# AgRISTARS

EW-L2-04248
JSC-17821



A Joint Program for Agriculture and Resources Inventory Surveys Through Aerospace Remote Sensing



## Early Warning and Crop Condition Assessment

March 1982



# PRELIMINARY STUDY FOR CORRELATION OF METEOROLOGICAL SATELLITE (METSAT) DATA WITH LANDSAT DATA

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| 1. Report No. | 2. Government Accession No. | 3. Recipient's Catalog No. |
|---|---|---|
| EW-L2-04245; JSC-17821 | | |

| 4. Title and Subtitle | 5. Report Date |
|---|---|
| Preliminary Study for Correlation of Meteorological Satellite (Metsat) Data With Landsat Data | March 1982 |
| | 6. Performing Organization Code |

| 7. Author(s) | 8. Performing Organization Report No. |
|---|---|
| J. L. Amery-Ryland<br>Lockheed Engineering and Management Services Company, Inc. | LEMSCO-17307 |
| | 10. Work Unit No. |

| 9. Performing Organization Name and Address | 11. Contract or Grant No. |
|---|---|
| Lockheed Engineering and Management Services Company, Inc.<br>1830 NASA Road 1<br>Houston, Texas 77258 | NAS 9-15800 |
| | 13. Type of Report and Period Covered<br>Technical Report |

| 12. Sponsoring Agency Name and Address | 14. Sponsoring Agency Code |
|---|---|
| Early Warning/Crop Condition Assessment Project<br>U.S. Department of Agriculture, 1050 Bay Area Blvd.<br>Houston, Texas 77058 (Technical Monitor: J. L. Dragg) | |

15. Supplementary Notes

The Agriculture and Resources Inventory Surveys Through Aerospace Remote Sensing is a joint program of the U.S. Department of Agriculture, the National Aeronautics and Space Administration, the National Oceanic and Atmospheric Administration (U.S. Department of Commerce), the Agency for International Development (U.S. Department of State), and the U.S. Department of the Interior.

16. Abstract

This document provides a description of the data set and the procedure developed for comparing Landsat data and meteorological data.

| 17. Key Words (Suggested by Author(s)) | 18. Distribution Statement |
|---|---|
| Global area coverage<br>Local area coverage<br>Multiyear Landsat data<br>Multiyear meteorological satellite data | |

| 19. Security Classif. (of this report) | 20. Security Classif. (of this page) | 21. No. of Pages | 22. Price* |
|---|---|---|---|
| Unclassified | Unclassified | 39 | |

*For sale by the National Technical Information Service, Springfield, Virginia 22161

EW-L2-04248
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# PRELIMINARY STUDY FOR CORRELATION OF METEOROLOGICAL SATELLITE (METSAT) DATA WITH LANDSAT DATA

Job Order 72-456

This report describes Meteorological Analysis activities of the Early Warning project of the AgRISTARS program.


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Under Contract NAS 9-15800


For

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1050 Bay Area Boulevard
Houston, Texas


March 1982

LEMSCO-17307

## PREFACE

The Agriculture and Resources Inventory Surveys Through Aerospace Remote Sensing is a multiyear program of research, development, evaluation, and application of aerospace remote sensing for agricultural resources, which began in fiscal year 1980. This program is a cooperative effort of the U.S. Department of Agriculture, the National Aeronautics and Space Administration, the National Oceanic and Atmospheric Administration (U.S. Department of Commerce), the Agency for International Development (U.S. Department of State), and the U.S. Department of the Interior.

CONTENTS

## ABBREVIATIONS

| | |
|---|---|
| AA | accuracy assessment |
| AVHRR | advanced very-high-resolution radiometer |
| CCA | Crop Condition Analysis |
| CS | cursor-selected pixel readout option |
| GAC | global area coverage |
| HRPT | high-resolution picture transmission |
| IMDACS | Integrated Multivariate Data Analysis and Classification System |
| JSC | Lyndon B. Johnson Space Center |
| LAC | local area coverage |
| LACIE | Large Area Crop Inventory Experiment |
| metsat | meteorological satellite |
| NASA | National Aeronautics and Space Administration |
| NOAA | National Oceanic and Atmospheric Administration |

# 1. INTRODUCTION

The task which is the subject of this report was defined during the study to simulate meteorological satellite (metsat) data using Landsat data. A comparison of the simulated metsat data with actual metsat data acquired by the National Oceanic and Atmospheric Administration (NOAA) seemed appropriate. For this purpose, a data set was defined: Multiyear Landsat Coverage Correlated With Available Metsat Global Area Coverage (GAC). Procedures were developed for viewing the metsat GAC imagery and for locating geographically a Large Area Crop Inventory Experiment (LACIE) segment which was defined on Landsat imagery.

The technical background, the data set, and the procedure utilized in this task are presented in sections 2, 3, and 4, respectively. Section 5 offers recommendations for future use of metsat GAC data in analysis. Referenced documentation is listed in section 6. A detailed procedure for displaying GAC data is given in the appendix.

## 2. TECHNICAL BACKGROUND

NOAA-6, the metsat which provides local area coverage (LAC) and GAC, scans a 110° angle from 844 kilometers (525 miles) above the Earth. This scan angle subtends 2048 LAC or full-resolution pixels. At nadir these full-resolution pixels are 1.1 kilometers square; the pixel size increases with distance from nadir since pixels are subtended by equal angles. Conversely, the pixel size as displayed decreases with distance from nadir because of the effect of the curvature of the Earth and because the display processor displays the same size pixel regardless of the area that the original pixel covered. (See figure 2-1.)

Metsat data can be obtained full resolution (LAC) or sampled (GAC). LAC provides a data value for every pixel and is broadcast continuously for line-of-sight from the satellite by high-resolution picture transmission (HRPT). GAC data are sampled from the full-resolution advanced very-high-resolution radiometer (AVHRR) sensor data; this sampling provides a data value which is the average of four contiguous pixels.

On every third scan, four pixels are averaged for a data value, the fifth pixel is skipped, and then four more pixels are averaged. This process is repeated throughout the scan. Consequently, on a sampled scan line, 409 data points are recorded for the 2048 full-resolution pixels. The sampling technique for six lines would be as follows, with the mean value of the four sampled pixels recorded by the onboard recorder:

```
0 0 0 0 0 0 0 0 0 0 0 0 0 0 . . .
(X X X X) 0 (X X X X) 0 (X X) . . .
0 0 0 0 0 0 0 0 0 0 0 0 0 0 . . .
0 0 0 0 0 0 0 0 0 0 0 0 0 0 . . .
(X X X X) 0 (X X X X) 0 (X X) . . .
0 0 0 0 0 0 0 0 0 0 0 0 0 0 . . .
```

The four circled full-resolution points (X) represent one GAC data value (ref.).

Since it takes NOAA-6 approximately three passes to scan the continental United States, GAC acquisitions occur in sets of three which respectively cover the eastern, middle, and western portions of the United States (as well as southern Canada, northern Mexico, and portions of both the Atlantic and Pacific Oceans). Normally acquisitions deal with one orbit per file, but there are occasions when two different orbits appear on the same file. For the purposes of this study, each orbit has been considered a separate acquisition. (See table 2-1.)

# TABLE 2-1.- CORRELATION OF 1980 GAC AND LANDSAT DATA

## (a) Tape GAC010

| File | GAC acquisition date | Universal-formatted file[a] | Location of LACIE segment (county, state) | LACIE segment | Landsat acquisition date | Center point | | | | Data quality |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Lat., N. | Long., W. | Pixel | Scan line | |
| [b]3 | 193 | 6 | Whitley, Indiana | 133 | 188 | 41.2° | -85.8° | 192 | 386 | Clear |
| | | | Crittenden, Kentucky | 153 | 188 | 37.3° | -88.2° | 166 | 525 | Clear |
| | | | Pontotoc, Mississippi | 195 | 188 | 34.3° | -89.1° | 165 | 626 | Clear |
| | | | Kankakee, Illinois | 828 | 190 | 41.1° | -88.0° | 146 | 400 | Clear (clouds nearby to the east) |
| | | | Palo Alto, Iowa | 883 | 194, 195 | 43.1° | -94.9° | 46 | 356 | Clear (clouds nearby to the east) |
| | | | Jerauld, South Dakota | 1755 | 197 | 44.0° | -98.9° | 17 | 328 | Clear (?); possibly hazy |
| | | | La Moure, North Dakota | 1924 | 199 | 46.5° | -98.8° | 16 | 242 | On the edge of a cloud; doubtful quality |
| [c]3 | 193 | 6 | Gentry, Missouri | 209 | 193, 194 | 40.3° | -94.4° | 393 | 335 | Clear but blurred |
| | | | Flathead, Montana | 1725 | 191 | 48.3° | -114.2° | 99 | 290 | Clear but closely surrounded by clouds |
| | | | Jerauld, South Dakota | 1755 | 197 | 44.0° | -98.9° | 367 | 342 | Cloud covered |
| | | | La Moure, North Dakota | 1924 | 199 | 46.5° | -98.8° | 350 | 264 | Clear with small clouds nearby |
| 4 | 193 | 7 | Palo Alto, Iowa | 883 | 194, 195 | 43.1° | -94.9° | 393 | 335 | Clear |
| | | | Flathead, Montana | 1725 | 191 | 48.3° | -114.2° | 99 | 290 | Clear (clouds to the west and north) |
| | | | Jerauld, South Dakota | 1755 | 197 | 44.0° | -98.9° | 367 | 342 | Clear (small clouds nearby to the east) |
| | | | La Moure, North Dakota | 1924 | 199 | 46.5° | -98.8° | 350 | 264 | Clear (possibly has small clouds within segment boundaries) |
| [b]8 | 194 | 8 | Whitley, Indiana | 133 | 188 | 41.2° | -85.8° | 91 | 375 | On the edge of a cloud; probably cloud covered |
| | | | Crittenden, Kentucky | 153 | 188 | 37.3° | -88.2° | 70 | 510 | Clear |
| | | | Pontotoc, Mississippi | 195 | 188 | 34.3° | -89.1° | 66 | 612 | Clear |
| | | | Gentry, Missouri | 209 | 193, 194 | 40.3° | -94.4° | 14 | 423 | On the edge of a cloud; probably cloud covered |
| | | | Kankakee, Illinois | 828 | 190 | 41.1° | -88.0° | 63 | 383 | Possibly clear; clouds nearby |
| | | | Palo Alto, Iowa | 883 | 194, 195 | 43.1° | -94.9° | 10 | 326 | Clear |
| [c]8 | 194 | 8 | Palo Alto, Iowa | 883 | 194, 195 | 43.1° | -94.9° | 352 | 1331 | Probably clear |
| | | | Flathead, Montana | 1725 | 191 | 48.3° | -114.2° | 42 | 1252 | Cloud covered |
| | | | Jerauld, South Dakota | 1755 | 197 | 44.0° | -98.9° | 295 | 1328 | Possibly cloud covered |
| | | | La Moure, North Dakota | 1924 | 199 | 46.5° | -98.8° | 277 | 1250 | Partially cloud covered |
| | | | Fergus, Montana | 1948 | 187, 188 | 47.6° | -109.3° | 94 | 1264 | Clear |

[a]Located on tape OA0054.

[b]Orbit 1.

[c]Orbit 2.

## TABLE 2-1.- Continued.

## (b) Tape GAC011

| Fi. | GAC acquisition date | Universal-formatted file[a] | Location of LACIE segment (county, state) | LACIE segment | Landsat acquisition date | Center point | | | | Data quality |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Lat., N. | Long., W. | Pixel | Scan line | |
| 2 | 195 | 1 | Whitley, Indiana | 133 | 188, 206 | 41.2° | -85.8° | 32 | 362 | Clear with clouds nearby |
| | | | Crittenden, Kentucky | 153 | 188, 206 | 37.3° | -88.2° | 19 | 494 | Clear with clouds nearby |
| | | | Pontotoc, Mississippi | 195 | 188 | 34.3° | -89.1° | 16 | 599 | Clear |
| | | | Kankakee, Illinois | 828 | 190 | 41.1° | -88.0° | 17 | 366 | Clear with clouds nearby |
| 3 | 195 | 2 | Whitley, Indiana | 133 | 188, 206 | 41.2° | -85.8° | 388 | 415 | |
| | | | Crittenden, Kentucky | 153 | 188, 206 | 37.3° | -88.2° | 386 | 557 | |
| | | | Pontotoc, Mississippi | 195 | 188 | 34.3° | -89.1° | 390 | 662 | |
| | | | Gentry, Missouri | 209 | 193, 194 | 40.3° | -94.4° | 304 | 509 | Clear |
| | | | Kankakee, Illinois | 828 | 190 | 41.1° | -88.0° | 373 | 436 | Cloud covered |
| | | | Palo Alto, Iowa | 883 | 194, 195 | 43.1° | -94.9° | 277 | 421 | Cloud covered |
| | | | Flathead, Montana | 1725 | 191 | 48.3° | -114.2° | 5 | 308 | Cloud covered |
| | | | Jerauld, South Dakota | 1755 | 197 | 44.0° | -98.9° | 193 | 416 | Possibly hazy |
| | | | La Moure, North Dakota | 1924 | 199 | 46.5° | -98.8° | 178 | 331 | Clear |
| | | | Fergus, Montana | 1948 | 187, 188 | 47.6° | -109.3° | 36 | 327 | Partially cloud covered |
| 8 | 196 | 3 | Whitley, Indiana | 133 | 188 | 41.2° | -85.8° | 343 | 404 | Hazy |
| | | | Crittenden, Kentucky | 153 | 188 | 37.3° | -88.2° | 332 | 541 | Clear |
| | | | Pontotoc, Mississippi | 195 | 188 | 34.3° | -89.1° | 336 | 645 | Clear |
| | | | Gentry, Missouri | 209 | 193, 194 | 40.3° | -94.4° | 200 | 480 | Clear with small clouds nearby |
| | | | Kankakee, Illinois | 828 | 190 | 41.1° | -88.0° | 312 | 420 | Hazy |
| | | | Palo Alto, Iowa | 883 | 194, 195 | 43.1° | -94.9° | 170 | 390 | Cloud covered |
| | | | Jerauld, South Dakota | 1755 | 197 | 44.0° | -98.9° | 93 | 365 | Clear |
| | | | La Moure, North Dakota | 1924 | 199 | 46.5° | -98.8° | 89 | 290 | Clear with small clouds nearby |
| 9 | 196 | 4 | Glenn, California | 260 | 194, 195 | 39.6° | -122.0° | 149 | 535 | Clear |
| | | | Flathead, Montana | 1725 | 191 | 48.3° | -114.2° | 242 | 250 | Cloud covered |
| | | | Fergus, Montana | 1948 | 187, 188 | 47.6° | -109.3° | 323 | 241 | Cloud covered |

[a] Located on file DA0054.

## TABLE 2-1.- Continued.

## (c) Tape GAC012

| File | GAC acquisition date | Universal-formatted file[a] | Location of LACIE segment (county, state) | LACIE segment | Landsat acquisition date | Center point | | | | Data quality |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Lat., N. | Long., W. | Pixel | Scan line | |
| $b_2$ | 197 | 3 | Whitley, Indiana | 133 | 188, 206 | 41.2° | -85.8° | 254 | 392 | Small clouds |
| | | | Crittenden, Kentucky | 153 | 188, 206 | 37.3° | -88.2° | 252 | 530 | Clear |
| | | | Pontotoc, Mississippi | 195 | 188, 207 | 34.3° | -89.1° | 233 | 633 | Clear |
| | | | Gentry, Missouri | 209 | 193, 194 | 40.3° | -94.4° | 93 | 460 | Cloud covered |
| | | | Bolivar, Mississippi | 812 | 207, 208 | 33.8° | -90.8° | 198 | 662 | Clear |
| | | | Kankakee, Illinois | 828 | 190, 208 | 41.1° | -88.0° | 208 | 401 | Clear with small clouds nearby |
| | | | Palo Alto, Iowa | 883 | 194, 195 | 43.1° | -94.9° | 79 | 367 | Cloud covered |
| | | | Jerauld, South Dakota | 1755 | 197 | 44.0° | -98.9° | 36 | 346 | Hazy; clouds nearby but not over segment |
| | | | La Moure, North Dakota | 1924 | 199 | 46.5° | -98.8° | 34 | 262 | Cloud covered |
| $c_2$ | 197 | 3 | Flathead, Montana | 1725 | 191 | 48.3° | -114.2° | 144 | 1283 | Cloud covered |
| | | | Jerauld, South Dakota | 1755 | 197 | 44.0° | -98.9° | 384 | 1320 | Cloud covered |
| | | | La Moure, North Dakota | 1924 | 199 | 46.5° | -98.8° | 375 | 1243 | Cloud covered |
| | | | Fergus, Montana | 1948 | 187, 188 | 47.6° | -109.3° | 237 | 1282 | Small clouds over area |
| 3 | 197 | 4 | Glenn, California | 260 | 194, 195 | 39.6° | -122.0° | 65 | 579 | Clear |
| | | | Flathead, Montana | 1725 | 191 | 48.3° | -114.2° | 144 | 264 | Cloud covered |
| | | | Jerauld, South Dakota | 1755 | 197 | 44.0° | -98.9° | 384 | 303 | Cloud covered |
| | | | La Moure, North Dakota | 1924 | 199 | 46.5° | -98.8° | 374 | 224 | Cloud covered |
| | | | Fergus, Montana | 1948 | 187, 188 | 47.6° | -109.3° | 237 | 264 | Small clouds over area |
| $b_8$ | 198 | 5 | Whitley, Indiana | 133 | 188, 206 | 41.2° | -85.8° | 141 | 376 | Cloud covered |
| | | | Crittenden, Kentucky | 153 | 188, 206 | 37.3° | -88.2° | 116 | 513 | Clear |
| | | | Pontotoc, Mississippi | 195 | 188, 207 | 34.3° | -89.1° | 113 | 616 | Clear |
| | | | Gentry, Missouri | 209 | 193, 194 | 40.3° | -94.4° | 32 | 431 | Clear |
| | | | Bolivar, Mississippi | 812 | 209, 208 | 33.8° | -90.8° | 86 | 640 | Possibly hazy |
| | | | Kankakee, Illinois | 828 | 190, 208 | 41.1° | -88.0° | 102 | 389 | Cloud covered |
| | | | Palo Alto, Iowa | 883 | 194, 195 | 43.1° | -94.9° | 26 | 338 | Clear |
| $c_8$ | 198 | 5 | Palo Alto, Iowa | 883 | 194, 195 | 43.1° | -94.9° | 378 | 1294 | Clear |
| | | | Flathead, Montana | 1725 | 191, 209 | 48.3° | -114.2° | 68 | 1240 | Cloud covered |
| | | | Jerauld, South Dakota | 1755 | 197 | 44.0° | -98.9° | 336 | 296 | Clear |
| | | | La Moure, North Dakota | 1924 | 199 | 46.5° | -98.8° | 332 | 1227 | Clear |
| | | | Fergus, Montana | 1948 | 187, 188 | 47.6° | -109.3° | 142 | 1274 | Clear |

[a] Located on tape DA0189.
[b] Orbit 1.
[c] Orbit 2.

## TABLE 2-1.- Concluded.

### (d) Tape GAC013

| File | GAC acquisition date | Universal-formatted file[a] | Location of LACIE segment (county, state) | LACIE segment | Landsat acquisition date | Center point | | | | Data quality |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Lat., N. | Long., W. | Pixel | Scan line | |
| [b]2 | 199 | 1 | Whitley, Indiana | 133 | 188, 206 | 41.2° | -85.8° | 59 | 368 | Clear |
| | | | Crittenden, Kentucky | 153 | 188, 206 | 37.3° | -88.2° | 41 | 504 | Clear (clouds to the east) |
| | | | Pontotoc, Mississippi | 195 | 188, 207 | 34.3° | -89.1° | 39 | 601 | Clear (clouds to the northwest) |
| | | | Bolivar, Mississippi | 812 | 207, 208 | 33.8° | -90.8° | 25 | 624 | Cloud covered |
| [c]2 | 199 | 1 | Flathead, Montana | 1725 | 191, 209 | 48.3° | -114.2° | 36 | 1238 | Clear with clouds nearby |
| | | | Jerauld, South Dakota | 1755 | 197 | 44.0° | -98.9° | 251 | 1332 | Cloud covered |
| | | | La Moure, North Dakota | 1924 | 199 | 46.5° | -98.8° | 234 | 1251 | Cloud covered |
| | | | Fergus, Montana | 1948 | 188 | 47.6° | -109.3° | 62 | 1256 | Clear |
| 3 | 199 | 2 | Whitley, Indiana | 133 | 188, 206 | 41.2° | -85.8° | 404 | 387 | Clear |
| | | | Crittenden, Kentucky | 153 | 188, 206 | 37.3° | -88.2° | 403 | 530 | Clear with clouds nearby to the east |
| | | | Bolivar, Mississippi | 812 | 207, 208 | 33.8° | -90.8° | 398 | 666 | Hazy |
| | | | Kankakee, Illinois | 828 | 190, 208 | 41.1° | -88.0° | 392 | 411 | Clear |
| | | | Palo Alto, Iowa | 883 | 194, 195 | 43.1° | -94.9° | 324 | 402 | Possibly cloud covered (clouds to the west) |
| | | | Flathead, Montana | 1725 | 191, 209 | 48.3° | -114.2° | 24 | 307 | Probably cloud covered |
| | | | Jerauld, South Dakota | 1755 | 197 | 44.0° | -98.9° | 252 | 399 | Cloud covered |
| | | | La Moure, North Dakota | 1924 | 199 | 46.5° | -98.8° | 233 | 317 | Cloud covered |
| | | | Fergus, Montana | 1948 | 188 | 47.6° | -109.3° | 63 | 322 | Clear |
| 8 | 200 | 1 | Whitley, Indiana | 133 | 206 | 41.2° | -85.8° | 13 | 358 | Cloud covered |
| | | | Crittenden, Kentucky | 153 | 206 | 37.3° | -88.2° | 5 | 492 | Clear |
| 9 | 200 | 2 | Whitley, Indiana | 133 | 206 | 41.2° | -85.8° | 369 | 406 | Cloud covered |
| | | | Crittenden, Kentucky | 153 | 206 | 37.3° | -88.2° | 366 | 554 | Clear |
| | | | Pontotoc, Mississippi | 195 | 207 | 34.3° | -89.1° | 369 | 1657 | Clear |
| | | | Gentry, Missouri | 209 | 193, 194 | 40.3° | -94.4° | 258 | 500 | Possibly cloud covered (clouds to the west) |
| | | | Bolivar, Mississippi | 812 | 207, 208 | 33.8° | -90.8° | 354 | 688 | Clear |
| | | | Kankakee, Illinois | 828 | 190, 208 | 41.1° | -88.0° | 350 | 432 | Cloud covered |
| | | | Palo Alto, Iowa | 883 | 194, 195 | 43.1° | -94.9° | 229 | 410 | Cloud covered |
| | | | Jerauld, South Dakota | 1755 | 197 | 44.0° | -98.9° | 144 | 400 | Possibly cloud covered |
| | | | La Moure, North Dakota | 1924 | 199 | 46.5° | -98.8° | 131 | 318 | Clear |

[a]Files for day 199 located on tape DAU149; files for day 200 located on tape DAU684.

[b]Orbit 1.

[c]Orbit 2.

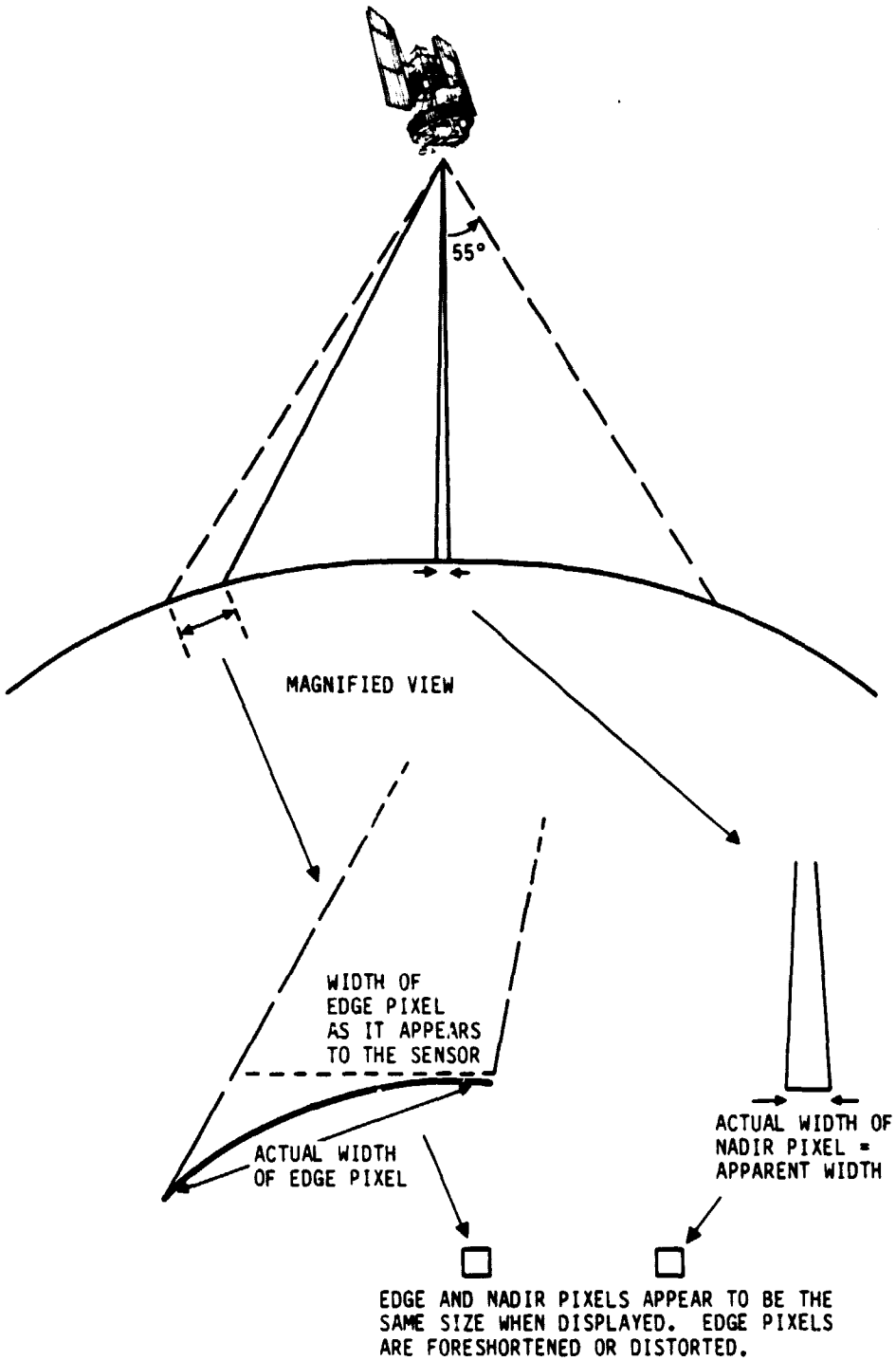


Figure 2-1.- Illustration of the effect of view angle on pixel size.

# 3. THE DATA SET

The multiyear Landsat and metsat data set is based on two lists:

1. Candidate LACIE segments with Landsat coverage
   a. Which occur in areas covered by one or more of the available GAC tapes
   b. For which four or more Landsat acquisitions per year of good data quality are available for 3 consecutive years
   c. For which at least 1 year of accuracy assessment (AA) ground-truth data is available
2. GAC metsat acquisitions which are
   a. Available in-house (i.e., within the Agena Building)[1]
   b. Reasonably clear over the areas of interest
   c. Within 11 days of a candidate Landsat acquisition
   d. Over the continental United States

Several GAC acquisitions were rejected from final consideration because their scan occurred during a night pass by NOAA-6 and, thus, contained little or no information which could be correlated to Landsat imagery. The remaining (or daylight) GAC acquisitions are listed in table 3-1; candidate LACIE segments and their pertinent information are listed in table 3-2.

Table 2-1 lists the data set which correlates the GAC acquisitions with the appropriate Landsat acquisitions. Information provided is arranged according to the original GAC tape and file numbers and includes the following:

1. The tape and file numbers of the Universal-formatted version of each GAC acquisition
2. The dates of acquisition (Julian) for each GAC acquisition and its corresponding Landsat acquisitions

[1]Unfortunately, only 1980 data were available in-house, and these acquisitions were further confined to within a 6-day span (Julian days 194 through 200).

3. The location of the corresponding LACIE segments by county and state, latitude and longitude of the segment center point, and pixel and scan line coordinates within the GAC scene

4. A general description of data quality for the areas in and around candidate LACIE segments within the GAC scene.

## TABLE 3-1.- AVAILABLE GAC DATA

### (a) Tape GAC010

| File | Number of _ | | Coordinates | | Geographic area covered |
|---|---|---|---|---|---|
| | Scan lines | Pixels | Lat., N. | Long., W. | |
| 2 | 890 | 409 | 48.2°<br>43.1°<br>27.9°<br>23.9° | -75.8°<br>-41.6°<br>-77.7°<br>-51.3° | New York, Maine, North Carolina, Delaware, New Jersey, Massachusetts, Connecticut, Vermont, New Hampshire, Maryland, Pennsylvania |
| 3 | 1513 | 409 | 50.7°<br>45.3°<br>42.3°<br>37.6° | -101.0°<br>-65.3°<br>-126.8°<br>-95.7° | Michigan, northern Indiana and Illinois, Iowa, Wisconsin, Minnesota, northwestern Missouri, Kansas, Nebraska, North and South Dakota, Montana, Wyoming, Idaho, Oregon, Washington |
| 4 | 1035 | 409 | 54.3°<br>48.6°<br>28.2°<br>24.2° | -126.3°<br>-87.9°<br>-128.3°<br>-101.8° | Kansas, Colorado, New Mexico, Nebraska, western Iowa, Minnesota, northwest Wisconsin, North and South Dakota, Montana, etc., to the Pacific Ocean |
| 8 | 1491 | 409 | 49.7°<br>44.4°<br>44.1°<br>39.3° | -95.4°<br>-60.4°<br>-121.1°<br>-89.1° | Northern United States: Maine, Massachusetts, Pennsylvania, New York, Ohio, northern Indiana and Illinois, Michigan, Wisconsin, Iowa, Minnesota, Nebraska, Montana, Idaho, Oregon, North and South Dakota |
| 9 | 957 | 409 | 51.1°<br>45.7°<br>27.9°<br>24.0° | -120.7°<br>-84.7°<br>-122.8°<br>-96.4° | Texas, Arkansas, Oklahoma, Missouri, Illinois, northern Michigan, Wisconsin, Iowa, Minnesota, Nebraska, North and South Dakota, Montana, Colorado, New Mexico, Arizona, California, Utah, Washington, Oregon, Idaho |
| 10 | 211 | 409 | 54.3°<br>48.6°<br>51.4°<br>46.0° | -146.0°<br>-107.6°<br>-146.0°<br>-109.9° | Canada and a small portion of the Northern United States |

TABLE 3-1.- Continued.

(b) Tape GAC011

| File | Number of — | | Coordinates | | Geographic area covered |
|---|---|---|---|---|---|
| | Scan lines | Pixels | Lat., N. | Long., W. | |
| 2 | 925 | 409 | 48.9°<br>43.7°<br>25.7°<br>21.7° | -89.9°<br>-55.4°<br>-92.2°<br>-66.3° | Mississippi, eastern Arkansas, Tennessee, Illinois, eastern Wisconsin, Michigan, Indiana, Kentucky, Alabama, Georgia, Florida, North and South Carolina, Ohio, and the East Coast |
| 3 | 1091 | 409 | 54.3°<br>48.6°<br>28.2°<br>24.3° | -115.1°<br>-76.8°<br>-117.1°<br>-90.7° | Western portions of Alabama, Tennessee, and Kentucky and Indiana, western Ohio, Michigan, Illinois, Wisconsin, Iowa, Minnesota, Missouri, Arkansas, Louisiana, Texas, Oklahoma, Kansas, Nebraska, North and South Dakota, Montana, Wyoming, Colorado, New Mexico, Arizona |
| 4 | 527 | 409 | 54.3°<br>48.6°<br>42.8°<br>38.2° | -140.4°<br>-102.1°<br>-140.9°<br>-109.6° | Wyoming, Montana, Utah, Idaho, Oregon, Washington, northern Nevada |
| 7 | 890 | 409 | 48.4°<br>43.3°<br>27.9°<br>23.9° | -84.3°<br>-50.1°<br>-86.3°<br>-60.0° | Everything east of the eastern portions of Alabama, Tennessee, Kentucky, and Michigan and east of Ohio |
| 8 | 1051 | 409 | 52.6°<br>47.1°<br>26.5°<br>22.6° | -109.5°<br>-72.5°<br>-111.8°<br>-85.7° | Western Georgia, North Carolina, Pennsylvania, Ohio, Kentucky, Michigan, Indiana, Tennessee, Mississippi, Louisiana, Arkansas, Missouri, Iowa, Wisconsin, Minnesota, North and South Dakota, Nebraska, Kansas, Oklahoma, Texas, New Mexico, Colorado, Wyoming, Montana, eastern Arizona |
| 9 | 959 | 409 | 54.3°<br>48.6°<br>31.1°<br>27.0° | -134.8°<br>-96.5°<br>-136.5°<br>-109.4° | Northwestern New Mexico, Colorado, northwestern South Dakota, Montana, Wyoming, Utah, Arizona, Idaho, Nevada, Washington, Oregon, California |

TABLE 3-1.- Continued.

(c) Tape GAC012

| File | Number of — | | Coordinates | | Geographic area covered |
|---|---|---|---|---|---|
| | Scan lines | Pixels | Lat., N. | Long., W. | |
| 1 | 890 | 409 | 48.2°<br>43.1°<br>27.9°<br>23.9° | -78.7°<br>-44.7°<br>-80.7°<br>-54.4° | Mostly the Atlantic Ocean: New York, Pennsylvania, Virginia, North Carolina, etc. |
| 2 | 1471 | 409 | 51.3°<br>45.9°<br>45.7°<br>40.8° | -104.0°<br>-67.9°<br>-129.5°<br>-96.8° | Michigan, Wisconsin, northern Iowa, Minnesota, North and South Dakota, northeastern Montana |
| 3 | 1005 | 409 | 53.9°<br>48.2°<br>27.8°<br>23.8° | -129.2°<br>-91.2°<br>-131.3°<br>-105.0° | West Texas, western Kansas, Nebraska, Minnesota, North and South Dakota, Montana, Wyoming, Colorado, New Mexico, Arizona, Utah, Idaho, Washington, Oregon, Nevada, California |
| 8 | 1457 | 409 | 50.1°<br>44.8°<br>43.5°<br>38.8° | -98.4°<br>-63.1°<br>-124.1°<br>-92.5° | Maine, Michigan, Wisconsin, Iowa, northern Nebraska, Minnesota, North and South Dakota, Wyoming, Montana, Idaho, Washington, northern Oregon, southern Canada |
| 9 | 1045 | 409 | 54.1°<br>48.4°<br>28.1°<br>24.1° | -123.7°<br>-85.5°<br>-125.7°<br>-99.4° | Central and west Texas, Oklahoma, western Missouri, Iowa, Wisconsin, Minnesota, North and South Dakota, Nebraska, Kansas, New Mexico, Colorado, Wyoming, Montana, Arizona, Nevada, Idaho, Oregon, California, Washington |

TABLE 3-2.- Concluded.

(d) Tape GAC013

| File | Number of _ | | Coordinates | | Geographic area covered |
|---|---|---|---|---|---|
| | Scan lines | Pixels | Lat., N. | Long., W. | |
| 2 | 1481 | 409 | 49.3°<br>44.0°<br>43.7°<br>39.0° | -92.8°<br>-58.1°<br>-118.5°<br>-86.8° | Maine, New York, northern Massachusetts, Vermont, New Hampshire, northern portions of Ohio, Indiana, Illinois, Michigan, Wisconsin, northern Iowa, Idaho, North and South Dakota, Minnesota, northern Wyoming and Nebraska, southern Montana |
| 3 | 1077 | 409 | 54.3°<br>48.6°<br>28.2°<br>24.2° | -118.1°<br>-79.8°<br>-120.1°<br>-93.8° | Louisiana, northwestern Mississippi, Arkansas, northwestern Indiana, Michigan, Wisconsin, Illinois, Missouri, Iowa, Minnesota, North and South Dakota, Nebraska, Kansas, Oklahoma, Texas, New Mexico, Colorado, Wyoming, Montana, Utah, Idaho, Nevada, Arizona |
| 4 | 341 | 409 | 54.3°<br>48.6°<br>48.5°<br>43.4° | -143.4°<br>-105.1°<br>-143.5°<br>-109.3° | Northwestern corner of Wyoming, Montana, Washington, British Columbia, Quebec, eastern Ontario |
| 8 | 915 | 409 | 48.7°<br>43.5°<br>25.4°<br>21.5° | -87.3°<br>-53.0°<br>-89.6°<br>-63.8° | East coast and Florida, Michigan, Indiana, eastern Illinois, Ohio, Pennsylvania, Tennessee, Kentucky, Alabama, Georgia, eastern Mississippi |
| 9 | 1075 | 409 | 53.6°<br>47.9°<br>27.5°<br>23.5° | -112.5°<br>-74.8°<br>-114.6°<br>-88.4° | Alabama, Tennessee, Kentucky, Ohio, Michigan, Indiana, Illinois, Mississippi, Louisiana, Arkansas, Missouri, Iowa, Wisconsin, Minnesota, North and South Dakota, Nebraska, Kansas, Texas, Oklahoma, New Mexico, Colorado, Wyoming, Montana, Utah, Arizona, eastern Idaho |
| 10 | 705 | 409 | 54.3°<br>48.5°<br>36.9°<br>32.5° | -137.8°<br>-99.6°<br>-138.8°<br>-110.0° | Arizona, northwestern New Mexico and Colorado, Wyoming, northwestern portions of North and South Dakota, Montana, Idaho, Utah, Nevada, Oregon, Washington, California |

## TABLE 3-2.- CANDIDATE LACIE SEGMENTS

| Segment | Location (county, state) | Center point coordinates | | Acquisitions available[a] | | | | AA ground-truth data available | Data quality[b] |
|---|---|---|---|---|---|---|---|---|---|
| | | Lat., N. | Long., W. | 1977 | 1978 | 1979 | 1980 | | |
| 133 | Whitley, Indiana | 41.2° | -85.8° | | 152, 197, 233, 251, 260, 269 | 138, 155, 174, 183, 191, 200, 210, 219, 228, 246, 263, 272 | 124, 170, 188, 206, 277, 313 | 1978, 1979 | 78260: cloudy; 1979 imagery not available for analysis; 80124 and 80170: not available, 80313: cloudy |
| 153 | Crittenden, Kentucky | 37.3° | -88.2° | | 152, 180, 197, 207, 233, 251, 260, 269, 297, 305 | 120, 138, 166, 219, 247, 265, 273 | 188, 206, 224, 296, 297 | 1978, 1979 | 78260: cloudy; 79138 and 79166: cloudy; 79293: not available; 80188 and 80206: cloudy |
| 195 | Pontotoc, Mississippi | 34.3° | -89.1° | | 126, 143, 180, 197, 207, 215, 233, 234, 251, 260, 269, 305 | 121, 166, 184, 219, 220, 228, 247, 265, 273 | 188, 207, 224, 242, 260, 261, 279, 296 | 1978, 1979 | 78126: extremely hazy; 78143 and 78251: hazy; 78180 and 78197: cloudy; 78234 and 78260: data drop; 79121, 79219, 79220: hazy; 79265: cloudy; 79273: not available; 80279: extremely hazy; 80296: not available |
| 209 | Gentry, Missouri | 40.3° | -94.4° | | 167, 185, 212, 220, 221, 238, 247, 266, 274, 292, 293, 301 | 107, 144, 161, 162, 180, 215, 224, 234, 243, 260, 261 | 112, 130, 193, 194, 211, 247, 248, 265, 284, 301 | 1978, 1979 | 78212: cloudy; 79107: cloudy; 80284: not available |

[a] Acquisitions, by Julian date, listed as being available in JSC Building 17.

[b] All available acquisitions which are not listed were clear; the first two digits designate the year of the acquisition.

TABLE 3-2.- Continued.

| Segment | Location (county, state) | Center point coordinates | | Acquisitions available[a] | | | | AA ground-truth data available | Data quality[b] |
|---|---|---|---|---|---|---|---|---|---|
| | | Lat., N. | Long., W. | 1977 | 1978 | 1979 | 1980 | | |
| 260 | Glenn, California | 39.6° | -122.0° | | | 127, 136, 145, 154, 162, 172, 181, 199, 208, 217, 262, 271 | 177, 194, 195, 212, 213, 230, 231, 266, 267, 284, 285, 302, 303 | 1979, 1980 | 79127: clouds and haze; 80177: hazy; 80303: not available |
| 261 | Fresno, California | 36.6° | -120.2° | | | 133, 143, 205, 206, 224, 259 | 147, 210, 228, 246, 283, 301 | 1979, 1980 | 79143: hazy; 80147: hazy |
| 263 | Kern, California | 35.6° | -119.3° | | | 124, 133, 151, 160, 169, 196, 205, 214, 232, 250 | 128, 146, 174, 210, 228, 246, 264 | 1979, 1980 | 80146: small clouds; 80228: slight data drop |
| 276 | Wharton, Texas (2) | 29.6° | -96.3° | | | 133, 134 161, 250, 268, 269 | 111, 247, 283, 301, 302 | 1979, 1980 | 79133: hazy; 79250: cloudy; 80247 and 80301: cloudy |
| 812 | Bolivar, Mississippi | 33.8° | -40.8° | | 181, 199, 207, 226, 235, 243, 279, 280, 289, 307 | 185, 193, 211, 230, 248, 257, 266 | 207, 208, 244, 261, 279, 280, 297, 298 | 1978, 1979 | 78181: not available; 79185 and 79248: hazy; 79266: not available; 80261: cloudy; 80279: hazy; 80298: cloudy |

[a]Acquisitions, by Julian date, listed as being available in JSC Building 17.

[b]All available acquisitions which are not listed were clear; the first two digits designated the year of the acquisition.

TABLE 3-2.- Continued.

| Segment | Location (county, state) | Center point coordinates | | Acquisitions available[a] | | | | AA ground-truth data available | Data quality[b] |
|---|---|---|---|---|---|---|---|---|---|
| | | Lat., N. | Long., W. | 1977 | 1978 | 1979 | 1980 | | |
| 828 | Kankakee, Illinois | 41.1° | -88.0° | | 126, 163, 180, 198, 207, 216, 226, 234, 243, 252, 263, 271, 291 | 103, 121, 149, 157, 167, 175, 202, 203, 220, 230, 248, 265, 266 | 108, 171, 190, 208, 243, 297 | 1978, 1979 | 78126, 78198, and 78263: extremely hazy; 78180: hazy; 79103 and 79121: not available; 78248: cloudy; 80108: 10% clouds; 80190: less than 10% clouds; 80208: hazy; 80297: not available |
| 883 | Palo Alto, Iowa | 43.1° | -94.9° | 157, 175, 193, 211, 229 | 131, 141, 150, 186, 204, 213, 234, 258, 267, 293, 303 | 112, 126, 127, 145, 153, 162, 163, 181, 216, 235, 243, 261, 262 | 194, 195, 212, 249, 284, 285 | 1978, 1979 | 1977 imagery: no information available on data quality; 78258: cloudy; 80195: cloudy; 80212: slight data drop |
| 886 | Pottawatomie, Iowa | 41.3° | -95.4° | 105, 122, 123, 140, 141, 158, 159, 176, 230 | 131, 167, 186, 204, 212, 231, 249, 258, 267, 293 | 118, 136, 144, 162, 163, 172, 180, 243, 261, 262, 271 | 113, 177, 213, 231, 248, 249, 284, 285 | 1978, 1979 | 1977 imagery: no information available on data quality; 78131 and 78186: hazy; 79136: hazy; 80213: extremely hazy; 80249: cloudy |
| 1725 | Flathead, Montana | 48.3° | -114.2° | 115, 152, 170, 188, 223, 224 | 165, 182, 183, 201, 209, 210, 218, 219, 263 | 142, 178, 196, 204, 213, 214, 241, 250 | 174, 191, 209, 210, 228 | 1977, 1978, 1979 | 78182, 78183, and 78201: cloud shadowed; 78218: hazy; 79241: doubtful quality |

[a]Acquisitions, by Julian date, listed as being available in JSC Building 17.

[b]All available acquisitions which are not listed were clear; the first two digits designate the year of the acquisition.

TABLE 3-2.- Concluded.

| Segment | Location (county, state) | Center point coordinates | | Acquisitions available[a] | | | | AA ground-truth data available | Data quality[b] |
|---|---|---|---|---|---|---|---|---|---|
| | | Lat., N. | Long., W. | 1977 | 1978 | 1979 | 1980 | | |
| 1755 | Jerauld, South Dakota | 44.0° | -98.9° | 140, 158, 194, 211, 230 | 117, 134, 135, 153, 197, 198, 207, 216, 225, 234, 243, 251, 252, 270 | 120, 148, 165, 166, 184, 202, 220, 246 | 162, 197, 251, 252, 262, 287 | 1978, 1979 | 80251: 5% clouds; 80287: 30% clouds |
| 1924 | La Moure, North Dakota | 46.5° | -98.8° | 122, 140, 176, 194, 230 | 135, 136, 154, 198, 207, 208, 216, 217, 226, 243, 252, 270 | 112, 148, 166, 167, 176, 184, 220 | 162, 199, 252, 306 | 1977, 1978, 1979 | 77122: hazy; 77194: 50% cloud shadowed; 78198: extremely cloudy; 78226 and 78243: hazy; 78252: cloudy; 79112 and 79148: cloudy; 79166: too cloudy; 79176: cloudy; 79184: popcorn clouds |
| 1948 | Fergus, Montana | 47.6° | -109.3° | 112, 148, 184, 220 | 143, 179, 197, 206, 215, 224, 233, 242, 251, 269 | 120, 201, 219, 246 | 106, 124, 142, 170, 187, 188, 242, 296 | 1977, 1978, 1979 | 77148: 20% clouds; 77220: hazy; 78143: hazy; 80124: cloudy; 80296: extremely cloud shadowed |

[a]Acquisitions, by Julian date, listed as being available in JSC Building 17.

[b]All available acquisitions which are not listed were clear; the first two digits designate the year of the acquisition.

# 4. THE PROCEDURE

A list of all recent multiyear LACIE segments within the continental United States was compiled using the Data Management System in Building 17 at the National Aeronautics and Space Administration, Lyndon B. Johnson Space Center (NASA/JSC). From this list, all segments having at least four acquisitions of good quality per year (between Julian days 100 and 315) for 1977-80 (or in the case of predominently corn and soybean segments for 1978-80) and at least 1 year of AA ground-truth data were selected. In an effort to preserve the widest possible geographic dispersion, segments 260, 261, and 263 in California and segment 276 in Texas were also selected although data were only available for 1979-80.

Similarly, all tapes of GAC data available in-house were located as were the printouts from SAMPLE, a program which lists the solar zenith angles (hereafter referred to as sun angles) and the latitude and longitude coordinates for each of 51 points along every selected (100th for this case) scan line. Based on these SAMPLE statistics, GAC acquisitions having sun angles of over 65° were eliminated from consideration as being night-pass data. Acquisitions which fell in areas where there were obviously no candidate LACIE segments, such as the Atlantic Ocean, were discovered by plotting the latitude and longitude coordinates of the four vertices on a large-scale map of the United States. (See figure 4-1.) In addition to screening out useless acquisitions, this procedure provided general information on the geographical areas covered by a particular GAC file (see the last column of table 3-1) and the location of the LACIE segment on the metsat image.

As an aid to locating candidate LACIE segments within the much larger GAC scene (a LACIE segment covers approximately 6 GAC pixels), 26 of the 51 SAMPLE points (every other one) listed for every 100th scan line were plotted and connected to represent a grid overlay of the GAC acquisition. (See figure 4-2.) Using the grid overlay, it was then possible to calculate from the latitude and longitude coordinates the pixel and scan line coordinates of the center points of each of the LACIE segments within the scene.

Metsat GAC data were reformatted and displayed on the Image Processing System in the Agena Building. Each GAC acquisition was examined for data quality using the following procedure, which was defined for (1) display and (2) location:

1. Display

    a. Log on to the Integrated Multivariate Data Analysis and Classification System (IMDACS), the appropriate computer software system.

    b. Histogram the data.

    c. Edit the initialization parameters to GAC specifications.

2. Location of candidate segments

    a. Use the cursor-selected (CS) pixel readout option to establish the general area of the segment center point.

    b. Magnify the area around the segment.

    c. Repeat step 2a.

A more detailed description of this procedure is provided in the appendix to this document.

The latitude/longitude coordinates of the four vertices can be determined from the SAMPLE printout, which looks something like this:

Scan Line Number* 145 Year 80 Day 199 . . . . . check=100†
Solar Zenith Angles
64.0000 63.0000 . . . . . .
Lat/Long

48.19/-75.77 48.16/-73.84 . . . . . 43.55/-43.16

Scan Line Number 245 Year 80 Day 199. . . . . check=200
Solar Zenith Angles
61.5000 . . . . . .
Lat/Long
45.30/-75.92. . . . . 40.86/-44.87
.
.
.

Scan Line . . . . . check=1000
Solar Zenith Angles
68.5000 . . . . . .
Lat/Long

25.16/-86.20 . . . . . 23.95/-55.68

The boxed latitude/longitude coordinates are the coordinates of the vertices unless two orbits are recorded within the same acquisition. In that case, the bottom of the first orbit is signaled by an abrupt break in the flow of latitude coordinates and sun angles.

⊙ Indicates a vertex.

* Not the actual scan line number.

† Indicates the actual scan line number to which the statistics apply.

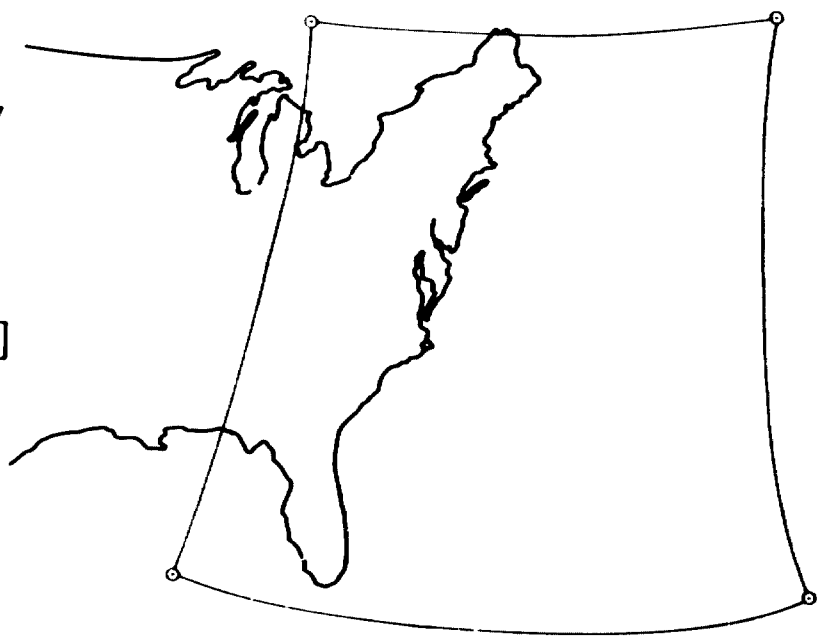

Figure 4-1.- Plot used to determine acquisitions covering areas other than LACIE segments.

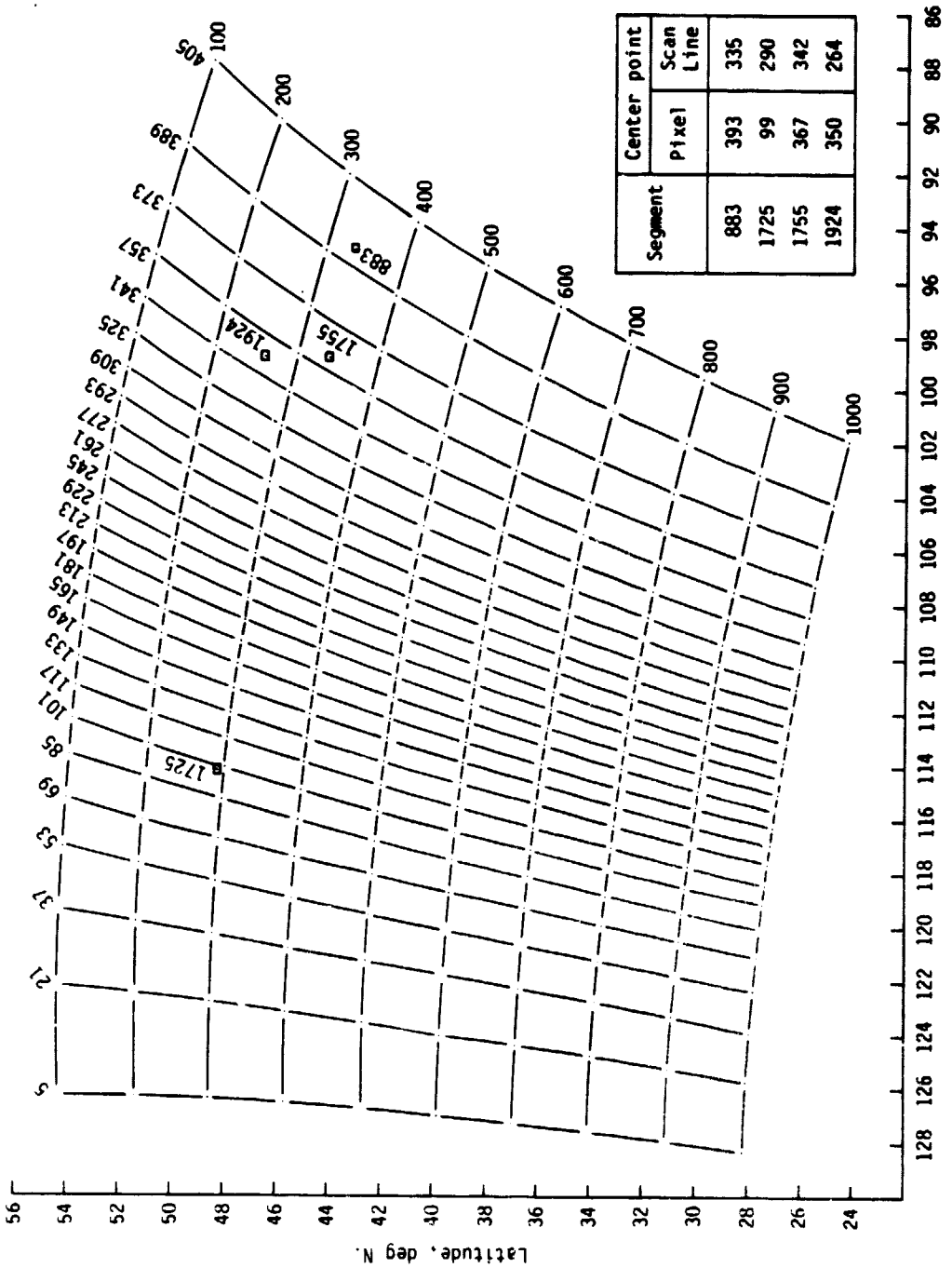


Figure 4-2.- Calculation of pixel and scan line scene coordinates from latitude and longitude positions for day 199, located on tape GAC010, file 4.

# 5. RECOMMENDATIONS

The following recommendations are made with respect to software programs, required data, and further analysis.

## 5.1 SOFTWARE

The following software programs available for use in the computer system in the Agena Building should be adapted for use with GAC data:

1. PIXCAL
2. SAMPLE

In addition to the above, a program that would provide grid overlays based on SAMPLE statistics similar to the present hand-drawn graphs would be extremely useful.

## 5.2 MATERIALS

The following materials should be ordered:

1. GAC data for 1977-79 covering the continental United States
2. GAC 1980 data for time periods other than Julian days 194 through 200

## 5.3 ANALYSIS

Further analysis should include the following:

1. A study of the information content of GAC data as compared to simulated GAC data, LAC data, and Landsat data
2. An examination of the validity of the GAC sampling technique
3. An examination of the potential of GAC over areas having larger-than-average field size (e.g., the U.S.S.R.)
4. A user search for other users of GAC data to examine other potential uses and methods for dealing with GAC data

## 6. REFERENCE

Austin, W. W.; and Ryland, W. E.: Simulation of Meteorological Satellite (Metsat) Data Using Landsat Data. Lockheed Engineering and Management Services Company, Inc., LEMSCO-16928. (To be published.)

# APPENDIX

# PROCEDURE FOR DISPLAYING GAC DATA

# APPENDIX

## PROCEDURE FOR DISPLAYING GAC DATA

The following is a detailed explanation of how to display GAC data using the IMDACS software available on the Crop Condition Analysis (CCA) System located in the Agena Building. After the preliminary procedures have been dealt with, the remaining explanation is presented as it appears on the terminal screen (with explanatory footnotes). User responses to computer queries are delineated by a preceding ">" symbol and are underlined.

1. Preliminary procedures

   a. Log on to the terminal.

   b. Mount the Universal-formatted version of the GAC tape to be viewed.

   c. Enter IMDACS by typing:

      > IMDACS
      > (password)
      > (name)
      > (organization)
      > (location; i.e., room number)

2. Actual display

```
ENTER PROCESSOR SELECTION
  LOA = LOAD PROCESSOR
  IMG = IMAGE DISPLAY AND FIELD DEFINITION PROCESSOR
  STS = SIGNATURE STATISTICS PROCESSOR
  CLS = MAXIMUM LIKELIHOOD CLASSIFICATION PROCESSOR
  CLU = ADAPTIVE / ITERATIVE CLUSTERING PROCESSOR
  CSR = CLUSTER / SUBCLASS / SIGNATURE RELABELING PROCESSOR
  IVN = IMAGE VEGETATION INDEX NUMBER PROCESSOR
  GCO = GRID CELL OVERLAY PROCESSOR
  RID = RAPID IMAGE DISPLAY PROCESSOR
  EXT = EXIT
>
IMG
ENTER IMAGE FILE INPUT DEVICE
  MT = MAG TAPE                          DP = DISK
>
MT
ENTER INPUT TAPE UNIT AND FILE NUMBERS  ( X,Y )
>
1,8
```

```
                    *  IMAGERY DATA HEADER  *
SENSOR ID                    SITE ID                          0
NO. OF CHANNELS                    4  NO. VIDEO ELEMENTS PER SCAN      409
START PIXEL                        1  STOP PIXEL                       409
ACQUISITION DATE        0=UNK= 0  ACQUISITION TIME          0: 0: 0
ACQ DATE   66536.                  0.                0.                0.
* I101: UNABLE TO CONVERT LATITUDE AND LONGITUDE
                         ACTIVE CHANNEL LIST
 1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
 1  1  1  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
                    ASSIGNED COLOR BIAS AND GAIN
CHANNELS    BIAS     GAIN     BIAS     GAIN     BIAS     GAIN     BIAS     GAIN
 1- 4        0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0
 5- 8        0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0
 9-12        0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0
13-16        0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0
17-20        0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0
21-24        0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0
1ST SCAN LINE                      1
ENTER FILE VERIFICATION CODE
  AC = ACCEPT                      RE = REDEFINE
>
AC
** IMAGE MANAGEMENT INITIALIZATION IN PROGRESS **

ENTER IMAGE PROCESSOR FUNCTION SELECTION OR FIXED FUNCTION
HI=HISTOGRAM              EX=EXIT PROCESSOR          GA=GENERAL INFORMATION
DI=DISPLAY                MC=MASTER CLEAR DISPLAY    DF=DEFINE FIELD
HD=HISTOGRAM-DISPLAY      AC=ACTIVATE IMAGE          DE=DELETE FIELD
DC=DISPLAY CLASS MAP      RI=RELEASE IMAGE           OF=SINGLE FIELD OVERLAY
SW=SWAP IMAGES            LI=LIST IMAGE DIRECTORY    LF=LIST FIELD DIRECTORY
PA=PIXEL ANALYSIS         OI=OFFLOAD IMAGE TO TAPE   LR=LIST FIELD REPORT
IA=IMAGE ANALYSIS         CF=CHANGE FIELD FILE       LA=LIST ALL FIELDS RPT.
GD=GRID CELL DISPLAY      DU=DISPLAY UTILITIES       RL=RELABEL FIELD(S)
                            FIXED FUNCTIONS
AB=DISPLAY 4 BIOSTAGES    CC=COLOR CHART DISPLAY     AF=ALL FIELDS OVERLAY
                          FC=FALSE COLOR CHART
>
ND
ENTER PARAMETER INITIALIZATION OPTION
  DEF = DEFAULT TO FILE INITIALIZATION PARAMETER BLOCKS
  EDT = EDIT FILE INITIALIZATION PARAMETER BLOCKS
  EDC = EDIT DATA CONTROL PARAMETER BLOCK ONLY
  EID = EDIT IMAGE DISPLAY PARAMETER BLOCK ONLY
  EIE = EDIT IMAGE ENHANCEMENT PARAMETER BLOCK ONLY
>
EDT
```

NOTE: The framed error message appears automatically for all files on all GAC tapes; however, the fact that the latitude and longitude coordinates cannot be converted does not appear to present a serious problem.

```
                    *    DATA CONTROL PARAMETERS    *
CODE PARAMETER                                                    VALUE
  1  DISPLAY START SCAN LINE                                        1
  2  DISPLAY STOP SCAN LINE                                       117
  3  HISTOGRAM START SCAN LINE                                      1
  4  HISTOGRAM STOP SCAN LINE                                     117
  5  TRANSFER START SCAN LINE                                       1
  6  TRANSFER STOP SCAN LINE                                      117
  7  TRANSFER SKIP SCAN FACTOR                                      1
  8  HISTOGRAM-DISPLAY START PIXEL                                  1
  9  HISTOGRAM-DISPLAY NUMBER OF PIXELS                           196
 10  DISPLAY IMAGE SIZE   N=NORMAL                                  N
                          C=COMPRESSED
                          Z=ZOOMED
 11  HORIZONTAL FACTOR    1 - 100                                   1
 12  VERTICAL FACTOR      1 - 100                                   1
ENTER CODE 99 TO ACCEPT PARAMETER VALUES DISPLAYED OR
ENTER CHANGE(S) IN FORMAT : CODE=VALUE,CODE=VALUE,...,CODE=VALUE
>
9=409,6=1400,5=1000,1=1000,4=1400,2=1400,1=1000
                    *    DATA CONTROL PARAMETERS    *
CODE PARAMETER                                                    VALUE
  1  DISPLAY START SCAN LINE                                     1000
  2  DISPLAY STOP SCAN LINE                                      1400
  3  HISTOGRAM START SCAN LINE                                   1000
  4  HISTOGRAM STOP SCAN LINE                                    1400
  5  TRANSFER START SCAN LINE                                    1000
  6  TRANSFER STOP SCAN LINE                                     1400
  7  TRANSFER SKIP SCAN FACTOR                                      1
  8  HISTOGRAM-DISPLAY START PIXEL                                  1
  9  HISTOGRAM-DISPLAY NUMBER OF PIXELS                           409
 10  DISPLAY IMAGE SIZE   N=NORMAL                                  N
                          C=COMPRESSED
                          Z=ZOOMED
 11  HORIZONTAL FACTOR    1 - 100                                   1
 12  VERTICAL FACTOR      1 - 100                                   1
ENTER CODE 99 TO ACCEPT PARAMETER VALUES DISPLAYED OR
ENTER CHANGE(S) IN FORMAT : CODE=VALUE,CODE=VALUE,...,CODE=VALUE
>
99
```

NOTE: The framed changes refer to the size of the GAC image to be displayed. Each acquisition is 409 pixels across. Start and stop scan lines depend upon the particular portion of the scene to be viewed and were determined from the grid overlay graph. (See figure 4-2.)

```
                    *    IMAGE DISPLAY PARAMETERS    *
CODE PARAMETER                      OPTION/VALUE RANGE                VALUE
 31  DISPLAY MODE                   C=3 CHANNEL COMPOSITE COLOR         C
                                    B=1 CHANNEL BLACK AND WHITE
 32  DISPLAY MONITOR                P=PRIMARY       S=SECONDARY         P
 33  OUTPUT MODE                    P=PAINT         S=SCROLL            P
 34  OUTPUT FROM                    B=BOTTOM        T=TOP               T
 35  OUTPUT FROM                    L=LEFT          R=RIGHT             L
 36  IMAGE DISPLAY AREA             0=FULL SCREEN                       0
                                    1=TOP HALF      2=BOTTOM HALF
                                    3=LEFT HALF     4=RIGHT HALF
                                    5=QUADRANT 1    6=QUADRANT 2
                                    7=QUADRANT 3    8=QUADRANT 4
 37  CHANNEL ASSIGNED RED           1 - 24                              4
 38  CHANNEL ASSIGNED BLUE          1 - 24                              1
 39  CHANNEL ASSIGNED GREEN         1 - 24                              2
 40  CHANNEL ASSIGNED BLACK/WHITE   1 - 24                              3
ENTER CODE 99 TO ACCEPT PARAMETER VALUES DISPLAYED OR
ENTER CHANGE(S) IN FORMAT : CODE=VALUE,CODE=VALUE,...,CODE=VALUE
>
37=2,39=1
                    *    IMAGE DISPLAY PARAMETERS    *
CODE PARAMETER                      OPTION/VALUE RANGE                VALUE
 31  DISPLAY MODE                   C=3 CHANNEL COMPOSITE COLOR         C
                                    B=1 CHANNEL BLACK AND WHITE
 32  DISPLAY MONITOR                P=PRIMARY       S=SECONDARY         P
 33  OUTPUT MODE                    P=PAINT         S=SCROLL            P
 34  OUTPUT FROM                    B=BOTTOM        T=TOP               T
 35  OUTPUT FROM                    L=LEFT          R=RIGHT             L
 36  IMAGE DISPLAY AREA             0=FULL SCREEN                       0
                                    1=TOP HALF      2=BOTTOM HALF
                                    3=LEFT HALF     4=RIGHT HALF
                                    5=QUADRANT 1    6=QUADRANT 2
                                    7=QUADRANT 3    8=QUADRANT 4
 37  CHANNEL ASSIGNED RED           1 - 24                              2
 38  CHANNEL ASSIGNED BLUE          1 - 24                              1
 39  CHANNEL ASSIGNED GREEN         1 - 24                              1
 40  CHANNEL ASSIGNED BLACK/WHITE   1 - 24                              3
ENTER CODE 99 TO ACCEPT PARAMETER VALUES DISPLAYED OR
ENTER CHANGE(S) IN FORMAT : CODE=VALUE,CODE=VALUE,...,CODE=VALUE
>
99
```

NOTE: The framed step assigns colors to the two reflective channels. The emissive channels, 3 and 4, were not studied.

```
                    *    IMAGE ENHANCEMENT PARAMETERS    *
CODE PARAMETER                                                    VALUE
 61  ENHANCEMENT    0=RAW DATA DISPLAY      1=NON-LINEAR STRETCH      2
                    2=LINEAR STRETCH BIAS/GAIN COMPUTED
                    3=LINEAR STRETCH BIAS/GAIN FROM HEADER
                    4=LINEAR STRETCH BIAS/GAIN INPUT
                    5=FALSE COLOR
 62  BIAS-RED                    0.0   63  GAIN-RED                  0.0
 64  BIAS-BLUE                   0.0   65  GAIN-BLUE                 0.0
 66  BIAS-GREEN                  0.0   67  GAIN-GREEN                0.0
 68  LO-DISCARD PERCENT RED      0.00  69  HI-DISCARD PERCENT RED    0.00
 70  LO-DISCARD PERCENT BLUE     0.00  71  HI-DISCARD PERCENT BLUE   0.00
 72  LO-DISCARD PERCENT GREEN    0.00  73  HI-DISCARD PERCENT GREEN  0.00
 74  BIAS-BLACK AND WHITE        0.0   75  GAIN-BLACK AND WHITE      0.0
 76  LO-DISCARD PERCENT B/W      0.00  77  HI-DISCARD PERCENT B/W    0.00
 78  LO-DISCARD PERCENT ALL      0.00  79  HI-DISCARD PERCENT ALL    0.00
 80  RADIOMETRIC CONVERSION TABLE PRINT OPTION  Y=YES  N=NO           N
ENTER CODE 99 TO ACCEPT PARAMETER VALUES DISPLAYED OR
ENTER CHANGE(S) IN FORMAT : CODE=VALUE,CODE=VALUE,....,CODE=VALUE
>
99
                    *    DYNAMIC COMMAND SET    *
HA = HALT PROCESSING                ZO = ZOOM IMAGE
GO = RESUME PROCESSING              CO = COMPRESS IMAGE
SC = SET COLOR (ON-OFF) SWITCHES    SG = SET GRAPHICS (ON-OFF) SWITCHES
CI = CLEAR IMAGE MEMORY             CG = CLEAR OVERLAY GRAPHICS MEMORY
CF = CHANGE FUNCTIONS
PROCESSING INTERRUPTED ON SCAN LINE     1
ENTER COMMAND
GO
```

NOTE: The image should appear at the point enclosed in a frame. There is normally about a 20-minute delay working from tape.

3. Location

```
                    *    DYNAMIC COMMAND SET    *
HA = HALT PROCESSING                ZO = ZOOM IMAGE
GO = RESUME PROCESSING              CO = COMPRESS IMAGE
SC = SET COLOR (ON-OFF) SWITCHES    SG = SET GRAPHICS (ON-OFF) SWITCHES
CI = CLEAR IMAGE MEMORY             CG = CLEAR OVERLAY GRAPHICS MEMORY
CF = CHANGE FUNCTIONS
END OF RUN - LAST SCAN PROCESSED IS  710
PROCESSING INTERRUPTED ON SCAN LINE  710
ENTER COMMAND
CF
ENTER IMAGE PROCESSOR FUNCTION SELECTION OR FIXED FUNCTION
HI=HISTOGRAM            EX=EXIT PROCESSOR        GA=GENERAL INFORMATION
DI=DISPLAY              MC=MASTER CLEAR DISPLAY  DE=DEFINE FIELD
HD=HISTOGRAM-DISPLAY    AC=ACTIVATE IMAGE        DE=DELETE FIELD
DC=DISPLAY CLASS MAP    RI=RELEASE IMAGE         OF=SINGLE FIELD OVERLAY
SW=SWAP IMAGES          LI=LIST IMAGE DIRECTORY  LF=LIST FIELD DIRECTORY
PA=PIXEL ANALYSIS       OI=OFFLOAD IMAGE TO TAPE LR=LIST FIELD REPORT
IA=IMAGE ANALYSIS       CF=CHANGE FIELD FILE     LA=LIST ALL FIELDS RPT.
GD=GRID CELL DISPLAY    DU=DISPLAY UTILITIES     RL=RELABEL FIELD(S)
                          FIXED FUNCTIONS
AB=DISPLAY 4 BIOSTAGES  CC=COLOR CHART DISPLAY   AF=ALL FIELDS OVERLAY
                        FC=FALSE COLOR CHART
>
PA
```

**ORIGINAL PAGE IS OF POOR QUALITY**

```
ENTER PIXEL ANALYSIS FUNCTION
  CP = CENTER POINT DISPLAY
  CS = CURSOR SELECTED PIXEL READ-OUT
  DS = DIGITAL SPECIFICATION PIXEL READ-OUT
  CL = CURSOR SELECTED PIXEL CONVERSION TO LATITUDE/LONGITUDE READ-OUT
  DL = DIGITAL SPECIFICATION CONVERSION TO LATITUDE/LONGITUDE READ-OUT
  IP = INTENSITY PLOT OF PIXELS BETWEEN SELECTED END POINTS
>
CS
PIXEL IDENTIFICATION INSTRUCTIONS
  (1) POSITION CURSOR TO PIXEL TO BE IDENTIFIED
  (2) DEPRESS OPERATOR INTERRUPT BUTTON 'A' TO RETRIEVE PIXEL
  (3) REPEAT STEPS 1 AND 2 FOR SUCCESSIVE POINTS
  (4) DEPRESS OPERATOR INTERRUPT BUTTON 'B' WHEN FINISHED
PIXEL READ/OUT FOR COLOR IMAGE
   DISPLAY      IMAGE              INTENSITY          CENTER PIXEL
    X    Y   PIXEL  SCAN    RED  BLUE  GREEN  LATITUDE   LONGITUDE
  198  230    199   481     17     6      6  180.000N   180.000E
PIXEL READ/OUT FOR COLOR IMAGE
   DISPLAY      IMAGE              INTENSITY          CENTER PIXEL
    X    Y   PIXEL  SCAN    RED  BLUE  GREEN  LATITUDE   LONGITUDE
  199  230    200   481     17     6      6  180.000N   180.000E
PIXEL READ/OUT FOR COLOR IMAGE
   DISPLAY      IMAGE              INTENSITY          CENTER PIXEL
    X    Y   PIXEL  SCAN    RED  BLUE  GREEN  LATITUDE   LONGITUDE
  199  231    200   480     18     6      6  180.000N   180.000E
```

These are the approximate coordinates of the LACIE segment center point within the displayed scene.

```
ENTER IMAGE PROCESSOR FUNCTION SELECTION OR FIXED FUNCTION
HI=HISTOGRAM              EX=EXIT PROCESSOR          GA=GENERAL INFORMATION
DI=DISPLAY                MC=MASTER CLEAR DISPLAY    DF=DEFINE FIELD
HD=HISTOGRAM-DISPLAY      AC=ACTIVATE IMAGE          DE=DELETE FIELD
DC=DISPLAY CLASS MAP      RI=RELEASE IMAGE           OF=SINGLE FIELD OVERLAY
SW=SWAP IMAGES            LI=LIST IMAGE DIRECTORY    LF=LIST FIELD DIRECTORY
PA=PIXEL ANALYSIS         OI=OFFLOAD IMAGE TO TAPE   LR=LIST FIELD REPORT
IA=IMAGE ANALYSIS         CF=CHANGE FIELD FILE       LA=LIST ALL FIELDS RPT.
GD=GRID CELL DISPLAY      DU=DISPLAY UTILITIES       RL=RELABEL FIELD(S)
                            FIXED FUNCTIONS
AB=DISPLAY 4 BIOSTAGES    CC=COLOR CHART DISPLAY     AF=ALL FIELDS OVERLAY
                          FC=FALSE COLOR CHART
>
IA
```

**ORIGINAL PAGE IS OF POOR QUALITY**

```
ENTER IMAGE CHANNEL MANIPULATION FUNCTION
SUM = PIXEL-BY-PIXEL SUMMATION OF DISPLAY CHANNELS
DIF = PIXEL-BY-PIXEL DIFFERENCING OF DISPLAY CHANNELS
MUL = PIXEL-BY-PIXEL MULTIPLICATION OF ANY TWO DISPLAY CHANNELS
DIV = PIXEL-BY-PIXEL DIVISION OF ANY TWO DISPLAY CHANNELS
LOG = APPLY LOGRITHMICALLY SHAPED INTENSITY MAPPING
EXP = APPLY EXPONENTIALLY SHAPED INTENSITY MAPPING
LIN = LINEAR MAPPING FROM USER SUPPLIED BREAKPOINTS
TLM = LINEAR MAPPING FROM TRACKBALL POSITION
KAR = KARHUNEN-LOEUVE TRANSFORMATION OF THE SPECTRAL CHANNELS
ZOM = ZOOM IMAGE ABOUT TRACKBALL CONTROLLED CURSOR POSITION
FLK = ALTERNATELY DISPLAY TWO IMAGES AT BUTTON SELECTED RATE
>
ZOM
INSTRUCTIONS FOR HARDWARE ZOOM
  (1) POSITION CURSOR TO AREA OF INTEREST
  (2) DEPRESS BUTTONS AS FOLLOWS:
      .BUTTON A = ACTIVATE ZOOM ABOUT CURSOR IN BUTTON MODE
      .BUTTON B = ACTIVATE ZOOM ABOUT CURSOR IN TRACKBALL MODE
      .BUTTON C = INCREASE MAGNIFICATION BY FACTOR OF 2(MAX=8)
      .BUTTON D = DECREASE MAGNIFICATION BY FACTOR OF 2(MIN=1)
      .COMBINATION OF ANY TWO BUTTONS = RETURN TO PROCESSOR MENU
```

NOTE: A magnification factor of 4 is usually the optimum choice for this procedure.

```
ENTER IMAGE PROCESSOR FUNCTION SELECTION OR FIXED FUNCTION
HI=HISTOGRAM          EX=EXIT PROCESSOR       GA=GENERAL INFORMATION
DI=DISPLAY            MC=MASTER CLEAR DISPLAY DF=DEFINE FIELD
HD=HISTOGRAM-DISPLAY  AC=ACTIVATE IMAGE       DE=DELETE FIELD
DC=DISPLAY CLASS MAP  RI=RELEASE IMAGE        OF=SINGLE FIELD OVERLAY
SW=SWAP IMAGES        LI=LIST IMAGE DIRECTORY LF=LIST FIELD DIRECTORY
PA=PIXEL ANALYSIS     OI=OFFLOAD IMAGE TO TAPE LR=LIST FIELD REPORT
IA=IMAGE ANALYSIS     CF=CHANGE FIELD FILE    LA=LIST ALL FIELDS RPT.
GD=GRID CELL DISPLAY  DU=DISPLAY UTILITIES    RL=RELABEL FIELD(S)
                        FIXED FUNCTIONS
AB=DISPLAY 4 BIOSTAGES CC=COLOR CHART DISPLAY AF=ALL FIELDS OVERLAY
                       FC=FALSE COLOR CHART
>
PA
ENTER PIXEL ANALYSIS FUNCTION
  CP = CENTER POINT DISPLAY
  CS = CURSOR SELECTED PIXEL READ-OUT
  DS = DIGITAL SPECIFICATION PIXEL READ-OUT
  CL = CURSOR SELECTED PIXEL CONVERSION TO LATITUDE/LONGITUDE READ-OUT
  DL = DIGITAL SPECIFICATION CONVERSION TO LATITUDE/LONGITUDE READ-OUT
  IP = INTENSITY PLOT OF PIXELS BETWEEN SELECTED END POINTS
>
CS
PIXEL IDENTIFICATION INSTRUCTIONS
  (1) POSITION CURSOR TO PIXEL TO BE IDENTIFIED
  (2) DEPRESS OPERATOR INTERRUPT BUTTON 'A' TO RETRIEVE PIXEL
  (3) REPEAT STEPS 1 AND 2 FOR SUCCESSIVE POINTS
  (4) DEPRESS OPERATOR INTERRUPT BUTTON 'B' WHEN FINISHED
```

PIXEL READ/OUT FOR COLOR IMAGE

| DISPLAY X | DISPLAY Y | IMAGE PIXEL | IMAGE SCAN | INTENSITY RED | INTENSITY BLUE | INTENSITY GREEN | CENTER PIXEL LATITUDE | CENTER PIXEL LONGITUDE |
|---|---|---|---|---|---|---|---|---|
| 197 | 230 | 198 | 481 | 17 | 6 | 6 | 180.000N | 180.000E |

PIXEL READ/OUT FOR COLOR IMAGE

| DISPLAY X | DISPLAY Y | IMAGE PIXEL | IMAGE SCAN | INTENSITY RED | INTENSITY BLUE | INTENSITY GREEN | CENTER PIXEL LATITUDE | CENTER PIXEL LONGITUDE |
|---|---|---|---|---|---|---|---|---|
| 198 | 231 | 199 | 480 | 18 | 6 | 6 | 180.000N | 180.000E |

PIXEL READ/OUT FOR COLOR IMAGE

| DISPLAY X | DISPLAY Y | IMAGE PIXEL | IMAGE SCAN | INTENSITY RED | INTENSITY BLUE | INTENSITY GREEN | CENTER PIXEL LATITUDE | CENTER PIXEL LONGITUDE |
|---|---|---|---|---|---|---|---|---|
| 199 | 231 | 200 | 480 | 18 | 6 | 6 | 180.000N | 180.000E |

At this point the scene has been magnified, and the center point of the segment of interest has been located. Nearby pixels were then examined, and the data quality of the scene was recorded. (See the last column in table 2-1.)



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