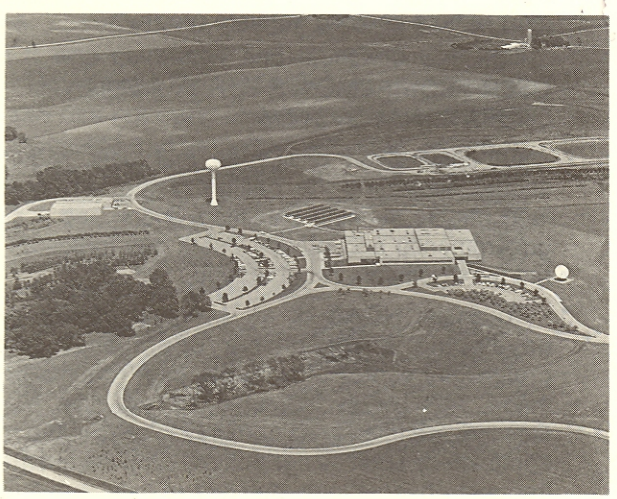
TRANSITION TO OPERATIONAL LANDSAT SYSTEM BEING PLANNED

(The following section on Landsat system planning is based on a document entitled "Planning for a Civil Operational Land Remote Sensing Satellite System: A Discussion of Issues and Options," prepared by the National Oceanic and Atmospheric Administration (NOAA) Satellite Task Force.)

In November of 1979, the President provided the framework for the implementation of a civil operational land remote sensing satellite system. NOAA has since been studying the issues and options relating to its new responsibilities which are based on the policies established in the President's decision and are reflected in the following guidelines:

- An operational land remote sensing satellite system should ensure continuity of data through the 1980's and provide timely standard data products.
- User requirements, projected levels of demand, and the cost of meeting these requirements should determine the design of the operational system.
- The private sector should eventually own and operate the system; thus operation would include the assumption of financial risk as well as control by the private operator.
- Prices for land remote sensing satellite products should be high enough to ensure maximum recovery of system costs consistent with the public good.
- The practice of widest practical dissemination of Landsat data on a nondiscriminatory basis will be continued for data and standard data products from the interim and fully operational systems in accordance with prevailing U.S. policies.
- Eventual private sector ownership and operation of the U.S. program will be conducted under Federal Government regulation, consistent with U.S. policies and international obligations.



Aerial view of the EROS Data Center. The futre role of EDC is part of the discussions and planning now taking place prior to transition of management responsibility for Landsat to NOAA.

Landsat Data Users NOTES

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NASA

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

- A civil operational land remote sensing satellite program will be a national program responsive to Federal interests and U.S. user requirements. Due regard will be given to foreign user interests and to foreign participation in the U.S. program.
- NOAA will manage the operational system until a new institutional framework is established.

PRESENT STATUS OF LANDSAT D

In addition to Landsats 2 and 3, which are currently in orbit and operating, two other satellites, Landsats D and D', are under construction. Landsat D is planned for launch in 1982 or 1983. The Landsat D series of satellites are designed to carry a new sensor, the Thematic Mapper (TM), which will provide a 30-meter ground resolution. They will also carry a multispectral scanner (MSS) system. The MSS, which provides 80-meter resolution, will continue to be flown on Landsat D and D' to provide continuity of data from previous Landsats.

Because of difficulties in developing the TM and the associate ground data processing system, the National Aeronautics and Space Administration (NASA) is considering launching Landsat D without the TM, to be followed later by Landsat D' with a TM. The Administration is also considering other alternatives.

THE INTERIM AND FULLY OPERATIONAL SYSTEMS

A fully operational land remote sensing system that meets optimal performance standards can be implemented at the earliest in 1989, given best estimates of the state-of-the-art advances in sensor technology and the time required for Federal contracting procedures. Although sensors specifically designed to record data meeting a broad scope of user requirements cannot be provided until 1989, the Landsat D sensors can be used as the basis for an interim system which will help ensure continuity of data through the 1980's and meet many user needs.

The Administration is currently reviewing the Landsat D system to see where improvements may be required to optimize data continuity during the 1980's. For instance, the current Landsat system includes no provision for satellites after Landsat D'. Anticipated gaps in spacecraft coverage of several years between about 1986 and the initiation of a fully operational system may have to be filled by the construction of one or more satellites or by the refurbishment of Landsat D. In addition, changes in the Landsat D ground segment may be required to minimize the risk of losing some data or incurring excessively long delays in processing data. The Landsat D system, with any follow-on satellites and ground system improvements, has been designated the "Interim Operational System."

By 1989, the research and development necessary for new solid-state, multilinear array sensors should have been completed, and the sensors will have been fabricated, tested, and incorporated into either an existing multimission modular spacecraft (MMS) or a new spacecraft. A Landsat D system so modified has been designated the "Fully Operational System."

MANAGEMENT TRANSITION

Certain changes are planned in management responsibility when the Interim Operational System is implemented.

NOAA plans to assume in FY 1983 NASA's responsibility for the command and control of the system after NASA has demonstrated that the system is operational. NOAA will then begin providing MSS data on an operational basis after the successful launch and checkout of Landsat D and the MSS ground system. NOAA will also assume responsibility for TM data when that portion of the system reaches an acceptable operational level of performance.

Also, NOAA plans to assume in FY 1983-84 the responsibility of NASA and the Earth Resources Observation Systems (EROS) Data Center for the generation and dissemination of data and standard data products. Assuming it is cost-effective, a new facility will be colocated with the Landsat D preprocessing facility at NASA/Goddard and will be the sole sales outlet in the United Syates for data and standard data products from the Interim Operational System.

Plans are for NOAA to take title to the Landsat archival material at NASA/Goddard and the EROS Data Center (EDC) in FY 1984 and to be responsible for the archival and dissemination functions for the Interim Operational System.

During the interim operational phase based on the Landsat D series of satellites, NOAA will manage the system in coordination with an interagency Program Board. Within NOAA, a new major line component, the National Earth Satellite Service, has been proposed to have managerial responsibility for the civil operational land remote sensing satellite program.

USER REQUIREMENTS FOR THE FULLY OPERATIONAL SYSTEM

An assumption has been that user requirements should determine the design of the fully operational land remote sensing satellite system, and a survey of governmental and private users has indicated a wide range of possible requirements.

To assist NOAA or an eventual private owner in developing a responsive operational system, a preliminary survey of possible user requirements was made. This survey indicated, for example, that agencies that are interested primarily in renewable resource applications such as agricultural crop assessment want frequent observations, delivery of data within 48 hours under certain circumstances, spectral bands that can be used to discriminate between various types of vegetation, and a spatial resolution higher than that pro-

vided by the current Landsat system. State and local governments requested higher resolution of data collected over urban and suburban areas and requested multitemporal data for detection and analysis of change. The U.S. mineral extraction and related industries call for stereoscopic capabilities, global coverage, 30- to 40-meter resolution, and processing of data within a few weeks. Foreign users interests appear to be similar to those of their U.S. counterparts, although area coverage requests obviously differ.

Hypothetical system performance options have been identified to meet many of the preliminary user requirements identified above. These options range from designing a system with capabilities similar to the Landsat 3 with MSS only, at an estimated 10-year cost of $1 billion, to building a new system which meets most of the currently stated user requirements, including 2-meter resolution, at an estimated 10-year maximum cost of $10 billion. Stereoscopic coverage could be provided at an additional cost of up to $700 million.

REVENUES AND PRICING POLICIES

Reliable projections of revenues from sales of standard data products, and from the direct-reception fees to be paid by foreign ground station operators, cannot be made at this time because the characteristics of the Interim and the Fully Operational Systems, the users' level of demand at various prices, the potential impact of a market expansion program, and the impact of foreign competition are not now known. Tentative projections indicate that the system probably will not be self-financing before the end of the century. Therefore, continued Federal financial contributions in support of the system likely will be necessary in the foreseeable future.

Part of any budgeting policy will probably include a program to increase revenues and reduce required Federal financial assistance as much as possible, regardless of the type of system management chosen. This would be accomplished in part through a market expansion program for the operational system which would build on the types of training and technology transfer activities now being conducted by NASA and the Department of the Interior.

PRIVATE SECTOR INVOLVEMENT

Several institutional options exist for achieving the goal of eventual ownership and operation by the private sector of civil land remote sensing satellite activities. The four principal options under consideration at this time are:

1. A private corporation (or consortium) selected competitively to own and operate all or part of the civil operational land remote sensing satellite system and to sell data to Federal agency users under a guaranteed purchase contract;
2. A for-profit private corporation, authorized by Federal legislation, with private equity and privately and publicly appointed Board members;
3. A wholly owned Government corporation authorized by Federal legislation, and with Government equity, reporting to the Secretary of Commerce with provision for subsequent transformation to a private stock corporation as system revenues warrant;
4. A Government-owned agency with private contractor operation.

Options 1 and 2 offer the earliest possibilities of private sector ownership and assumption of risk. Options 3 and 4 delay implementation of private sector ownership until the next decade.

These options will be examined by the Administration over the next several months to evaluate which alternative best serves the Federal, State, and local governments, and private sector interests in an operational land remote sensing satellite program.

It is realized that a private owner of the land remote sensing satellite system could enjoy a monopoly. To protect the national interest, the private owner's activities would probably be regulated to conform to national space and other domestic and foreign policy objectives. For example, an organization owning the operational system would have to comply with international treaties such as the Outer Space Treaty for the conduct of peaceful activities in outer space; continue the widest practical dissemination of data and standard data products on a public nondiscriminatory basis; meet the needs of U.S. government users; and refrain from misuse of inside knowledge obtained from the land remote sensing satellite data.

INTERNATIONAL ASPECTS

The United States will very probably continue to encourage international participation in the U.S. civil operational land remote sensing satellite program by further developing an international community of data users and by continuing discussions with prospective foreign land satellite system operators to explore the prospects for encouraging complementarity among future operational land satellite systems.

Data from the Interim and Fully Operational Systems would be made available to foreign users through sales of standard data products on a nondiscriminatory basis. NOAA, working closely with the Department of State and other interested agencies, would also take the following actions:

1. Consider foreign user requirements in planning the Fully Operational System.
2. Conclude agreements with those foreign agencies wishing to receive data directly from the Interim and Fully Operational Systems.
3. Establish pricing policies for data sales and direct reception fees that are consistent for domestic and foreign users.

4. Continue the Landsat Ground Station Operations Working Group as a forum for the exchange of technical information.

The land remote sensing satellite systems being developed by other countries offer the prospect of both competition and cooperation with the United States. The competitive challenge to U.S. technological leadership is likely to occur in such areas as the development of multilinear array sensor technology and sales of ground equipment, services, and data products. NOAA, working closely with the Department of State and other interested agencies, will probably encourage the expansion of world-wide markets for U.S. equipment, services, and data products and will pursue prospects for complementarity with foreign satellite operators in order to develop complementary system characteristics (for example, orbits, coverage patterns, and repeat cycles) and compatible system outputs (for example, standard data product formats.)

PECORA VII

The 7th Annual Pecora Symposium has been scheduled for October 18-21, 1981, in Sioux Falls, South Dakota. The meeting is to be sponsored by the Association of American Geographers, the National Council for Geographic Education, the American Society of Photogrammetry, and the U.S. Geological Survey. Like the previous six Pecora symposia, the objective will be to foster an exchange of scientific and resource management findings resulting from the use of remotely sensed data. The theme of the symposium will center around national and international resource inventories utilizing remote sensing technology. The program is in the early stages of planning but is expected to include an introductory workshop on applied remote sensing, plenary and general sessions, local area field trips, and tours of the EROS Data Center's facilities.

NEW METHODS FOR MSS PRECISION-PROCESSED AND/OR COLOR PRODUCTS

The Canada Centre for Remote Sensing has been using its Digital Image Correction System (DICS) to produce precision-processed products directly from Landsat MSS digital data. The DICS produces digital MSS subscenes (coverage area: 0.5° lat. by 1.0° long.) which have been rotated and aligned on a UTM projection. These digital data are then processed by a color image recording system utilizing a minicomputer which controls the illumination of three primary color displays corresponding to three MSS bands. The light from these displays is combined and exposed on film by a color imaging recorder.

The techniques for pixel registration, combined with the techniques used for direct color production, are of interest in the EROS Data Center, and EDC will continue to evaluate such systems for the production of Landsat products.

LGSOWG MEETING

The 10th meeting of the Landsat Ground Station Operations Working Group (LGSOWG) was held in Buenos Aires June 16-17. Hosted by the Comision Nacional de Investigaciones Espaciales of Argentina, the meeting was immediately preceded by a 2-day User Services and Data Management workshop. Both conferences provided a forum for discussion on current and future Landsat developments throughout the world.

Highlights included a briefing by a representative of NOAA on the planning being done in this country for an operational land remote sensing system. The status of Landsats D and D' and the options being studied regarding their sensor complements were also reviewed. Representatives from all stations intend (ap-

FY 1980 LANDSAT STATISTICS (MSS Only)*

	Feb. 80	Mar. 80	Apr. 80	May 80	June 80	July 80	6-MO. Total
Landsat scenes acquired (satellite acquisition)	1,398	1,773	2,957	3,089	3,084	3,999	16,300
Landsat scenes received at EDC**	2,704	835	1,745	2,776	3,712	4,037	15,809
Average time in days from acquisition to EDC receipt (by month of EDC receipt)	143.9	98.3	157.2	80.6	65.5	90.1	—
Average time in days from EDC receipt to archive availability	2.2	3.3	1.7	2.1	2.6	4.0	—
Average delivery time from receipt of order at EDC to shipment:							
Standard photographic products	9	10	10	9	12	13	—
Standard digital products	6	6	6	6	11	9	—
Landsat photographic frames sold	10,798	14,495	13,360	9,718	12,480	8,216	69,067
Landsat digital scenes sold	330	260	340	290	505	564	2,289
Total Landsat dollar volume	$199,822	217,919	234,133	156,046	259,884	$232,182	$1,299,986

*No digital RBV data received at EDC.
**April and May include some reprocessed data

proved or pending) to upgrade their facilities for the receipt of Landsat D data. In addition, current information on Landsats 2 and 3 was provided by various members in response to action items identified at the last meeting.

A new LGSOWG member, China, was introduced. This country recently signed an agreement with NASA for direct reception of Landsat data and hopes to begin operations by 1982. Another country, South Africa, has entered into negotiations with NASA with the objective of reaching a similar agreement.

A brief status summary of each country's Landsat activities is given below. The next LGSOWG meeting has been scheduled for the week of May 11, 1981, and will be hosted by the Australian Government's Department of Science and Environment.

ARGENTINA. The receiving station at Mar Chiquita was dedicated in March and has been undergoing acceptance tests since May; the processing facility in Buenos Aires was scheduled for acceptance testing in July or August. Argentina conducted several training courses during the past year and will continue to do so in the future. Significant applications projects in progress include an urban land classification study in the Buenos Aires area and a mineral study being conducted in the Farallon Negro area of Argentina.

AUSTRALIA. The Australian reception and processing facilities were to be fully operational in August. Recent efforts have centered on developing a pricing schedule for data products, which is now available.

BRAZIL. Brazil's MSS data processing capability has not been operational since January as a result of the line-start anomaly in Landsat 3 data, but a software modification to resolve this problem is expected very soon. Return-beam vidicon (RBV) data production has continued normally. Brazil is currently looking into the acquisition of digital image analysis capabilities. Recent applications projects have included utilizing Landsat data for updating cartographic maps and aeronautical charts.

CANADA. The Canadian Landsat facilities continue to operate normally. Several applications projects are in progress, and those that have been fully developed are being advertised in a series of small brochures. The idea is to encourage increased use of Landsat data analysis techniques.

CHILE. Chile reports progress in its efforts to develop hardware components for the reception and processing of Landsat data. Landsat data are currently being used in Chile for water resources administration and in the northern part of the country for geological research.

CHINA. China recently signed an agreement with NASA for the reception of Landsat data and is moving ahead with plans to install receiving facilities approximately 50 km from Beijing. Processing facilities will be located in Beijing. The target date for completion of these facilities and operational status is 1982. Landsat data are being used in China for surveying forests, mapping lakes in remote regions, and for geological research and mineral exploration.

EUROPEAN SPACE AGENCY. The Earthnet Landsat stations in Kiruna, Sweden, and Fucino, Italy, are both operating normally, and data sales from the two stations have continued to increase. Applications projects in Italy have involved the use of Landsat data in agriculture, water resources, and land use. France reports applications in updating cartographic maps, monitoring timber inventories, and evaluating forest fire destruction.

INDIA. India's Landsat receiving and data processing facilities are now collecting and processing data on a regular basis. Data are being archived in high-density digital tape format and products are being produced as 240-mm and 70-mm images, as well as computer-compatible tapes. Studies underway with Landsat data include a soil survey in the State of Uttar Pradesh, a geological study in the State of Orissa, and a ground water potential evaluation in the Betual District.

JAPAN. Japan's systems are operating normally. Efforts are currently being directed at the development of software for processing RBV data and also to arrive at a resolution of the MSS line-start anomaly problem. A data storage and retrieval facility is under construction and will be operational by the Fall of 1980. Several applications projects are underway, one of which involves the use of Landsat data to study ash deposits from the October 1979 eruption of Mount Ontake in Japan.

THAILAND. A contract was signed in February for the construction of a Landsat ground station to be located about 25 km from Bangkok, with completion scheduled for August, 1981. A number of training programs are being conducted in remote sensing applications, including digital analysis techniques. Ongoing project work has included studies of soil erosion, a forest inventory, and an agricultural crop classification study.

SPECIAL-REQUEST ACQUISITIONS

Landsat data needed to record or monitor natural disasters, short-lived phenomena, or for other special purposes can be scheduled for acquisition upon request to NASA.

Normally, Landsat MSS coverage of the conterminous United States and Alaska is acquired on a continuous basis; RBV coverage is acquired quarterly and only when weather conditions call for 30 percent or less cloud cover. Outside the United States, users must arrange for the use of onboard tape recorders (done on a rather limited basis) or contact the respective foreign receiving stations for coverage of areas of interest.

As a service, though, NASA considers requests for special acquisitions over any area (consistent with the capabilities of the system.) These requests, and requests for information on satellite position and times of scheduled passes over particular areas, should be directed to Dr. Stanley Freden, Code 902, NASA/Goddard Space Flight Center, Greenbelt, Maryland 20771, phone: (301)344-5818.

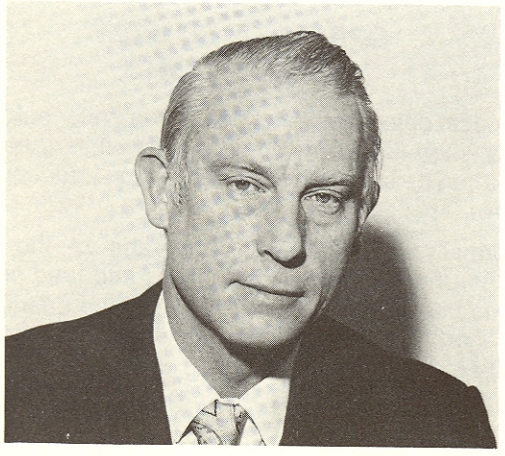
If the data are needed on an emergency basis, requests for priority processing can be made to the User Services Section, EROS Data Center, U.S. Geological Survey, Sioux Falls, South Dakota 57198, phone: (605)594-6511.

Non-U.S. facilities maintain similar policies. The utility of Landsat data for assessment of natural disasters and short-lived phenomena has been demonstrated repeatedly, and every effort will be made to ensure that coverage will be obtained if needed. A list of operational stations in other countries and complete information on how to initiate a request for non-scheduled Landsat coverage can be obtained from the EROS Data Center.

DECEASED

William A. Fischer, 61, a distinguished scientist with the U.S. Geological Survey for more than 35 years and a pioneer in the application of remote sensing techniques to the Earth sciences, drowned on July 29 while swimming near his home at Lake of the Woods, Locust Grove, Virginia.

Dr. Fischer gained international recognition for his research that proved the feasibility of expanding Earth science knowledge through the use of high-altitude remote sensing. His research led to the concept and planning of the Earth Resources Technology Satellite (ERTS), now known as Landsat, and spurred the Department of the Interior to establish the Earth Resources Observation Systems (EROS) Program in 1966.



THE AVRI PROJECT: ARIZONA VEGETATION RESOURCES INVENTORY

The EROS Data Center's Applications Branch recently completed a cooperative demonstration project with the Bureau of Land Management (BLM) in Northwestern Arizona. The overall objective was to evaluate the usefulness of Landsat computer-compatible tapes (CCT's), aerial photographs, and ground data for mapping and inventorying 2.5 million acres of wildland vegetation in Mojave County, Arizona.

Landsat data were analyzed using the Interactive Digital Image Manipulation System (IDIMS) in the EROS Data Center's Data Analysis Laboratory. A controlled clustering and an unsupervised clustering technique were used to derive training statistics for use with the maximum likelihood classification algorithm. As a result, each pixel in the project area was classified into one of 76 spectral computer classes. These 76 classes were subsequently combined into 9 land cover classes. A simple random cluster sample indicated that 54 percent (standard error - 5 percent) of the Landsat pixels were correctly classified. An accuracy estimate and sampling error were also calculated for each land cover type.

Digital terrain data were then acquired for the project area and registered to the Landsat data. These data were used to calculate an elevation, slope, and aspect value for each Landsat pixel. The vegetation cover type of selected pixels was determined from large-scale aerial photographs.

Using these data, an elevation range for each cover type and each computer class was calculated and used to derive elevation decision rules. The Landsat classification results were then reclassified based on these decision rules. The overall classification accuracy of these results was estimated at 73 percent, a sizable improvement over the 54 percent achieved with Landsat data alone.

The digital terrain data (that is, elevation, slope, aspect) were then combined with the Landsat classification results to produce output products useful for specific resource management applications. Using these products, it was possible, for example, to locate potential pinyon-juniper chaining areas, mule deer winter ranges, and sagebrush treatment areas. The vegetation cover type, elevation range, slope, and aspect for each of these examples were defined by BLM personnel. The combined Landsat cover type classes and terrain data were processed to tabulate those pixels which met the defined criteria. The results were then tallied as area summaries and displayed as map overlays, which were geometrically corrected and registered to a 50-meter Universal Transverse Mercator (UTM) grid.

The overall cost of acquiring the basic inventory data

was estimated at $0.06 per acre. In general, it appears that the technology used in this project can contribute significantly to BLM's need to efficiently acquire resource information on BLM lands.

For more information about this project, contact Dr. Wayne Rohde, Applications Branch, EROS Data Center, Sioux Falls, South Dakota 57198, phone: (605)594-6511.

LANDSAT 3 LIGHT-SOURCE PROBLEM

Following a recent scan-monitor change from light source A to light source B in the Landsat 3 MSS sensor system (changed to help alleviate the line-start problem[1]), a previously unknown condition was discovered. The change in light source is causing a small shift in the ground representation of the MSS scan lines. The apparent shift is in the scan-line direction and measures 36 to 38 pixels. Because the nominal spacing between along-scan MSS pixels is 57 meters, this results in a shift to the east in ground representation of 2,052 to 2,166 meters.

Such a shift in the optical start and end of the scan line with respect to the boresight of the spacecraft, and its attitude measurement system, affects image processing in at least two ways:

1. A 2.1-km shift or error is encountered in searching for ground control point extraction areas prior to control point correlation in the Master Data Processor. The search "budget" allows for ± 2.8 km, which means that 75 percent of the budget (on one side of the image) is used up by the shift. This greatly increases the risk that correlation may not be attained.
2. When scenes are processed without ground control points, the scene center and tick mark coordinates automatically suffer a systematic 2.1-km offset.

Landsat 2 was calibrated and launched with light source A. On August 24, 1979, it was switched to source B and has not been changed since. Landsat 3 was also calibrated and launched with light source A, but it has been switched back and forth between source A and source B several times over its life. Offset errors should be expected anytime the scan monitor systems are using light source B. The actual shift for Landsat 2 has yet to be determined.

Because the Goddard Image Processing Facility's image production control system uses pre-launch attitude information, the system will have to be modified to provide for automatic correction of the above described shift problem. An assessment of this effort is currently in progress.

Further information on the light source problem may be requested from Dr. Stanley C. Freden, Chief, Missions Utilization Office, NASA/Goddard Space Flight Center, Code 902, Greenbelt, Maryland 20771.

[1]Refer to May issue (No. 12) of the Landsat NOTES.

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.

Oct 20 - Oct 24 *Terrain Analysis: Interpretation of Aerial Photographs and Images* (Sioux Falls, South Dakota). Contact: Coordinator, Continuing Education Program, Harvard Graduate School of Design, Gund Hall L-37, Harvard University, Cambridge, Massachusetts 02138, phone: (617)495-2578.

Oct 26 - Oct 27 *Introduction to Agricultural Remote Sensing* (Kansas City, Missouri). Immediately precedes the Soil Conservation Society of America Conference on Remote Sensing for Resource Management. Open enrollment. Contact: Branch of Applications, EROS Data Center, Sioux Falls, South Dakota 57198, phone: (605) 594-6511, ext. 114.

Nov 3 - Nov 7 *Water Resources Remote Sensing Workshop* (Sioux Falls, South Dakota). Open enrollment, reference given to Federal agency personnel. Contact: Branch of Applications, EROS Data Center, Sioux Falls, South Dakota 57198, phone: (605) 594-6511, ext. 114.

Nov 17 - Nov 21 *Advanced Course in Geological Remote Sensing Techniques* (Sioux Falls, South Dakota). Open enrollment, preference given to Federal agency personnel. Contact: Branch of Applications, EROS Data Center, Sioux Falls, South Dakota 57198, phone: (605) 594-6511, ext. 114.

Dec 8 - Dec 11 *Concepts and Operational Use of IDIMS* (Anchorage, Alaska). Open to Bureau of Land Management personnel. Contact: Chief, USGS/EROS Field Office, 218 'E' Street, Anchorage, Alaska 99501.

Jan 19 - Jan 23, 1981 *Introduction to Computer Analysis of Remote Sensing Data* (Anchorage, Alaska). Open to Bureau of Land Management personnel. Contact: Chief, USGS/EROS Field Office, 218 'E' Street, Anchorage, Alaska 99501.

Jun 2 - July 3, 1981 *Advanced Training in Geologic Interpretation* (Flagstaff, Arizona). Open to non-U.S. scientists. Contact: Office of International Geology, U.S. Geological Survey, National Center, Mail Stop 917, Reston, Virginia 22092.

Oct 5 - Nov 6, 1981 *Advanced Training in Land Use Planning and Environmental Applications* (Flagstaff, Arizona). Open to non-U.S. scientists. Contact: Office of International

Geology, U.S. Geological Survey, National Center, Mail Stop 917, Reston, Virginia 22092.

ADDITIONAL TRAINING IN REMOTE SENSING

Oct 17 - Oct 17 *Synthetic Aperture Radar with Remote Sensing Applications* (Washington, D.C.). Contact: Continuing Engineering Education, George Washington University, Washington, D.C. 20052, phone (202) 676-6106.

Oct 13 - Oct 24 *International Geologic Correlation Programme (IGCP) Workshop on Remote Sensing and Mineral Exploration* (Nairobi, Kenya). Contact: W. D. Carter or L. C. Rowan, U.S. Geological Survey, National Center, Mail Stop 730, Reston, Virginia 22092.

Nov. 17 - Nov 21 *Terrain Analysis* (Washington, D.C.). Contact: Director, Continuing Engineering Education, George Washington University, Washington, D.C. 20052, phone: (202) 676-6106.

Feb 9 - Mar 6, 1981 *Digital Image Processing* (Flagstaff, Arizona). Open to non-U.S. scientists. Contact: Office of International Geology, U.S. Geological Survey, National Center, Mail Stop 917, Reston, Virginia 22092.

Apr 28 - May 29, 1981 *International Remote Sensing Workshop: Applications in Geologic and Hydrologic Exploration and Planning* (Sioux Falls, South Dakota). Open to non-U.S. scientists. Contact: Office of International Geology, U.S. Geological Survey, National Center, Mail Stop 917, Reston, Virginia 22092.

Aug 31 - Oct 21, 1981 *International Remote Sensing Workshop: Applications in Vegetation Assessment and Land-Use Planning* (Sioux Falls, South Dakota). Open to non-U.S. scientists. Contact: Office of International Geology, U.S. Geological Survey, National Center, Mail Stop 917, Reston, Virginia 22092.

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.

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