

NASA

LANDSAT DATA USERS NOTES

UNITED STATES GEOLOGICAL SURVEY

EARTH RESOURCES OBSERVATION SYSTEMS DATA CENTER

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ISSUED: New Data Users Notes

To keep Landsat data users informed of changes in the technology of remote sensing, the Department of Interior, Geological Survey, and the National Aeronautics and Space Administration are cooperating in issuing a series of newsletters through the EROS Data Center.

Projected events include the launch of another Landsat (C) with improved sensors, including a thermal band, changes in data handling and processing that will upgrade the quality of data products, and investigations into new applications of the data. This newsletter will be issued as required to inform users of significant programs and of remote sensing in general.

The *Landsat Data Users Notes* will not be issued on a fixed schedule; three or four issues a year are planned. The issues will be numbered in sequence and are designed to be placed in the looseleaf *Landsat Data Users Handbook, Revised*.

REVISED: Landsat Data Users Handbook

A revised version of the *Landsat Data Users Handbook*, expected to be available in April, 1978, is being prepared by the Na-

tional Aeronautics and Space Administration Goddard Space Flight Center (NASA - GSFC) and the EROS Data Center (EDC). The revised handbook will describe the data processing and resulting products associated with the changes to the GSFC processing system and the EDC digital image processing system that are being implemented in support of Landsat-C.

Mailing List

Names and addresses from several sources have been combined to form the mailing list for this first issue. This list has been edited, insofar as possible, to remove duplications, but multiple copies may be received. Those who wish to receive future issues of this publication should fill out the "Reader Response" on the last page of the Notes and return the form in the enclosed envelope.

To reach all users and potential users of Landsat and other remotely sensed data, the widest possible distribution of these Notes is desired. Reproduction and distribution of any or all information in this and subsequent issues are permitted and encouraged.

Soon after the launch of Landsat-C, scheduled for 1978, the processing of Landsat data from all operating Landsat observatories will change. The NASA Data Processing Facility (NDPF) is being augmented with additional equipment and renamed "Image Processing Facility" (IPF); EDC will assume a larger role in the processing and distribution of Landsat photographic and digital products, using a new digital image processing system (EDIPS). The *Landsat Data Users Handbook, Revised*, is designed to describe in depth these processing and data product changes.

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The complete table of contents will be given in the next issue of the Notes; the major sections into which it is divided are:

- Landsat System
- Landsat Observatories
- Landsat Payload
(multispectral scanner, return-beam vidicons, and data collection relay system)
- Landsat Orbit and Coverage
- Landsat Data Handling and Processing
- Availability and Ordering of Landsat Data
- Appendixes
(covering various topics, including

data products, map projections, and details on placing orders)

Plans call for issuing the *Landsat Data Users Handbook, Revised* in looseleaf form similar to the two previous versions. The cost of printing is not presently known, but is expected to be in the range of \$20 to \$30. To aid us in determining the number to print, please indicate your interest on the "Reader Response" and the number of copies you will require.

Certain parts of this handbook pertaining to characteristics of the new data products, including the revised format of the computer-compatible tapes (CCTs), will be available in January, 1978, and may be obtained upon application to the EROS Data Center.

Handling and Processing Systems for Landsat Data

By mid-1978, a new system for handling and processing Landsat data will be in operation and will be providing improved products to data users. The NDFP will become an all-digital processing system called the "Image Processing Facility" (IPF). IPF will provide the EROS Data Center (EDC) with Landsat data on high-density digital tapes (HDTs). EDC will in turn implement a digital image processing system (EDIPS) that will process the HDTs to provide users with digital and photographic products, to which "restoration" techniques have been applied. Figure 1 on page three illustrates the total data flow through the processing system, along with user options for various products.

Image Processing Facility

The GSFC Image Processing Facility (IPF) will use the sensor data tapes from the NASA data receiving stations, the GSFC-computed spacecraft ephemeris, spacecraft performance telemetry, and a library of ground control points to produce a high-density digital product tape (HDT-P). The processing of HDT-Ps involves the radiometric restoration of the sensor data recorded on the station tapes to correct for detector gain and offset; the computation and application of geometric corrections; and reformatting of the data. The geometric correction depends upon spacecraft attitude and position, detector geometry mirror scan velocity, Earth rotation, image projection, and the correlation of detectable ground control points with accurately known locations.

The standard map projection will be

Space Oblique Mercator (SOM). Universal Transverse Mercator (UTM) map projection will be available upon request, and Polar Stereographic (PS) will be used for areas above 65° N latitude or below 65° S latitude. Requests for data in UTM or PS projection will be treated as a retrospective order. The HDT-P (product) data will be resampled with a cubic convolution resampling algorithm except in those cases where a user retrospectively orders data with the optional nearest neighbor resampling algorithm. If a data user desires uncorrected data, a retrospective order will again be used for the production of an HDT-A (archival) in the IPF. The data will have undergone radiometric restoration (gain and offset), but no geometric corrections or resampling will have been done

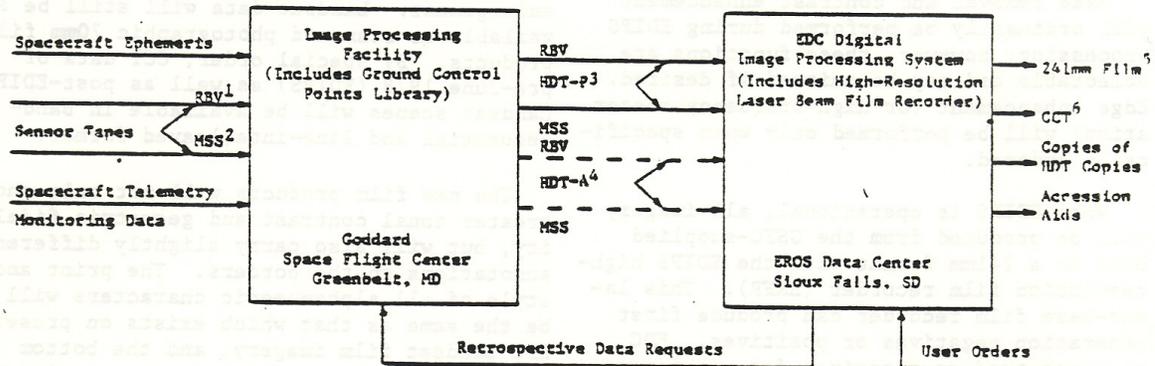
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Notes:

- 1) Two 236mm panchromatic (.505-.750 micrometer) return-beam vidicon cameras-- Landsat-C.
- 2) Five-band (.5-.6, .6-.7, .7-.8, .8-1.1, and 10.4-12.6 micrometer)-- Landsat-C.
- 3) Fully corrected high-density digital tape: SOM Projection cubic resampled standard - Universal Transverse Mercator or Polar Stereographic projection and nearest neighbor optional via retrospective data request.
- 4) Radiometrically corrected high-density digital tape; no geometric corrections, no options; available by retrospective data request.
- 5) Third generation positive Space Oblique Mercator projection, cubic resampling - standard - enhancements and other photographic derivatives optional. No photographic products from partially corrected high-density digital tapes.
- 6) RBV available in subscene sequential format from either HDT-P or HDT-A, in 800 or 1600 8PI. MSS data available in band sequential or band interleaved formats from both HDT-P and HDT-A.

Figure 1. Block diagram illustrating data flow through the NASA - Goddard Space Flight Center Image Processing Facility and the EROS Data Center digital image processing system, along with user options for various products.

EDC Digital Image Processing System

The EDC digital image processing system (EDIPS) is an integrated system, of both hardware and software components, that transforms the HDT-P (product) data into (1) latent film imagery or (2) digital magnetic tape products. It consists primarily of a computer, an array processor, two high-density tape recorders, and a high-resolution laser-beam film recorder (HRFR). Normally EDIPS will process only HDT-Ps. HDT-As (archival) will be produced by IPF and processed by EDIPS only upon special request.

EDIPS' major processing capability includes:

- distribution data, including a histogram portraying the distribution
- contrast enhancement based on data provided by the brightness-value distribution
- haze removal based on data provided by the brightness-value distribution
- high-frequency edge enhancement, or restoration
- production of two separate output products: film products and digital products
- selection of specified images from an HDT

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Haze removal and contrast enhancement will ordinarily be performed during EDIPS processing; however, these functions are selectable and may be omitted if desired. Edge enhancement (or high-frequency restoration) will be performed only when specifically ordered.

When EDIPS is operational, all imagery will be produced from the GSFC-supplied HDTs in a 241mm format with the EDIPS high-resolution film recorder (HRFR). This laser-beam film recorder can produce first generation negatives or positives. EDC plans to produce negatives for working masters, thereby delivering second generation positives to the data user. Computer-compatible tape (CCT) data from the HDTs will be formatted and recorded by EDIPS for delivery to the user.

All orders for new or retrospective data from Landsat-1, -2, and -C will be process-

New Landsat Digital Magnetic Tape Products

Copies of high-density digital magnetic tapes (HDTs) described on page 2, and computer-compatible tapes (CCTs) will be available from the EROS Data Center when the digital image processing system becomes operational in mid-1978. The current CCT

format is described in Appendix G of the *Landsat Data Users Handbook, Revised*. Complete descriptions of high-density tapes will be provided in Appendixes H (archival multispectral scanner HDTs), I (processed multispectral scanner HDTs), J (archival

return-beam vidicon HDTs), and K (processed return-beam vidicon HDTs). These lengthy appendixes will not be included routinely in the Handbook, as most users will not require them, but they will be made available upon request to the EROS Data Center.

ed in this manner. Photographic products will be available as negative or positive film transparencies and black and white or color composite prints at various scales of enlargement. Landsat data will still be available as standard photographic 70mm film products. By special order, CCT data of pre-June 1978 (EDIPS) as well as post-EDIPS Landsat scenes will be available in band-sequential and line-interleaved format.

The new film products will not only show greater tonal contrast and geometric fidelity, but will also carry slightly different annotations on the borders. The print and style of all alphanumeric characters will be the same as that which exists on present EDC Landsat film imagery, and the bottom annotation block and 15-step gray scale will remain essentially the same. The top border will include a 9-digit roll/frame number. Worldwide reference path and row numbers will be shown on the bottom border. These are intended to aid the user in referencing each image.

Available Enhanced Landsat Scenes

A limited number of computer enhanced Landsat scenes, produced in preparation for EDIPS, are available from the EROS Data Center. Enhancements performed on the majority of the scenes include destripping, edge enhancement, contrast enhancement, and synthetic line generation. A listing of the available scenes, along with ordering and pricing information, may be obtained from User Services, Attention: Computer Enhancements, EROS Data Center, Sioux Falls, SD 57198.