather satellites, etc.) which might otherwise be delayed by an already crowded shuttle schedule. Missions for the space shuttle are currently backlogged into 1984.

The plan to recover Landsat platforms has advantages beyond that of reduced cost. The most obvious advantage is that repairs could be made in case of a malfunction, thus assuring continuity in the receipt of data.



Landsat D will be retrievable by the shuttle.

MAP PROJECTIONS FOR LANDSAT DATA

The basic problem of any map projection is to represent the curved surface of the Earth, a spheroid, in a plane. This must be done while attempting to preserve true terrestial properties such as areas, shapes, distances, and directions. Since it is impossible to preserve all of these properties simultaneously, it is necessary to select a projection that preserves those desired. Map makers generally consider the characteristic of conformality, that is, correct shape, to be the most important.

Landsat Data Users NOTES

ISSUE NO. 10
JANUARY 1980

U.S. DEPARTMENT OF THE INTERIOR
March 3, 1849

NASA

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

Conformality retains equal scale locally in all directions and preserves angular relationships. The imagery obtained by Landsat warrants description as conformal, and conformal maps are used to correlate Landsat imagery to ground locations.

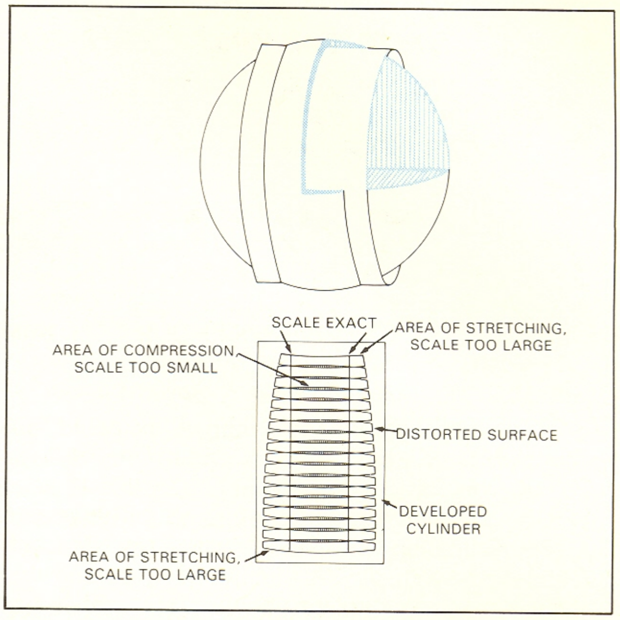
A conformal projection can be developed by transferring (projecting) details of the globe to a cylinder that is tangent or secant to a great circle (the Equator, for example). This cylinder can be cut along a meridian and laid flat, thus forming a planar projection surface. Cylindrical conformal projections are named after Mercator, who first conceived them. The regular Mercator projection is most frequently used in navigation. On it, meridians and parallels appear as straight lines crossing at right angles, and distances between parallels increase as latitudes grow higher. The regular Mercator is the only projection on which a rhumb line (a line which crosses successive meridians at constant angle) appears as a straight line.

When the cylinder of the regular Mercator projection is turned 90° about an axis through the Equator and the center of the globe, it becomes a tangent or secant to a meridian. This is the "transverse" case of the Mercator projection. All the properties of the regular Mercator are preserved, except that rhumb lines are no longer straight. In addition, the line of zero distortion is no longer the Equator but the central meridian to which the cylinder is tangent. In the secant case, two lines parallel to a central meridian have zero distortion. This makes the Transverse Mercator projection well suited for mapping a large extent of latitude having a restricted longitude. The system is also suited to a "universal" application in repeated columns (or zones) of longitude.

The Universal Transverse Mercator (UTM) projection is widely used in conjunction with Landsat imagery. It satisfies the need for conformality, and it is based on north-south strips (60 of them, to be exact), which is roughly how Landsat imagery is acquired. UTM maps are widely available at scales which are appropriate for most Landsat products.

There are certain problems in using UTM projections, however. UTM projections impose scale distortions of up to 1 part in 1,000 (1:1,000). Landsat imagery can theoretically be projected with far less distortion than this because of its geometric fidelity. Also, UTM projections are not suited for use in the polar regions where north-south strips converge. Even in the lower latitudes, scenes frequently fall into two or more zones.

To solve these problems, some rather specialized variations on the basic Mercator projection have been devised. These are the Hotine Oblique Mercator (HOM) and the Space Oblique Mercator (SOM) projections. They are both based on north-south strips that are oblique, or inclined at an angle away from, the polar axis, matching, therefore, the ground track of the satellite more nearly. Both are distortion-free for all practical purposes since they create a scale difference of no more than 1 part in 10,000 (1:10,000). HOM and SOM projections do not fall into multiple zones, they are suitable for imagery acquired at any latitude, and they are conformal.



The Universal Transverse Mercator projection is based on longitudinal zones represented on a cylinder which has been laid flat.

Briefly, the HOM projection divides the Earth into five zones of latitude. Within each, oblique strips corresponding to individual Landsat paths are projected onto a plane in such a way that the projection axis approximates the path of the scene centers.

The SOM projection is based on an entirely different concept. The projection plane is modeled on the dynamics of satellite motion. The movements of the satellite platform, the sensors, and the Earth, expressed as functions of time, are used to calculate which latitudes and longitudes on the Earth correspond to locations in the projection plane. Thus, a continuous projection of the entire area of coverage is obtained.

A drawback to using either the HOM or the SOM projection for Landsat imagery is that of projection incompatibility with the UTM system. The reason is scale distortion. Whereas scale *differences* can be easily adjusted to fit an SOM or HOM image to a UTM grid, it is the *change in scale* over the area involved that is critical.

The maximum distortion in a UTM projection occurs at the Equator on a zone boundary. If the left side of an SOM (or HOM) image is fitted to a UTM grid at the Equator so that the same ground distance (185 km) is represented in both at the left side, the ground distance at the right side of the SOM (or HOM) projection will vary from that of the UTM by 204 meters. This is the

General information on map projections was obtained from the new book Maps for America *by Morris M. Thompson, published by the U.S. Geological Survey (Government Printing Office Stock Number 024-001-03145-1). Further details on the HOM and SOM projections in particular can be obtained by contacting User Services, EROS Data Center, U.S. Geological Survey, Sioux Falls, South Dakota 57198, phone: (605) 594-6511.*

worst case, and the differences decrease with latitude, so that at 45° latitude they are only half as much as at the Equator. Although such distortions are quite small for a single image, a mosaic of several SOM or HOM images could not be expected to fit a UTM grid without measurable error.

For the vast majority of applications, these discrepancies between UTM and SOM/HOM are virtually insignificant and very difficult to detect.

MAGSAT

On October 30, 1979, a magnetic field sensing satellite called Magsat was launched into a low-altitude polar orbit by NASA. Providing both scalar and vector measurements on a broad scale, the magnetometers on board are expected to tell much about regional anomalies in the Earth's magnetic field, which are undoubtedly related to variations in the crustal structure. This capability will be of significance to mineral and petroleum exploration and to a host of other applications as well.

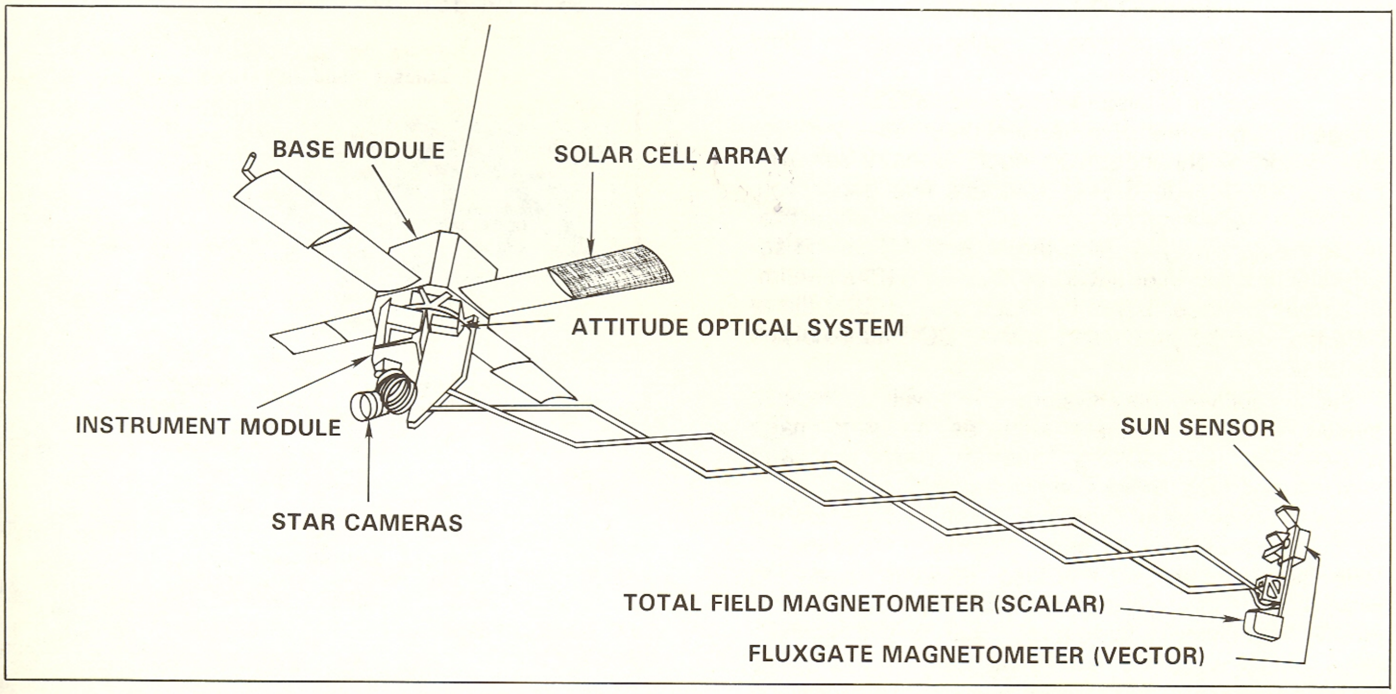
Traditionally, satellite measurements of the magnetosphere have been of little practical value to geologic and geophysical studies. Poor spatial distribution of data and less than adequate information on the temporal behavior of the magnetic field have limited the usefulness of geomagnetic field models for magnetic surveys. Magsat will improve this situation by providing global coverage on a repetitive basis. Its high-resolution data on the amplitude of field anomalies and directional characteristics observable from a satellite platform will make it possible to obtain an accurate and current quantitative description of the Earth's main magnetic field.

These data will allow detailed investigations that could lead to an enhanced knowledge of geological and physical crustal properties, indirect measurement of upper mantle conductivity, and a better understanding of the structure and dynamics of the core and core-mantle boundary. The U.S. Geological Survey plans to use Magsat data to update and refine its published magnetic charts, which are maps used for navigation and geologic purposes.

The principle sensors aboard Magsat are a Cesium-vapor total field magnetometer and a three-axis fluxgate magnetometer. To reduce the effects of the spacecraft's own magnetic field, the sensors are located at the end of a 6.1-meter extendable boom to separate them from the base module.

The complexity of making vector measurements requires state-of-the-art technology to achieve desired fluxgate accuracy. A sophisticated optical system incorporating two star cameras is used to obtain sensor attitude information.

Magsat data products are almost certain to be provided on computer-compatible digital tapes. In such a format, the data could be analyzed by a computer or integrated with other ground data, for example, Landsat multispectral scanner (MSS) data. The NASA Goddard Space Flight Center will handle the data on an experimental basis; details on availability are not known at this time.



Sketch of Magsat. The sensors are mounted on a boom away from the main platform in order to minimize effects of vehicle's own magnetic field.

GENERALIZED IMAGE PROCESSING SYSTEM

During the Landsat program, Landsat digital data have been available to users in multiple formats. Early computer-compatible tape (CCT) data were distributed in a band-interleaved-by-pixel format (referred to now as the "X" format). As non-U.S. stations began to record and process data, additional formats were defined and implemented, and when Landsat 3 digital processing systems were implemented, both band-sequential and band-interleaved-by-line formats were developed.

Most of the early data were provided in uncorrected form, and a number of organizations were involved in experimenting with various types of radiometric and geometric corrections. As a result, each new data format and the algorithms that became available to process the data gave rise to the development of a collection of data processing programs at the EROS Data Center (EDC). Features and techniques obtained from other systems and facilities, such as the Jet Propulsion Laboratory VICAR system and the Flagstaff image processing facility, also evolved. This collection of routines is now being consolidated into a generalized image processing system (GIPS) designed to support continued research by the Department of the Interior as required.

The objectives of GIPS are to allow input of a digital image, to process that image using any of a variety of algorithms, and to produce a product in either digital or film format. The initial capability includes input routines for all Landsat formats currently in existence, for U.S. Geological Survey digital elevation data, and for data processed by the EDC Data Analysis Lab.

The processing options currently available allow variable image annotation, mating of two corrected images, application of systematic corrections, sizing of an image through either pixel replication or sampling, and application of enhancements such as haze removal, contrast stretch, destriping, synthetic line generation, and high frequency edge enhancement. Output products are generally in one of three forms: (1) a band-sequential or band-interleaved-by-line CCT, (2) a film image from the laser beam film recorder, or (3) a file of data that can be processed in the EDC Data Analysis Laboratory.

Still a relatively new system, GIPS will continue to evolve as other features such as image-to-image registration, mosaicking, change detection, and latitude-longitude annotation are added.

Since these techniques are useful in generating specialized products for various Department of the Interior applications and are also useful in producing materials for training and demonstrations, the user community has become increasingly aware of their existence. An expected increase in the number of requests for such processing has occurred, and EDC is handling these requests as follows.

When requests for specialized processing are received from within the Department of the Interior, they are evaluated based on the EDC GIPS functional capabilities and throughput capacity. If the processing can be accomplished, the request is accepted.

Requests from industry and non-U.S. Government agencies are not accommodated but are referred to a list of commercial firms which offer Landsat image processing services. This list was published in Issue No. 3 of the NOTES, and an updated version of it is available from EDC upon request. It is likely that any image processing that could be performed at EDC could also be performed by one or more of the firms appearing on this list.

To keep the list updated, commercial firms offering image processing services or hardware are welcome to submit their names, addresses, and capabilities to the NOTES editorial staff at any time.

UPDATE ON LANDSAT microIMAGE SYSTEM

Resumption of the Landsat microIMAGE system, which was discontinued temporarily as announced in our last issue, is tentatively scheduled for March or April of this year. Microfilm cassettes of MSS band 5 imagery are being made available in the interim.

Users wishing to order these reference images on 16-mm rolls can do so for $15 per roll. Appropriate indexing materials in the form of microCATALOG fiche will be included. Queries may be directed to the User Services Section, EROS Data Center, U.S. Geological Survey, Sioux Falls, South Dakota 57198, phone: (605) 594-6511, ext. 151.

LANDSAT PRODUCTION STATUS

Data Availability
As of 11/30/79

Film Archive	
MSS and RBV	370,016 scenes
Color Composites	13,495 scenes
Tape Archive	
CCT's	8,747 scenes
HDT's	17,478 scenes

Landsat Sales
From launch thru 11/79

Frames of Imagery	1,132,866
Scenes of Digital Data	12,545

Order Turnaround Time
As of 11/30/79

All EDC imagery, including Landsat	13 days
Standard Digital Imagery	9 days

Digital Acquisitions
September and October

	RBV	MSS
Scenes Acquired by NASA/Goddard	1,704	6,155
Scenes Delivered to EDC	—	3,620

NOTE: Order turnaround times above exclude Goddard-to-EDC delivery time.

NON-U.S. DATA AVAILABILITY

A useful diversity of Landsat products is available from several of the non-U.S. Landsat stations in operation. Canada, Italy, Brazil, and Japan offer both film and digital products, and Australia plans to publish its first product list in February or March 1980.

Records of non-U.S. holdings are kept at the EROS Data Center as part of the standard information carried in its Main Image File. This is the result of a program of information exchange between EDC and the other stations that has been going on for the past year. Approximately 20,000 Brazilian station scenes and 70,000 scenes from the Italian center in Rome are referenced in the EDC files; Canada has 120,000 scenes that have been added. Users wishing to purchase products made from any of these scenes should contact the appropriate station and deal directly with that agency.

Non-U.S. products generally resemble those available from the United States in format, scale, and other characteristics. A summary of the more popular standard products is as follows:

BRAZIL

Image Size (mm)	Scale	Format	B/W	Color
59 x 73	1:3,704,000	Film Pos	X	
59 x 73	1:3,704,000	Film Neg	X	
220 x 270	1:1,000,000	Film Pos	X	X
220 x 270	1:1,000,000	Paper	X	X
440 x 540	1:500,000	Paper	X	X
880 x 1080	1:250,000	Paper	X	

CCT Type	Tracks	Bits per Inch	Format
Bulk	9	800	2-tape set
Edge-Enhanced	9	800	2-tape set

EUROPEAN SPACE AGENCY
(FRASCATI, ITALY)

Image Size (mm)	Scale	Format	B/W	Color
58 x 58	1:3,369,000	Film Pos	X	X
185 x 185	1:1,000,000	Film Pos	X	X
185 x 185	1:1,000,000	Film Neg	X	X
185 x 185	1:1,000,000	Paper	X	X
371 x 371	1:500,000	Paper	X	X
742 x 742	1:250,000	Paper	X	

CCT Type	Tracks	Bits per Inch	Format
System Corrected	9	800	1-tape set

NOTE: Quick-look prints and microfiche available.

CANADA

Image Size (mm)	Scale	Format	B/W	Color
70 x 70	1:3,369,000	Film Pos	X	
70 x 70	1:3,369,000	Film Neg	X	
185 x 185	1:1,000,000	Film Pos	X	X
185 x 185	1:1,000,000	Film Neg	X	
185 x 185	1:1,000,000	Paper	X	X
371 x 371	1:500,000	Film Pos	X	
371 x 371	1:500,000	Paper	X	X
742 x 742	1:250,000	Paper	X	X

CCT Type	Tracks	Bits per Inch	Format
4-band MSS	9	1600	1-tape set
DICS	9	1600	4-tape set (one tape per subscene)

NOTE: Quick-look microfiche available.

JAPAN

Image Scale (mm)	Scale	Format	B/W	Color
70 x 70	1:3,369,000	Film Pos	X	
70 x 70	1:3,369,000	Film Neg	X	
240 x 240	1:1,000,000	Film Pos	X	X
240 x 240	1:1,000,000	Film Neg	X	
240 x 240	1:1,000,000	Paper	X	X

CCT Type	Tracks	Bits per Inch	Format
BSQ	9	1600	1-tape set
BIL	9	1600	1-tape set

These are samples of the products currently available. Contact the respective data centers directly for further information. The addresses are:

BRAZIL:
Instituto de Pesquisas Espaciais
Rodovia Presidente Dutra Km. 210
Caixa Postal 01
CEP 12.630
Cochoeira Paulista
Sao Paulo
Brazil
Telefone: (0125) 61-1377
Telex: 0122160

ITALY:
European Space Agency (ESA)
ESRIN
Via Galileo Galilei
00044 Frascati
Italy
Tel: 06-9424116
TWX: 61637

CANADA:
Canada Centre for Remote Sensing (CCRS)
2464 Sheffield Road
Ottawa
Ontario K1A OY7
Canada
Telephone: (613) 993-0121

JAPAN:
Remote Sensing Technology Center of Japan (RESTEC)
Uni-Roppongi Bldg.
7-15-17, Roppongi, Minatoku
Tokyo 106
Japan
Tel: Tokyo (403) 1761

LANDSAT IMAGE ANNOTATIONS

Since February 1979, the geodetic tick marks provided on each Landsat product have been annotated with a new coordinate system associated with the Hotine Oblique Mercator (HOM) map projection. Images produced prior to that time had tick mark locations defined in terms of latitude/longitude coordinates.

The primary advantage of the HOM tick marks is that they can be interpolated accurately to any location on the image. However, use of this type of annotation does not allow easy correlation of the image with normally available map bases. The map bases used with Landsat imagery are usually polyconic projections and include latitude/longitude indicators.

As a result, discussions have been going on for some time to determine whether the HOM annotation should be replaced with the more familiar latitude/longitude information. It was recently learned that the NASA Goddard Image Processing Facility systems can be modified to add latitude/longitude designators to the high-density digital data transferred to the EROS Data Center. This capability will enable both the HOM annotation and latitude/longitude annotation to be provided on digital Landsat products (e.g., CCT's), and the

HOM annotation to be replaced with latitude/longitude data on photgraphic products.

The necessary modifications to the NASA Goddard Image Processing Facility will be time-consuming, so it is not known exactly when the annotation changes will go into effect. Future issues of the NOTES will report on the progress of the modifications.

SYMPOSIA

The Sixth Annual William T. Pecora Symposium on Remote Sensing will be held April 13-17, 1980, Sioux Falls, South Dakota. The symposium is being sponsored by the Society of Exploration Geophysicists in cooperation with the U.S. Geological Survey, the American Association of Petroleum Geologists, the National Aeronautics and Space Administration, and the Geosat Committee. The theme of the symposium is centered on how remote sensing can be combined with other more conventional techniques to provide an integrated approach to the discovery of energy and mineral resources. In view of the rapidly expanding interest in remote sensing techniques for exploration, it is anticipated that the meeting will be one of the largest Pecora Symposia to date. A strong international representation is expected. For further information, readers are invited to contact the Society of Exploration Geophysicists, P.O. Box 3098, Tulsa, Oklahoma 74101.

The 6th Canadian Symposium on Remote Sensing will be held May 21-23, 1980, in Halifax, Nova Scotia. Sponsored by the Canadian Remote Sensing Society, the symposium should be of value to anyone interested in the technical advances and practical usage of remote sensing. Interested persons should contact Mr. Graham Doyle, CBCL Ltd., 61 Young Street, Halifax, Nova Scotia, B3K 2A4 phone: (902) 455-7241, for further information.

The 14th International Symposium on Remote Sensing of Environment will be held April 23-30, 1980, in San Jose, Costa Rica. It is being sponsored jointly by the Environmental Research Institute of Michigan and the Costa Rican Instituto Geografico Nacional. Applications of remote sensing technology, particularly as relevant to Latin America, will be stressed. Further information may be obtained from Dr. Jerald J. Cook, Environmental Research Institute of Michigan, P.O. Box 8618, Ann Arbor, Michigan 48107, phone: (313) 994-1200.

EDC TRAINING SCHEDULE

The EROS Data Center's Applications Branch staff will conduct or participate in several training courses and workshops in the coming months.

Mar 10 - Mar 14 *Introductory Course in Geological Remote Sensing Techniques* (Sioux Falls, South Dakota). Open enrollment, preference given to U.S. Federal agency personnel. Contact: Branch of Applications, EROS Data Center, Sioux Falls, South Dakota 57198, phone: (605) 594-6511, ext. 114.

Mar 17 - Mar 21 *Applications of Digitally Processed Data to Geological Investigations* (Sioux Falls, South Dakota). Open enrollment, preference given to U.S. Federal agency personnel. Contact: Branch of Applications, EROS Data Center, Sioux Falls, South Dakota 57198, phone: (605) 594-6511, ext. 114.

Mar 24 - Mar 28 *Water Resources Remote Sensing Workshop* (Sioux Falls, South Dakota). Open enrollment, preference given to U.S. Federal agency personnel. Contact: Branch of Applications, EROS Data Center, Sioux Falls, South Dakota 57198, phone: (605) 594-6511, ext. 114.

May 5 - May 30 *International Remote Sensing Workshop* (Sioux Falls, South Dakota). Open to non-U.S. scientists. Contact: Office of International Geology, U.S. Geological Survey, National Center (917), Reston, Virginia 22092.

May 12 - May 16 *Remote Sensing for Wetlands Analysis* (NSTL, Bay St. Louis, Mississippi). Open to U.S. Fish and Wildlife Service personnel only. Contact: Dr. Allan Marmelstein, Office of Biological Services, U.S. Fish and Wildlife Service, Washington, D.C.

Jun 9 - Jun 13 *Remote Sensing Applications Training Course* (Sioux Falls, South Dakota). Open to U.S. Fish and Wildlife Service personnel only. Contact: Dr. Allan Marmelstein, Office of Biological Services, U.S. Fish and Wildlife Service, Washington, D.C.

Jun 15 - Jun 20 *Third Annual Vegetation Remote Sensing Workshop* (Glen Arbor, Michigan). Open enrollment. Contact: Prof. Charles Olson, School of Natural Resources, University of Michigan, Ann Arbor, Michigan 48109, phone: (313) 764-1413.

Jun 16 - Jun 20 *Forest and Rangeland Inventory Methods* (Berkeley, California). Contact: S. Arce, Letters and Sciences, U.C. Extension, 2223 Fulton St., Berkeley, California 94720, phone: (415) 642-1061.

Jun 23 - Jun 27 *Terrain Analysis: Interpretation of Aerial Photographs and Images* (Sioux Falls, South Dakota). Contact: Lisa Underkoffler, Graduate School of Design, Gund Hall L-37, Harvard University, Cambridge, Massachusetts 02138, phone: (617) 495-2578.

Jul 14 - Jul 18 *Applications of Digitally Processed Remote Sensing Data* (Sioux Falls, South Dakota). Open to U.S. Dept. of Interior personnel only. Contact: Branch of Applications, EROS Data Center, Sioux Falls, South Dakota 57198, phone: (605) 594-6511, ext. 114.

Aug 11 - Aug 15 *Introduction to Geologic and Hydrologic Remote Sensing Techniques* (Sioux Falls, South Dakota). Open enrollment, preference given to U.S. Federal agency personnel. Contact: Branch of Applications, EROS Data Center, Sioux Falls, South Dakota 57198, phone: (605) 594-6511, ext. 114.

Sep 8 - Oct 3 *International Remote Sensing Workshop* (Sioux Falls, South Dakota). Open to non-U.S. scientists. Contact: Office of International Geology, U.S. Geological Survey, National Center (917), Reston, Virginia 22092.

Oct 20 - Oct 24 *Advanced Course in Geological Remote Sensing Techniques* (Sioux Falls, South Dakota). Open enrollment, preference given to U.S. Federal agency personnel. Contact: Branch of Applications, EROS Data Center, Sioux Falls, South Dakota 57198, phone: (605) 594-6511, ext. 114.

ADDITIONAL TRAINING IN REMOTE SENSING

Feb 11 - Feb 15 *Aerial Photo Interpretation - Aerial Photography Workshop* (Moscow, Idaho). Contact: University of Idaho, Office of Continuing Education, Moscow, Idaho 83843, phone: (208) 885-7016.

Mar 17 - Mar 21 *The Application of Remote Sensing Techniques to Environmental Resource Problems* (Terre Haute, Indiana). Also to be held June 16-20 and Aug 18-22. Contact: Dr. Paul M. Mausel, Dept. of Geography and Geology, Indiana State University, Terre Haute, Indiana 47809.

Apr 7 - Apr 25 *Introduction to Remote Sensing* (Panama). Also to be held Sept 8-26. Instruction in Spanish. Sponsored by the Defense Mapping Agency, Inter-American Geodetic Survey, and EROS Program. Contact: Chief, DMA-IAGS Cartographic School, APO Miami, Florida 34004.

Apr 14 - Apr 16 *Mapping from Space - Techniques and Applications* (Washington, D.C.). Contact: Continuing Engineering Education, George Washington University, Washington, D. C. 20052, phone: (202) 676-6106.

Apr 28 - May 2 *Manipulation of Computer-Compatible Tapes* (Panama). Also to be held Sep 22-26. Instruction in Spanish. Sponsored by the Defense Mapping Agency, Inter-American Geodetic Survey, and EROS Program. Contact: Chief, DMA-IAGS Cartographic School, APO Miami, Florida 34004.

May 12 - May 16 *Advanced Topics in the Analysis of Remote Sensing Data* (West Lafayette, Indiana). Contact: Philip H. Swain, Purdue/LARS, 1220 Potter Drive, West Lafayette, Indiana 47906, phone: (317) 749-2052.

Jun 9 - Jun 13 *Soil Applications of Digital Analysis of Multispectral Data* (West Lafayette, Indiana). Contact: Douglas B. Morrison, Purdue/LARS, West Lafayette, Indiana 47906, phone: (317) 749-2052.

Jul 21 - Jul 25 *International Conference on Soil Conservation* (Bedford, England). Contact: Mrs. P. M. King, National College of Agricultural Engineering, Silsoe, Bedford, England MK45 4DT.

Sep 29 - Oct 17 *Landsat Mosaic Workshop* (Panama). Instruction in Spanish. Sponsored by the Defense Mapping Agency, Inter-American Geodetic Survey, and EROS Program. Contact: Chief, DMA-IAGS Cartographic School, APO Miami, Florida 34004.

DATA ANALYSIS LABORATORY UPGRADES CAPABILITY

A key element in the EROS Data Center's training and assistance program is the Data Analysis Laboratory (DAL) where three state-of-the-art image analysis systems are maintained. The DAL equipment is used to extract information from Landsat data in a variety of ways to develop new analysis techniques as well as to accomplish technology transfer to the user community.

Two of these systems, the Image 100 and the IDIMS, were recently upgraded with additional hardware. The expanded capability will widen the range of DAL functions for use in solving Earth resource problems, and it will ensure that the DAL systems continue to represent current image processing technology.

The Image 100 system has been upgraded with the addition of two 300-megabyte disk drives. An extremely fast, interactive, image processor, the Image 100 is used primarily to extract thematic information from multispectral imagery. It also is used as an image enhancement system. Thematic information extraction is "supervised" by an analyst who first defines the ground area of interest. The system then classifies the remainder of the image based on system-measured spectral properties of the defined area. A comprehensive set of over 70 software programs and many hardwired functions (both arithmetic and display-oriented) are provided to assist in various image analysis and interpretation tasks. The addition of new disk storage space will increase the Image 100's batch processing capabilities and allow it to manipulate larger images. New software development is scheduled to add spatial filtering, stereo pair generation, and statistics generation capabilities.

The Interactive Digital Image Manipulation System (IDIMS) is being upgraded to expand its digital image display capabilities and to add certain components for increased operating efficiency. The IDIMS provides comprehensive data analysis capabilities in a multitasking, time-shared environment. After images to be analyzed are loaded onto disk, the analyst may invoke such functions as geometric correction and resampling, classification and statistical refinement, map digitization and entry of ancillary data, and numerous arithmetic and display options. An array processor and a 20-megabyte system disk have been added to substantially reduce execution times and requirements on system software. Other additions include a New Hewlett-Packard Series III central processor to replace the existing HP-3000 CX, two 300-megabyte disk storage units, two 6250/1600-bpi tape drives, and a Comtal Vision I display monitor.

Although no additions are being made to the ISI-270 at this time, this third system in the DAL complements the other two. Analog processing techniques provide the fast visual feedback needed for some analyses. ISI-270 capabilities include analog density manipulation, density slicing as a simple classification technique, planimetric measurements, isometric 3-D display, and both linear and logarithmic data manipulations. The ISI-270 equipment configuration presently incorporates a 600-image video disk storage unit which receives input from either a magnetic tape or a vidicon camera. Numerous display monitors, both black-and-white and color, are also used.

* * *

The Landsat Data Users NOTES is published bi-monthly 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, South Dakota 57198, U.S.A., telephone: (605)594-6511.

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

Editor, Landsat NOTES
U.S. Geological Survey
EROS Data Center
Sioux Falls, South Dakota 57198

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