Introduction

Many NASA Earth Observing System (EOS) have either already reached the end of their active life or are nearing it. Preservmissionsation of data products is a fairly well defined task for the NASA EOS Data Centers or DAACs. However, supporting documentation and other artifacts from these missions are also critical to the long-term studies of our planet's climate, and to aid future generation's ability to understand climatic changes. The challenge is how to preserve these items along with the traditional data products.

The Goddard Earth Sciences Data and Information Services Center (GES-DISC) has implemented a repository system, which is capable of long-term archive of documentation artifacts and other associated digital content. The existing GES-DISC Repository System is based on Fedora Commons, an open-source repository management software, for cost savings and flexibility.

The first mission to utilize the GES-DISC Repository System was the High Resolution Dynamics Limb Sounder (HIRDLS) on the Aura spacecraft. Since then, the GES DISC has gathered documentation from the UARS and TOMS into the Repository. The Microwave Limb Sounder (MLS) team has begun delivering some early pre-launch documents to the GES-DISC Repository System as well. Other missions in planning or progress include AIRS, OMI, SORCE, SNPP Sounder, and TRMM.

NASA Earth Science Data Preservation Content Specification 432-SPEC-001

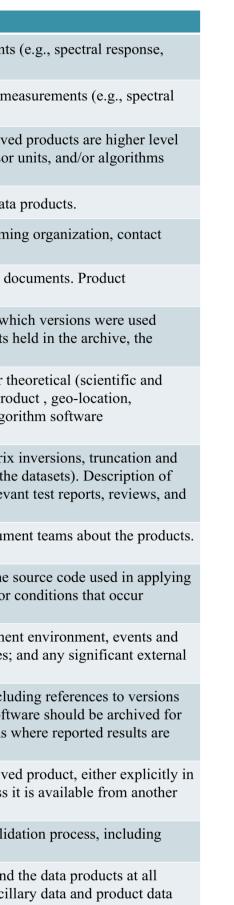
Being able to understand and interpret data from these older missions after the experts familiar with them have moved on or are no longer available is a concern to NASA. The importance of preserving the Earth Science documentation and data resulted in the issuance of the "NASA Earth Science Data Preservation Content Specification" (423-SPEC-001) for the Earth Science Data and Information System (ESDIS) supported data centers. Documents and data in the GES-DISC repository are archived and classified according to 423-SPEC-001 into 9 categories listed in the table below for each mission.

Available at https://earthdata.nasa.gov/files/NASA_ESD_Preservation_Spec.pdf

1. Category	2. Content Item	3. Definition/Description		
Preflight/Pre- Operations Calibration	Instrument Description	Documentation of Instrument/sensor characteristics including pre-flight or pre-operational performance measurements instrument geometric calibration (geo-location offsets), noise characteristics, etc.).		
	Preflight/Pre-operational Calibration Data	Numeric (digital data) files of Instrument/sensor characteristics including pre-flight or pre-operational performance meresponse, instrument geometric calibration (geo-location offsets), noise characteristics, etc.).		
Science Data Products	Raw Data and Derived Products	Raw data are data values at full resolution as directly measured by a spaceborne, airborne or <i>in situ</i> instrument. Derive products (level 1b through 4) where calibration and geo-location transformations have been applied to generate sensor have been applied to generate gridded geophysical parameters.		
	Metadata	Information about data to facilitate discovery, search, access, understanding and usage associated with each of the		
Science Data Product Documentation	Product Team	Names of key science team leads and product team members (development, help desk and operations), roles, performing information, sponsoring agencies or organizations and comments about the products.		
	Product Requirements	Requirements and designs for each science data product, either explicitly or by reference to the requirements/design do requirements and designs should include content, format, latency, accuracy and quality.		
	Processing and Algorithm Version History	For all products held in the archive, documentation of processing history and production version history, indicating when, why different versions came about, and what the improvements were from version to version. For all products h versions of source code used to produce the products should be available at the archive.		
	Product Generation Algorithm	Detailed discussion of processing algorithms, outputs, error budgets and limitations. Processing algorithms and their the mathematical) basis, including complete description of any sampling or mapping algorithm used in creation of the product, algorithmetric calibration, geophysical parameters, sampling or mapping algorithms used in creation of the product, algorithmetric documentation, & high-level data flow diagrams. Description of how the algorithm is numerically implemented.		
	Product Quality	Description of the impact to product quality due to issues with computationally intensive operations (e.g., large matrix rounding). Documentation of product quality assessment (methods used, assessment summaries for each version of the embedded data at the granule level including quality flags, product data uncertainty fields, data issues logs, etc. Releva appraisals.		
	Product Application	Useful references to published articles about the use of the data and user feedback received by the science and instrum. Includes reports of any peculiarities or notable features observed in the products.		
Mission Data Calibration	Calibration Method	The methods used for instrument/sensor radiometric and geometric calibration while in operation (e.g., in orbit). The set the calibration algorithms. Documentation of in-line changes to calibration or to instrument or platform operations or throughout the mission.		
	Calibration Data	Instrument and platform engineering data collected during operations (e.g., on orbit), including platform and instrument maneuvers; attitude and ephemeris; aircraft position; acquisition logs that record data gaps; calibration look-up tables; event data that may have impacted the observations.		
Science Data Product Software	Science data product generation software and software documentation	Source code used to generate products at all levels in the science data processing system. Software release notes of operating systems, compilers, commercial software libraries used in the code. Versions of science data product each major product release. A major product release is characterized by the appearance of peer reviewed publicate based on the product version.		
Science Data Product Algorithm Inputs	Ancillary data and documentation	Complete information on any ancillary data or other data sets used in generation or calibration of the data set or derive data descriptions or by reference to appropriate publications. Ancillary data should be stored with the products unless is permanent archive facility.		
Science Data Product Validation	Datasets and documentation	Accuracy of products, as measured by validation testing, and compared to accuracy requirements. Description of valid identification of validation data sets, measurement protocols, data collection, analysis and accuracy reporting.		
Science Data Software Tools	Software and documentation	Product access (reader) tools. Software source code that would facilitate use of the calibration data, ancillary data and levels. Includes software source code useful for creating programs that will read and display the calibration data, ancill and metadata values. Commercial tools should be identified with appropriate references.		

Data Preservation Final Step in the Life Cycle of a Mission

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Fedora Commons Interface

The GES-DISC uses Fedora Commons, an open-source repository management system that is used in many universities, research centers, and libraries. It comes with a simple web-based GUI interface which provides for easy administration of the system. The GUI also allows one to enter objects or datastreams (these can be of any type document, image, source code, binary data, etc.) into the system. The system uses XML to manage the objects. The GES-DISC has also developed a command line script to allow batch ingest of objects into the Fedora Repository.

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Public Access of Preservation Documents

External users access the publicly available documents by visiting the mission specific documentation page for that instrument. The Fedora repository system is at the backend and makes access to the linked documents possible. Note that restricted objects (ITAR, proprietary, or software) are not accessible through the public interface. Four missions are now public:

https://disc.gsfc.nasa.gov/information/documents?title=MLS%20Mission%20Preservation%20Documents MLS

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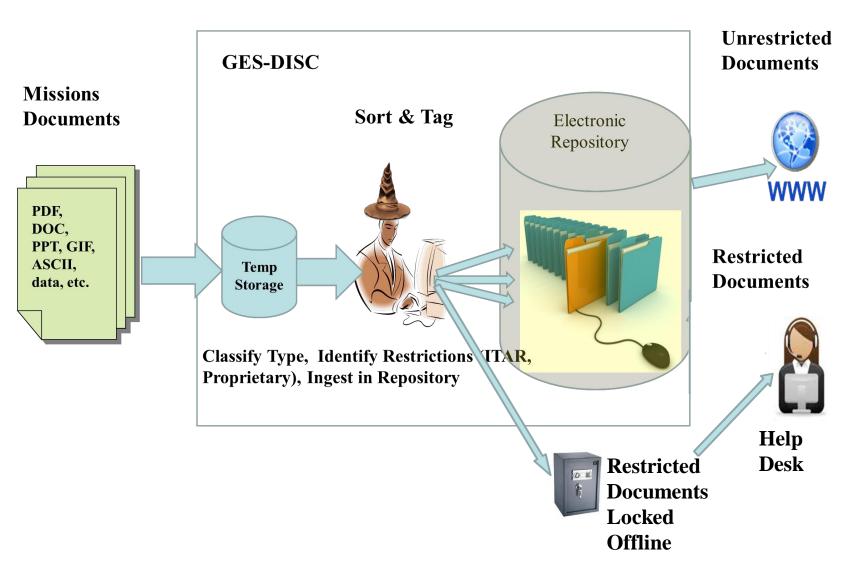
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HIR	DLS Mission Preservation Documents	Originator: John C. Gille	Date: 1997–10-20	
	ort to more readily distributed documentation related to the legacy Aura/HIRDLS mission, we are making available a listing of all			
	accessible documents with URL links to the actual documents. The documents have been organized according to the NASA Earth Data Preservation Content Specification (423-SPEC-001). Please refer to this document for the overall preservation guidelines	Subject / Title: Instrument Requirements Doc	ument (IRD)	
and polic	icies of the ESDIS supported missions. If you have a problem retrieving any of the documents listed here, please send an e- mail to o Desk (gsfc-help-disc@lists.nasa.gov) with the name of the document and any information describing the problem you			
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	ectral Performance and Spectral Verification Requirements for HIRDLS Optical Elements: SP-HIR-155.pdf			
	aseline Scan Patterns for HIRDLS Design and Test: SP-HIR-198.pdf			
	ience Algorithm Implementation Language (SAIL) Requirements Document: SW-HIR-1470.pdf			
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NASA/Goddard Earth Sciences Data and Information Services Center (GES DISC)

GES DISC Data Preservation Implementation

Overview of the physical objects sorting, tagging, storage in archive and distribution system.

Restricted documents are currently only available by contacting the GES DISC user services.



1) Identify documentation

GES DISC Science Support staff identified specific information needed permission in Data Preservation Mission List by working closely with the original mission teams to sort out documents for preservation

2) Specify and implement preservation environment

- a) Local archive based on open-source system Fedora Commons
- b) Implementation is complete for HIRDLS, TOMS and UARS missions
- c) Other missions MLS, OMI, AIRS, SORCE, TRMM, etc. are in progress

3) Retrieve documentation

Public documents accessed by users from GES DISC web site

4) Implement retrieval and distribution services

- a) Access for internal GES-DISC users
- b) External Access via WWW for unrestricted (public) documents
- c) External Access for restricted documents (ITAR) via User Services contact
- *d) Iterate with other DAACs/community*

Lessons Learned, Challenges, Future

- Heritage missions require extensive work to identify and classify documents
- Restricted (ITAR or Proprietary) requires special handling vs. Unrestricted
- Incorporate DOI metadata into repository (if available)
- Replace or upgrade Fedora Commons which is currently 5 years old
- Move Repository to a NASA ESDIS-wide Repository?

Aura STM 2019

https://disc.gsfc.nasa.gov