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LANDSAT 5 (L5) INTERNATIONAL GROUND STATION (IGS) OPERATIONS PROCEDURES FOR ACQUISITION OF DATA TO POPULATE THE UNITED STATES LANDSAT DATA ARCHIVE

Version 1

February 2004

USGS
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LANDSAT 5 (L5) INTERNATIONAL GROUND STATION (IGS) OPERATIONS PROCEDURES FOR ACQUISITION OF DATA TO POPULATE THE UNITED STATES LANDSAT DATA ARCHIVE

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Executive Summary

The purpose of this document is to define and describe the procedures used to acquire, ship, ingest, transcribe, archive, and process Landsat 5 (L5) data downlinked to International Ground Stations (IGSs) in support of U.S. Geological Survey (USGS) archive population.

This document is under the configuration management of the Landsat Configuration Control Board (LCCB). Submit all Configuration Change Requests (CCRs) to this document, along with supportive material justifying the proposed change, to the LCCB.

Keywords: IGS, USGS, DCPF, Landsat 5, L5, Tape Shipment, Operations Procedure, International Ground Station, Archive, Capture

Document Change Summary

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Section 1 Introduction

1.1 Purpose

This document defines and describes the procedures used to acquire, ship, ingest, transcribe, archive, and process Landsat 5 (L5) data downlinked to International Ground Stations (IGSs) in support of U.S. Geological Survey (USGS) archive population.

This document uses “DCPF (Data Capture and Processing Facility)” or “USGS/EDC (Earth Resources Observation System (EROS) Data Center)”, and “IGS” to denote which organization is responsible for executing specific tasks in support of the operations described herein.

1.2 Overview

In light of the Landsat 7 (L7) Scan Line Corrector (SLC) Anomaly in May 2003, a number of IGS operators have expressed interest in acquiring L5 to supplement their L7 acquisitions. This document outlines the procedures the IGSs and the USGS/EDC follow when an IGS provides L5 data to the USGS/EDC for population of the U.S. Landsat archive. These requirements are in addition to those specified for IGS reception of L5 data as detailed in the International Ground Station ICD (LS-ICD-41).

Data are captured by the IGSs in Raw Computer Compatible (RCC) format and sent to USGS/EDC for ingest and archival. Following archival, the data are made available using existing USGS/EDC search and order capabilities for L5 data.

1.3 Data Policy

Data acquired under this procedure are used to populate the USGS national Landsat archive for redistribution. There are no restrictions imposed on data redistributed by the USGS or specific attribution requirements.

Section 2 Data Flow Overview

2.1 Dataflow

Figure 2-1 shows the data flow for IGS L5 operations. The International Ground Station ICD (LS-ICD-41) details the planning and scheduling of L5 downlinks to the IGSs.

For data to be sent to the USGS/EDC, the raw downlink (D/L) data stream is captured by the IGS and copied to a Digital Linear Tape (DLT) in RCC format. A backup tape or backup file is also generated at this point. Data are accumulated on a tape for shipping to USGS/EDC approximately twice per week. Before shipping, a tape manifest is generated that describes the contents of each tape shipped. The tape manifest is sent via e-mail to USGS/EDC before shipping, and enclosed with the tape shipment in hardcopy format.

Data on the DLT are processed to Level 0 (L0) using the Landsat Archive Conversion System (LACS). Both the raw data and L0 archive (L0a) data are stored in the Landsat Archive Management System (LAM).

As part of the L0 processing stream, browse and metadata are generated for each scene and are stored in the Landsat database on the Distributed Ordering, Research, Reporting, and Accounting Network (DORRAN). These statistics are also entered into the [Landsat] Mission Management Office (MMO) Database System (MDS) to enable comparison between scheduled and acquired scenes, and generation of performance statistics.

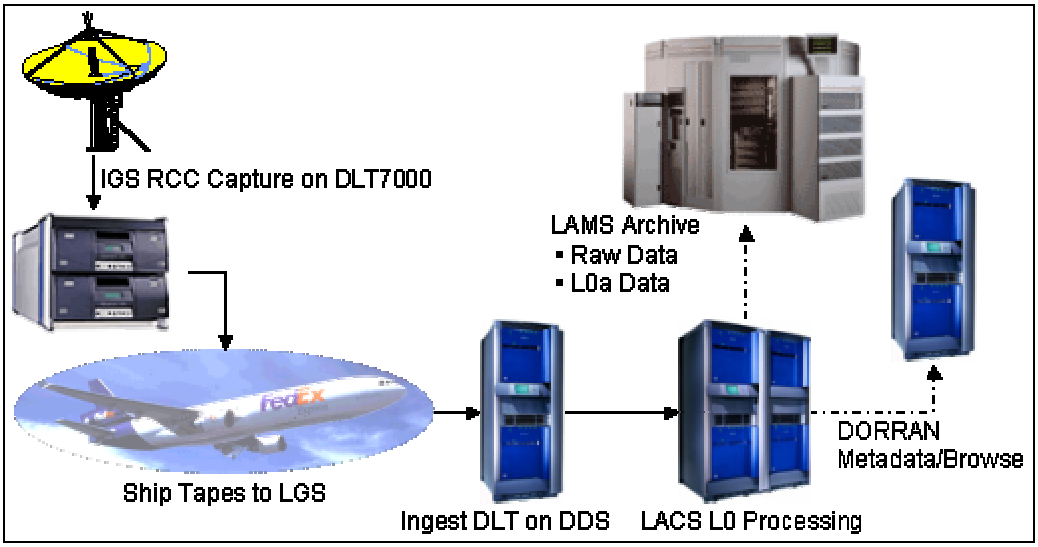

Figure 2-1. IGS Operations Data Flow

Once a DLT is successfully ingested and archived, it is sent back to the IGS. This also serves as an indication that the backup tape or file can be deleted or released for other purposes.

2.2 MMO Database System

The L5 Mission Operations Center (MOC) generates a weekly list of scenes scheduled for D/L when the Command (CMD) load is generated (typically 24 hours before the first D/L event for the week). This information is sent to USGS/EDC via e-mail (ftp in the future) and is used to populate the MMO database. Scheduled scenes are compared with received (and successfully processed) scenes to generate performance statistics and track archive population. The MDS is also used to support anomaly resolution and investigations.

2.3 Station Certification

Before a station provides data for the USGS national archive, it must be certified as providing valid data, and must have an acceptable performance for data capture (including both technical and logistical performance).

Appendix A details the procedures for this certification process.

Section 3 IGS Data Capture and Tape Shipment

3.1 Data Capture

The D/L datastream shall be captured by the IGS and transcribed onto a DLT tape, in a format compliant with the TM RCC Data Format Control Book (DFCB), for shipment to USGS/EDC. The IGS shall also generate a backup tape or file at this time. The backup tape or file shall be stored until the original tape is received back by the IGS (which indicates successful ingest and processing, enabling the backup to be released).

3.2 Data Quality Analysis (QA) and Quality Control (QC)

The IGS shall provide and use a means to verify the quality of the acquired D/L datastream (i.e., moving window display, DataScope, data detector, etc.) to ensure that good data are sent to USGS/EDC, as well as to aid in troubleshooting as required. If any data quality problems are encountered during D/L acquisition, the IGS will make notes in the tape manifest before sending the data to USGS/EDC.

3.3 Data Backup

Each station shall maintain a backup copy of acquired data, either as a DLT backup copy made during acquisition, or as a file backup that can be used to regenerate a copy of the acquired data upon request. The backup copy will be used to mitigate problems with shipping or ingest at EDC.

3.4 Tape Shipping Operations

3.4.1 Receiving DLT Tapes from the IGS

3.4.1.1 Shipping Vendor

The IGS will use the most effective means for shipping DLT tapes to the EDC as is possible at the time of shipment. Once a shipping method is established, it will only be changed due to significant performance issues.

3.4.1.2 Prior to Shipping

Before shipping a DLT data tape, the IGS completes the L5 Tape Shipment Manifest Report and e-mails the report and shipping tracking number to the DCPF Operations processing staff at `dhfops@usgs.gov`. DCPF Operations staff uses these manifests to track DLT tapes during shipment. Figure 3-1 provides an example of the L5 Tape Shipment Manifest Report.

3.4.1.3 Shipping DLTs

The IGS includes a hard copy of the L5 Tape Shipment Manifest Report with each DLT tape shipped to the DCPF.

3.4.1.4 DCPF Shipping Address

The IGS sends tapes to the following DCPF address:

USGS/EROS Data Center
Attn: DCPF Landsat Operations
Room #1505
Mundt Federal Building
47914 252nd Street
Sioux Falls, SD 57198
USA
605-594-2533

3.4.1.5 Receiving DLTs

When a DLT tape arrives at the DCPF, Operations staff unpacks the tape and stores it for a 24-hour period to allow the tape to acclimate to room temperature.

3.4.1.6 Logging Tapes

DCPF Operations staff logs the DLT tapes in a specified IGS Access Database and binder. Each log entry includes the date received and the tape identification (ID) number.

3.4.1.7 Manifest Reports

DCPF Operations staff makes a copy of the original L5 Tape Shipment Manifest Report and places the copy on a clipboard until processing begins. The staff files the original manifest in a folder for future reference.

3.4.1.8 Final Steps before Returning Tapes to the IGS

After the files from a DLT tape are successfully processed and archived by the LAM, the DCPF Operation staff returns the tape to the IGS (See 3.4.2).

3.4.1.9 Requesting Backup Tapes

Before shipping DLT tapes to DCPF, the IGS makes a backup copy of the original tape. If discrepancies arise between the data on the original DLT tape and the Mission MDS after processing, the DCPF staff requests the backup tape from the IGS for reprocessing. Before shipping the backup DLT, the IGS makes a second copy of the backup tape. If the results remain the same, DCPF staff generates an Anomaly Report (see 4.2 and 4.3), and then notifies the L5 MOC and the IGS.

3.4.1.10 Shipping Charges

Arrangements for shipping charges are defined in specific agreements between an IGS and the Landsat Project. Typically, the IGS shall be responsible for payment of shipping and other charges to send tapes to USGS/EDC, and the USGS shall pay to ship tapes back to the IGS.

3.4.2 Returning DLT Tapes to the IGS

3.4.2.1 Information Collected during Processing

DCPF Operations staff monitors the processing operations and completes a log of processing statistics and pertinent information for future reference and anomaly resolution.

3.4.2.2 Manifest Returned to IGS

DCPF Operations staff places a copy of the L5 Tape Shipment Manifest Report with the appropriate tape and packages it in the received boxes.

3.4.2.3 Shipping Forms

DCPF Operations staff completes shipping forms addressed to the IGS. The Operations staff provides all tapes to the EDC Dissemination department to ship to the IGS.

3.4.2.4 Shipping Address

DCPF Operations staff sends tapes to the current IGS addresses maintained in the L5 MOC IGS database.

3.4.2.5 Shipping Charges

Arrangements for shipping charges are defined in specific agreements between an IGS and the Landsat Project. Typically, the IGS shall be responsible for payment of shipping and other charges to send tapes to USGS/EDC, and the USGS shall pay to ship tapes back to the IGS.

3.4.3 Backup Tape Retention

3.4.3.1 Backup Tapes

Before shipping the original DLT to DCPF, the IGS makes a backup of the original tape and retains all backup tapes until DCPF returns the original. If the DCPF staff request the backup, the IGS makes a second copy of the backup before shipping. The DCPF returns all tapes successfully processed and archived.

3.4.3.2 Release of Backup Tapes

Backup tapes may be released for re-use only after the original DLT returns from the DCPF. If a backup tape was sent to the DCPF at their request, the second backup tape copy may be released for re-use only after the original DLT and the first backup tape returns from the DCPF.

3.4.4 Tape and Media Format

3.4.4.1 Acceptable Media

SuperDLT320 is preferred, but SuperDLT220, DLT7000, and DLT8000 media are also acceptable for use.

3.4.4.2 Acceptable Data Format

Each RCC data file must be written at an even increment of one megabyte. Each contact/pass must be written as separate Tape Archiver (TAR) files on the same DLT. No compression shall be used. The software package GNU TAR `1.13.25`, with the block size of 20 (default), shall be used to write the tapes.

For multi-Mission ground stations, each DLT tape sent to the DCPF must contain only data from a single Mission (*i.e.* – L7 and L5 data files shall not be mixed on a single DLT).

The L5 RCC data format is defined in the Landsat Thematic Mapper (TM) Raw Computer Compatible (RCC) Data Format Control Book (DFCB), (document number LS-DFCB-06).

Landsat 5 Tape Shipment Manifest

Number of Tapes		**Airway Bill Number**		**Shipping Date**
Total Packages				
Ground Station ID				

Tape ID:	Backup Tape	Orbit No.	File No.	Raw Data File Name	Activity Information	
					Description	Value
					X-Band AOS/LOS	
Comments:					Bit Sync # / Channel	
					X-Band AOS/LOS	
Comments:					Bit Sync # / Channel	
					X-Band AOS/LOS	
Comments:					Bit Sync # / Channel	
					X-Band AOS/LOS	
Comments:					Bit Sync # / Channel	
					X-Band AOS/LOS	
Comments:					Bit Sync # / Channel	
					X-Band AOS/LOS	
Comments:					Bit Sync # / Channel	
					X-Band AOS/LOS	
Comments:					Bit Sync # / Channel	

Figure 3-1. L5 Tape Shipment Manifest Report

Section 4 IGS Downtime and Anomaly Reporting

4.1 Downlink Coordination and Station Downtime

The IGS shall provide a minimum of 14 days notice for scheduled downtime (i.e., maintenance, etc.), and as much notice as possible for unscheduled downtime. This provides sufficient time for the downlink schedules to be adjusted accordingly.

4.2 Anomaly Reporting and Resolution

4.2.1 Overview

The IGS uses e-mail or tape manifests to report anomalies or problems at the IGS stations that result in data loss or the failure to capture data, as described below. Some of these may result in the DCPF generating the formal Anomaly Reports.

The DCPF uses Anomaly Reports to report problems during tape ingest at the USGS/EDC or the lack of expected.

Problems noted by the MOC during downlinks to the IGSs will be reported on Image Impact Reports. As appropriate, the MOC will transcribe the problems reported by the IGSs and the DCPF onto Image Impact Reports. These are sent out to a distribution list that includes the participating IGSs, mission management staff, DCPF staff, and the MOC staff.

4.2.2 Anomalies Discovered by the IGS During Downlink or Data Capture

Spacecraft anomalies detected by the IGS during a pass shall be reported by the IGS to the MOC via e-mail, with informational copies to the MMO and DCPF. Anomalies or station problems resulting in data loss (i.e., equipment failure, missed contact, etc.) shall be reported by the IGS in the tape manifest and to the DCPF via e-mail (with information copies to the MMO and MOC).

The DCPF generates a formal Anomaly Report (shown in Appendix C) for IGS data losses, or potential IGS data losses, based upon the information in the informational e-mail or on the tape manifest. The MOC uses the Anomaly Report as a basis for generating an Image Impact Report, as appropriate.

In the case of equipment problems, the IGS shall also generate a local equipment failure report or equivalent for tracking the problem. A copy of this report shall be sent to the DCPF and MMO, with an informational copy to the MOC.

4.2.3 Anomalies Discovered by the DCPF During Ingest or Processing

If data anomalies are discovered during processing (i.e., missing scenes, scenes with low image quality, etc.), the DCPF generates an Anomaly Report detailing the nature of the problem and the expected or true number of scenes lost. This may be adjusted in a later revision to the Anomaly Report if the number of lost scenes changes (i.e., data recovered from a backup tape, data reprocessed).

Data loss from DCPF equipment or processing problems will also be reported via an Anomaly Report.

4.2.4 Anomalies Reported by the MOC or Mission Management

The MOC shall provide e-mail notification to the IGS, DCPF, and MMO in the event of a spacecraft anomaly discovered by the MOC (i.e., scheduling problem, transmitter thermal shutdown). If the anomaly is expected to result in a data loss, the DCPF generates an Anomaly Report as appropriate.

The MOC shall also provide e-mail notifications to the IGS, DCPF, and MMO whenever non-standard conditions are present that may affect IGS data reception or acquisition.

4.3 Image Impact Reports

4.3.1 Image Impact Report Generation

Image Impact Reports are generated by the MOC based upon Anomaly Reports generated by the DCPF, IGS, and/or MOC, and sent to the MOC via e-mail.

4.3.2 Image Impact Report Format and Content

Appendix B shows the Image Impact Report format. The report describes the cause of the data loss, if known, or the symptom if the specific cause is not known. The report also identifies the number of scenes (path/rows) lost, as well as any corresponding failure reports related to the data loss.

4.3.3 Image Impact Report Revision

If scenes are recovered at a later date (i.e., from a backup tape), a revised Image Impact Report is generated describing the new data loss status.

Section 5 Level 0 Processing

5.1 Landsat Archive Conversion System (LACS) Data Flow

5.1.1 Ingest

Data are un-TAR-ed from DLT using the Data Distribution System (DDS) in USGS/EDC Computer Room 2. The data files are then transferred to the LACS for L0 processing.

5.1.2 L0 Processing

LACS processes the raw data to L0a format, and generates metadata and browse for each scene processed. LACS also interacts with the Landsat MDS to determine whether all scheduled (expected) scenes were received.

5.1.3 Archival of Raw and L0 Data

LACS sends the completed L0a and raw data files to the Landsat Archive Management System (LAM) for archival. Reprocessing and product generation requests are satisfied using data stored on the LAM.

5.2 Data QA/QC

LACS provides a Moving Window Display (MWD) to enable data Quality Assurance (QA) /Quality Control (QC) during L0 processing. Operations staff monitors the display to check for obvious data errors and dropped scan lines. Note that pixel noise typically is not visible due to the subsampling in the moving window display.

5.3 Data Backup

DLTs from the IGSs are retained at USGS/EDC until L0 processing (and archival) is successfully completed. If a problem is found during processing, the corresponding backup tape is requested from the IGS. The IGS retains the backup tape until the primary tape is received back for reuse.

5.4 Anomaly Reporting and Resolution

The DCPF uses an Anomaly Report to report discrepancies found between scheduled and ingested/processed data, as described in Section 4. Similarly, data losses or dropouts are also be reported.

Section 6 Database Population

6.1 Earth Explorer (EE) and Global Visualization Viewer (GloVis) Browse Population

Browse imagery generated during ingest and L0 processing are added to EE and GloVis using existing production data flows. Search and order capabilities are also available for IGS L5 scenes displayed in these systems using existing systems and current processes and procedures.

6.2 Production Database Population (Metadata)

Scene-level metadata are extracted from the data and generated during L0 processing by LACS using the current L5 processing flow. These metadata are used to populate the L5 production [metadata] database to allow search and order of archived L5 data [scenes].

6.3 IGS Station Flags

The `station_ID` metadata field is populated with the appropriate three-letter mnemonic for the source IGS. A new ingest routine is developed to automatically populate the `station_ID` metadata field based upon source IGS (extracted from the filename and/or manual `station_ID` data entry).

Search and order constraints based on the `station_ID` metadata field is available in EE using existing capabilities.

6.4 IGS Database Dumps

Dumps of metadata for a specific IGS are made available via ftp by specific arrangement with the MMO. A single TAR file containing both the metadata and corresponding browse images is generated on a case-by-case basis and placed on an ftp server for the IGS to download.

Section 7 Level 1 (L1) Production

7.1 L1 Production

L1 data products are generated using established procedures and processes for L5/TM data production. Users can order L1 products using Earth Explorer at:

http://edcsns17.cr.usgs.gov/EarthExplorer/

Additionally, some browse products are also visible using GloVis at:

http://glovis.usgs.gov/

Products are available for distribution on media (i.e., CD-ROM) or electronically (ftp). Standard polices for volume discounts and processing restrictions apply.

Appendix A – IGS Certification Plan

Overview

Before a station provides data for the USGS national archive, it must be certified as providing valid data and having an acceptable performance for data capture (including both technical and logistical performance).

Requirements

Five consecutive passes without data anomalies are required for a station to become certified. The MMO, which is responsible for managing the test in coordination with the MOC, selects these passes. Testing occurs with “real” L5 data from the satellite.

Pre-Certification Testing

An IGS may request test D/Ls in order to validate their systems and procedures before certification testing. Typically, five consecutive D/Ls are scheduled for this purpose, with additional passes handled on a case-by-case basis. The IGS shall submit a request for test D/Ls to the MMO at `smilek@usgs.gov`. The MMO will approve the request and inform the MOC and the IGS. After approval, these passes are coordinated directly between the MOC and the IGS, with informational distribution provided to the MMO and the DCPF.

Formal Certification Testing

To start the process, the IGS shall inform the MMO that it is ready for formal certification testing. At this point, the IGS should have all appropriate systems integrated, tested, and validated. Certification testing is Pass/Fail. A failure or anomaly on any one or more of the five certification passes “resets the clock” and a new series of five D/Ls is selected.

The MMO shall select five consecutive passes for certification testing. Since L5 only images on descending passes, the testing may take up to three days. The data from these certification passes shall be processed by the IGS using their operational system and shipped to USGS/EDC in an expedited fashion. The data will be processed, compared with the scheduled scenes, and any anomalies noted. Additionally, low scene quality scores will also be grounds for failing the certification test.

While the data are in transit or being validated at USGS/EDC, the IGS will not be considered certified, even if an independent validation of the data by the IGS is successful. However, data may continue to be acquired “speculatively” during the validation period, and subsequently ingested into the USGS national archive once the validation is successful. If the validation is unsuccessful, these passes may be applied towards a new round of certification testing if the IGS and MMO concur that the cause of the testing failure has been addressed. The entire chain shall be exercised during certification testing, from IGS D/L acquisition to USGS/EDC Landsat archive population.

A scene quality of 99, as determined by the L0 processing system, for all scheduled scenes and partials constitutes a successful acquisition. Any missing data (dropouts, missing scenes, short scenes, tape read issues, etc.) will cause the certification test to fail.

Re-Certification

If an IGS makes a significant change to their data acquisition or capture system (i.e., repair, replacement, or upgrade), an additional round of certification testing needs to be performed to validate the new equipment configuration.

Configuration Management

In order to assess changes in the IGS configuration that may affect data quality, the IGS shall provide notice to the MMO (along with informational distribution to the MOC and DCPF) whenever there is a significant change in the equipment complement or configuration. This allows the MMO to determine if re-certification testing is required.

Appendix B – Image Impact Report Format

Report Date:

Originator:

Contact Information:

Event:

Event Date:

Event Time:

Interruption Duration:

Information:

Comments:

Path/Rows Lost:

Appendix C – Anomaly Report Format

PGS Anomaly Report #*nn – IGS*

Report Date:

Originator:

Contact Information:

Events: *IGS* X-Medium data loss

Event Dates:

Event Times:

Description of Event:

Comments:

Orbit

Antenna

Path/Rows Lost:

(*nn* **Full Scenes Lost**)

Appendix D – Acronyms

AOS	Acquisition of Signal
CCR	Configuration Change Request
CD-ROM	Compact Disk – Read Only Memory
CMD	Command
CSC	Computer Sciences Corporation
D/L	Downlink
DCPF	Data Capture and Processing Facility
DDS	Data Distribution System
DFCB	Data Format Control Book
DLT	Digital Linear Tapes
DORRAN	Distributed Ordering, Research, Reporting, and Accounting Network
EDC	EROS Data Center
EE	Earth Explorer
EROS	Earth Resource Observation System
ftp	File transfer protocol
GloVis	Global Visualization Viewer
I	In-Phase Channel
ICD	Interface Control Document
ID	Identification
IGS	International Ground Station
L0	Level 0
L0a	Level 0 archive
L1	Level 1
L5	Landsat 5
L7	Landsat 7
LACS	Landsat Archive Conversion System
LAM	Landsat Archive Manager
LCCB	Landsat Configuration Control Board
LOS	Loss of Signal

MDS	MMO Database System
MMO	Mission Management Office
MOC	Mission Operations Center
MOC	Mission Operation Center
PD	Program Directive
QA	Quality Assurance or Quality Analysis
QC	Quality Control
RCC	Raw Computer Compatible
SAIC	Science Applications International Corporation
SLC	Scan Line Corrector
TAR	Tape Archiver
TM	Thematic Mapper
USGS	U.S. Geological Survey

References

The latest published version of these documents shall apply. They are available at:

http://landsat7.usgs.gov/igsdocsl5.php

LS-DFCB-06. Thematic Mapper (TM) Raw Computer Compatible (RCC) Data Format Control Book.

SVS-10126. Landsat D Data Format Control Book, Volume V (Payload).

LS-ICD-41. Landsat-5 International Ground Station Interface Control Document (ICD).