

**GSFC ESDIS CMO**  
**November 1, 2016**  
**Released**

423-ICD-012, Original  
Earth Science Data and Information Systems (ESDIS), Code 423

**Interface Control Document Between the  
ECOsystem Spaceborne Thermal  
Radiometer Experiment on Space Station  
(ECOSTRESS) Science Data System (SDS)  
and the LP DAAC**



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**Goddard Space Flight Center**  
**Greenbelt, Maryland**

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National Aeronautics and  
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## Interface Control Document Between the ECOsystem Spaceborne Thermal Radiometer Experiment on Space Station (ECOSTRESS) Science Data System (SDS) and the LP DAAC Signature/Approval Page

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## Preface

This document is under ESDIS Project configuration control. Once this document is approved, ESDIS approved changes are handled in accordance with Class I and Class II change control requirements described in the ESDIS Configuration Management Procedures, and changes to this document shall be made by document change notice (DCN) or by complete revision.

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## Abstract

This document shall be used in conjunction with the Interface Control Document between the Earth Observing System Data and Information System (EOSDIS) Core System (ECS) and the Science Investigator-led Processing Systems (SIPS) Volume 0 (Document Number 423-41-57) for implementing the interfaces and data flows between the ECOSTRESS SDS and the LP DAAC. The ECOSTRESS SDS is located at JPL.

**Keywords:** *ECOSTRESS, LP DAAC, SDS, ICD*

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## Change History Log

Revision	Effective Date	Description of Changes (Reference the CCR & CCB Approval Date)
Original, Baseline	TBD	CCR 423-ESDIS-95; Approved 1/15/2016; funding approved 8/2016.

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# 1 INTRODUCTION

## 1.1 Scope

This Interface Control Document (ICD) provides specific information about the interfaces between the ECOsystem Spaceborne Thermal Radiometer Experiment on Space Station (ECOSTRESS) Science Data System (SDS) and the Land Processes (LP) Distributed Active Archive Center (DAAC). The ECOSTRESS SDS has facilities at Jet Propulsion Laboratory (JPL) to provide L0 through L4 data products and metadata to the LP DAAC located at the US Geological Survey (USGS) Earth Resources Observation and Science (EROS) Center in Sioux Falls, South Dakota. The LP DAAC will then distribute L1 through L4 ECOSTRESS data products and metadata to the ECOSTRESS science users. The interfaces defined are in support of routine Standard Product generation and distribution for the ECOSTRESS instrument.

The LP DAAC and ECOSTRESS Projects have joint responsibility for the maintenance of this ICD. Any changes in the interfaces must be agreed to by the relevant participating parties, and then assessed at the ESDIS Project Level. This ICD will be approved under the signature of ESDIS, LP DAAC and ECOSTRESS Project Managers.

The standard products identified in this ICD are one of the types of ECOSTRESS data and information to be archived at LP DAAC. The parent document “NASA Earth Science Data Preservation Content Specification” identifies additional categories of data and information (like software, algorithms, ancillary data, etc.) from the ECOSTRESS Project that will be archived by National Aeronautics and Space Administration (NASA). Plans will be made to identify and transfer these other data and information to the appropriate NASA archive before the end of the ECOSTRESS mission. The additional categories of data and information specified in the parent document are outside the scope of this ICD.

Included are:

- a. Documentation references.
- b. Context information for the LP DAAC-ECOSTRESS interfaces.
- c. Identification of Standard Products generated by ECOSTRESS along with other products generated by ECOSTRESS that directly support Standard Products for transfer to the LP DAAC for archive and distribution.

## 1.2 Mission Description

The Science Mission Directorate (SMD) at NASA Headquarters selected the ECOSTRESS as an Earth System Science Pathfinder (ESSP) Earth Venture Instrument (EVI-2) class Mission of Opportunity. The NASA JPL is responsible for the development and operation of the ECOSTRESS project. The ECOSTRESS instrument is manifested to be deployed on the International Space Station (ISS) at the Japanese Experiment Module-Exposed Facility (JEM-EF) site 10 in August 2017. The instrument is currently planned to be deployed for one year after 30 days of In-Orbit Checkout (IOC), with a possibility of an extended mission.

ECOSTRESS will answer critical scientific questions on plant–water dynamics and the potential for future ecosystem changes with climate and allow us to address the following science objectives:

1. Identify critical thresholds of water use and water stress in key climate sensitive biomes;
2. Detect the timing, location, and predictive factors leading to plant water uptake decline and/or cessation over the diurnal cycle; and,
3. Measure agricultural water consumptive use over the contiguous United States (CONUS) at spatiotemporal scales applicable to improve drought estimation accuracy.

ECOSTRESS will use thermal infrared (TIR) brightness temperature measurements made from the ISS to address the science objectives. The ECOSTRESS payload is a stand-alone instrument built using the Prototype HypsIRI Thermal Infrared Radiometer (PHyTIR) instrument, with additional elements as required to enable installation and operation on the ISS. The ECOSTRESS instrument is a multispectral thermal infrared radiometer that can support up to six spectral bands. The ECOSTRESS instrument uses an actively cooled mercury cadmium telluride (MCT) detector and operates in a whiskbroom mode with a continuously rotating scan mirror. ECOSTRESS data are calibrated with one or more blackbodies, which are viewed with each mirror scan.

### 1.3 Land Processes Distributed Active Archive Center Mission Overview

The LP DAAC operates as a partnership between the USGS and the NASA. The LP DAAC serves to complement NASA's Earth Observing System Data and Information System (EOSDIS). Science data specialists, systems engineers, user services representatives, and outreach staff work together to support LP DAAC activities and distribute data to the remote sensing community.

The LP DAAC provides land data products that are vital contribution to the inter-disciplinary study of the integrated Earth system to the public remote sensing community.

### 1.4 Related Documentation

The latest versions of all documents below should be used. The latest ESDIS Project documents can be obtained from URL: <https://ops1-cm.ems.eosdis.nasa.gov>. ESDIS documents have a document number starting with either 423 or 505. Other documents are available for reference in the ESDIS project library website at: [https://esdisfmp.gsfc.nasa.gov/fmi/xsl/esdis\\_lib/default.xsl](https://esdisfmp.gsfc.nasa.gov/fmi/xsl/esdis_lib/default.xsl) unless indicated otherwise.

#### 1.4.1 Parent Documents

The parent document is the document from which this interface control document's scope and content are derived

423-41-57	ICD Between the EOSDIS Core System (ECS) and the Science Investigator-led Processing Systems (SIPS), Volume 0
423-ICD-002_Z	Appendix Z. ICD Between the EOS Networks and the ECOSTRESS ICD
ECOSTRESS-ESDIS-IPA	Inter-Project Agreement (IPA) Between the NASA ECOSTRESS Project and the ESDIS Project for Science Data Archive and Distribution Support, July 2015.
423-SPEC-001	NASA Earth Science Data Preservation Content Specification

#### 1.4.2 Applicable Documents

The following documents are referenced within this interface control document, or are directly applicable, or contain policies or other directive matters that are binding upon the content of this volume.

423-46-01	Functional and Performance Requirements Specification for the ECS Science Data Processing System.
423-RQMT-003	Metadata Requirements – Base Reference for NASA Earth Science Data Products
611-EED-001	Release 8.0 Mission Operation Procedures for the EED Contract

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## 2 ECS DAAC-ECOSTRESS INTERFACE SPECIFICS

### 2.1 Interface Characteristics

Figure 2-1 ECOSTRESS Data Flow summarizes the data flows between the LP DAAC and the ECOSTRESS SDS.

This section describes the data flows between ECOSTRESS SDS and the LP DAAC. The type of data exchanged between ECOSTRESS SDS and the LP DAAC include Level 0 through Level 4 products, metadata and ancillary data.

The ECOSTRESS SDS will receive raw ISS and instrument packet data from the Huntsville Operations Support Center (HOSC) Payload Operations Integration Center (POIC) and process it into higher-level data products. Level 1 products will include metadata for processing and further decoding the data, such as geometric and calibration coefficients. Level 2 surface temperature and emissivity products will be generated using existing retrieval algorithms developed for the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) and Moderate Resolution Imaging Spectroradiometer (MODIS) instruments. Level 3 evapotranspiration and Level 4 water use efficiency and evaporative stress index products will be generated in cooperation with ECOSTRESS science co-investigators at the U.S. Department of Agriculture (USDA). The ECOSTRESS SDS will deliver these data products to the LP DAAC for the purposes of archival and distribution. The LP DAAC will only interface to the JPL SDS, and will not be receiving any products directly from the Marshall Space Flight Center (MSFC) HOSC.

### 2.2 ECOSTRESS Data/Information Flows

Table 2-1 summarizes the data flows between the LP DAAC and the ECOSTRESS SDS.

The ECOSTRESS SDS provides metadata and standard product data granules via a standardized electronic polling with delivery record mechanism. The ECOSTRESS SDS will generate metadata in XML format for each delivered granule, Level 0 – Level 4. In addition to the data, the ECOSTRESS SDS is also responsible for providing the algorithm packages to the LP DAAC for archive and distribution. The NASA Earth Science Data Preservation Content Specification (Reference 423-SPEC-001) defines the contents of all items needed for preservation at the end of the mission to ensure their availability to support future investigations in long-term scientific research. The ECOSTRESS SDS will work with the LP DAAC to ensure that the items needed for preservation are collected and archived.

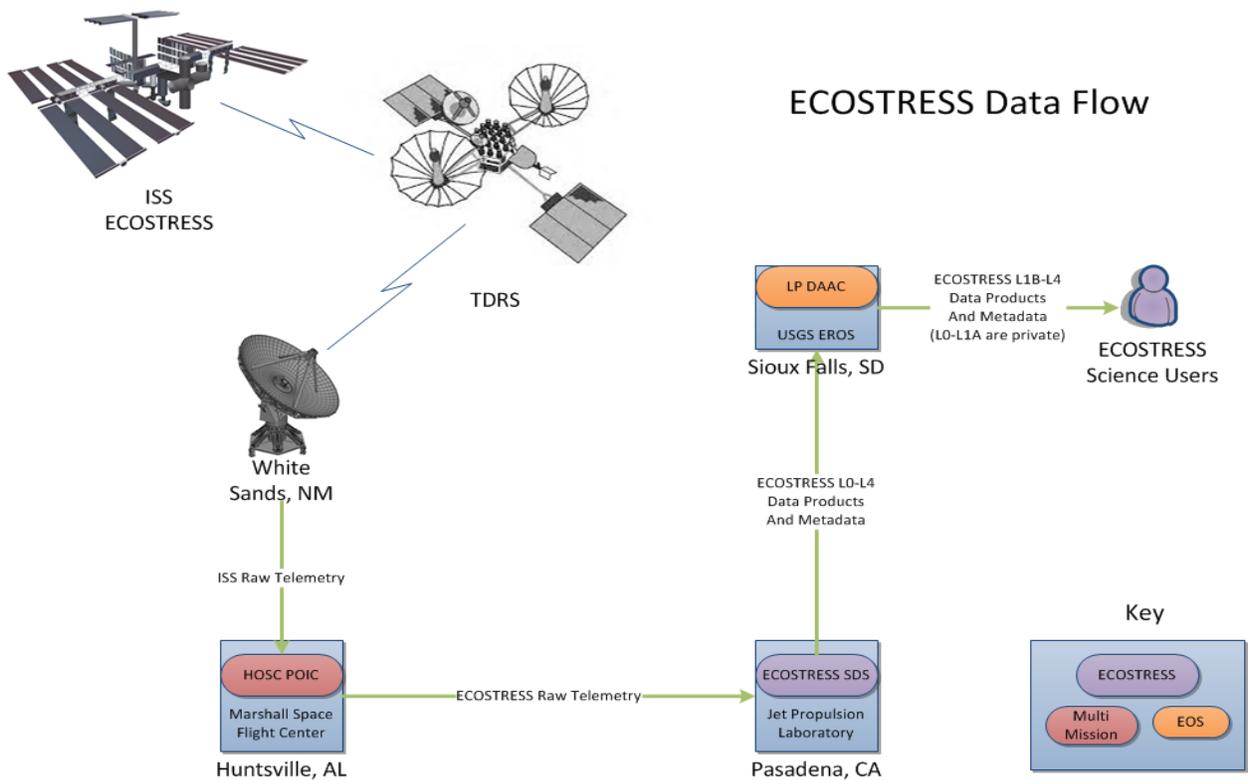


Figure 2-1 ECOSTRESS Data Flow

Table 2-1 LP DAAC and SDS Interface Overview

Item No.	Source	Destination	Message	Data	Transfer Mechanism	Frequency
1	SDS	DAAC	PDR	N/A	Pull initiated by DAAC	In sync with Standard Products
2	SDS	DAAC	N/A	ECS Metadata File for each granule transferred	Pull initiated by DAAC	In sync with Standard Products
3	SDS	DAAC	N/A	Standard Products	Pull initiated by DAAC	Daily
4	DAAC	SDS	PDRD (Short/Long)	N/A	Push and/or email initiated by DAAC	In sync with Standard Products (when needed)
5	DAAC	SDS	PAN (Short/Long)	N/A	Push and/or email initiated by DAAC	In sync with Standard Products (when needed)
6	SDS	DAAC	N/A	Report of granules sent since last report	Refer to OAs	Refer to OAs

### 2.3 Products Produced by ECOSTRESS SDS for delivery to the LP DAAC

The ECOSTRESS SDS uses the ECS specified Polling with Product Delivery Record (PDR) ingest based data transfer scheme for delivering all ECOSTRESS standard products to the LP DAAC. Any reference below to PDR server implies the PDR server at JPL. The LP DAAC pulls L0-L4 products from the JPL PDR server.

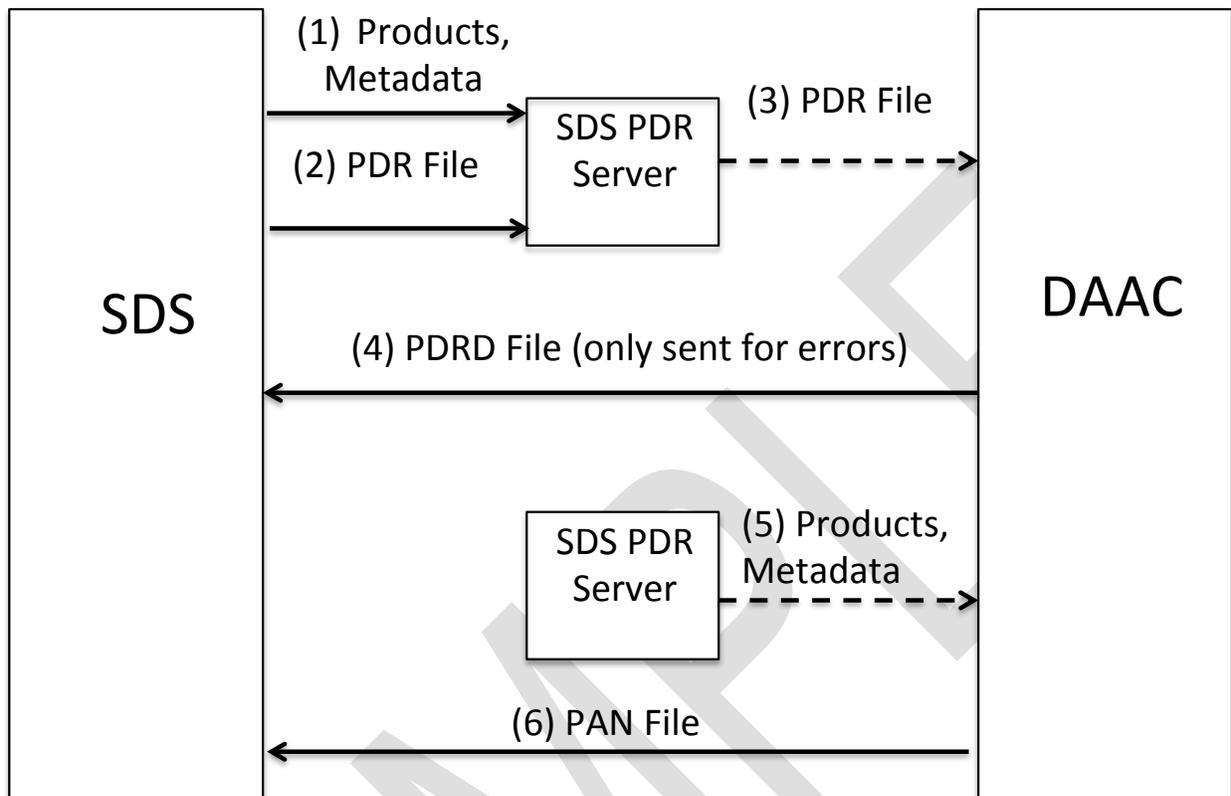
Figure 2-2 Provides an illustration of the Data Pool Ingest Polling with Delivery Record and archiving processes which are described in the following steps:

- (1) The SDS places ECOSTRESS data files in specified locations on the PDR Server.
- (2) The SDS generates a PDR and places it on the PDR Server in a previously specified directory.
- (3) The LP DAAC continually polls the PDR Server directory, detects a PDR, and acquires the PDR file via a secure transfer mechanism.
- (4) Once a PDR has been detected and acquired by the LP DAAC, the PDR is validated. In the event that the PDR is invalid, the LP DAAC automatically returns a Product Delivery Record Discrepancy (PDRD) to the SDS. If an error is detected in the PDR, LP DAAC processing is terminated and none of the specified files are transferred to the LP DAAC for processing until a corrected PDR is received from the SDS and successfully processed. If the PDR is valid, the LP DAAC pulls the files specified in the PDR from the PDR Server using ftp and no PDRD is sent.
- (5) The LP DAAC pulls the specified files from the PDR Server to be ingested or otherwise processed. The files are then archived.
- (6) The LP DAAC sends a Production Acceptance Notification (PAN) to the SDS. There are two forms of the PAN, a short form and a long form. The short form of the PAN is sent to acknowledge that all files have been successfully transferred, or to report errors that are not specific to individual files but which have precluded processing of any and all files (e.g., scp failure). If all files in a request do not have the same disposition, the long form of this message is employed. The SDS is responsible for deleting ECOSTRESS products and files, from the PDR server, after the products have been successfully ingested by the LP DAAC.

**Table 2-2 Product Delivery Record FILE\_TYPEs Used by ECOSTRESS**

<b>PDR FILE_TYPE</b>	<b>Description</b>
CFdata	File is a science data granule that conforms to Climate Forecast (CF) conventions and metadata such as in HDF5 and/or netCDF file format(s).
METADATA	File is XML metadata (conformant with the ECS data model), which accompanies all science and ancillary data granules at the collection level.
SCIENCE	File contains science data in an unspecified format.
QA	File is a pixel-by-pixel quality assessment layer included in the CFdata HDF5 file for L1-L4 products.

\*Browse files will be generated using HDF5 to GeoTIFF tool through a data exchange tool, such as GDAL.



**Figure 2-2 LP DAAC – ECOSTRESS Interface for Product Delivery Data Flows**

## 2.4 File Naming Convention

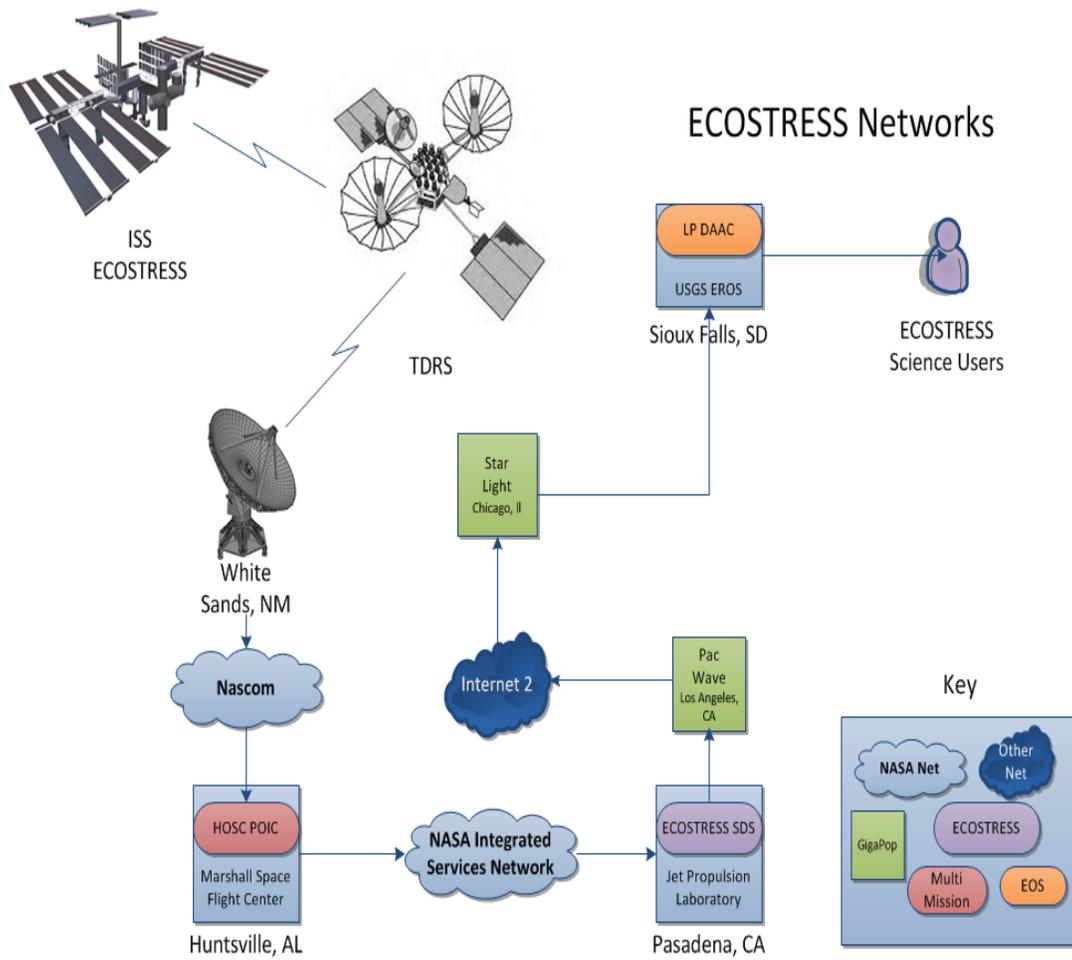
Other than the restriction that PDR filenames must end in “.pdr”, the ECS system only requires unique filenames. Since the ECOSTRESS file naming convention more than meets this requirement, it will be used (see document: ECOSTRESS-xxx-xxx-15).

## 2.5 Granule Reports

Granule reports will be generated by the ECOSTRESS SDS and sent to the LP DAAC. These weekly reports sent via email will list the granules that have been sent to the LP DAAC since the last report was generated. The reports will contain information including count, size, whether the granule is orderable, and the version numbers for each granule ShortName.

## 2.6 ECOSTRESS Networks and Connectivity

The network architecture between JPL and LP DAAC is illustrated in Figure 2-3



**Figure 2-3 ECOSTRESS Networks**

## 2.7 LP DAAC Implementation Details

### 2.7.1 Products Generated by ECOSTRESS for delivery to the LP DAAC

The ECOSTRESS SDS is charged with the production and delivery of the Standard Data Products, listed in Table 2-3, to the LP DAAC.

Additional information on network capability requirements are discussed in 423-ICD-002\_Z: Appendix Z. ICD Between the EOS Networks and the ECOSTRESS SDS.

**Table 2-3 Standard Data Products Archived at the LP DAAC**

<b>PDR FILE_TYP E</b>	<b>Short Name</b>	<b>Data Level</b>	<b>Collection Description</b>	<b>Granule Size (MB)</b>	<b>Granules/ Day</b>	<b>Average Vol/Day (GB) Uncompressed</b>	<b>Average Vol/Day (GB) Compressed</b>
SCIENCE METADATA	ECOSTRESSL0	L0	Raw Instrument Telemetry and engineering data	5080	12	61	24.5
HDF METADATA QA	ECOSTRESSL1APIX	L1A	Parsed Radiometer pixels	4024	74	298	298
HDF METADATA QA	ECOSTRESSL1ABB	L1A	Black Body calibration data	19	74	1.4	1.4
HDF METADATA QA	ECOSTRESSL1BGEO	L1B	Geolocation Parameters	1140	74	83.4	83.4
HDF METADATA QA	ECOSTRESSL1BRAD	L1B	Calibrated at- sensor radiance	402	74	29.8	29.8
HDF METADATA QA	ECOSTRESSL1BATT	L1B	Refined S/C attitude/ephemeris	0.0023	74	0.17	0.17
HDF METADATA QA	ECOSTRESSL2TES	L2	Surface emissions and temperatures	1073	74	79.4	79.4
HDF METADATA QA	ECOSTRESSL2CLOUD	L2	Cloud mask	67	74	5.0	5.0
HDF METADATA QA	ECOSTRESSL3ET	L3	Evapotranspiration	536	74	39.7	39.7
HDF METADATA QA	ECOSTRESSL4ESI	L4	Evaporative Stress Index	201	74	14.9	14.9
HDF METADATA QA	ECOSTRESSL4EWUE	L4	Water Use Efficiency	134	74	9.9	9.9
TOTAL					752	623	586

## Appendix A Abbreviations and Acronyms

ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
CF	Climate Forecasting
CMO	Configuration Management Office
CONUS	Contiguous United States
DAAC	Distributed Active Archive Center
DCN	Document Change Notice
ECOSTRESS	ECOSystem Spaceborne Thermal Radiometer on Space Station
ECS	EOSDIS Core System
EED	EOSDIS Evolution and Development
EOS	Earth Observing System
EOSDIS	EOS Data and Information System
EROS	Earth Resources Observation and Science
ESDIS	Earth Science Data and Information System
ESSP	Earth System Science Pathfinder
EVI-2	Earth Venture Instrument
FTP	File Transfer Protocol
GB	Gigabytes
GDAL	Geospatial Data Abstraction Library
GeoTiff	Graphic Tagged Image File Format
GigaPoP	Gigabit Point of Presence
GSFC	Goddard Space Flight Center
HDF	Hierarchical Data Format
HOSC	Huntsville Operations Support Center
ICD	Interface Control Document
IOC	In-Orbit Checkout
IPA	Inter-Project Agreement
ISS	International Space Station
JEM-EF	Japanese Experiment Module-Exposed Facility
JPL	Jet Propulsion Laboratory
L0 – L4	Level 0 through Level 4
LP	Land Processes
MB	Megabytes
MCT	Mercury Cadmium Telluride
MODIS	Moderate Resolution Imaging Spectroradiometer
MSFC	Marshall Space Flight Center
NASA	National Aeronautics and Space Administration
NASCOM	NASA Communications
netCDF	Network Common Data Form
NISN	NASA Integrated Services Network
OA	Operations Agreement
PAN	Production Acceptance Notification
PDR	Product Delivery Record

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PDRD	Product Delivery Record Discrepancy
PHYTIR	Prototype HypsIRI Thermal Infrared Radiometer
POIC	Payload Operations Integration Center
QA	Quality Assurance
SCP	Secure Copy Protocol
SDS	Science Data System
SIPS	Science Investigator-led Processing Systems
SMD	Science Mission Directorate
TDRS	Tracking And Data Relay Satellite
TIR	Thermal Infrared
USDA	United States Department of Agriculture
USGS	United States Geological Survey
XML	Extensible Markup Language