604-CD-002-003

EOSDIS Core System Project

Operations Concept for the ECS Project: Part 2B - ECS Release B

March 1996

Hughes Information Technology Systems
Upper Marlboro, Maryland

ECS Operations Concept for the ECS Project: Part 2B - ECS Release B

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SUBMITTED BY

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Preface

This document is a formal contract deliverable with an approval code 1. It requires Government review and approval prior to acceptance and use. This document is under ECS contractor configuration control. Once this document is approved, Contractor approved changes are handled in accordance with Class I and Class II change control requirements described in the EOS Configuration Management Plan, and changes to this document shall be made by document change notice (DCN) or by complete revision.

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Abstract

This is Part 2B of the ECS Operations Concept Document (OCD). The ECS OCD consists of a Part 1 which is a release independent ECS Overview and several Part 2s which are release specific. This volume - Part 2B - provides the operational concepts for ECS Release B.

This document provides an overview of the missions supported by Release B, a set of activity descriptions for the process performed by ECS, a description of ECS activities at each site, and several scenarios which span across ECS Sites.

Keywords: Operations, Scenarios, DAACs, SMC, Mission Support, Release B, Interfaces

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Abbreviations and Acronyms

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1. Introduction

1.1 Identification

This document is Part 2B of the ECS Operations Concept Document (OCD). It is submitted as required by Data Item Description (DID) 604/OP1 for the Earth Observing System Data and Information System (EOSDIS) Core System (ECS) Contract (NAS5-60000).

1.2. Scope

This OCD Part 2B document describes the Operations Concept for Release B of ECS. The OCD Part 2s are Release and site specific for each Release and are separately identified as OCD Part 2A for Release A, OCD Part 2B for Release B, etc.

This document reflects the February 14, 1996 Technical Baseline, maintained by the Contracts Configuration Control Board in accordance with ECS Technical Direction No. 11 dated December 6, 1994. It is anticipated that GSFC's contractual compliance documentation will be revised to be consistent with the Technical Baseline.

This document provides the operations concept for the science data processing and system management activities of ECS Release B. These activities are performed at the DAACs and SMC. Operations concepts for the Flight Operations performed at the EOC can be found in the Flight Operations Segment (FOS) Operations Concept for the ECS Project Volume 2 document, 604-CD-004-001.

1.3 Purpose and Objectives

This OCD Part 2B establishes the ECS Release B mission support, describes the ECS processes, provides overviews of the activities at each Release B ECS site (including a Day in the Life of each site), and describes some system level, i.e., cross site, system scenarios. The OCD Part 2B provides guidance to system engineers during the system design phase to ensure that the system architecture and design supports the mission operational concepts and system users'/providers' needs. Additionally, the OCD Part 2s:

- provide a configurable basis for detailed scenarios in other Project documents that contain scenarios, such as test and acceptance plans and procedures, and in the Operations Scenarios Document (605/OP2).
- provide guidance for the establishment of staffing plans.
- define operational roles.
- help to define the performance of the individual system elements and the performance between those functional elements.
- provide initial material for development of the more detailed operation and maintenance procedures.

The OCD Part 2s are release-specific and make specific references to detailed scenarios that are to be published in the Operations Scenario document (DID 605) and in Software Development Folders. The difference between the IDR and CDR versions of the OCD Part 2s is the level of detail in references to the DID 605 scenarios. The IDR version identifies the detailed scenarios that need to be written as part of the design cycle. The CDR version will reference specific scenarios found in DID 605.

1.4 Status and Schedule

The original version of the ECS Operations Concept Document was submitted to Goddard Space Flight Center (GSFC) one month prior to the System Requirements Review (SRR) as a Configuration Control Board (CCB) approval code 1 document. An updated version was submitted as a post - SDR (System Design Review) revision in August of 1994.

In March 1995 the baseline version of the OCD Part 2B Annotated Outline was submitted as a result of a number of comments from the user community and an agreement with GSFC to reformat the document into a system level Part 1 and Release specific Part 2s. A Configuration Change Request (CCR) was initiated to formally change the OCD's format to consist of the multiple Parts described earlier in this section. The OCD Part 1 was approved by the CCB in June of 1995.

In July 1995, an update to the Annotated Outline was issued. The current version of the OCD Part 2B is no longer an outline. Updates include reviewers' comments, comments from the Operations Workshop held June 13 - 15, 1995, and represents the maturity of the design as depicted in the scenarios. The OCD Part 2B issue dates are shown in Table 1.4-1.

Table 1.4-1. OCD Summary Schedule

Document	Maturity	Schedule[1]
Part 2B - Release B	Baselined Annotated Outline	Rel B RIR + 30 days (4/30/95) Issued
	Updated Annotated Outline	7/31/95
	Working Draft (Available on EDHS)	Rel B IDR - 14 days (10/16/95)
	Preliminary	Rel B CDR - 30 days
	Final	Rel B CDR + 30 days

Note 1: Specific calendar dates are for reference only. They will not be maintained current if the schedule changes.

1.5 Document Organization

The contents of this document are organized as follows:

Section 1	Introduction - This section introduces the ECS OCD scope, purpose, objectives, status, schedule, and document organization. Clarifies the purpose and scope of the OCD Part 1 versus the Release-specific OCD Part 2s.
Section 2	Related Documentation - This section provides a bibliography of reference documents for the OCD Part 1 organized by parent document, reference document, and information document subsections.
Section 3	Release Overview - This section provides description of the activities supported by ECS Release B in the categories: Missions and ECS support for these missions, interdisciplinary investigators, and V0 Data Migration. This section depicts which sites are involved in support of each mission.
Section 4	Release B "Key" System Activities - This section provides descriptions of the key activities of ECS science data processing and system management. These activities are the piece parts for the description of the site activities. The activities as described here are site independent, i.e., they describe the way an activity will be performed without site or dataset specifics. Included in this section are scenarios depicting examples of events of an activity.
Section 5	Site Overviews - This section describes the activities performed at each site during ECS Release B, including the following subsections: site interfaces, site mission activities, and Day in the Life of the Site. The frequency at which the activities are performed at a site are provided.
Section 6	System Level Scenarios - This section provides specific examples of how individual ECS activities discussed above in Section 4 combine to provide the infrastructure needed for ingest, production and archiving ("push"); information discovery and retrieval ("pull"); and overall system management.

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2. Related Documentation

2.1 Parent Documents

The following documents are the parents from which this document's scope and content derive:

423-10-01-00	Goddard Space Flight Center, Earth Science Data and Information System (ESDIS) Project -- Level 2 Requirements, Volume 0, February 18, 1993
423-10-01-01	Goddard Space Flight Center, Earth Science Data and Information System (ESDIS) Project -- Level 2 Requirements, Volume 1, January 27, 1993
423-10-01-05	Goddard Space Flight Center, EOSDIS Core System Statement of Work, May 21, 1993 (as updated by CCR 95-0053)
423-41-02	Goddard Space Flight Center, Functional and Performance Requirements Specification for the Earth Observing System Data and Information System (EOSDIS) Core System

2.2 Applicable Documents

The following documents are referenced herein and are directly applicable to this document. In the event of conflict between any of these documents and this document, this document shall take precedence.

209-CD-002-003	Interface Control Document Between EOSDIS Core System (ECS) and the ASTER Ground Data System
209-CD-007-003	Interface Control Document Between EOSDIS Core System (ECS) and the TRMM Science Data and Information System (TSDIS)
209-CD-008-004	Interface Control Document Between EOSDIS Core System (ECS) and the Goddard Space Flight Center (GSFC) Distributed Active Archive Center (DAAC) for the ECS Project
209-CD-009-002	Interface Control Document Between EOSDIS Core System (ECS) and the Marshall Space Flight Center (MSFC) Distributed Active Archive Center (DAAC) for the ECS Project
210-TP-001-006	Technical Baseline for the ECS Project
505-41-13	Goddard Space Flight Center, Interface Requirements Document between Earth Observing System Data and Information System (EOSDIS) and the Landsat 7 System; 7/95

505-41-15	Goddard Space Flight Center, Interface Requirements Document between the Earth Observing System Data and Information System (EOSDIS) and the AM Project for AM-1 Flight Operations; 7/95

2.3 Information Documents

The following documents, although not directly applicable, amplify or clarify the information presented in this document, but are not binding.

102-CD-002-001	Maintenance and Operations Configuration Management Plan for the ECS Project
160-TP-004-001	User Pull Analysis Notebook for the ECS Project
161-TP-001-001	EOSDIS Product Use Survey Technical Paper for the ECS Project
19400311TPW	User Scenario Notebook for the ECS Project
19400312TPW	User Characterization and Requirements Analysis for the ECS Project
19400313TPW	ECS User Characterization Methodology and Results for the ECS Project
19400548TPW	User Scenario Functional Analysis for the ECS Project
JPL D-12511	Jet Propulsion Laboratory, Implementation Plan for Support of the SeaWinds Project, PO DAAC, February 1995.

3. Release Overview

This section of the document describes the mission operations supported which Release B will support. This section complements Section 5 in which the operational concept for ECS support of the missions is given on a DAAC by DAAC basis.

Section 3 contains the following subsections:

3.1 Release B Mission Statement

The purpose of Release B is to provide an end-to-end system that supports multiple satellites, instruments and missions, not a unique system for each (See Figure 3.1-1). In addition to functions, services and data provided by Release A, Release B will provide flight operations for EOS AM-1 and data functions for EOS AM-1, Landsat 7, ADEOS II and other NASA-identified data collections including the international SAR missions supported at the Alaska SAR Facility DAAC. The data from each EOS instrument will be sent to Distributed Active Archive Centers (DAAC) for processing, archiving, and distribution These data centers will house the ECS computing facilities and operational staff needed to produce EOS Standard Products and to manage, store, and distribute EOSDIS data, as well as the associated metadata and browse data, that allow effective use of the data holdings. The DAACs will exchange data via dedicated EOSDIS networks to support processing at one DAAC which requires data from another DAAC.

End-to-end EOSDIS services depend on ECS providing a robust infrastructure with components having high reliability, high throughput or large storage capacity. Certain mission critical components must be highly reliable to support launches and to ensure that data are not lost. Examples of mission critical components include command and control of EOS spacecraft and instruments, and maintenance of reliable, long-term data archives for global change research. Loss of either space assets or long-term data would seriously impair the EOS mission. Other ECS components, i.e. the EOS data processing components, provide high throughput in order to ingest, process, and archive the high data rates from EOS instruments. Capturing the raw EOS instrument data and processing it to the level required to confirm data validity are mission critical functions. However, downstream processing of higher level products is important but not mission critical since recovery from processing errors or loss of data products can be accomplished by reprocessing from lower level input data.

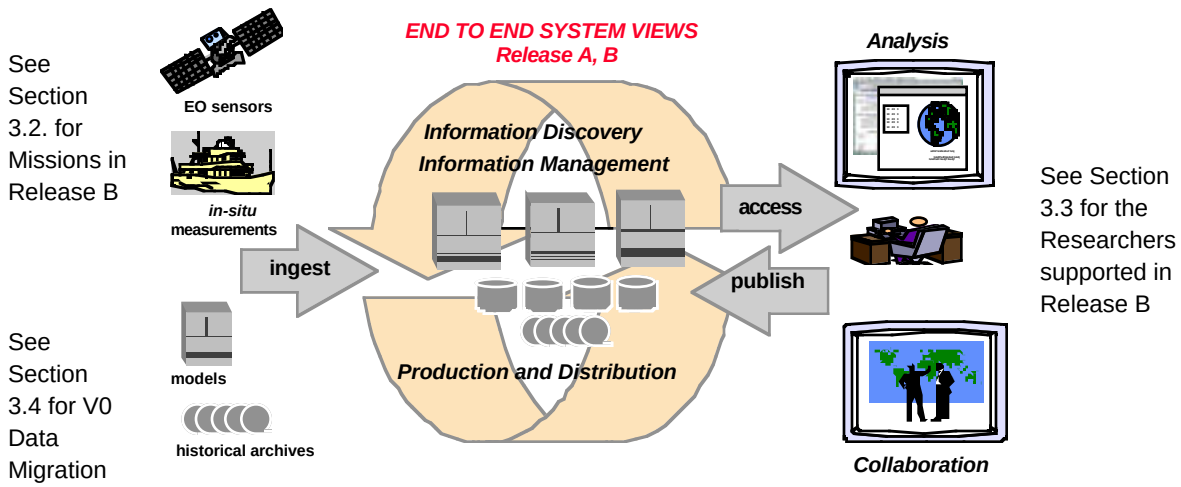

Figure 3.1-1. ECS End-to-End System Views

NASA is placing special emphasis on pre-launch and post-launch calibration of EOS instruments as well as validation and quality assessment of the EOS standard products so that interdisciplinary scientists need not have detailed knowledge of the instruments and the science algorithms . Maintaining accuracy and calibration over long time periods is crucial to studies of climate and global change. Each EOS instrument team is planning post-launch validation of their science algorithms through techniques such as comparisons with in situ measurements, field measurements, and comparisons with other EOS and non-EOS derived products.

Open access to EOS and other Earth science data by all members of the science community, about 16000, distinguishes EOS from previous research satellite projects, where selected investigators had proprietary data rights for a number of years after data acquisition. This open data policy will lead to greater utilization of EOS data products, for global change research and other applications. The EOS program is also distinguished by the large number of NASA funded investigators (over 500), who provide expertise across the broad range of scientific disciplines in Earth system science.

Releases C and D will support future EOS missions, such as EOS PM-1, and will incorporate evolutionary changes such as new processing and storage technologies. Successive releases will provide expanded and increasingly enhanced data search and access, based on feedback from the science community.

3.2 Missions Supported by ECS Release B

The missions supported by the Release B of ECS are shown in Table 3.2-1. Details of the ECS support for the missions are given in Section 3.7.

Table 3.2-1. Mission Baseline

Mission	Instruments	Launch Date
TRMM	CERES, LIS, VIRS, PR, TMI	17 August, 1997 Initially Supported by ECS Release A
EOS AM-1	ASTER, CERES, MISR, MODIS, MOPPIT	30 June, 1998
Landsat 7	ETM+	May, 1998
FOO	COLOR	May, 1998
ADEOS II	SeaWinds	February, 1999
ALT RADAR (CNES or GFO)	DFA, MR	Mar, 1999
ACRIMSAT	ACRIM	June, 1999
METEOR	SAGE III	August, 1998
ERS-1	SAR	July, 1991
ERS-2	SAR	April, 1995
JERS-1	SAR	February, 1992
RADARSAT	SAR	October, 1995

3.3 Interdisciplinary Investigators

In an effort to improve scientific knowledge of Earth system science, NASA has selected 29 Interdisciplinary Science (IDS) Teams as part of the EOS/MTPE Program. See the 1995 MTPE/EOS Reference Handbook edited by Ghassem Asrar and Reynold Greenstone and published by Sterling and Spangler for a list of these teams and for more information. An important part of these IDS Team efforts will be to use the geophysical products created by the various EOS Instrument Teams, (as well as other remotely sensed and in situ data sets), to improve their computer-assisted models of the complex processes and cycles of the Earth. The 29 investigation teams selected cover a wide range of Earth system science and modeling expertise and have been grouped into seven broad categories by McKay and Ardanuy, 1992, in their summary report concerning the IDS Teams. These categories are listed in The Major Disciplines of Earth System Science of The EOS Interdisciplinary Investigation Teams in TableÊ3.3-1.

Table 3.3-1. The Major Disciplines of Earth System Science of The EOS Interdisciplinary Investigation Teams

Carbon, Energy and Water Cycles
Oceans/Atmosphere
Chemistry of the Troposphere and Lower Stratosphere
Chemistry of the Middle and Upper Troposphere
Land Surface Hydrology and EcoSystem Processes
Glacier and Polar Ice Sheets
Solid Earth

Source: McKay, A. and P. Ardanuy. 1992. "EOS Interdisciplinary Science Investigations: Analysis of Modeling Elements and Their Interrelationships. Technical Report Published for the NASA/GSFC EOS Project Science Office. July, 1992.

Examples of ECS Services that should facilitate the research efforts of these IDS teams are the following:

1. The capability to search the DAAC holdings for EOS and Version 0 Data Products relevant to their research efforts. Also the use of the *Advertising Service* to learn and implement new methods of analyzing or using data products that may/may not be at the DAACs;
2. The ability to obtain data products from any of the DAACs in a common data structure for use in their modeling efforts; and
3. The long term plan of implementing parts of or all of each IDS Team's models on DAAC computing resources to allow these Teams to concentrate their efforts on improving their respective models.

3.4 Version 0 (V0) Data Migration

Because of the value of past remote sensing data to Global Change Research, NASA has elected to migrate Version 0 data to ECS as part of the overall V0-to-V1 transition. ECS is being designed for a long life cycle (at least two decades beyond the launch of the first EOS spacecraft) with architectural features that facilitate technology upgrades and evolution. Migration to ECS will ensure continued maintenance of these important historical Earth science data. After migration, ECS will provide information management and data archive and distribution functions for past NASA Earth science flight missions and other Earth science data held by NASA. Users will gain access to improved services, new functions, and better performance. V0-to-V1 migration is being planned from a users' point of view to ensure continuous data availability throughout the migration process.

The data migration process for each data product, or group of similar data products, is depicted in Figure 3.4-1 and consists of two phases: the Engineering Phase and Operations Phase. Both phases are performed by the ECS V0 data migration team. The Engineering Phase includes: 1)Êresource analysis of the data and metadata, 2) development of any software and procedures, and 3) benchmark migration testing of samples to prove the process. During resource analysis, ECS will identify and document the effort required to convert and migrate the candidate V0 data product and metadata. Software and procedures are developed, constrained by the available budget, to perform data conversion to HDF-EOS, map V0 metadata to the ECS metadata model, and derive new metadata. Benchmark testing, with a sample of the migrated data and metadata, is performed in the ECS Development Facility environment, and at the DAAC, on the installed ECS system, to demonstrate readiness for operational migration.

The Operations Phase accomplishes the preprocessing of the V0 data and metadata, ingest into ECS, and the operational population of an ECS Data Server, i.e. the physical migration of the data and metadata from V0 to ECS. At the end of the migration of a data product a Data Readiness Review will be held with ESDIS and DAAC personnel to verify the operational readiness of the data product. Upon successful completion of the review, operational responsibility will transfer from V0 to ECS. For ORNL, the data will not physically move but the metadata will migrate to ECS components at ORNL.

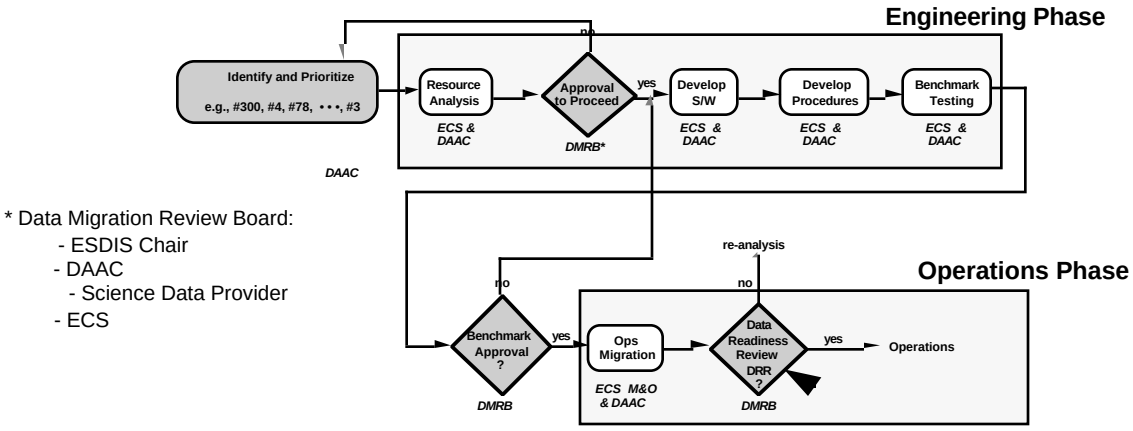

Figure 3.4-1. The V0 Data Migration Process for Each V0 Data Product

Before, during, and after the migration process, V0 data will be available to the science community. Before starting the migration process, V0 data will be available to users through direct access to V0. During the migration process, V0 data will be available either through direct access to V0 or through interoperability between ECS and V0. After operational responsibility transfers from V0 to ECS, data will be available through direct access to ECS or through interoperability between V0 and ECS.

The migration process is designed to allow ESDIS/DAACs to steer the migration process through their decisions, as depicted in Figure 3.4-2, with ECS providing the engineering, expertise, and recommendations needed for management and technical decision making. For each V0 data product there are four key decision points: 1) prior to beginning analysis of the data product, 2) after analysis and before beginning software development, 3) after benchmark testing and before beginning operational migration, and 4) after operational migration and before declaring migrated data and metadata available in ECS to end users. Decisions are made by the Data Migration Review Board (chaired by ESDIS with DAAC, Science Data Provider and ECS representation) and the decisions executed by the ECS V0 data migration team. At each DAAC, the migration process is documented in a DAAC Data Migration Plan which is a working document that lives throughout the migration process at a DAAC. The V0 data products that are candidates for migration are identified in NASA's Science Data Plan (SDP): the most recent published SDP is dated July 1994, Version 3.

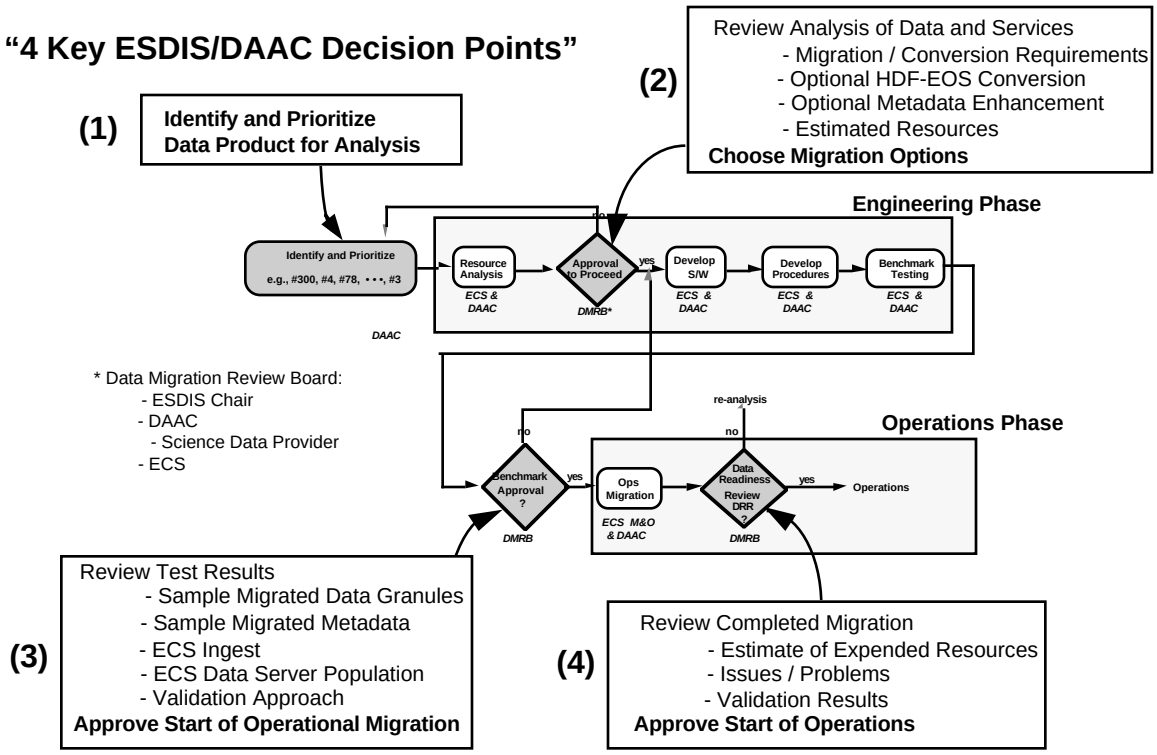

Figure 3.4-2. ESDIS/DAACs Steer the Migration Process; ECS Provides the Engineering, Expertise, and Recommendations to Support Management and Technical Decision Making

3.5 ECS Functionality

Release B represents the initial EOS AM launch ready configuration of ECS, including functionality described by the Functional and Performance Requirements Specification for the Earth Observing System Data and Information System (EOSDIS) Core System dated May 21, 1993. Additionally, Release B includes the capacity to perform initial post-launch science processing for EOS AM, plus the functions, services and data provided by previous Releases. The Release provides full functionality to support the missions shown in Table 3.2-1. The Release also provides the capacity to support Integration and Test (I&T) of new science software and ECS upgrades in parallel with production operations. The functionality to be provided is as follows:[1]

Information Management and Archive functions

- Full functionality and performance including:
  - Network access and distribution of data holdings
  - Subsetting

[1] In accordance with ECS SOW as updated by CCR 95-0053.

- Security
- Hard media shipping and handling
- Access to all authorized users
- Interoperability with ADCs and Version 0

• Launch ready for EOS AM-1, LANDSAT-7, COLOR and ADEOS II
• Capability to migrate all Version 0 data to ECS archive
• Information management services to ORNL
• Data distribution/access for RADARSAT, ERS1/2, and JERS1 data at ASF

Science Processing

• Full functionality and performance including:
  - Algorithm environment for final I&T for AM-1 and COLOR
  - Ebnet interfaces
• Launch ready for EOS AM-1, LANDSAT-7, COLOR and ADEOS II

Mission Operations

• Full functionality and performance including:
  - Flight operations
  - Institutional interfaces (e.g., FDF, SN, NCC), EDOS and EBNet
• Launch ready for EOS AM-1
• Full instrument and spacecraft testing support for EOS AM-1

Networks

• Full functionality and performance

System Management

• Full functionality and performance

3.6 ECS Sites for Release B

This document is based on the ECS Change Order 1 list of locations and Statement of Work. ECS elements are deployed to the institutions shown below:

• Distributed Active Archive Centers (DAACs):
  _ Alaska SAR Facility (ASF) - University of Alaska-Fairbanks, Fairbanks, Alaska
  _ Consortium for International Earth Science Information Network (CIESIN) - University Center, Michigan
  _ EROS Data Center (EDC) - Sioux Falls, South Dakota
  _ Goddard Space Flight Center (GSFC) - Greenbelt, Maryland
  _ Jet Propulsion Laboratory (JPL) - Pasadena, California
  _ Langley Research Center (LaRC) - Hampton, Virginia

- National Snow and Ice Data Center (NSIDC) - University of Colorado, Boulder, Colorado
- Oak Ridge National Laboratory (ORNL) - Oak Ridge, Tennessee

- System Monitoring and Coordination Center (SMC) - GSFC Building 32, Greenbelt, Maryland
- ECS Operations Center (EOC) - GSFC Building 32, Greenbelt, Maryland. The Flight Operations Segment is housed at the EOC. Operations concepts can be found in a separate ECS OCD volume.

3.7 Description of ECS Support for Missions

This section provides descriptions of each mission and the a description of flows between each DAACs and EOC for each of the following missions:

TRMM Support (3.7.1)
TSDIS Interface (3.7.1.1)
CERES Instrument (3.7.1.2)
LIS Instrument (3.7.1.3)
AM-1 Support (3.7.2)
ASTER Instrument (3.7.2.1)
CERES Instrument (3.7.2.2)
MISR Instrument (3.7.2.3)
MODIS Instrument (3.7.2.4)
MOPITT Instrument (3.7.2.5)
Landsat 7 Support (3.7.3)
COLOR Support (3.7.4)
ADEOS II - SeaWinds Support (3.7.5)
ALT RADAR Support (3.7.6)
ACRIMSAT Support (3.7.7)
METEOR - SAGE III Support (3.7.8
SAR Support (3.7.9)
ERS-1/2 (3.7.9.1)
JERS-1 Mission Support (3.7.9.2)
RADARSAT Mission Support (3.7.9.3)
Data Assimilation Office (DAO) Support (3.7.10)

3.7.1 TRMM Mission Support

TRMM is a Mission to Planet Earth mission designed to advance our understanding of total rainfall and to determine the rate of rainfall and the total rainfall occurring over the tropics and

subtropics (between +35 and -35 degrees latitude). TRMM is also designed to facilitate the measurement and analysis of the Earth's radiant energy budget and lightning. The mission is a joint venture between National Aeronautics and Space Administration (NASA) and the National Space Development Agency of Japan (NASDA).

3.7.1.1 TSDIS

The TRMM Science Data and Information System (TSDIS) and ECS work together to provide support for the Visible and Infrared Scanner (VIRS), TRMM Microwave Imager (TMI), Precipitation Radar (PR) instruments to be flown on the TRMM observatory, and corresponding Ground Validation (GV) data. The ECS interface is at the Goddard Space Flight Center (GSFC) Distributed Active Archive Center (DAAC). This support includes science data archive and distribution. A brief description of the TRMM mission and TSDIS-ECS interfaces follows. See Figure 3.7.1-1 for an overview of ECS support of the TRMM mission.

TSDIS, located at GSFC, will house a TRMM Science Data Operations Center (SDOC) and a Science Operations Control Center (SOCC). The TSDIS will process PR, TMI, VIRS, and GV data and generate various levels of standard data products. The TSDIS-generated science data products will be made available to the TSDIS Science Users (TSUs) (algorithm developers, instrument scientists, and quality control scientists) through Remote Science Terminals (RSTs). In addition, the standard TRMM data products will be transferred from the TSDIS to the ECS for archive, TSDIS access for reprocessing, and distribution to the research user communities.

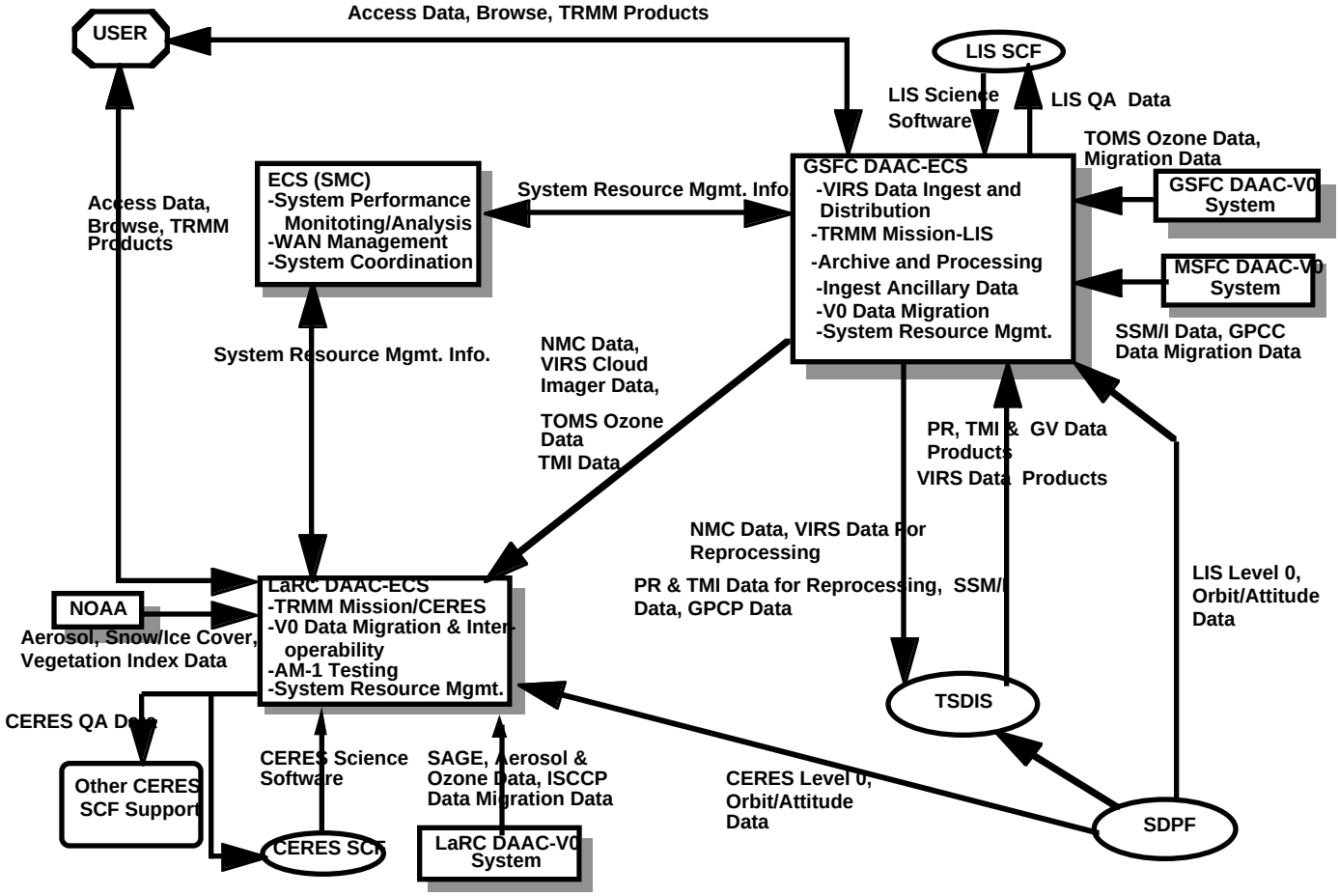

Figure 3.7.1-1. ECS Support of the TRMM Mission

The GSFC DAAC supports research in the discipline areas of passive microwave remote sensing of the atmosphere, atmospheric electricity and lightning detection, and global hydrologic and atmospheric modeling. The GSFC DAAC will have responsibility for archive and distribution of the TMI, PR, combined PR/TMI, GV data, and ancillary data.

The GSFC DAAC also supports research in the discipline areas of the upper atmosphere, atmospheric dynamics, global biosphere, and geophysics. The GSFC DAAC will have responsibility for archive and distribution of data products for the VIRS instrument, ancillary data, and products generated using VIRS and other data products.

3.7.1.2 CERES

The CERES investigation will provide EOS with an accurate and self-consistent cloud and radiation database for researchers of the World Climate Research Program, including the Tropical Ocean Global Atmosphere campaign, World Ocean Circulation Experiment, and the

Global Energy and Water Experiment. The CERES instrument will measure the Earth's radiation budget through observation of both short- and long-wave radiation using two broad band scanning radiometers. The two identical scanners will normally operate in two different scan modes: cross-track or biaxial. The CERES sensor system consists of three co-aligned broad band thermistor bolometer detectors. The three detectors are identical except for optical filters on two detectors (longwave and short-wave) which restrict their spectral ranges to a portion of the Earth's radiation bandwidth. Each CERES unit has dedicated microprocessors to control and direct instrument operations. Reprogramming the instrument microprocessors is expected to be infrequent. Updates to the instrument microprocessor flight software, scan table, or internal sequences will be uplinked through the EOC as part of an integrated command load. The CERES PI facility is located at LaRC in Hampton, Virginia.

CERES Science Software will be delivered to the LaRC DAAC for I&T in the pre-mission timeframe. CERES level 0 data will be ingested from SDPF at the LaRC DAAC. CERES higher level products will be produced and archived at LaRC.. ECS will support full access to CERES products. Details on CERES operations at LaRC may be found in Section 5.6.

3.7.1.3 LIS

LIS is an instrument that will investigate the global incidence of lightning and its relationship with rainfall and the global electric system. The instrument itself is a staring telescope which detects the rate, location and radiant energy of lightning flashes.

LIS Science Software will be delivered to the GSFC DAAC for I&T in the pre-mission timeframe. LIS level 0 data will be ingested from SDPF at the GSFC DAAC. LIS higher level products will be produced and archived at GSFC. ECS will support full access to LIS products. Details on LIS operations at GSFC may be found in Section 5.4.

3.7.2 AM-1 Mission Support

The AM-1 payload complement consists of five instruments: Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER), Clouds and Earth's Radiant Energy System (CERES), Multi-angle Imaging SpectroRadiometer (MISR), Moderate Resolution Imaging SpectroRadiometer (MODIS), and Measurements Of Pollution In The Troposphere (MOPITT). Facility Instrument operations are coordinated by Team Leads (TLs). The Facility Instruments on AM-1 are ASTER and MODIS. CERES, MISR and MOPITT operations are coordinated by their principal investigators (PIs).

A brief description of the AM-1 mission and AM-1 Mission to ECS interfaces follows. See Figure 3.7.2-1 for an overview of ECS support of the AM-1 mission.

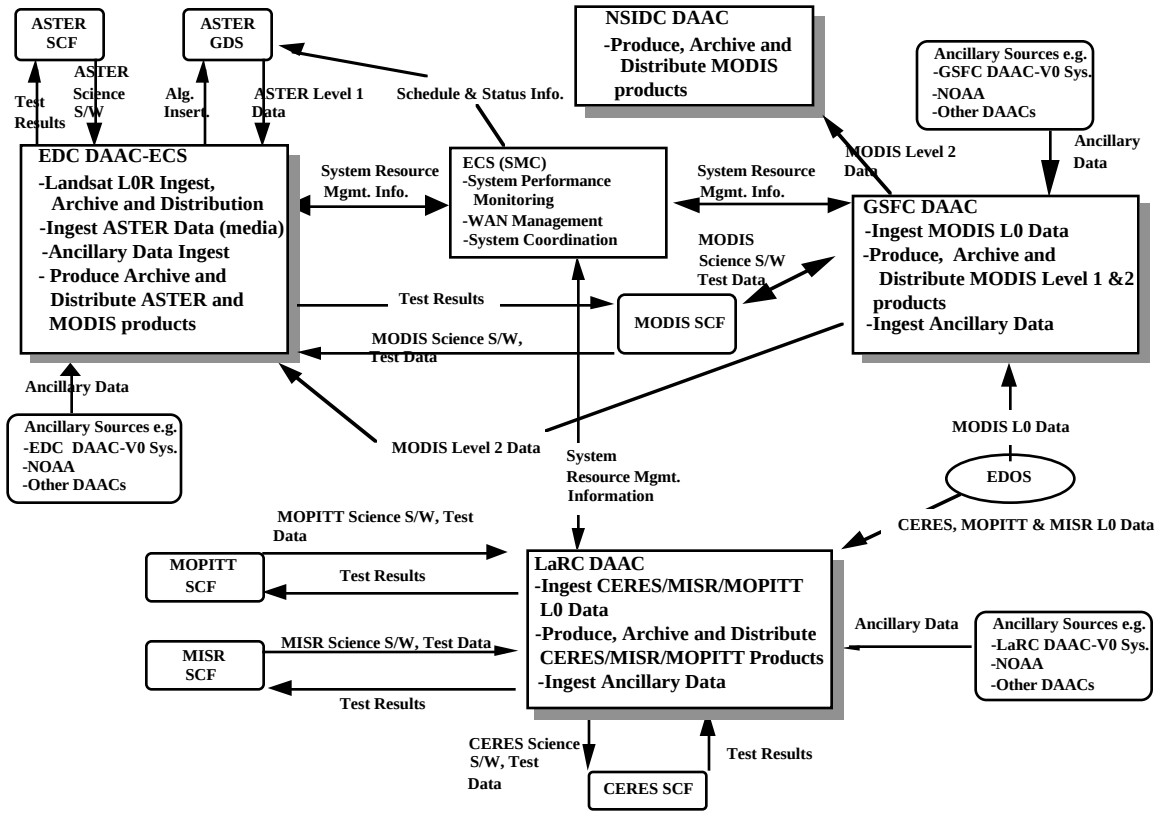

Figure 3.7.2-1. ECS Support of the AM-1 Mission

3.7.2.1 ASTER

The ASTER instrument is a high-resolution multi-spectral imaging radiometer provided by Japan's MITI. ASTER provides high spatial resolution images of land surfaces, water, ice, and clouds. ASTER will operate in three visible and near infrared (VNIR) channels, six short-wave infrared (SWIR) channels and five thermal infrared (TIR) channels. ASTER also has a same-orbit stereo imaging capability. The ASTER instrument will be controlled from an Instrument Control Center (ICC) which will be developed by the Japanese as part of the ASTER Ground Data System (GDS). Interface requirements between the ASTER GDS and the ECS are documented in the IRD Between ECS and MITI ASTER Project.

ASTER Science Software will be delivered to the EDC DAAC for I&T in the pre-mission timeframe. ASTER DARs may be submitted by approved users to ECS and will be forwarded to the ASTER GDS. ASTER level 1 products will be produced at the ASTER GDS and delivered on media to the EDC DAAC for archival and distribution. ASTER higher level land products will be produced and archived at EDC. ECS will support two-way level 3 catalog interoperability with the ASTER GDS. Details on ASTER operations at EDC may be found in Section 5.3.

3.7.2.2 CERES

The CERES investigation will provide EOS with an accurate and self-consistent cloud and radiation database for researchers of the World Climate Research Program, including the Tropical Ocean Global Atmosphere campaign, World Ocean Circulation Experiment, and the Global Energy and Water Experiment. The CERES instrument will measure the Earth's radiation budget through observation of both short- and long-wave radiation using two broad band scanning radiometers. The two identical scanners will normally operate in two different scan modes: cross-track or biaxial. The CERES sensor system consists of three co-aligned broad band thermistor bolometer detectors. The three detectors are identical except for optical filters on two detectors (longwave and short-wave) which restrict their spectral ranges to a portion of the Earth's radiation bandwidth. Each CERES unit has dedicated microprocessors to control and direct instrument operations. Reprogramming the instrument microprocessors is expected to be infrequent. Updates to the instrument microprocessor flight software, scan table, or internal sequences will be uplinked through the EOC as part of an integrated command load. The CERES PI facility is located at LaRC in Hampton, Virginia.

CERES Science Software will be delivered to the LaRC DAAC for I&T in the pre-mission timeframe. CERES level 0 data will be ingested from EDOS at the LaRC DAAC. CERES higher level products will be produced and archived at LaRC. ECS will support full access to CERES products. Details on CERES operations at LaRC may be found in Section 5.6.

3.7.2.3 MISR

MISR is an instrument for studying the ecology and climate of the earth. The MISR investigation also will be used to validate and correct MODIS and ASTER images. MISR will acquire images at nine discrete viewing angles, with a charged coupled device (CCD) camera allocated to each viewing direction. Four cameras are pointed forward, one pointed at nadir, and four pointed aft. Images at each angle are obtained in four spectral bands using CCD line arrays for a total of 36 channels (nine cameras, four bands each). Each of the 36 instrument data channels is individually commandable to one of four averaging modes (i.e., one-sample-by-one-line [no averaging], two sample-by-two-line, four-sample-by-four-line, and one-sample-by-four-line). MISR targeting is controlled by a table of sites stored in the instrument microprocessor. Instrument microprocessor loads, table loads, and memory loads will be uplinked through the EOC as part of an integrated command load. The MISR PI facility is located at JPL.

MISR Science Software will be delivered to the LaRC DAAC for I&T in the pre-mission timeframe. MISR level 0 data will be ingested from EDOS at the LaRC DAAC. MISR higher level products will be produced and archived at LaRC.. ECS will support full access to MISR products. Details on MISR operations at LaRC may be found in Section 5.6.

3.7.2.4 MODIS

MODIS is designed to measure biological and physical processes on a global scale. The instrument will provide long-term observations from which to derive and enhance knowledge of global dynamics and processes occurring on the surface of the Earth and in the lower atmosphere. The MODIS instrument uses a conventional imaging radiometer concept, consisting of a cross-track scan mirror and collecting optics, and a set of linear detector arrays, with spectral

interference filters located in four focal planes. The optical arrangement will provide imagery in thirty-six discrete bands selected for diagnostic significance in Earth science. MODIS Telemetry and Command Processor (TCP) loads will be uplinked through the EOC as part of the integrated command load. The MODIS TL facility is located at GSFC.

MODIS Science Software will be delivered to the GSFC DAAC for I&T in the pre-mission timeframe. MODIS level 0 data will be ingested from EDOS at the GSFC DAAC. MODIS level 1 and 2 products will be produced and archived at GSFC. MODIS Level 3 ocean and atmosphere products will be produced and archived at GSFC.

MODIS level 3 Land products will be produced and archived at the EDC DAAC. MODIS level 2 land products will also be archived at EDC. MODIS level 3 snow/ice products will be produced and archived at the NSIDC DAAC. MODIS level 2 snow/ice products will also be archived at NSIDC. ECS will support full access to MODIS products. Details on MODIS operations at GSFC may be found in Section 5.4. Details on MODIS operations at EDC may be found in Section 5.3. Details on MODIS operations at NSIDC may be found in Section 5.8.

3.7.2.5 MOPITT

The MOPITT instrument, provided by the Canadian Space Agency (CSA), will measure emitted and reflected infrared radiance in the atmospheric column. The MOPITT experiment uses tropospheric carbon monoxide profile as well as carbon monoxide and methane (a greenhouse gas) columns to study how these gases interact with the surface, ocean, and biomass systems. MOPITT is designed as a scanning instrument with four parallel optical chains. Each chain incorporates its own scanning mirror, calibration targets, optics, and correlation cells (pressure modulated gas filters). Each optical chain has two signal paths, each leading to a detector array, with each detector array consisting of four elements. Infrequent instrument microprocessor software and table loads will be uplinked through the EOC as part of the integrated command load. The MOPITT PI facility is located at the University of Toronto, Ontario, Canada.

MOPITT Science Software will be delivered to the LaRC DAAC for I&T in the pre-mission timeframe. MOPITT level 0 data will be ingested from EDOS at the LaRC DAAC. MOPITT higher level products will be produced and archived at LaRC.. ECS will support full access to MOPITT products. Details on MOPITT operations at LaRC may be found in Section 5.6.

3.7.3 Landsat 7 Mission Support

The Landsat 7 Program provides a satellite remote sensing capability serving a broad community of users, including those involved in global change research as well as civil, national security, academic, and commercial applications. The goal of the Landsat 7 System is to acquire and periodically refresh global, substantially cloud free data of all sun-lit land masses. The Landsat 7 Program continues the remote sensing capability currently provided by Landsats 4 and 5.

Landsat 7 and ECS work together to provide user access to data collected by the Enhanced Thematic Mapper Plus (ETM+) instrument flown on the Landsat 7 satellite. The Landsat 7 Project processes the raw instrument data into Level 0R data and then provides the data to ECS for ingest, archive and distribution. All ECS registered users are permitted access to Landsat 7 Level 0R data, metadata and browse data archived by ECS.

The Landsat 7 satellite is scheduled for launch in 1998 and operation for a minimum of five years. The ETM+ Instrument on the satellite performs multispectral imaging. Data is downlinked via direct X-band interfaces to the Landsat 7 Ground Data Processing System (GDPS) at the Earth Resources Observation System (EROS) Data Center (EDC), a USGS facility near Sioux Falls South Dakota.. At the GDPS, the raw data is processed into Level 0R subinterval data files and transferred to ECS via a direct link between the Landsat 7 Processing System communication network to the ECS communication network. Other data and information exchanged between ECS and the other Landsat 7 System elements are generally transferred via Internet interfaces or through physical media.

Landsat 7 System elements interfacing with ECS are the Landsat 7 Processing System (LPS), the Image Assessment System (IAS), the Mission Operations Center (MOC), the Mission Management Office (MMO), and the International Ground Stations (IGSs). The first three elements belong to the Landsat 7 Ground System. The LPS and the IAS are ECS external data providers. In addition, both the IAS and the MOC function as ECS users to acquire Landsat 7 data from ECS. MMO functions, provided by the National Oceanic and Atmospheric Administration (NOAA), include exchange of system management status and Landsat 7 product cost information with ECS. The IGSs, which are geographically dispersed, receive downlinked Landsat 7 data via their own direct X-band interface and provide to ECS only inventory metadata and browse data corresponding to the Landsat 7 image data they acquire.

ECS support for the Landsat 7 science data is collocated with the Landsat 7 Ground System at EDC. ECS at the EDC Distributed Active Archive Center (DAAC) provides: ingest of and long-term storage for Landsat 7 image data and other related data; ingest of Landsat 7 calibration coefficient files and associated metadata updates; EOSDIS user access to browse images and a catalog of archived Landsat 7 data for data search and product order; and distribution of products in response to orders.

See Figure 3.7.3-1 for an overview of ECS support of the Landsat-7 mission.

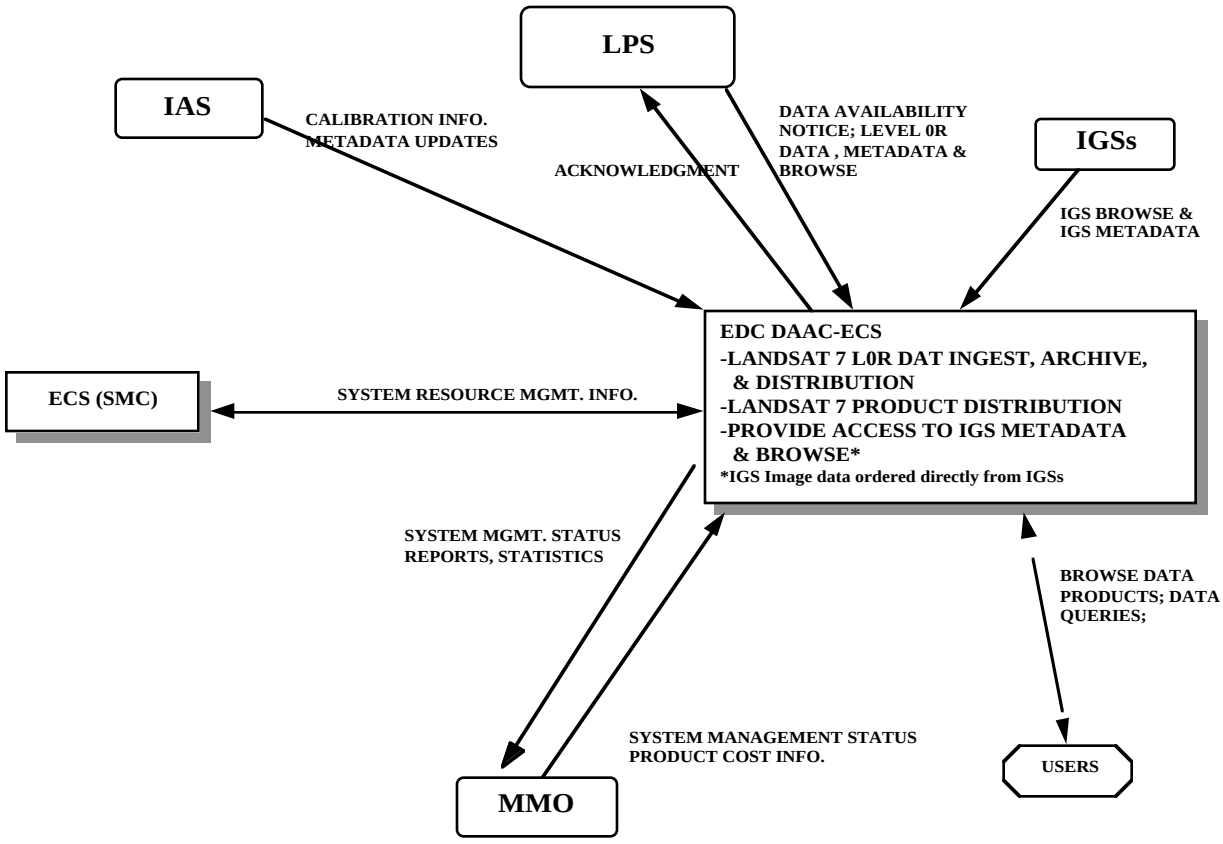

Figure 3.7.3-1. ECS Support of the Landsat-7 Mission

3.7.4 Color Mission Support

TBS

3.7.5 ADEOS II - SeaWinds Mission Support

The SeaWinds instrument will fly on the second National Space Development Agency (NASDA) Japanese Advanced Earth Observing Satellite II (ADEOS-II). The SeaWinds instrument is a spaceborne scatterometer designed to make all-weather measurements of near-surface wind velocity (both speed and direction) over the world oceans. The SeaWinds Experiment is part of the EOS program. The SeaWinds Project is responsible for producing the SeaWinds-specific data processing algorithms including all necessary documentation, test procedures, and results to the JPL DAAC for integration with the EOSDIS system.

SeaWinds Science Software will be delivered to the JPL DAAC for I&T in the pre-mission timeframe. SeaWinds level 0 data will be ingested from ADEOS II GPS at the JPL DAAC. SeaWinds higher level products will be produced and archived at JPL. ECS will support full access to SeaWinds products. Details on SeaWinds operations at JPL may be found in Section 5.5.

See Figure 3.7.5-1 for an overview of ECS support of the SeaWinds mission.

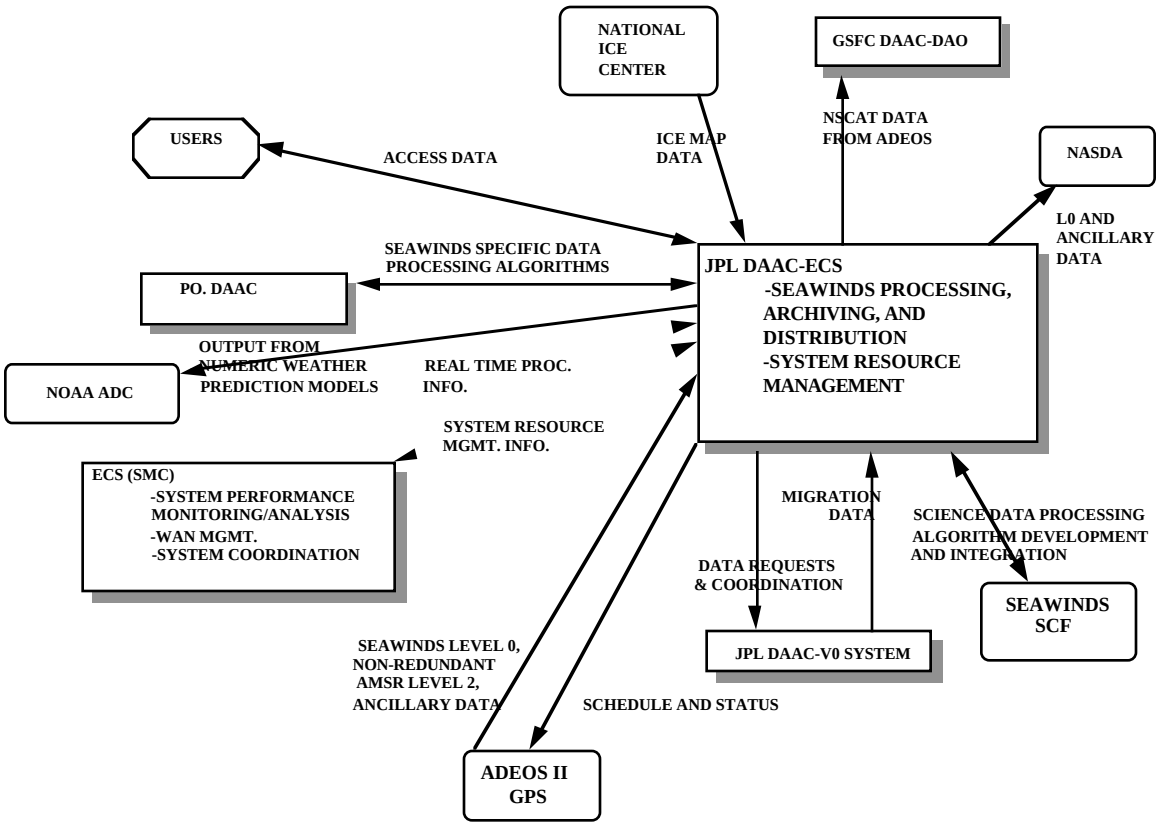

Figure 3.7.5-1. ECS Support of the SeaWinds Mission

3.7.6 ALT Radar Mission Support

ALT Radar, to be launched in March 1999, will have on board the Dual Frequency Altimeter (DFA) and Microwave Radiometer (MR). These instrument programs are not yet fully defined, and thus little is known about ECS support of these instruments. It is assumed that data archiving and distribution will occur at the JPL DAAC.

ALT Radar Science Software will be delivered to the JPL DAAC for I&T in the pre-mission timeframe. ALT Radar level 0 data will be ingested at the JPL DAAC. ALT Radar higher level products will be produced and archived at JPL. ECS will support full access to ALT Radar products. Details on ALT Radar operations at JPL may be found in Section 5.5.

See Figure 3.7.6-1 for an overview of ECS support of the ALT RADAR mission.

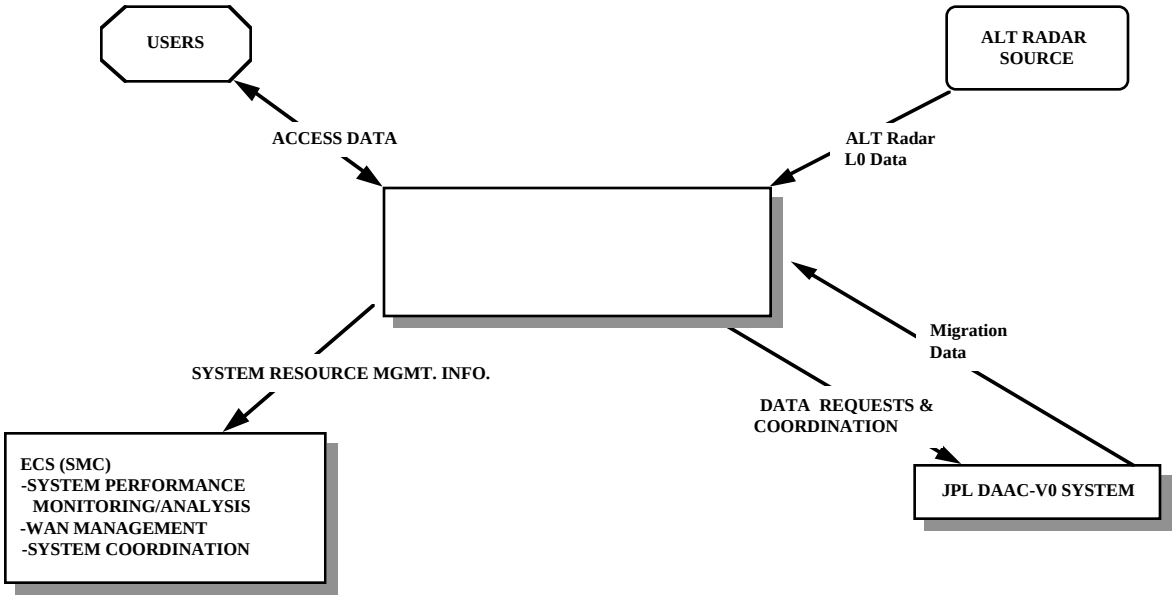

Figure 3.7.6-1. ECS Support of the ALT RADAR Mission

3.7.7 ACRIM Mission Support

ACRIMSAT, to be launched in June 1999, is a small satellite on which the Active Cavity Radiometer Irradiance Monitor (ACRIM) will fly. ACRIM will monitor the variability of the total solar irradiance.

ACRIM Science Software will be delivered to the LaRC DAAC for I&T in the pre-mission timeframe. ACRIM level 0 data will be ingested at the LaRC DAAC. ACRIM higher level products will be produced and archived at LaRC. ECS will support full access to ACRIM products. Details on ACRIM operations at LaRC may be found in Section 5.6.

See Figure 3.7.7-1 for an overview of ECS support of the ACRIMSAT mission.

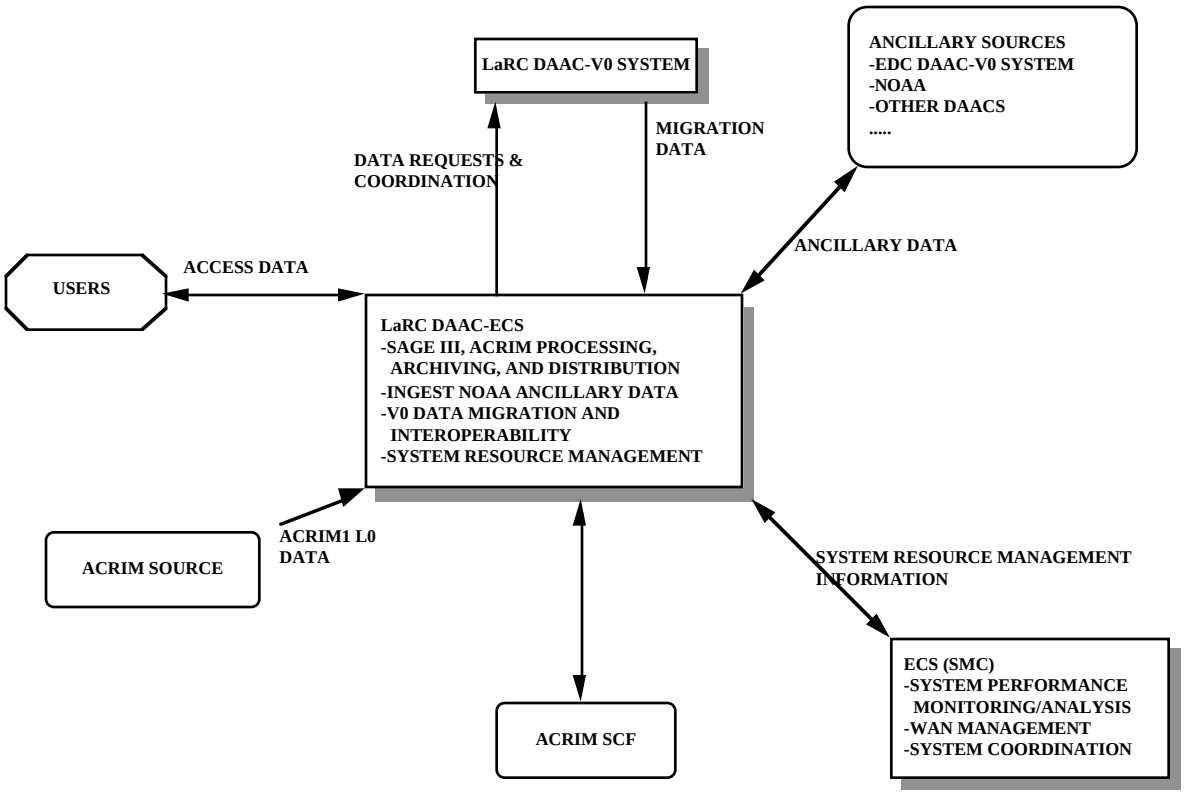

Figure 3.7.7-1. ECS Support of the ACRIMSAT Mission

3.7.8 METEOR - SAGE III Mission Support

The Stratospheric Aerosol and Gas Experiment (SAGE) III instrument will fly on the Meteor 3M vehicle. SAGE III is a limb-scanning spectroradiometer which will measure tropospheric and stratospheric aerosol and gas variability.

SAGE III Science Software will be delivered to the LaRC DAAC for I&T in the pre-mission timeframe. SAGE III level 0 data will be ingested at the LaRC DAAC. SAGE III higher level products will be produced and archived at LaRC. ECS will support full access to SAGE III products. Details on SAGE III operations at LaRC may be found in Section 5.6.

See Figure 3.7.8-1 for an overview of ECS support of the SAGE III mission.

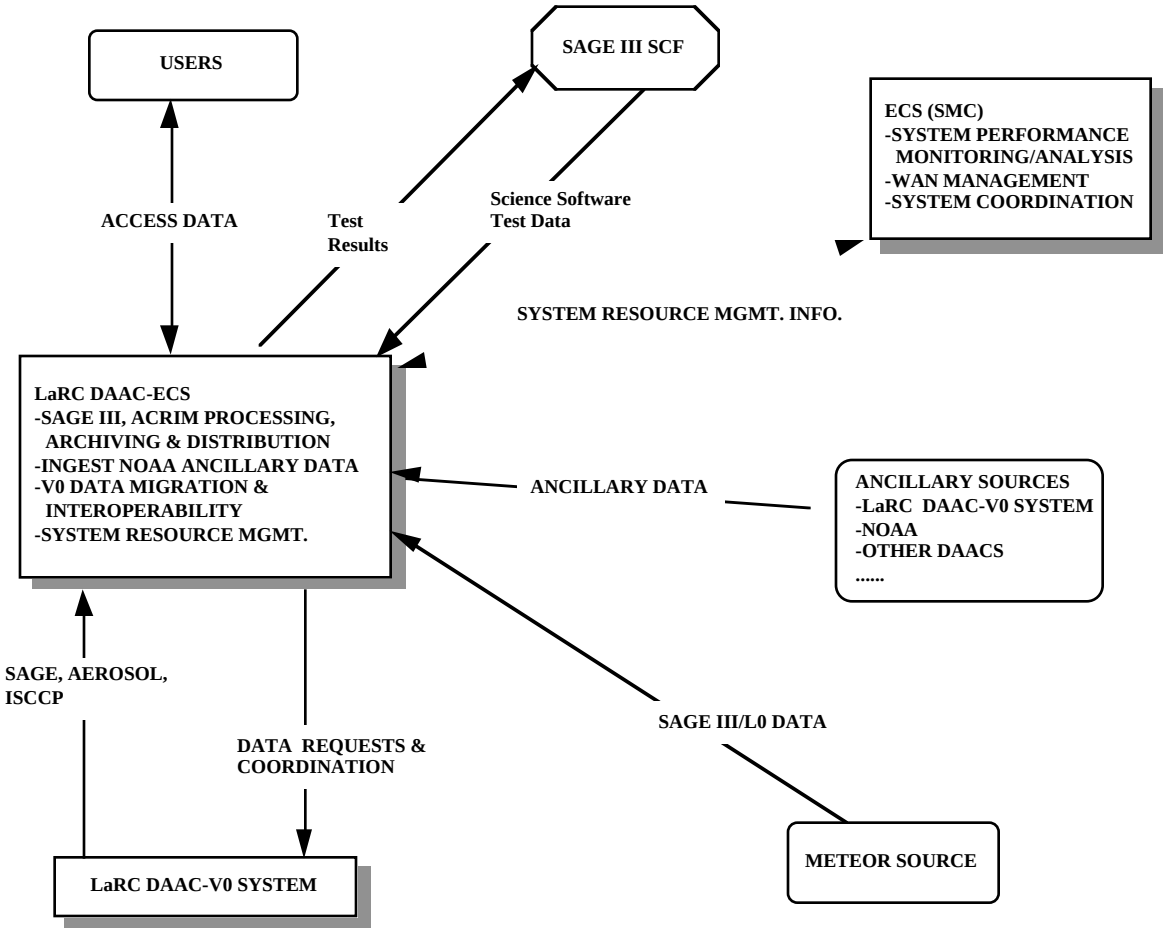

Figure 3.7.8-1. ECS Support of the SAGE III Mission

3.7.9 SAR Support

The ERS-1, ERS-2, JERS-1 and Radarsat Missions together comprise the SAR Mission. See Figure 3.7.9-1 for an overview of ECS support of the SAR mission.

SAR Science Software will be delivered to the ASF DAAC for I&T in the pre-mission timeframe. SAR level 0 data will be ingested at the ASF DAAC. SAR higher level products will be produced and archived at ASF. ECS will support full access to SAR products. Details on SAR operations at ASF may be found in Section 5.2.

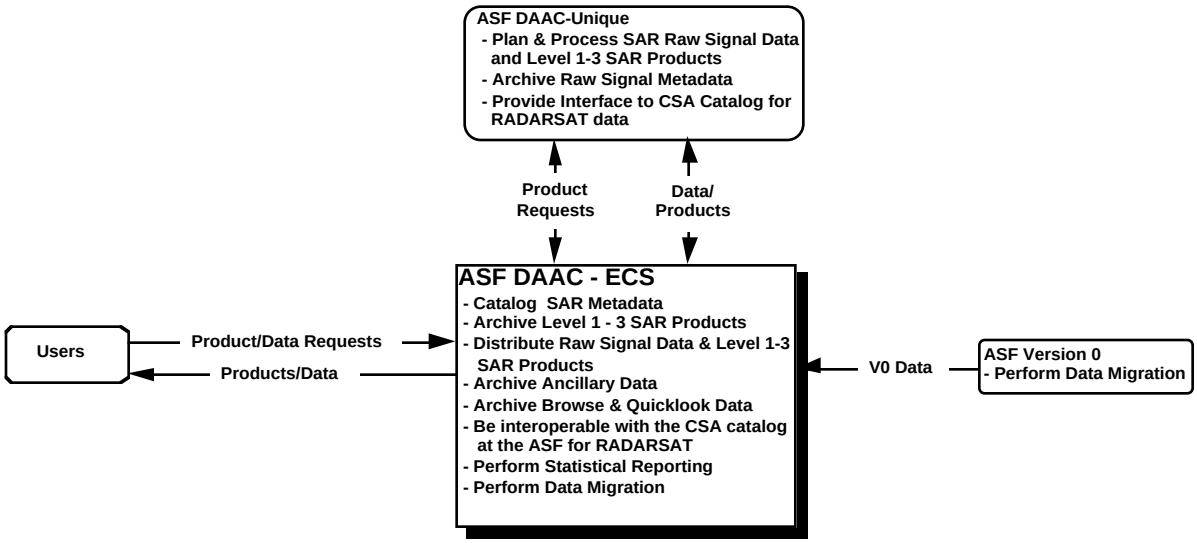

Figure 3.7.9-1. ECS Support of Synthetic Aperture Radar (SAR) Missions

3.7.9.1 ERS-1, ERS-2 Mission Support

ERS-1 launched July 1991; ERS-2 launched April 1995

ECS supports ERS-1, and ERS-2 for archiving and distributing processed products and associated metadata, performing order management, and facilitating user access to data. It is expected that ECS will migrate existing data from the "V0" system and then support these missions operationally (receipt of daily data products) after Release B delivery.

3.7.9.2 JERS-1 Mission Support

JERS-1 launched Feb., 1992

ECS supports JERS-1 for archiving and distributing processed products and associated metadata, performing order management, and facilitating user access to data. It is expected that ECS will migrate existing data from the "V0" system and then support these missions operationally (receipt of daily data products) after Release B delivery.

3.7.9.3 RADARSAT Mission Support

RADARSAT scheduled for October 1995.

ECS supports RADARSAT for archiving and distributing processed products and associated metadata, performing order management, and facilitating user access to data. It is expected that ECS will migrate existing data from the "V0" system and then support these missions operationally (receipt of daily data products) after Release B delivery.

3.7.10 Data Assimilation Office (DAO) Support

The Data Assimilation Office (DAO), located at GSFC and part of the GSFC DAAC, is responsible for developing advanced assimilation algorithms used to produce research-quality assimilated data products, e.g., multi-year gridded global atmospheric datasets, for the Earth Observing System (EOS). Data from the National Oceanic and Atmospheric Administration (NOAA) and other sources are provided to the Data Assimilation System (DAS) (at the DAO) in an operational mode. Some of the DAO-acquired NOAA (i.e., NMC) datasets are required by ECS as ancillary data for ECS production (e.g., CERES). In addition, ECS supplies the TRMM Science Data Information System (TSDIS) with ancillary data, including the NMC data, for TSDIS production. All DAS data production and archival takes place at the GSFC DAAC.