https://ntrs.nasa.gov/search.jsp?R=19830026131 2020-03-21T03:02:21+00:00Z

General Disclaimer

Metadata, citation and similar papers a

NASA Technical Reports Server

One or more of the Following Statements may affect this Document

- This document has been reproduced from the best copy furnished by the organizational source. It is being released in the interest of making available as much information as possible.

- This document may contain data, which exceeds the sheet parameters. It was furnished in this condition by the organizational source and is the best copy available.

- This document may contain tone-on-tone or color graphs, charts and/or pictures, which have been reproduced in black and white.

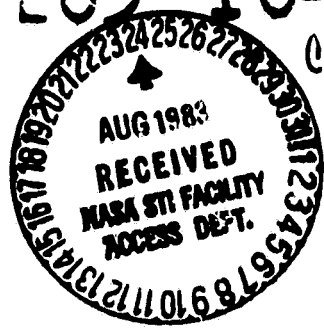
- This document is paginated as submitted by the original source.

- Portions of this document are not fully legible due to the historical nature of some of the material. However, it is the best reproduction available from the original submission.

Produced by the NASA Center for Aerospace Information (CASI)

"Made available under NASA sponsorship in the interest of early and wide dissemination of Earth Resources Survey Program information and without liability for any use made thereof."

E83-10410
CR-173004



ANALYSIS OF THE QUALITY OF IMAGE DATA ACQUIRED BY THE LANDSAT-4 THEMATIC MAPPER AND MULTISPECTRAL SCANNERS

Principal Investigator

Professor Robert N. Colwell

Remote Sensing Research Program
Space Sciences Laboratory
University of California
Berkeley 94720

Period of Performance

January 3, 1983 - August 13, 1984

Quarterly Status and Technical Progress Report #2
April 1, 1983 - June 30, 1983

NASA Contract #NAS 5-27377
National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, MD

August 10, 1983

(E83-10410) ANALYSIS OF THE QUALITY OF IMAGE DATA ACQUIRED BY THE LANDSAT-4 THEMATIC MAPPER AND MULTISPECTRAL SCANNERS Quarterly Status and Technical Progress Report, 1 Apr. - 30 Jun. 1983 (California

N83-34402

Unclas
G3/43 00410

TABLE OF CONTENTS

ORIGINAL PAGE IS
OF POOR QUALITY

1.0 TECHNICAL PROGRESS REPORT

Three major research activities occurred during this phase of the performance period: 1) completing the Landsat Early Results Symposium paper, 2) planning and purchasing TM and MSS Analytical film products, and 3) preparing lecture material for the Landsat Sensor Design and Operation Course.

1.1 Early Results Symposium Paper

On May 18, 1983 an illustrated copy of our Landsat Early Results Symposium Paper was forwarded to Mr. John Barker at NASA-GSFC. This paper summarized our research on the quality of Landsat-4TM and MSS digital and image products for the period January - March 1983. This phase of our research concentrated on the visual displays of the digital data for detecting and identifying agricultural crops. The results of that work are summarized in the symposium paper, and will not be included here.

1.2 Analysis of Analytical Film Products

The major emphasis of our effort is to analyze the film products that are generally accessible to the user community, with minimal analysis of the quality of digital products. Therefore, during this 3-month period we have directed our effort at acquiring a data set consisting of a variety of TM and MSS image products for two of our test sites in Central California where Landsat-4 data has been acquired. The first test site is the San Francisco Bay Area (Path 44, Row 34, 12/31/82) and the second is the Sacramento scene (Path 44, Row 33, 2/01/83). The CCT-PT's and film products for both scenes were received from NASA-GSFC at UC Berkeley during April.

There are currently three types of Landsat-4 film products generated at various facilities: 1) standard MSS analytical film products, 2) "interim" TM analytical film products, and 3) LAS-Scrounge TM 'engineering' film products. The standard MSS film products are generated at the EROS Data Center (EDC), Sioux Falls, South Dakota using the CCT-PM digital data and a Laser Beam Recorder (LBR) to produce master film copies for black and white and color composite reproduction. The "interim" TM analytical film products are also generated at EDC using the RBV system for producing the 1st generation working masters during the SCROUNGE environment and prior to the operational film generation under the TIPS environment at GSFC. These interim analytical film products will be those analyzed prior to film produced under the TIPS environment. The LAS-SCROUNGE TM "engineering" film products are generated at GSFC for engineering purposes, archiving, and routing with CCT orders for LIDQA investigators. This LAS P-film format differs slightly from the probable TIPS format and will not be used for analytical purposes.

ORIGINAL PAGE IS
OF POOR QUALITY

The interim TM analytical film products were to be generated by LAS-Scrounge during the pre-TIPS environment. As demand for these products increased, arrangements were made to have EDC produce the TM imagry. This included first generation black-and-white masters, subsequent reproductions to meet standing orders, and distribution. Using the CCT-PT data, EDC produces the film masters using the Laser Beam Recorder (LBR) and supporting computer system formerly dedicated to RBV film production. Given the different spot size of the LBR than that used under LAS or to be used under TIPS (38μ vs. 28.5μ), EDC had to exercise one of three possible options: 1) adapt the LBR to simulate the LBR at GSFC, 2) use another spot size, or 3) a combination of #1 and #2. In exercising option #3, film generation is accomplished by providing TM digital data to the LBR in a format in which the data resembles RBV data. Therefore, each 'interim' TM analytical film product is truly a sub-area of a full TM scene with no border tic marks, and an annotation line similar to that used for the standard MSS film products. The size of the sub-area within each TM scene reproduced in film format is shown in Figure 1. The format is 5322 pixels square, centered in the full scene; and is produced using the LBR 38μ spot size. This results in an image which is 0.202 m. sq. (7.95" sq.), covering a land surface area of approximately 2,300,590 ha. (5,684,760 ac.) and having an image scale of approximately 1:750,880. This interim TM film product represents approximately 72% of the area of a full TM scene.

The film in positive mode is produced by the LBR using a linear transmission function. Histograms of the extracted sub-area are generated for each band and given to an analyst for selecting the proper contrast stretch by assigning the 255 TM gray levels (digital count values) to sixteen possible film density levels. Image gray level 255 is brightest and grey level 0 is darkest. This linear look-up table is applied separately to each of the seven TM bands. Once the LBR generates the individual black-and-white masters, the natural and false color composites are created. Standard TM color composites produced by EDC which do not require payment of the color composite generation fee are termed "natural" and "false" color composites. Natural color composites use TM Bands 1, 2, 3; false color composites use TM Bands 1,3,4. Use of TM-1 (Blue) in the false color composites is contrary to the conventional use of the green, red and reflectance infrared regions of the spectum. Because of detector problems in TM-2 (Green) and enhancement of certain surface features in TM-1 (Blue), TM-1 was selected by EDC for the standard false color composite.

Given the limitations of less than full scene representation in the interim TM black-and-white film master generation and use of the TM-1 instead of TM-2 in the false color composite, a variety of TM and MSS film products were ordered from EDC on June 22, 1983. These film products are listed in Table 1. The same set of products was also ordered for the San Francisco scene (Path 44, Row 34; 12/31/82) assuming both MSS and TM data were available. A subsequent computer search at EDC determined that no MSS data were acquired on that date. The film order was amended to include only film products from the Sacramento scene.

ORIGINAL PAGE IS
OF POOR QUALITY

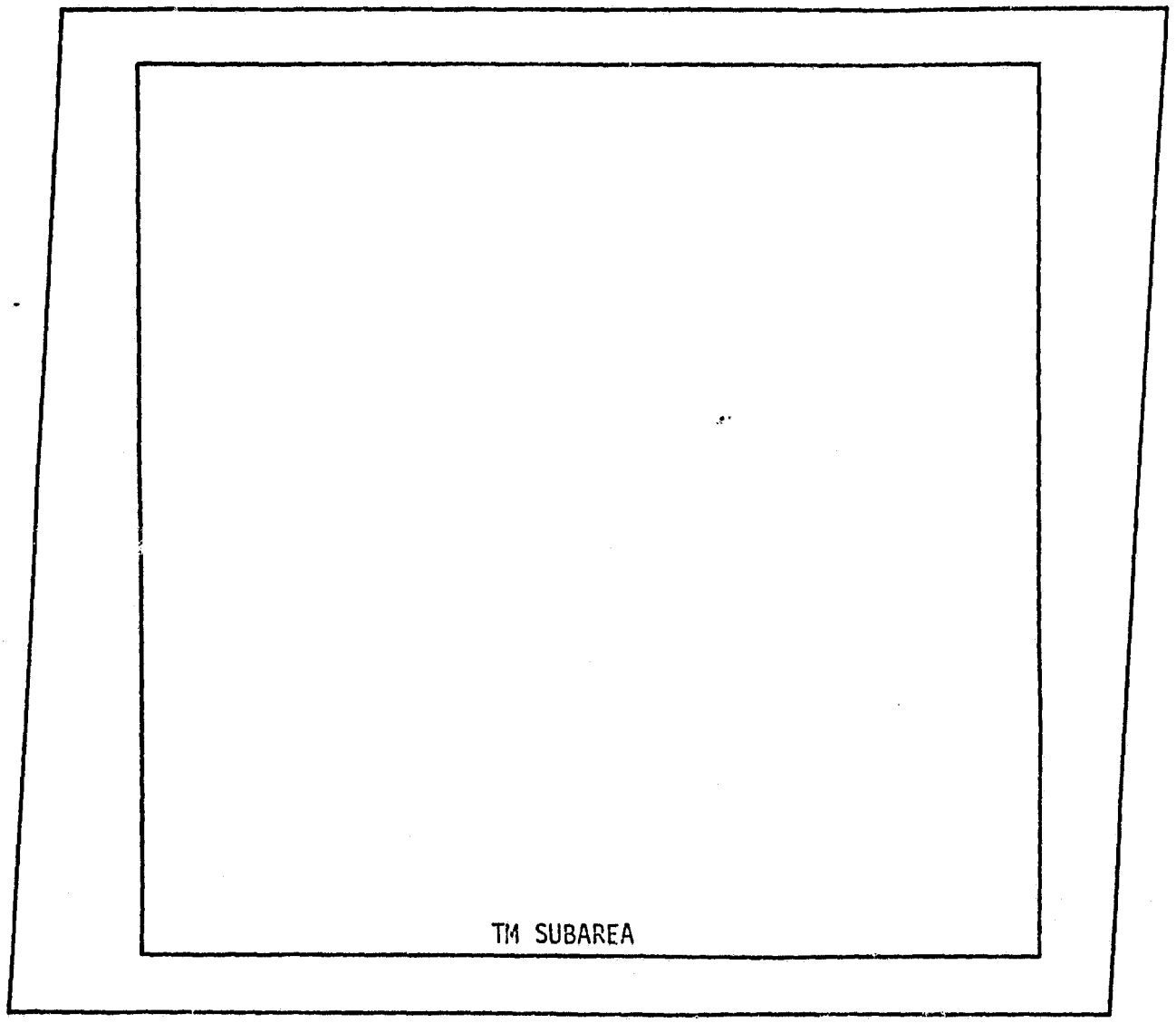


Figure 1. Actual size of a full TM scene reproduced in GSFC "engineering" film product (outer polygon), and location of the EDC "interim" analytical film product within full scene coverage; the interim product shown at reduced scale from original film.

ORIGINAL PAGE IS
OF POOR QUALITY

The variety of film products ordered provides maximum flexibility to generate black-and-white prints at various scales, and unique combinations of bands for constructing image interpretation keys and for conducting interpretation tests. These keys and tests will be used to determine the best combination of bands to detect and identify important forest and agricultural features. The image products will also be used to test their spectral, geometric and spatial valuability over natural targets. This work will commence once the film products are received from EDC. As of this date, only the TM black-and-white film positives (18.5 cm.) for each band have been received. These film products were used to develop the schematic drawing in Figure 1 illustrating the difference in area coverage of these "interim" EDC film products and the full TM scene coverage.

Work to be accomplished during the next reporting period (July-Sept.) related to the analysis of film product quality will be:

1) Receive and catalogue film products for the Sacramento scene.

2) Generate non-standard color composite images which use not only the visible and near reflectance IR bands but also the short-wave IR (SWIR) bands.

3) Construct selective and elimination photointerpretation keys for both black-and-white and color composite testing purposes. Testing the image types will occur during the fourth quarter of 1983.

4) Evaluate geometric quality of the image products by making selective photo measurements and by relating film coordinates to ground coordinates of known features using a standard linear least squares regression approach. Usefulness of the SOM projection and film border tick marks will also be evaluated.

1.3 Preparation of Landsat Sensor Design and Operation Course Material

Based on an invitation from Drs. Jeff Dozier (U.C. Santa Barbara) and Carl Schueler (Santa Barbara Research Center), Stephen DeGloria will be presenting a lecture on Landsat-4 sensor design and operation considerations for agriculture, forestry and soil survey. Time has been spent this quarter for developing those lecture materials based on information derived from our LIDQA investigation. The lecture will be given during the third quarter phase of our project. A summary of the course lecture and copies of the lecture materials will be included in the next quarterly report.

LOCATION	SCENE ID	PATH/ROW	PRODUCT	BANDS
Sacramento	402001845 (2/1/83)	44/33	B&W, Film Negative (18.5 cm.)	MSS1-4, TM1-7
			B&W, Film Positive (18.5 cm.)	MSS1-4, TM1-7
			B&W, Paper (74.2 cm.)	MSS1-4, TM1-7
			Color, Positive, Natural (18.5cm.)	TM1-3
			Color, Positive, False (18.5cm.)	MSS 1,2,4 TM 1,3,4
			Color, Paper, Natural (74.2 cm.)	TM1-3
			Color, Paper, False (74.2 cm.)	MSS 1,2,4 TM 1,3,4

Table 1. Landsat-4 film products ordered from the EROS Data Center for the analysis of spectral, spatial and geometric quality.

ORIGINAL PAGE IS
OF POOR QUALITY

ORIGINAL PAGE IS
OF POOR QUALITY

1.4 Acknowledgements

Much of the material contained in this quarterly report has been developed from telephone conversations with those individuals responsible for film product development, production and distribution. Special acknowledgement is extended to Mr. Lynn Oleson, EROS Data Center, who provided techincal background material, EDC's philosophical approach to film production in the Scrounge (pre-TIPS) environment, and other contacts who would be helpful in the pursuit of our investigation. Also, Mr. Doug Binnie, EROS Data Center, who is the engineer-in-charge of implementing the EDC film processing and reproduction system in the TIPS environment, has provided useful information on the film types being used, LBR procedures, and trouble-shooting our film order through EDC User Services and Photolab. In addition, Mr. Doug Buckley, GE-Lanham, has provided information on the LBR film production system at GSFC. All discussions focused on the use of the a priori, band-dependent look-up tables for assigning a selected range of digital count values to one of 16 film density levels used by the LBR in generating the black-and-white film masters. This information is contained in the 241 mm. Interface Control Document (ICD), dated July 1983. Stephen DeGloria has requested a copy from EDC through Lynn Oleson. Grateful acknowledgement is extended to Mr. Darrel Williams who has facilitated this information flow by providing names and phone numbers of important contacts in a timely and efficient manner.

2.0 PUBLICATION AND PRESENATIONS

There were no publications or presentations during this three-month period of performance.

3.0 FUNDS EXPENDED TO DATE

The funds expended to June 30, 1983 under this contract are summarized in NASA Form 533M, "Monthly Contractors Financial Management Report", dated 7/21/83. Approximately 30% of project funds have been expended for the first six months of the performance period.

4.0 PROBLEMS ENCOUNTERED TO DATE

1. Additional funds requested from NASA-GSFC for purchase of analytical film products from the EROS Data Center (EDC) have yet to be awarded.

2. TM Film Products currently being generated at EDC are "interim" film products and do not reflect the type and quality of film products to be generated under the TIPS operational environment. See Section 1.2 of this report for details.

3. These investigators have not received the latest ICD outlining procedures and density curves for producing the black-and-white film masters.

ORIGINAL PAGE IS
OF POOR QUALITY

4. Coincident MSS data is unavailable for the San Francisco scene, dated 12/31/82. Coincident MSS and TM data are available for the Sacramento scene dated 2/1/83; and film products have been ordered. The reason that MSS data were not acquired coincident with the TM data for the San Francisco scene on this date has yet to be determined. From a review of her records, Ms. Pat Parker, NASA-GSFC, indicates that this San Francisco MSS scene (12/31/82) has not been processed. The search continues for information leading to the whereabouts of this scene, if acquired.