

MAPSAT

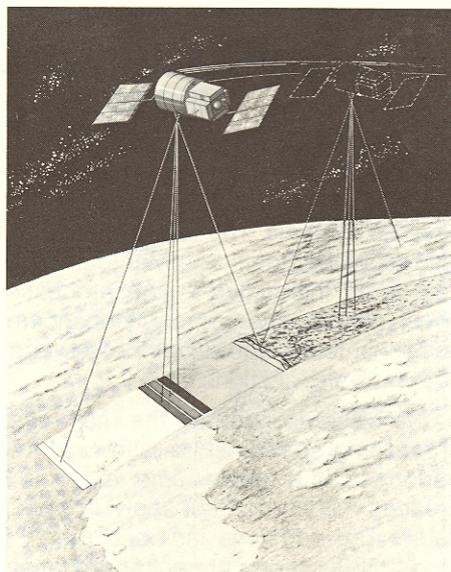
The U.S. Geological Survey has retained the ITEK Corp. and TRW, Inc., to perform a conceptual design study for a mapping satellite (Mapsats) capable of acquiring stereo multispectral Earth images. The study, when completed later this year, will be made available to the National Oceanic and Atmospheric Administration (NOAA) and the National Aeronautics and Space Administration (NASA) for their consideration in formulating plans for a civil operational satellite designed to remotely sense land features.

A key to the Mapsats concept is the minimal use of moving parts in a sensor employing solid-state technology. This will improve the satellite's stability and pointing precision. In this way, mapping accuracy can be maximized, stereo imaging can be attained by combining successive images, and data processing can be made less complex and cheaper than that required for the Thematic Mapper.

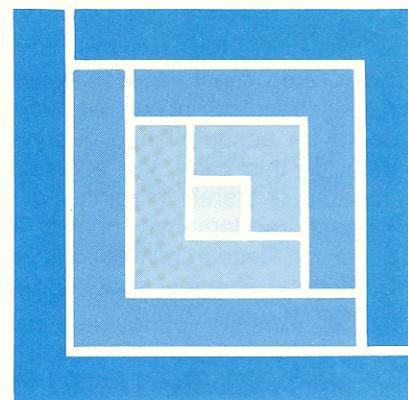
The Mapsats sensor would operate in three spectral bands which are nearly coincident with Landsat 3 bands 4, 5, and 7. Images with a spatial resolution as great as 10 meters could be produced when needed, although normal operations would be at a lower resolution and use slower rates of data transmission.

Significantly, Mapsats will employ a solid-state sensor. NASA had considered a solid-state sensor for its Multi-Spectral Resource Sampler (MRS) planned for the mid-1980's, but proposals to fund work on a multilinear array in FY 1980 and 1981 were rejected.

A big difference between Mapsats and other imaging systems is the manner in which the sensors are pointed. The Mapsats sensor would be in a fixed convergent stereoscopic system. The MRS sensor would have been pointed mechanically, so that a given area on the Earth could be observed as the satellite passed directly over it, as well as during a later, adjacent orbit. Other systems rely on slewing the spacecraft, rather than the sensor, which could degrade the spacecraft attitude control and shorten its life.



Artist's concept of Mapsats
(courtesy of ITEK Corporation).



Landsat Data Users NOTES

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

An operational Mapsat system may consist of two satellites instead of one, so that coverage of the Earth could be accomplished every 9 instead of every 18 days. In this case, the second satellite need not be capable of stereo imaging. For further information on Mapsat, readers may contact the Assistant Division Chief for Research, National Mapping Division, U.S. Geological Survey, National Center, Mail Stop 519, Reston, Virginia 22092.

LINE-START PROBLEM BEING FLAGGED IN DATA BASE

The May issue of the NOTES (no. 12) provided an explanation of the Landsat MSS line-start anomaly. At that time, the EDC data base did not indicate which images were affected by the anomaly. Also, users had not been alerted that affected images were being downgraded during quality evaluations because of the data loss on the left side of the image. These procedures have been changed recently in order to provide better descriptive information to users regarding images that have been affected by the line-start anomaly.

The EDC data base has been modified to give an indication of the problem's occurrence with a special flag in the image record. All computer listings provided in response to inquiries now indicate the scenes that are affected. In addition, the image quality rating is now based on the actual quality of the remaining image data, ignoring the loss of the left-one-third of the image. These revised procedures have been in effect for all data processed after June 10, 1980, and all images that were downgraded between February 20 and June 10, 1980, are being re-evaluated. Latitude and longitude coordinates, as well, are being changed to reflect the actual area of coverage of the unaffected part of each image.

Any questions concerning this matter should be referred to the User Services Section, U.S. Geological Survey, EROS Data Center, Sioux Falls, South Dakota 57198, phone: (605) 594-6511, ext. 151.

HIGH-ALTITUDE PHOTOGRAPHY PROGRAM

Initial data from the High-Altitude Photography program have been received at the Earth Resources Observation Systems (EROS) Data Center and are now available for purchase. The coverage so far is of eastern Oklahoma and a small portion of eastern Virginia and Maryland. Both black-and-white and color-infrared photographs are available.

Users are encouraged to contact the User Services Section, U.S. Geological Survey, EROS Data Center, Sioux Falls, South Dakota 57198, phone: (605)

594-6511, ext. 151, regarding any questions or requests for further information about the High-Altitude Photography program.

ALASKAN AERIAL PHOTOGRAPHY MICROFICHE AVAILABLE

The aerial photography micro(graphic)INDEX, first announced in the July 1979 issue (No. 7) of the NOTES, has recently been expanded to include the State of Alaska. Like that of the other 49 States, the Alaskan microfiche reference information is keyed to the USGS 1:1,000,000-scale map series. Currently, the INDEX for Alaska shows coverage in the large and medium scale ranges only (through a 1:75,000 scale). The information is current through 1979 and describes EDC holdings acquired from NASA aircraft programs.

Approximately 200 microfiche exist in the Alaskan part of the INDEX at this time. Information concerning the availability of these materials can be obtained from the User Services Section, U.S. Geological Survey, EROS Data Center, Sioux Falls, South Dakota 57198, phone (605) 594-6511.

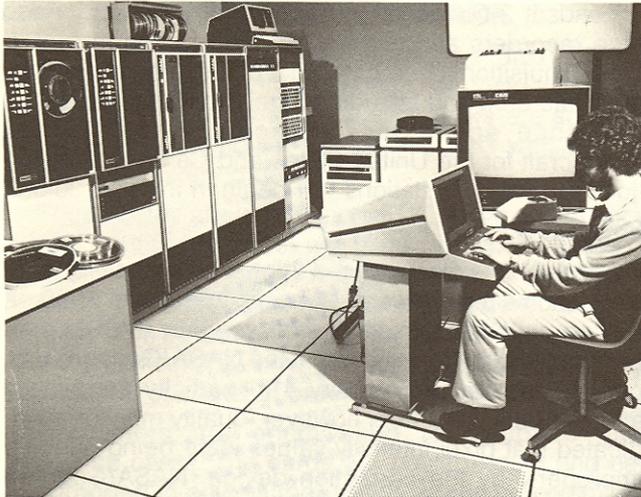
APPENDIXES TO HANDBOOK AVAILABLE

Appendixes J and K to the *Landsat Data Users Handbook* are now available. These documents describe the format and content of two types of high-density tapes containing Landsat return-beam vidicon (RBV) data. Appendix J deals with archival, or partially processed, tapes (HDT-AR's); Appendix K deals with processed, or fully corrected, tapes (HDT-PR's). To obtain copies of the appendixes contact the User Services Section, U.S. Geological Survey, EROS Data Center, Sioux Falls, South Dakota 57198, phone: (605) 594-6511, ext. 151.

DATA ANALYSIS LABORATORY UPGRADE

The EROS Data Center (EDC) recently expanded the capabilities of its Data Analysis Laboratory with a major upgrade to one of the Laboratory's three computer analysis systems. The improvements were made to the Interactive Digital Image Manipulation System (IDIMS). This is an interactive image processor used for land cover classification, image enhancements, numerical analyses, technique development, and many other image analysis functions.

The upgrade has had the main effect of increasing processing speed, which allows more functions to be performed in a shorter time, and this has permitted a greater amount of image analysis work to be accommodated. The additions included a new Hewlett-Packard Model 3000 Series III central processing unit, an array processor subsystem, more memory, and two dual-den-



The IDIMS as now set up in the Data Analysis Laboratory.

sity tape drives (1600/6250 bits per inch) as well as additional disk storage units. Several new software features were also part of the upgrade package.

The added computational and storage capacity of IDIMS is expected to result in improved access to the system by Department of Interior and other governmental agency personnel who have requirements for use of information extraction techniques. Specific analysis tasks connected with operational remote sensing projects will also be improved. Since the Data Analysis Laboratory's mission is to support EDC's Applications Branch in the development, evaluation, and transfer of image analysis technology, the IDIMS upgrade will benefit the user community as a whole.

Technical details on the IDIMS, or any of the systems in the Data Analysis Laboratory, are available from the Chief, Applications Branch, EROS Data Center, U.S. Geological Survey, Sioux Falls, South Dakota 57198.

INTERNATIONAL WORKSHOP QUESTIONNAIRE

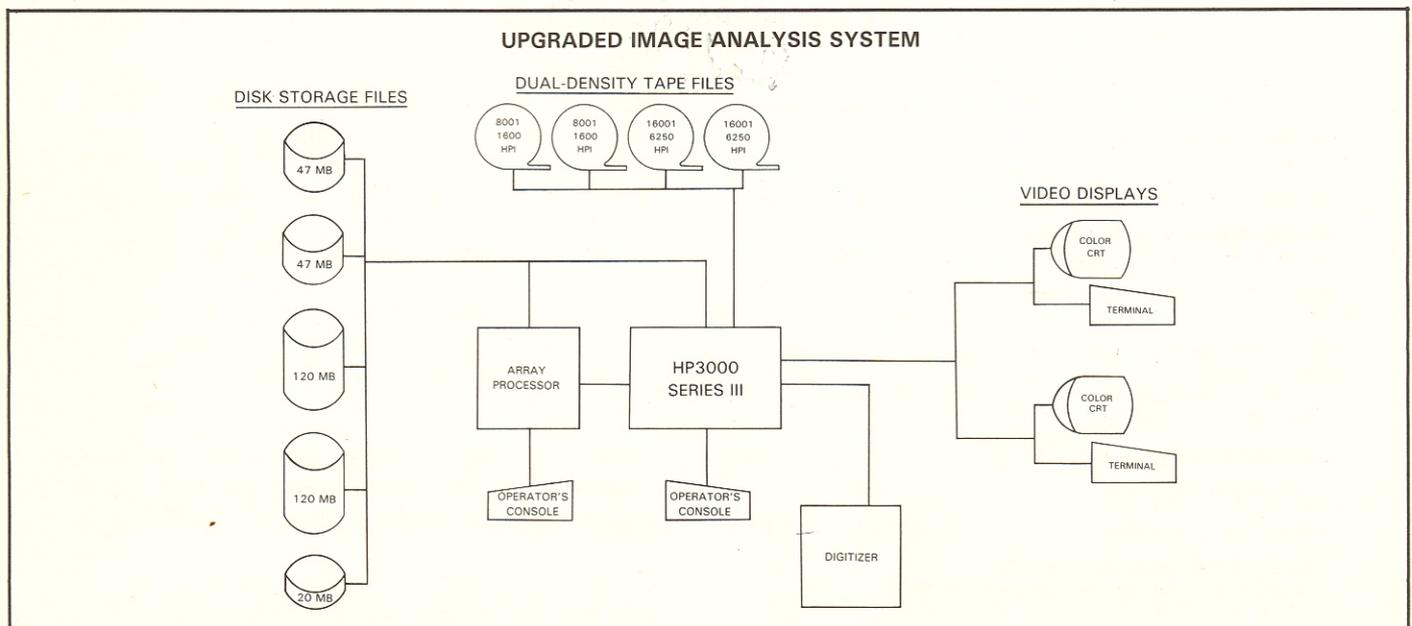
Since 1973, more than 400 scientists from outside the United States have come to EDC to participate in the International Workshops in Remote Sensing. Recently a questionnaire was sent to graduates requesting an evaluation of the training they received.

Thirty percent of the questionnaires were returned. Nearly all of the students indicated that the instruction had helped them in conducting project work in their home countries. At least six respondents had set up remote sensing workshops of their own, and several reported having worked in NASA cooperative programs.

Perhaps most useful were the answers received in response to a question asking the foreign scientists to describe the projects with which they have been involved. The range of applications they listed covered the entire spectrum of Landsat data utilization. Land use maps, vegetation cover assessments, and mineral use mapping were among the more common, but it was clear that virtually every discipline and conceivable use of remote sensing technology is being applied to their various resource studies. Most of the respondents are using Landsat data along with other data such as aerial photographs and radar images to achieve results.

The questionnaire reinforces the opinion of the EDC training staff that the workshops are of practical value to the students and that a multidisciplinary approach to remotely sensed data applications is frequently necessary. Future improvements in the courses will be based on these responses.

Currently, the International Workshops are held twice a year. Several other courses are held each year by EDC staff members who travel to sponsoring countries to conduct training. Citizens or officials interested in ar-



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ranging a remote sensing training course outside the United States should write the Chief, Training and Assistance, EROS Data Center, Sioux Falls, South Dakota 57198, USA. Queries related to the International Workshops held at EDC should be directed to the Office of International Geology, U.S. Geological Survey, National Center, Mail Stop 917, Reston, Virginia 22092.

LANDSAT STATUS

The ability of Landsats 2 and 3 to acquire data until the launch of Landsat D has been a matter of some concern. The current status of the two spacecraft is summarized below.

Landsat 2

Landsat 2 is operating again. For some time prior to November 1979, data acquisitions had been restricted in order to conserve attitude control gas on board the satellite. Then, on November 5, 1979, the yaw gyro wheel froze, resulting in attitude control problems and unusable MSS data. Shortly thereafter, data acquisition was suspended while a number of experimental maneuvers were conducted.

On May 5, 1980, after repeated attempts to recover and maintain spacecraft attitude, the satellite was turned on again. Its first acquisitions were over the Mount St. Helen's area on May 19 and May 20 (the data acquired were almost entirely cloud covered). The satellite was slightly off-track (by 16-40 km) at that time, but corrective actions were taken, and by June 6 the images being acquired were considered to be in their correct path/row position. Because of the orbital adjustment activity performed during the period from May 19 to June 6, only systematic corrections were applied to imagery acquired.

Landsat 2 no longer has functional wideband video tape recorders and is therefore being used in a real-time acquisition mode only. With achievement of an appropriate orbit and attitude control, however, Landsat 2 has once again been designated the primary spacecraft for the United States and Canada. Acquisitions by non-U.S. stations will begin in the near future.

Landsat 3

Landsat 3 experienced a high occurrence of line-start anomalies between January and June 1980. A device called the multispectral scanner (MSS) serial error corrector was installed at the NASA/Goddard processing facility on February 4 to partially correct the affected data. In March, however, quality monitoring indicated that pixel intensity values were being handled improperly by the correction device. NASA/Goddard suspended Landsat data processing pending a resolution of this problem. The problem has been resolved, and all data processed between February 13 and March 14 will be reprocessed.

Continuing efforts to determine the cause and solution to the line-start problem led NASA to switch from scan monitor source A to source B (in the MSS). With this adjustment, the frequency of the line-start anomaly decreased to a negligible level. Since there appears to be a correlation between line-start anomaly occurrences and MSS usage, the new configuration may degrade also, but when it will occur can not be predicted. The status of the line-start anomaly will be discussed in future issues of the Landsat Data Users NOTES.

In the meantime, Landsat 3 is being used conservatively in an attempt to prolong its lifetime and continue data availability until the launch of Landsat D.

**FY 1980 LANDSAT STATISTICS
(MSS Only)***

	Dec 79	Jan 80	Feb 80	Mar 80	Apr 80	May 80	6-MO. TOTAL
Landsat scenes acquired (satellite acquisition)	1,550	1,317	1,398	1,773	2,957	3,089	12,124
Landsat scenes received at EDC**	3,000	2,626	2,704	835	1,745	2,776	13,687
Average time in days from acquisition to EDC receipt (by month of EDC receipt)	81.6	113.5	143.9	98.3	157.2	80.6	—
Average time in days from EDC receipt to archive availability	3.8	3.9	2.2	3.3	1.7	2.1	—
Average delivery time from receipt of order at EDC to shipment:							
Standard photographic products	11	12	9	10	10	9	—
Standard digital products	8	10	6	6	6	6	—
Landsat photographic frames sold	8,192	10,650	10,798	14,495	13,360	9,718	67,213
Landsat digital scenes sold	248	417	330	260	340	290	1,885
Total Landsat dollar volume	\$149,565	\$210,798	\$199,822	\$217,919	\$234,133	\$156,046	\$1,168,283

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

CUSTOMER FEEDBACK

As the primary distributor of Landsat data, EDC is naturally interested in the reactions of customers. Opinions and comments from Landsat users are solicited on a special Customer Response Card which is included with every order.

These cards are important to EDC because the comments returned on them are used to pinpoint areas of difficulty (or success) in the user services and data production systems. Changes to the system resulting directly from customer comments have included equipment modifications, new methods of packaging, and procedural changes in order processing.

Customers are encouraged to complete their response cards. The cards are postage-paid and can be dropped in any mailbox. Since space for comments is limited, you may prefer to write a letter. The address is User Services Section, EROS Data Center, U.S. Geological Survey, Sioux Falls, South Dakota 57198. Telephone inquiries can be made by dialing (605) 594-6511 and asking for extension 151 (Customer Relations).

LANDSAT REFERENCE SYSTEMS

Since the beginning of the Landsat program in 1972, users have been informed of the availability and quality of Landsat acquisitions through a series of hardcopy and photographic reference materials. An objective of EDC has been to provide the public both with comprehensive listings of Landsat scenes and with reference images in microform.

The Landsat catalogs were originally issued by NASA and were organized according to U.S. or non-U.S. coverage. These hardcopy catalogs were made available to the general public through the National Technical Information Service (NTIS), and were supplemented by rolls of 16-mm microfilm containing images of all Landsat scenes acquired (normally band 5).

Access to the so-called "browse" images on microfilm required knowledge of the cassette and frame numbers, an identification supplied by NASA and made part of the accession listing in the catalogs and at EDC. To reduce this dependence on computer inquiry, a Landsat indexing method called the Worldwide Reference System (WRS) was developed. The WRS is a global network of paths and rows by which all Landsat scenes can be geographically located. A series of maps covering the world were produced by the Geological Survey to show nominal scene centers (path-row intersections) for scenes acquired; the WRS was also used by the World Bank in their Landsat Index Atlas published in February 1976 for selected regions of the world.

EDC was given the responsibility for producing the catalogs and "browse" images after Landsat 3 was

launched. The WRS now forms the basis for a new Landsat reference system maintained on microfiche. Each film record is dedicated to a single path and a group of rows along the path; sixty path-row intersections can be recorded on each microfiche. The catalog version is called the Landsat microCATALOG and has been available to the public since late 1977. The image version, formatted to show daily acquisitions along a path for up to 60 rows, has been designed but not yet implemented. In its place, EDC has begun (since February 1979) the production of microfilm cassettes for Landsat MSS data and will continue to do so until MSS and RBV data are received rapidly enough to make the microfiche approach workable.

In summary, Landsat catalogs, initially offered in hardcopy only, are now available as the Landsat microCATALOG in microfiche format and keyed to the WRS index. Landsat MSS image reference scenes continue to be available on 16-mm microfilm.

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.

- Aug 11 - Aug 14 *Application of Remote Sensing to Wildlife Habitat Inventory* (Arcata, California). Open enrollment. Contact: Lawrence Fox, School of Natural Resources, Humboldt State University, Arcata, California 95221.
- Sept 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, Mail Stop 917, Reston, Virginia 22092.
- Sept 8 - Sept 12 *Remote Sensing for Global Resource Applications: Principals and Techniques* (Washington, D.C.). Contact: Continuing Engineering Education, George Washington University, Washington, D.C. 20052, phone: (202) 676-6106.
- Sept 15 - Sept 19 *Digital Image Processing of Earth Observations Sensor Data* (Washington, D.C.). Contact: Continuing Engineering Education, George Washington University, Washington, D.C. 20052, phone: (202) 676-6106.
- 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

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- 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, preference 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.
- 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 29, 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.
- Sept 22 - Sept 26 *Manipulation of Computer-Compatible Tapes* (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.
- Sept 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.
- Oct 6 - Nov 7 *Advanced Training in Land Use Planning and Environmental Applications* (Flagstaff, Arizona). Contact: Office of International Geology, U.S. Geological Survey, National Center, Mail Stop 917, Reston, Virginia 22092.
- Oct 14 - 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.
- 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.
- Jun 2- Jul 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.

ADDITIONAL TRAINING IN REMOTE SENSING

- Aug 4 - Aug 22 *Remote Sensing of Natural Resources* (Blacksburg, Virginia). Contact: Dr. Roy Mead, School of Forestry and Wildlife Resources, Virginia Tech, Blacksburg, Virginia 24061, phone: (703) 961-5482.
- Aug 11 - Aug 15 *Fundamentals of Applied Remote Sensing* (Lawrence, Kansas). Also to be held Sept 8-12. Contact: James W. Merchant, KARS Program, Kansas University Space Technology Center, 2291 Irving Hill Drive, Lawrence, Kansas 66045, phone: (913) 864-4775.
- Sept 2 - Oct 3 *Theory and Applications of Remote Sensing* (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.
- 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.
- Oct 13 - Oct 24, 1981 *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.

ARID LANDS WORKSHOP

A 7-day workshop in Arid Land Resource Inventories is to be held from November 30 to December 6 in La Paz, Mexico. Sponsored by several resource agencies in the United States and Mexico, the workshop hopes to

discuss cost-efficient methods for inventorying arid lands and to examine ways of ensuring proper protection and management of these lands upon which increasing stresses are becoming evident. A field trip is included as part of the program.

Further details may be obtained from H. Gyde Lund, Program Chairman, USDA Forest Service RMF & RES, 240 W. Prospect Street, Fort Collins, Colorado 80526.

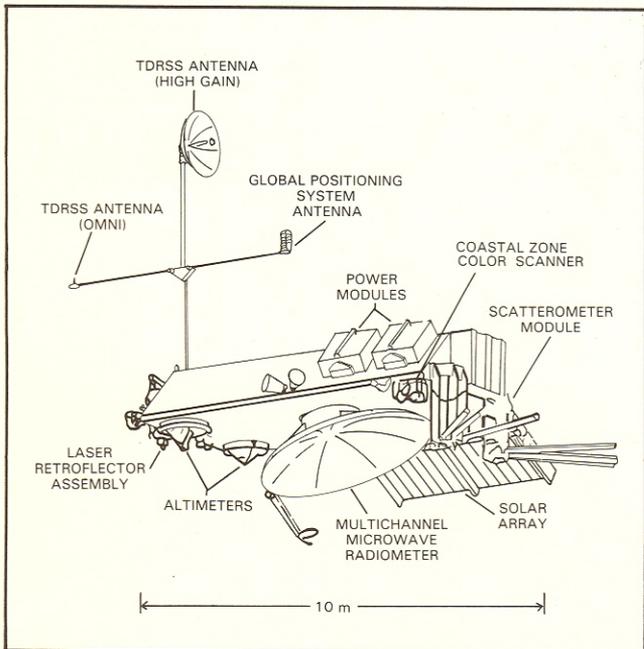
NOSS

A National Oceanic Satellite System (NOSS) is currently under study by NASA, NOAA, and the Department of Defense.

NOSS's baseline sensor complement is planned to include a Large Antenna Multichannel Microwave Radiometer to monitor sea surface temperatures, wind speeds, water vapor, and sea ice formation and breakup. A Radar Altimeter and a Scatterometer will measure ocean waves and currents, and surface wind velocities, respectively. Surface vegetation, turbidity, and chlorophyll content will be detected by a Coastal Zone Color Scanner, sensing data in nine different spectral channels.

Near real-time data will be provided on sea surface winds, water temperatures, wave heights, currents, chlorophyll distributions, and other data. The marine and geophysical parameters thus defined could have applications in ocean mining, coastal zone management, fisheries analysis, and meteorology.

A Sun-synchronous, polar orbit is being considered, at an altitude of approximately 700 km. Data relay to the ground will be by means of the Tracking and Data Relay Satellite System (TDRSS), and archived data products

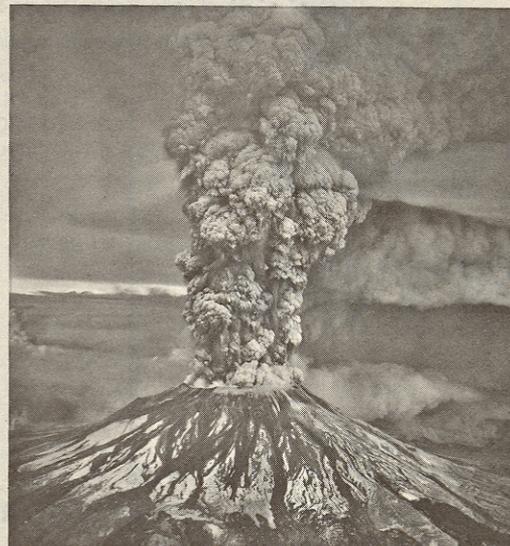


in the form of computer-compatible tapes and imagery could be available within 48 hours of data receipt.

Plans are for NOSS to begin its 5-year operational demonstration after launch from the Shuttle in 1986.

SYMPOSIUM

"Remote Sensing for Resource Management" will be the theme of a national conference, October 28-30, 1980, in Kansas City, Missouri. The program will feature numerous case histories and examples of how information collected by remote sensing systems can be used to solve resource-related problems. Only minor emphasis will be given to the actual technology of remote sensing. Further information can be obtained from the Soil Conservation Society of America, 7515 Northeast Ankeny Road, Ankeny, Iowa 50021.



VOLCANO PICTURES

About 1500 photographs of the Mount St. Helens area, taken from March 30 to June 4 and covering most of the significant aspects of the eruption, are now available for purchase from the EROS Data Center. The above photo (No. 80S3, frame 137) was shot on May 18, 1980. Interested persons can order 9-inch prints for \$3 each or can obtain larger reproductions in 18-inch, 27-inch, and 36-inch format for \$10, \$15, and \$20, respectively. Call or write the Users Services Section, U.S. Geological Survey, EROS Data Center, Sioux Falls, South Dakota 57198, phone: (605) 594-6511, ext. 151, for further information.

LANDSAT DATA USERS NOTES**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

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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:

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