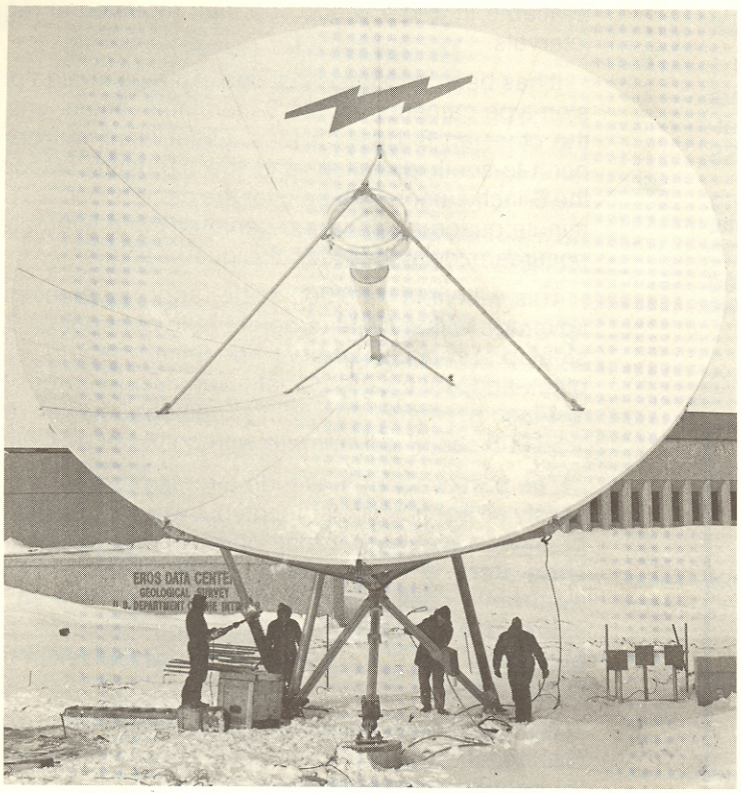
ANTENNA ACTIVATION

The Earth station antenna that will receive Landsat digital data relayed via communications satellite was installed on the EROS Data Center grounds on Thursday morning, January 25, 1979. The antenna and its various data subsystems have been undergoing a period of testing since then, and routine operations are expected to begin May 1, 1979.

A structure 14 meters high, the Earth station receives Landsat data relayed from NASA/Goddard via a domestic communications satellite link, minimizing the time between Initial acquisition of data by the Landsat sensors and final delivery to EDC.



EDC Antenna In Place

PHOTOGRAPHIC PRODUCTION IMPROVEMENTS

The EROS Data Center's photographic laboratories have recently converted to a new type of color reversal paper for producing photographic prints. The existing Kodak 1993 reversal color print and R-5 process production lines were converted to Kodak 2203 reversal color paper and R-100 process. The new paper has improved dye stability, improved image detail, better color reproduction characteristics, and greater sensitivity, which shortens exposure times and increases production rates. Customers should notice an improvement in their color paper products along with an increase in speed of service.

Landsat Data Users NOTES

ISSUE NO. 6
MAY 1979

NASA

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

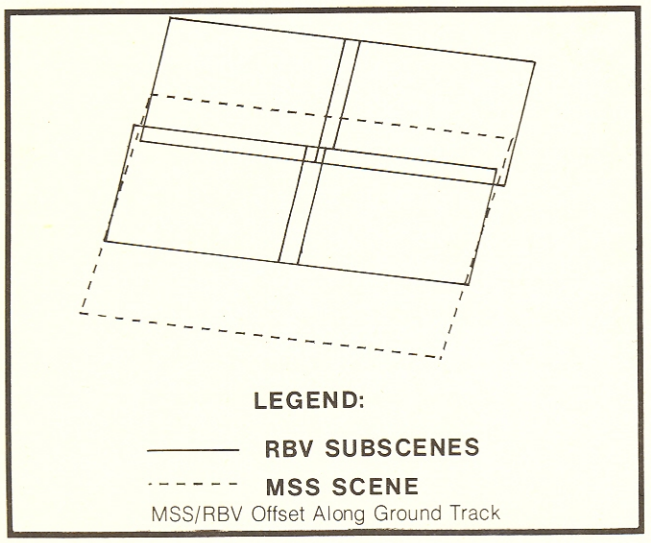
SCENE CENTER MISMATCH

On November 21, 1978, NASA/Goddard modified the data acquisition time schedule for Landsat 3 in order to permit more efficient handling of MSS data by their Master Data Processor. It became apparent shortly thereafter that significant discrepancies between RBV and MSS nominal scene centers were occuring. RBV images (i.e., sets of 4 subscenes) were being offset to the north of their companion MSS scenes by as much as 20 to 40 percent along the ground track of the satellite.

A second modification by NASA/Goddard on February 17, 1979, corrected the problem. However, about 87 days of MSS and RBV acquisitions remain permanently affected by the scene center mismatch.

The impact of this situation is that, with the normal 1:1 correspondence between MSS and RBV scene centers absent, users may experience some difficulty in locating RBV data that cover the same area as a given MSS scene.

Nevertheless, the geographic coordinates of all data, both RBV and MSS, *are* correct as entered in the EDC Main Image File. Specific records can thus be checked for the exact location of each scene's center point and coverage area.



MSS/RBV Offset Along Ground Track

HIGH-ALTITUDE PHOTOGRAPHS

Many Federal and State agencies have been acquiring high-altitude aircraft photographs for several years. Coverage at scales ranging from 1:60,000 to 1:135,000 is used extensively for mapping purposes and numerous other applications including resource inventory, pollution detection, and agricultural monitoring. A proposal currently under consideration recognizes the value of these efforts by suggesting a repetitive, cyclic, national high-altitude photograph data base for the use of all. The EROS Data Center would be designated as one of the facilities responsible for the storage, reproduction, and distribution of this material.

At a meeting in August 1978, representatives from interested agencies gathered to discuss this proposal and contribute their ideas on what kind of aerial coverage would best meet their needs. Many user requirements, it was learned, would be satisfied by using two mapping cameras to obtain color infrared and black-and-white panchromatic stereoscopic coverage from altitudes near 12,200 meters (40,000 feet). Portions of the conterminous United States would be photographed each year so that full coverage would be available in 3 to 4 years, and then repeated at regular intervals.

It has been proposed that one of the calibrated precision-type cameras have a 6-inch focal length lens and the other an 8 1/4-inch lens. Flight lines will be in a north-to-south direction, and the exposure stations of the 6-inch camera will be over the centers of USGS 7.5-minute quadrangles (quad-centered) with alternate exposures midway between the quad centers.

This will yield 1:80,000-scale (approx) stereoscopic coverage with a base-to-height ratio of about 0.57 and sidelap of about 30 percent. The 6-inch camera will use black-and-white panchromatic aerial film whereas the 8 1/4-inch camera, providing photographs at about 1:58,000 scale, will operate with color infrared film.

The proposed high-altitude aircraft program may not satisfy all agency photo needs but will, for the first time, provide systematic aerial photography coverage of large areas at regular intervals. As such, it will be a worthwhile complement to the Landsat program, providing a comparative base of high-resolution aerial photograph coverage offering spectral and textural signature data.

It is proposed that the Topographic Division of the Geological Survey assume lead agency responsibility for coordination of this high-altitude photograph program. The many Federal and State agencies who would make use of the imagery obtained would share the expense. Pooling resources in this way will help eliminate gaps and duplication in the coverage currently being obtained and is likely to satisfy more individual needs while reducing the collective cost of acquiring this type of photography. Contract flying is proposed to begin in early 1980.

TERMINALS FOR NON-FEDERAL USERS

The EROS Data Center has received approval to permit non-Federal terminal access to the EDC data base. The EDC data base contains descriptive information on over 6 million frames of reproducible imagery held at EDC, in addition to records of the Landsat holdings that exist at various foreign sites.

Availability of terminal access will present significant advantages to those firms who in the past have purchased copies of data base information for use in their own computerized retrieval systems. Should these firms avail themselves of the new capability for direct inquiry on the EDC data base, their present requirements for large-scale software development and maintenance activities in-house would be eliminated. Also, users could obtain data base information much quicker via a terminal than by earlier means.

EDC will make terminal access available utilizing data communications hardware that is currently installed. This will necessitate sharing of common access ports to the central computer by multiple terminal users, and will require teletype-compatible equipment (terminals utilizing ASCII character-mode transmission) to be used over dial-up telephone lines at transmission rates of up to 1200 bits per second.

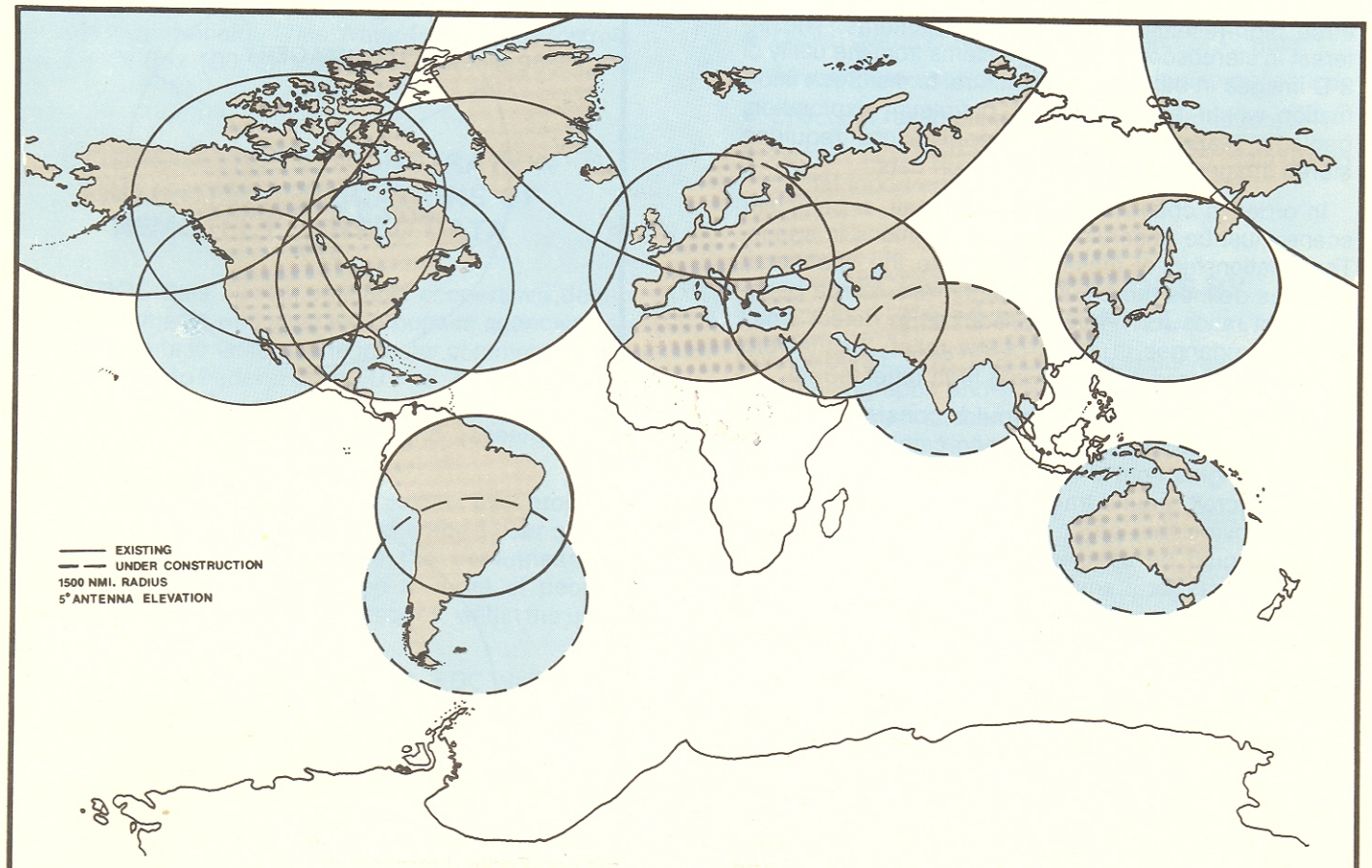
EDC is required to recover all costs associated with supplying terminal access and will bill terminal users for computer resources actually utilized. Each organization requesting terminal service must provide its own terminal equipment and pay all telephone line charges.

Organizations interested in the specifics of this service may obtain further information by contacting the Remote Terminal Coordinator, User Services, U.S. Geological Survey, EROS Data Center, Sioux Falls, South Dakota 57198, phone: (605) 594-6511, extension 158.

FOREIGN SITES

The Japanese Landsat receiving station has been completed and was in operation as of April, according to the Japanese Government.

The approximate receiving ranges of all existing or proposed Landsat ground stations is shown by the map included on this page. The common reception radius is 2,780 km (1,500 nmi.).



Approximate Receiving Ranges of Worldwide Landsat Ground Stations

GEOSAT AND STEREOSAT

The Geosat Committee, Inc., was formed in 1976 as a non-profit organization and is currently supported by about 100 U.S. and non-U.S. oil, gas, mining, and engineering companies. One of the purposes of the committee is to present to NASA and other applicable government bodies the recommendations of this large industrial group of users of satellite image data regarding future Earth resources satellite systems.

Among the Committee's recommendations has been the inclusion of several additional sensors to the NASA satellite systems. One of these sensors would be a Landsat-compatible stereoscopic imagery satellite — Stereosat. The other would be an additional reflectance wavelength (a 2.2-micrometer band) on the thematic mapper of Landsat D.

At present NASA has authorized the addition of the 2.2-micrometer band to the thematic mapper. It will enable better rock and soil spectral discrimination, enhancing the geologic applications of Landsat data.

Stereosat, which is still in the conceptual stage, would acquire worldwide stereoscopic coverage through a single-instrument system equipped with three high-resolution line-scanning cameras. The interest in stereoscopic coverage stems from the utility of 3-D images in determining structural forms. Such information would be valuable in petroleum exploration, geologic mapping, and other applications requiring stereo images and detailed elevation data.

In order to obtain a stereo image pair, a particular scene must be observed from two positions in space. The relationship of these positions to the spacecraft altitudes defines the base-to-height ratio. Large base-to-height ratios (b/h = 1) are required to detect small elevation changes in areas of low relief. Smaller b/h ratios are desired when viewing high relief terrain.

The Stereosat system would consist of three cameras: a fore and an aft pointing camera positioned at equal angles from a vertical pointing camera along the spacecraft ground track. The fore and aft cameras would provide the larger b/h ratio, while the vertical camera would be used with images from one of the other cameras for a smaller b/h ratio stereo pair. The vertical camera would also obtain an orthographic view which could be easily correlated with Landsat D thematic mapper data.

Other, proposed, characteristics of the mission are as follows:

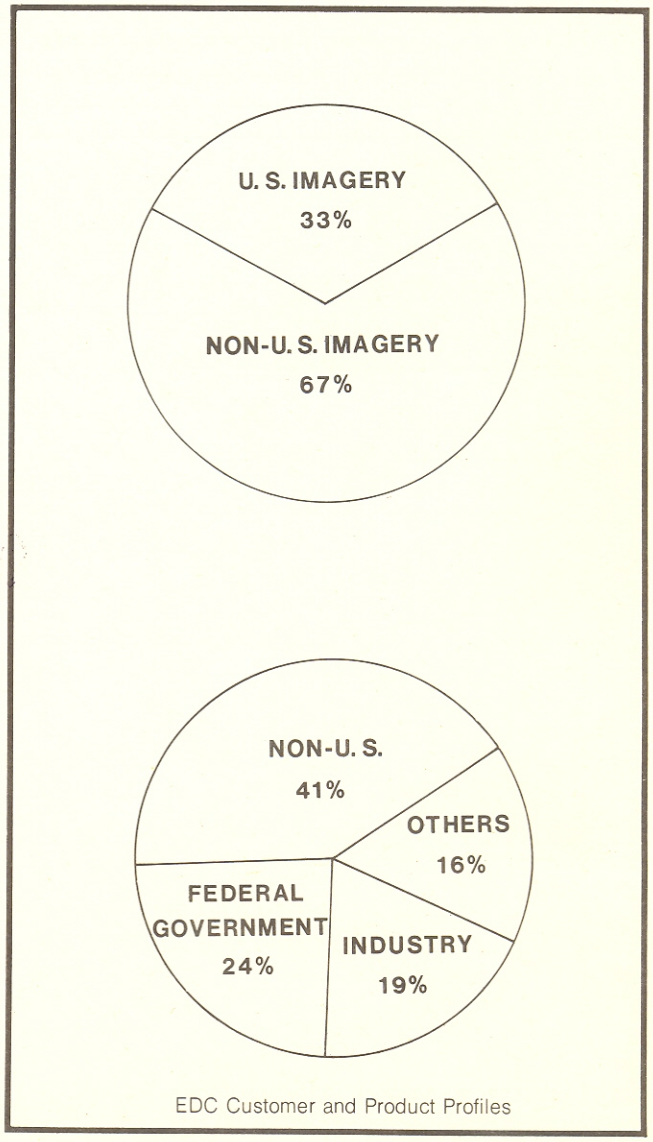
Orbit:	Sun-synchronous 705-km altitude 98.2° inclination 9:30 a.m. descending node Landsat-D compatible
Swath width:	61.4 km
Resolution (IFOV):	15m
Coverage cycle:	48 days, 7.6 cycles/year

LANDSAT CUSTOMER PROFILE

The EROS Data Center serves Landsat customers around the world and periodically compiles statistics on which coverage areas are in the most demand and who is ordering the imagery. It is interesting to note that the majority of Landsat images ordered are of areas outside the United States but that the majority of customers are from the United States.

Fully two-thirds of the Landsat images reproduced at EDC are of non-U.S. areas.

Customer statistics for 1978 indicate that 59% of last year's Landsat customers were from the United States, including Federal, State and local governments, the academic community, private industry, and individuals. The largest number of users were from the Federal Government and private industry, at 24% and 19%, respectively. Statistics on non-U.S. users, which comprise 41% of the total Landsat customers, are not compiled.



EDC Customer and Product Profiles

LANDSAT DATA USERS HANDBOOK

Final review of the 3rd edition of the *Landsat Data Users Handbook* is complete, and printing is scheduled for June. Copies may be ordered directly from the U.S. Geological Survey Branch of Distribution, 604 South Pickett Street, Alexandria, Virginia 22304.

This revised edition is the result of a joint effort by NASA/Goddard and the EROS Data Center and provides a comprehensive description of the Landsat observatories, data processing, and data products. It will be printed in looseleaf form to permit additions and corrections.

LOW-ALTITUDE AERIAL SURVEILLANCE

The California State Water Control Board has published a manual entitled *Manual of Practice: Low Altitude Aerial Surveillance for Water Resources Control.* This reference handbook and training supplement for a State-wide aerial surveillance program was published in July 1978. Copies may be obtained by contacting the Division of Planning and Research or the Office of Public Affairs, State Water Resources Control Board, P.O. Box 100, Sacramento, California 95801.

COOPERATIVE DEMONSTRATION PROJECTS: APPLICATIONS OF REMOTELY SENSED DATA

The EROS Data Center conducts cooperative demonstration projects with selected groups or agencies as part of its efforts to facilitate the transfer of remote sensing technology to Federal users. These projects are an adjunct to the EDC program in training and assistance and often include both training and research and development of new techniques.

Basically, the projects are designed as pilot projects or feasibility verification projects whereby a user group can simultaneously investigate the usefulness of specific techniques and develop a cadre of people knowledgeable about these techniques within the user group.

In a typical demonstration project, EDC staff members work with the user group to develop plans for project work, training, selection of those methods that would be most likely to serve the agency's requirements, and defining the project so that it can be completed in a reasonable amount of time. The emphasis during the project is on agency participation in all phases of work. Upon completion of the study the user group is then on its own to develop data analysis capabilities, or to contract with the private sector for the actual operational long-term work.

Examples of past or current cooperative projects are:

1. Urban and regional land use change detection (Atlanta Regional Commission)
2. Monitoring irrigated land acreage (Oregon Department of Water Resources)
3. Engineering geological analysis in the Danali region, Alaska (Bureau of Land Management)
4. Lake Mead National Recreation Area resource inventory (National Park Service)
5. Wildlife habitat evaluation procedures (U.S. Fish and Wildlife Service)
6. Arizona vegetation resource inventory (Bureau of Land Management)

In addition to this project work, EDC undertakes research in selected areas of remote sensing technology as required to satisfy identified information needs.

Among recent research and development projects have been:

- Rangeland to cropland conversion monitoring on Landsat data
- Principal component/canonical analysis
- Digital overlays of Landsat RBV and MSS data
- Atmosphere considerations in geologic applications
- Effects of resampling on classification accuracy
- Terrain illumination correction of MSS data using digital topographic information

RECENT PUBLICATIONS BY EROS PERSONNEL

Bonner, Janet, 1978, U.S. Geological Survey sources of photographs and images of biosphere reserves taken from spacecraft and aircraft - Olympic National Park: National Technical Information Service No. PB 2888 40/AS, 77p.

Carter, W. D., and Rowan, L. C., 1978, Satellite technology and its applications to energy and mineral exploration: Episodes: Ottawa, Canada, International Union of Geological Sciences, v. 1978, no. 4., p. 19-24.

Ferrigno, J. G., and Williams, R. S., 1978, Satellite image atlas of glaciers: Glaciological Data: University of Colorado, Boulder, Colorado. World Data Center A for Glaciology (Snow and Ice), Institute of Arctic and Alpine Research, Report GD-3, p. 59-60.

Williams, R. S., Jr., and Kover, A. N., 1978, Remote Sensing: Geotimes, v. 23, no. 1., p. 43-45.

Williams, R. S., Jr., 1978, Review of manual of remote sensing: Economic Geology, v. 73, no. 2., p. 290-292.

BRIEFS

LANDSAT MSS PROBLEM . . . NASA/Goddard has advised that an anomaly in the multispectral scanner (MSS) aboard Landsat 3 has been causing line-start errors, or picture tearing, in some of the scenes acquired. The MSS is currently being operated in an engineering mode, and only over the U.S., while investigation of the problem continues. In some cases, the entire MSS image is being lost. The situation is under investigation by NASA.

LGSOWG . . . The 8th LGSOWG (Landsat Ground Stations Operations Working Group) meeting will be held at the NASA Earth Resources Laboratory in Slidell, Louisiana, May 15-17, 1979. Representatives from NASA, EROS, Canada, Australia, Brazil, Chile, France, Italy, Sweden, India, Japan, Thailand, and Zaire are expected to participate in the meeting and will discuss their current status and planning for handling Landsat data.

HISTORICAL DATA . . . The continued availability of digital CCT Landsat data received prior to November of 1976 continues to be a subject of discussion between the EROS Data Center and NASA. An extension of the time limit for production of CCT's by NASA/Goddard for pre-November 1976 data until mid-1980 is under review by NASA. NASA has decided not to implement processing system modifications that would permit conversion of 1974-76 Landsat data to a form compatible with the new systems. As a fall-back position, EDC is in the process of selecting scenes of high priority from the data acquired before November 1976 that have not been converted to CCT's. These scenes will be converted to CCT's by NASA/Goddard and transferred to the EROS Data Center for archiving, reproduction, and dissemination to users as needed.

USER GROUP MEETING . . . A meeting of senior user services and data management personnel from several foreign countries will be held May 8-10, 1979, at the EROS Data Center. The purpose of the meeting will be to exchange information between participants on methods and techniques for providing Landsat data products and information to users. Establishment of closer working relationships between the organizations represented is the objective.

DIGITAL PROCESSING UPGRADE . . . The EROS Data Center plans to upgrade its digital image processing system such that it can perform resampling, and synthetic line generation. This will allow customer orders for uncorrected data, or data corrected to different projections with different resampling techniques, etc., to be satisfied from the EDC digital archive rather than through intermediate, retrospective orders from NASA/Goddard. Existing constraints will continue for some time, however, as these planned capabilities will not be available until October-November 1980.

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.

June 4-June 8 *Basic Geology 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.

June 10-June 15 *Vegetation Remote Sensing Workshop* (Ann Arbor, Michigan). Open enrollment. Contact: Dr. Charles Olson, Remote Sensing Program, School of Natural Resources, University of Michigan, Ann Arbor, Michigan 48109, phone: (313) 764-1413.

June 18-June 22 *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.

June 25-June 29 *Coal Surface Mining Remote Sensing Workshop - Abandoned Mines* (Sioux Falls, South Dakota). Open to OSM program participants. Contact: Branch of Applications, EROS Data Center, Sioux Falls, South Dakota 57198.

Sept. 10-Oct. 5 *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.

Sept. 24-Sept. 28 *Vegetation and Landform Remote Sensing Workshop* (Coeur d'Alene, Idaho). Open enrollment. Contact: Joseph Ulliman, College of Forestry, Wildlife, and Range Sciences, University of Idaho, Moscow, Idaho 83843. Phone: (208) 885-7016.

Oct. 15-Oct. 19 *Advanced Geology 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.

Oct. 23-Oct. 26 *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.

ADDITIONAL TRAINING IN REMOTE SENSING

May 28-June 29 *Advanced Training in Geologic Interpretation* (Flagstaff, Arizona). Open to non-U.S. scientists. Contact: Office of International Geology, U.S. Geological Survey, National Center (917), Reston, Virginia 22092.

June 18-June 22 *A Short Course on Remote Sensing and Image Intepretation* (St. Paul, Minnesota). Contact: Eugene L. Anderson, Office of Special Programs, 1420 Eckles Avenue, University of Minnesota, St. Paul, Minnesota 55108, phone: (612) 373-0725.

June 18-June 22 *Short Course on Remote Sensing Technology and Applications* (Lafayette, Indiana). Contact: Douglas B. Morrison, Purdue/LARS, 1220 Potter Drive, West Lafayette, Indiana 47906, phone: (317) 749-2052.

Aug. 19-Aug. 24 *Aerospace Technology and the Forest Environment—An International Short Course and Conference* (Arcata, California). Contact: Donna B. Hankins, Remote Sensing Technology Transfer Project, Humboldt State University, Arcata, California 95521, phone: (707) 826-3731.

Monthly: *Remote Sensing Short Course* (West Lafayette, Indiana). Contact: Douglas B. Morrison, Purdue/LARS, 1220 Potter Drive, West Lafayette, Indiana 47906, phone: (317) 749-2052.

Note: If you are planning a training course in remote sensing, please let us know *well in advance*. It will be listed in the newsletter. Contact: William C. Draeger, Chief, Training and Assistance Section, Applications Branch, U.S. Geological Survey, EROS Data Center, Sioux Falls, South Dakota 57198, phone: (605)594-6511.

PECORA V PROGRAM

The fifth annual William T. Pecora Symposium on "Satellite Hydrology" will be held June 10-15, 1979, in Sioux Falls, South Dakota. Sponsored by the American Water Resources Association and hosted by the EROS Data Center, the symposium will focus on the use of satellite and remote sensing in the observation of the hydrosphere and in the management of water resources. The preliminary program for the symposium is as follows:

Sunday, June 10

Registration

Monday, June 11

Plenary Session
"Challenges for Satellite Technology in National Water and Environmental Program"

Educational Sessions
1. "Earth Resource Satellites"
2. "Meteorological Satellites"

Reception

Tuesday, June 12

Concurrent Applications Sessions
3. "Hydro-Data Relay"
4. "Meteorology"

Poster Sessions and Exhibits
Presentation of papers and exhibits related to subjects in Sessions 1-4.

Keynote Luncheon
"History of the Landsat Application Program"

Concurrent Applications Sessions
5. "Snow and Ice"
6. "Water Quality and Environment"

Poster Sessions
Presentation of papers and exhibits related to subjects in Sessions 5-6.

Film Festival

Wednesday, June 13

Panel: Satellite Hydrology Overview

Future of Satellite Remote Sensing in State and Local Governments

Concurrent Applications Sessions
7. "Surface Water"
8. "Wetlands"

Poster Sessions
Presentation of papers and exhibits related to subjects in Sessions 7-8.

William T. Pecora Awards Dinner

Thursday, June 14

Concurrent Applications Sessions
9. "Coastal Zone"
10. "Water Use and Management"

Poster Sessions
Presentation of papers and exhibits related to subjects in Sessions 9-10.

Concurrent Applications Sessions
11. "Ground Water"
12. "Soil Moisture"

Friday, June 15

Field Trip
"Remote Sensing of Hydrology in Eastern South Dakota

Any inquiries concerning the activities of the symposium should be directed to:

American Water Resources Association
St. Anthony Falls Hydraulic Laboratory
Mississippi River at 3rd Ave., S.E.
Minneapolis, Minnesota 55414
Phone: (612) 376-5050

IMAGE ANALYSIS EQUIPMENT AND SERVICES

The list of sources offering image analysis equipment and services that was printed in Issue No. 3 of the *Landsat Data Users Notes* is maintained at the EROS Data Center and is revised and expanded as new information is made available to EDC. Organizations requesting changes in their listings, or wishing to receive copies of the most current list, should direct their inquiries to:

User Services Section
U.S. Geological Survey
EROS Data Center
Sioux Falls, South Dakota 57198
(605)594-6511

* * *

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
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