



## Assessment Information

[CoreTrustSeal Requirements 2017–2019](#)

Repository: Level-1 and Atmosphere Archive & Distribution System (LAADS)  
Distributed Active Archive Center (DAAC)  
Website: <https://ladsweb.modaps.eosdis.nasa.gov/>  
Certification Date: 12 July 2019

This repository is owned by: **NASA Goddard Spaceflight Center**



# LAADS DAAC

## Notes Before Completing the Application

*We have read and understood the notes concerning our application submission.*

True

*Reviewer Entry*

**Reviewer 1**

Comments:

Yes

**Reviewer 2**

Comments:

## CORE TRUSTWORTHY DATA REPOSITORIES REQUIREMENTS

### Background & General Guidance

### Glossary of Terms

## BACKGROUND INFORMATION

### Context

*R0. Please provide context for your repository.*

*Repository Type. Select all relevant types from:*

Domain or subject-based repository, Institutional repository, National repository system; including governmental, Publication repository, Research project repository

#### *Reviewer Entry*

##### **Reviewer 1**

Comments:

Accept

##### **Reviewer 2**

Comments:

Accept

### ***Brief Description of Repository***

The Level-1 Atmosphere Archive & Distribution System (LAADS) Distributed Active Archive Center (DAAC) is a domain-specific data center for atmospheric science that distributes large volumes of Level-1 as well as higher-level atmospheric, and terrestrial (land and snow/ice) data products primarily from the NASA Earth Observing System's (EOS) Terra and Aqua Moderate Resolution Imaging Spectroradiometer (MODIS), and NASA-NOAA Suomi National Polar-orbiting Partnership's (SNPP) as well as Joint Polar Satellite System's (JPSS) Visible Infrared Imaging Radiometer Suite (VIIRS) missions. The LAADS DAAC also serves the European Space Agency's (ESA ) Envisat Medium Resolution Imaging Spectrometer (MERIS ) and Copernicus-Sentinel-3 Sea and Land Surface Temperature Radiometer (SLSTR) and Ocean and Land Colour Instrument (OLCI) collections.

#### *Reviewer Entry*

##### **Reviewer 1**

Comments:

Accept

##### **Reviewer 2**

Comments:

Accept

### ***Brief Description of the Repository's Designated Community.***

As a domain-specific data center, the LAADS DAAC primarily serves MODIS and VIIRS atmospheric data products to a large and diverse user community, globally. It supports atmospheric science research and applications through a range of science data products and services. A broad categorization of the LAADS atmospheric products include: Aerosol (including dark-target aerosol and deep-blue aerosol), Water Vapor, Cloud (including cloud-top properties, cloud optical properties, cloud particle phase, cloud fraction and Cirrus reflectance), and Atmospheric Profiles. For additional information, check the following sites:

<https://ladsweb.modaps.eosdis.nasa.gov/>

<https://modis-atmos.gsfc.nasa.gov/>

Also, the LAADS DAAC is the primary distributor of the MODIS and VIIRS Level-1 products. These products are used by many research and application users, in addition to the atmospheric community. In addition, the LAADS DAAC serves as a secondary distributor and backup archive for products used by the terrestrial research and applications community, augmenting NASA's Land Processes DAAC (in Sioux Falls, SD) and NASA's National Snow and Ice Data Center DAAC (in Boulder, CO).

#### *Reviewer Entry*

##### **Reviewer 1**

Comments:  
Accept

##### **Reviewer 2**

Comments:  
Accept

### ***Level of Curation Performed. Select all relevant types from:***

A. Content distributed as deposited, B. Basic curation – e.g. brief checking; addition of basic metadata or documentation, C. Enhanced curation – e.g. conversion to new formats; enhancement of documentation, D. Data-level curation – as in C above; but with additional editing of deposited data for accuracy

#### *Reviewer Entry*

##### **Reviewer 1**

Comments:  
Accept

##### **Reviewer 2**

Comments:  
Accept

### ***Comments***

As one of the NASA EOSDIS DAACs, the LAADS DAAC is governed by the "Requirements for Archiving, Distribution and User Services in EOS Data and Information System (EOSDIS)" available via the following URL:

[https://cdn.earthdata.nasa.gov/conduit/upload/11349/423-10-69\\_ADURD\\_RevB.pdf](https://cdn.earthdata.nasa.gov/conduit/upload/11349/423-10-69_ADURD_RevB.pdf)

#### *Reviewer Entry*

##### **Reviewer 1**

Comments:  
Accept

##### **Reviewer 2**

Comments:  
Accept

## *Outsource Partners. If applicable, please list them.*

Not applicable

### *Reviewer Entry*

#### **Reviewer 1**

Comments:  
Accept

#### **Reviewer 2**

Comments:  
Accept

## *Other Relevant Information.*

The LAADS DAAC is one of the twelve NASA Earth Observing System Data and Information System (EOSDIS) data centers that is managed by NASA's Earth Observing System Data Information System (ESDIS) Project, which is a Network Member of the WDS. Based on the FY2017 metrics that covers the period between October 2016 to September 2017, the LAADS DAAC's metrics include the following:

Unique Datasets: 1,906

Distinct users of data and services: 388,119

LAADS Web site visits: 301,594

Average archive growth: 0.85 TB/day

Total archive volume: 5,818 TB

Number of data products distributed to end-users: 108 million

Average volume distributed to end-users: 6.07 TB/day

Number of distinct global data users: 226,661

### *Reviewer Entry*

#### **Reviewer 1**

Comments:  
Accept

#### **Reviewer 2**

Comments:  
Accept

## **ORGANIZATIONAL INFRASTRUCTURE**

### **I. Mission/Scope**

***R1. The repository has an explicit mission to provide access to and preserve data in its domain.***

### ***Compliance Level:***

4 – The guideline has been fully implemented in the repository

#### ***Reviewer Entry***

##### **Reviewer 1**

Comments:

4 – The guideline has been fully implemented in the repository

##### **Reviewer 2**

Comments:

4 – The guideline has been fully implemented in the repository

### ***Response:***

As part of the larger EOSDIS ecosystem (<https://earthdata.nasa.gov/about/daacs>), the LAADS DAAC's mission is to serve as the steward for satellite-derived atmospheric science data on a global scale. It provides different levels of standard geophysical data products to address critical Earth system science investigations that have been vetted, quality-checked, and validated via established protocols and processes. As part of serving a varied, global user community, the LAADS DAAC provides mechanisms, tools, and services to order, acquire, interact with, understand and use its atmospheric science product portfolio. Earth system science needs and requirements often cross disciplinary boundaries, and LAADS DAAC is well-positioned to serve users in such unique situations. For additional details, check the following URL: <https://ladsweb.modaps.eosdis.nasa.gov/about/purpose/>

As a NASA EOSDIS DAAC, LAADS is governed by the "Requirements for Archiving, Distribution and User Services in EOS Data and Information System (EOSDIS)" available via the following URL:

[https://cdn.earthdata.nasa.gov/conduit/upload/11349/423-10-69\\_ADURD\\_RevB.pdf](https://cdn.earthdata.nasa.gov/conduit/upload/11349/423-10-69_ADURD_RevB.pdf)

#### ***Reviewer Entry***

##### **Reviewer 1**

Comments:

Accept

##### **Reviewer 2**

Comments:

Accept

## **II. Licenses**

***R2. The repository maintains all applicable licenses covering data access and use and monitors compliance.***

***Compliance Level:***

4 – The guideline has been fully implemented in the repository

***Reviewer Entry***

**Reviewer 1**

Comments:

4 – The guideline has been fully implemented in the repository

**Reviewer 2**

Comments:

4 – The guideline has been fully implemented in the repository

***Response:***

The LAADS DAAC conforms to NASA's Earth Science Data and Information Policy

(<https://earthdata.nasa.gov/earth-science-data-systems-program/policies/data-information-policy>) and provides free and open access to scientific data. The LAADS DAAC works directly with data providers throughout the data curation process to ensure that data contents are documented and preserved with the distribution package and appropriate credit is provided to the authors of the data. The LAADS DAAC requests users to include data citations in their publications, and provides specific citation instructions

([https://modaps.modaps.eosdis.nasa.gov/services/faq/LAADS\\_Data-Use\\_Citation\\_Policies.pdf](https://modaps.modaps.eosdis.nasa.gov/services/faq/LAADS_Data-Use_Citation_Policies.pdf)).

***Reviewer Entry***

**Reviewer 1**

Comments:

Accept

**Reviewer 2**

Comments:

Accept

### **III. Continuity of access**

***R3. The repository has a continuity plan to ensure ongoing access to and preservation of its holdings.***

***Compliance Level:***

4 – The guideline has been fully implemented in the repository

*Reviewer Entry*

**Reviewer 1**

Comments:

4 – The guideline has been fully implemented in the repository

**Reviewer 2**

Comments:

4 – The guideline has been fully implemented in the repository

*Response:*

The long-term stability of the LAADS DAAC depends on funding from NASA, our sponsoring agency. NASA has clearly stated that it believes that long-term stewardship of NASA-collected remote sensing and field campaign data are essential. NASA's ESDIS Project, a Network Member of WDS, is responsible for funding and managing all the NASA Earth Science DAACs. The ESDIS Project is in turn funded by the Earth Science Data System Program at NASA Headquarters. As indicated in the ESDIS Project Plan, the functional and performance requirements for the ESDIS Project include the following:

- Provide active archive and distribution services for data until a peer review for science merit removes the need to maintain active status.
- Secure and preserve the unique (irreplaceable) and essential (designated for archive in perpetuity) data and information until such time as they are provided to permanent archival agencies.

Each of the DAACs is governed by the "Requirements for Archiving, Distribution and User Services in EOS Data and Information System (EOSDIS)" available via the following URL:

[https://cdn.earthdata.nasa.gov/conduit/upload/11349/423-10-69\\_ADURD\\_RevB.pdf](https://cdn.earthdata.nasa.gov/conduit/upload/11349/423-10-69_ADURD_RevB.pdf)

This document states: "Requirements to archive and distribute the data for a given mission extend as long as required by the ESDIS Project. This duration is dependent on the active use of the data by NASA-funded investigators and the provisions of long-term archiving as determined by ESDIS. [DAACs] will need to ensure that the data are transitioned to the appropriate Long-Term Archive when NASA notifies the [DAAC] that it is appropriate to do so." In the unlikely event that the NASA-EOSDIS LAADS DAAC is relocated to a different host institution, the LAADS DAAC will follow NASA procedures for activity transition.

*Reviewer Entry*

**Reviewer 1**

Comments:

Accept

**Reviewer 2**



Comments:  
Accept

## IV. Confidentiality/Ethics

***R4. The repository ensures, to the extent possible, that data are created, curated, accessed, and used in compliance with disciplinary and ethical norms.***

### ***Compliance Level:***

0 – Not applicable

#### ***Reviewer Entry***

##### **Reviewer 1**

Comments:  
0 – Not applicable

##### **Reviewer 2**

Comments:  
0 – Not applicable

### ***Response:***

The LAADS DAAC does not archive any data that requires addressing explicit disclosure risk. All data products are freely available at no monetary cost, and are open to the public. The European Space Agency products (for instance, Envisat/MERIS, and Sentinel/SLSTR and OLCI) require users to sign a “Terms & Conditions” agreement that specifically pertain to accepting full responsibility for their use, publishing results based on such use, and data source attribution to ESA. The data archived at the LAADS DAAC pertain to information about Earth and its environment. The LAADS DAAC staff are well-trained to handle such data. Personal and sensitive information are not published or stored in the DAAC archive system.

#### ***Reviewer Entry***

##### **Reviewer 1**

Comments:  
Accept

##### **Reviewer 2**

Comments:  
Accept

## V. Organizational infrastructure

***R5. The repository has adequate funding and sufficient numbers of qualified staff managed through a clear system of governance to effectively carry out the mission.***

### ***Compliance Level:***

4 – The guideline has been fully implemented in the repository

#### ***Reviewer Entry***

##### **Reviewer 1**

Comments:

4 – The guideline has been fully implemented in the repository

##### **Reviewer 2**

Comments:

4 – The guideline has been fully implemented in the repository

### ***Response:***

The LAADS DAAC is housed within NASA's Goddard Space Flight Center in Greenbelt, Maryland, and is funded through a five-year contract by the NASA ESDIS Project. Average spending per year is approximately \$2.3M. Approximately 8.25 (work-year equivalent) staff members support the LAADS DAAC's activities. The DAAC is sufficiently funded to carry out its mission including support for staffing, IT resources, as well as any necessary training and travel.

The LAADS DAAC, located within the Terrestrial Information Systems Laboratory at NASA's GSFC, is run by a diverse array of professionals that includes earth, atmospheric, and image processing/GIS scientists, information scientists, systems engineers and architects, data systems and operations engineers/technicians, software engineers, Web developers, data quality assurance technicians, communications and outreach specialists, and user services professionals. Given its role as an atmosphere DAAC, LAADS personnel also frequently work with and consult domain scientists from the Climate and Radiation Laboratory, which is one of the twelve NASA Earth Sciences Division laboratories at GSFC. The senior leadership includes the DAAC manager and the DAAC chief scientist.

The staff members are well-qualified and have an average of over ten years' experience in their respective fields. Many of them are members of the AGU (American Geophysical Union), ASPRS (American Society for Photogrammetry and Remote Sensing), IEEE's (Institute of Electrical and Electronics Engineers) Geoscience and Remote Sensing Society, SPIE (Society of Photographic Instrumentation Engineers), and/or ACM (Association for Computing Machinery). They remain active in annual conferences to present papers/posters highlighting their work, and network and share with their community peers as well.

### *Reviewer Entry*

#### **Reviewer 1**

Comments:

Accept

#### **Reviewer 2**

Comments:

Accept

## **VI. Expert guidance**

***R6. The repository adopts mechanism(s) to secure ongoing expert guidance and feedback (either inhouse or external, including scientific guidance, if relevant).***

### ***Compliance Level:***

3 – The repository is in the implementation phase

### *Reviewer Entry*

#### **Reviewer 1**

Comments:

3 – The repository is in the implementation phase

#### **Reviewer 2**

Comments:

3 – The repository is in the implementation phase

### ***Response:***

The LAADS DAAC, like almost all EOSDIS DAACS, has an external science advisory group, called a User Working Group (UWG), which comprises of domain-specific applications and research scientists as well as experts proficient in data and information systems. The LAADS DAAC recently established a UWG that provides continuing guidance to the DAAC specific to its data collections and all related aspects that are critical to serve the larger scientific community's needs. The LAADS DAAC UWG is a panel of domain knowledge experts in atmospheric science as well as information science and data management specialists. The UWG meets face-to-face once a year, and deliberates through teleconference on a quarterly basis. In addition, the LAADS DAAC receives less formal input from a variety of sources including members of the MODIS and VIIRS science teams, as well as experts from NASA, other U.S. Federal agencies, and several universities that work closely with NASA.

The LAADS DAAC maintains a User Services Office (USO) whose personnel directly interact with the user community served by the DAAC. The USO is staffed with people skilled in both domain-specific branches of Earth science, and

various aspects of handling and interpreting geospatial data collections specific to the LAADS DAAC.

The LAADS DAAC participates annually in the American Customer Satisfaction Index (ACSI) survey of users of the NASA EOSDIS DAACs. This survey has been conducted annually since 2004 by the CFI Group (<https://cfigroup.com/>), an external independent organization. The results from the survey provide a numerical index of customer satisfaction as well as detailed comments and suggestions to improve existing systems and services. These inputs are assessed regularly by the NASA ESDIS Project and the DAACs, and changes implemented as appropriate.

The LAADS DAAC regularly partners with other DAACs on data management- and data services-related activities. It also participates in expert communities such as the NASA's Earth Science Data System Working Groups (ESDSWG) and the Earth Science Information Partners (ESIP) Federation. The ESDSWG is a NASA organization that focuses on the exploration and development of recommendations derived from pertinent community insights of NASA's heterogeneous and distributed Earth science data systems. The ESIP Federation is a networked community that brings together science, data and information technology practitioners from over 120 organizations including U.S. federal agencies, universities and commercial entities. The LAADS DAAC actively contributes to the mission of these organizations and leverages appropriate new technologies deemed relevant through such partnerships.

#### *Reviewer Entry*

##### **Reviewer 1**

Comments:

Accept

##### **Reviewer 2**

Comments:

Accept

## **DIGITAL OBJECT MANAGEMENT**

### **VII. Data integrity and authenticity**

***R7. The repository guarantees the integrity and authenticity of the data.***

#### ***Compliance Level:***

4 – The guideline has been fully implemented in the repository

#### *Reviewer Entry*

##### **Reviewer 1**

Comments:

4 – The guideline has been fully implemented in the repository

## Reviewer 2

### Comments:

4 – The guideline has been fully implemented in the repository

### *Response:*

As indicated earlier in the Comments to the Background Information/Context section, the LAADS DAAC is a major data receiver and distributor (that is also a secondary distributor for two other domain-specific archives). Co-located with LAADS and sharing many personnel are two NASA Science Investigator-led Processing Systems (SIPS), the MODIS Adaptive Processing System (MODAPS) (<https://modaps.modaps.eosdis.nasa.gov/>) and VIIRS Land SIPS, that produce Level-1 and higher-level products derived from the MODIS and VIIRS instruments, respectively. Therefore, it has in place a number of quality-specific and standards-compliant protocols that cover various aspects of its data collections' lifecycle. Following are brief descriptions of these aspects:

**Data file integrity:** The integrity of all LAADS-produced and -exported data files are verified through the checksum function, specifically using the md5sum algorithm. Such verification happens to both internally produced and exported data; checksums are also employed at receiving DAACs, and are provided to users to validate data after receipt. These checksums are also used to regularly check the integrity of the data store in the LAADS archive.

**Metadata validation:** All metadata generated by the production systems at LAADS conform to acceptable standards defined by ESDIS, and are validated at various stages from algorithm development through the science software integration and testing, and pre-product-release stages to ensure that users expectations are fairly served. LAADS DAAC also works closely with its partner DAACs, who provide feedback based on their evaluation of the science metadata to fine-tune final metadata quality and completeness.

**Quality assurance:** QA comprises a major component of the production workflow within LAADS, and is further described in Section-VIII on Appraisal.

**Product validation:** All LAADS-produced and archived products are validated based on a process followed by each individual science product's Principal Investigator (PI). Consult the following sites for additional information:

<https://ladsweb.modaps.eosdis.nasa.gov/validation/atmosphere/>

<https://landval.gsfc.nasa.gov/>

<https://viirsland.gsfc.nasa.gov/Valstatus.html>

**Version management:** All LAADS-produced and archived products conform to a particular "collection" with an assigned a three-digit version number that is considered the most up-to-date and current publicly available version. To accommodate the evolution of the science algorithms over time in response to a number of factors (for instance, better quality data inputs, improvements in geometry, radiometric calibration, and an improved understanding, and therefore characterization of the algorithm itself), the entire product collection is reprocessed every 1 to 5 years; each reprocessed collection is assigned a new version number. Between major collection versions (e.g., 005 and 006), LAADS may decide to process interim collections (e.g., 051) to address immediate algorithm corrections and adjustments that are ultimately replaced by

a subsequent reprocessing via a major collection version. Once a new collection is released, the previous one is retained in parallel for about a year before it is decommissioned. Some parts of a previous collection are retained for specific time periods (e.g., Golden Months) or specific products (e.g., low resolution and volume Climate Modeling Grid products) to provide a record of the previous collection. The software that produced the previous collections is also retained, so that if needed, and with the proper resources, the previous collections could be reproduced.

Product documentation: A set of product-related information documents and/or links are provided with every publicly released product. They include the User Guide, the Algorithm Theoretical Basis Document (ATBD), the file specifications, QA- and validation-related links, and the Digital Object Identifier (DOI) link.

Data discovery and access: All LAADS DAAC's archived data collections are accessible through a website called LAADS Web, which is an in-house interface that provides both an extensive search-and-order capability as well as direct access to desired data products via HTTPS. HTTPS access also enables direct downloads from the LAADS archive (see <https://ladsweb.modaps.eosdis.nasa.gov/archive/>). Users also have a selection of Web services through which they may acquire specifically subset and/or transformed data products. LAADS Web orders support product selection, and a number of on-demand processing options. The Open-source Project for a Network Data Access Protocol (OPeNDAP) data architecture protocol is also available to end-users.

Additional information is available via the following URL: <https://ladsweb.modaps.eosdis.nasa.gov/tools-and-services/>

All LAADS data collections are also discoverable and orderable via ESDIS' enterprise portal called EarthData (<https://earthdata.nasa.gov/>). Many products in the LAADS data collections are also available through the NASA's Earth Science browse-based Global Imagery Browse Services (GIBS) and its Worldview interface (<https://worldview.earthdata.nasa.gov/>).

#### *Reviewer Entry*

##### **Reviewer 1**

Comments:  
Accept

##### **Reviewer 2**

Comments:  
Accept

## **VIII. Appraisal**

***R8. The repository accepts data and metadata based on defined criteria to ensure relevance and understandability for data users.***

***Compliance Level:***

4 – The guideline has been fully implemented in the repository

### *Reviewer Entry*

#### **Reviewer 1**

Comments:

4 – The guideline has been fully implemented in the repository

#### **Reviewer 2**

Comments:

4 – The guideline has been fully implemented in the repository

### *Response:*

Selection of data for archiving: Based on a NASA-assigned allocation, the LAADS DAAC is responsible for the stewardship of a portfolio of MODIS and VIIRS Level-1 and atmospheric science products. These products are funded by NASA as part of the EOS, SNPP, and JPSS missions; each mission supports specific science and instrument teams that are responsible for building and launching the instrument, characterizing the calibration, maintaining each instrument's geometry, developing the algorithms and data products, and validating them. The LAADS DAAC works closely with MODAPS, Land SIPS, and NASA's MODIS and VIIRS science teams to ensure the integrity of the final products, and to support the specific domain-specific atmospheric science user community.

Quality Assurance: Data and metadata quality assurance comprise a vital part of the production workflow for all products generated by the MODAPS and VIIRS Land SIPS. The Land Data Operational Product Evaluation (LDOPE) group provides a crucial component in evaluating and investigating data quality that are reflected in the final quality flags both at the file- and pixel-levels. Please consult the following Web sites for additional information:

MODIS: [https://landweb.modaps.eosdis.nasa.gov/cgi-bin/QA\\_WWW/newPage.cgi](https://landweb.modaps.eosdis.nasa.gov/cgi-bin/QA_WWW/newPage.cgi)

VIIRS: [https://landweb.modaps.eosdis.nasa.gov/NPP\\_QA/](https://landweb.modaps.eosdis.nasa.gov/NPP_QA/)

Metadata required to interpret and use the data: Data producers submitting data to the EOSDIS DAACs are required to conform to community standards for data formats, metadata, interfaces, etc. See <https://earthdata.nasa.gov/user-resources/standards-and-references> for details. Metadata standards have been evolving over the years that the DAACs have been in operation, and the DAAC works to maintain the archived product's metadata conformance with the evolving standards. The metadata accompanying the datasets submitted to the DAACs are verified to ensure they meet the standards that are sufficient to aid in their interpretation and use. The LAADS DAAC complies with the ESDIS Metadata Requirements - Base Reference for NASA Earth Science Data Products (423-RQMT-003) and submits all metadata to and complies with all requirements of the NASA Common Metadata Repository (CMR). See <https://earthdata.nasa.gov/about/science-system-description/eosdis-components/common-metadata-repository> for additional details. With its sister production organizations' (MODAPS and Land SIPS) responsibilities, it works closely with the Land Processes DAAC and the National Snow and Ice Data Center DAAC to ensure all metadata requirements are met over its data lifecycle.

Ensuring sufficiency of metadata for long-term preservation: Ensuring the compliance of metadata to internationally accepted standards supports long-term preservation as well. Complementing this, the documentation and other artefacts required to support long-term preservation are identified in NASA's Earth Science Data Preservation Content Specification (<https://earthdata.nasa.gov/user-resources/standards-and-references/preservation-content-spec>). Applying such a specification to NASA's Earth science mission-derived data ensures that content artefacts (e.g., Preflight/Pre-Operations, Science Data, Product Documentation, Mission Calibration, Product Software, Algorithm Input, Validation, Software Tools, etc.) are maintained to serve the long-term preservation needs.

List of preferred formats: A list of acceptable data and metadata formats is available to ensure that data providers comply with them (<https://earthdata.nasa.gov/user-resources/standards-and-references>). The LAADS DAAC routinely checks the data flows as it receives VIIRS atmosphere products from the Atmosphere SIPS (Space Science and Engineering Center, University of Wisconsin, Madison).

#### *Reviewer Entry*

##### **Reviewer 1**

Comments:  
Accept

##### **Reviewer 2**

Comments:  
Accept

## **IX. Documented storage procedures**

***R9. The repository applies documented processes and procedures in managing archival storage of the data.***

### ***Compliance Level:***

4 – The guideline has been fully implemented in the repository

#### *Reviewer Entry*

##### **Reviewer 1**

Comments:  
4 – The guideline has been fully implemented in the repository

##### **Reviewer 2**

Comments:  
4 – The guideline has been fully implemented in the repository



## ***Response:***

The LAADS DAAC, as part of the NASA ESDIS Network, is governed by the Requirements for Archiving, Distribution and User Services in EOSDIS (ADURD, see <https://earthdata.nasa.gov/about/esdis-project/esdis-policy/adurd>). Given its roles as a major data producer, archive, and distributor, a number of Interface Control Documents, Requirements Documents, and Operations Agreements exist that govern the data flow dynamics between LAADS and a number of other entities.

The ADURD document specifies requirements for information security that include the following:

1 The DAAC shall comply with all of NASA's information technology and information security requirements as in NASA Procedural Requirement (NPR) 2810.1A (<https://nodis3.gsfc.nasa.gov/displayDir.cfm?t=NPR&c=2810&s=1A>) (Security of Information Technology (Revalidated with Change 1, dated May 19, 2011)) and NASA Policy Directive (NPD) 2810.1E (<https://www.nasa.gov/content/security-requirements-policies>) (NASA Information Security Policy, 7/14/2020). The DAAC shall provide copies of security documentation to appropriate NASA officials and the ESDIS office.

2 The DAAC shall maintain confidentiality of user product requests and accounts per the ESDIS Privacy policy guidelines. The [LAADS DAAC] shall comply with all applicable guidelines for website and outreach communications as established by NASA.

The LAADS DAAC complies with these requirements, and its security plan is provided to and maintained by the NASA ESDIS office.

The EOS Data and Operations System provides both MODIS and VIIRS Level-0 (Raw Instrument Packets) data to MODAPS SIPS and VIIRS Land SIPS. Two backup sources exist for the Level-0 data: the White Sands Complex in White Sands, NM, and the Ocean Biology DAAC at GSFC. The MODAPS and VIIRS Land SIPS provide a robust Processing On-Demand (POD) process that meets all requirements to reproduce any desired MODIS or VIIRS higher-level products that need to be recovered by the LAADS DAAC. The European Space Agency (ESA) serves as the backup for all MERIS and Sentinel products supported and served by the LAADS DAAC.

### ***Reviewer Entry***

#### **Reviewer 1**

Comments:  
Accept

#### **Reviewer 2**

Comments:  
Accept

## **X. Preservation plan**

***R10. The repository assumes responsibility for long-term preservation and manages this function in a planned and documented way.***

## ***Compliance Level:***

4 – The guideline has been fully implemented in the repository

### ***Reviewer Entry***

#### **Reviewer 1**

Comments:

4 – The guideline has been fully implemented in the repository

#### **Reviewer 2**

Comments:

4 – The guideline has been fully implemented in the repository

## ***Response:***

The LAADS DAAC follows the NASA-provided preservation specification document (<https://earthdata.nasa.gov/user-resources/standards-and-references/preservation-content-spec>). This document articulates the critical need to preserve data derived from all NASA missions to benefit future generations. In the short-term, given the importance of these data for active scientific research, it is essential to provide easy access to these data and services, commensurate with current information technology. In the long-term, when the research community's focus shifts toward new missions and observations, it is imperative to preserve data and information from all previous missions to facilitate future users' ability to understand how the datasets were used to derive information, knowledge, and policy recommendations. The ability to repeat a previous experiment, ascertain the validity and possible limitations of conclusions reached in the past, and provide confidence to long-term trends based on data from multiple missions are further reasons in favor of such preservation.

### ***Reviewer Entry***

#### **Reviewer 1**

Comments:

Accept

#### **Reviewer 2**

Comments:

Accept

## **XI. Data quality**

***R11. The repository has appropriate expertise to address technical data and metadata quality and ensures that sufficient information is available for end users to make quality-related evaluations.***

## ***Compliance Level:***

4 – The guideline has been fully implemented in the repository

### ***Reviewer Entry***

#### **Reviewer 1**

Comments:

4 – The guideline has been fully implemented in the repository

#### **Reviewer 2**

Comments:

4 – The guideline has been fully implemented in the repository

## ***Response:***

As articulated under Appraisal (Section VIII) above, the LAADS DAAC has in place a rigorous set of practices and mechanisms that address data quality, primarily carried out by the LDOPE group, which is an integral part of MODAPS and VIIRS Land SIPS. Quality assurance, both at the file- and pixel-levels are addressed to give users, across the proficiency spectrum, mechanisms to interact with, understand and analyze data quality as deemed appropriate for their application needs. The LAADS staff was also instrumental in developing a set of QA-specific tutorials that are hosted by the Land Processes DAAC, given their stewardship role of the MODIS and VIIRS higher-level terrestrial products, which is the primary focus of these tutorials. Data quality-related information and explanations are provided both via LAADS Web and individual product user-guides that are electronically available to end-users. The LAADS User Services routinely fields calls from users, via e-mail and phone, to address data-quality-specific queries.

### ***Reviewer Entry***

#### **Reviewer 1**

Comments:

Accept

#### **Reviewer 2**

Comments:

Accept

## **XII. Workflows**

***R12. Archiving takes place according to defined workflows from ingest to dissemination.***

## ***Compliance Level:***

4 – The guideline has been fully implemented in the repository

### *Reviewer Entry*

#### **Reviewer 1**

Comments:

4 – The guideline has been fully implemented in the repository

#### **Reviewer 2**

Comments:

4 – The guideline has been fully implemented in the repository

### *Response:*

All data management functions and activities at the LAADS DAAC are defined by a number of workflows from data ingestion, curation, export, and archiving in a set of documents called the Science Data Processing Software System Description. These documents provide detailed descriptions of the system architecture, production rules, various levels of product generation executables (PGE), system performance, system operations, resource utilization, etc. Given the fact that the LAADS DAAC's sister organizations, MODAPS and VIIRS Land SIPS produce Level-1 MODIS and VIIRS data, and all higher-level land and atmosphere products (except for VIIRS atmosphere), there are hundreds of individual PGEs, and when different collection versions are factored, the total number of distinct PGEs is in the thousands. A configuration management group exists to manage the constantly evolving needs of all software-driven processes within a large operational environment.

MODAPS' responsibilities and requirements specific to MODIS data products, and the Land SIPS' responsibilities and requirements specific to VIIRS data products are defined in ESDIS-managed requirements documents. The LDOPE group ensures that the data quality of all LAADS-produced data meet the expected specifications and standards.

Well-tested workflows are in place between LAADS DAAC and the other domain-specific DAACs to whom it exports higher-level land and cryosphere products. These workflows sustain routine, daily interactions and transmittal of data that are accomplished electronically with minimal human intervention. As explained elsewhere, protocols exist to verify the fidelity of the exported data.

The User Services group follows a well-defined and tested workflow model that addresses user questions by providing feedback that is acquired and compiled through consultations with cascading levels of subject-matter experts (SME), as warranted by the complexity of questions. SMEs range from in-house science, geolocation, calibration, and data systems staff to the science PIs who are responsible for any given product. A majority of questions are answered by User Services within a day.

### *Reviewer Entry*

#### **Reviewer 1**

Comments:

Accept

#### **Reviewer 2**

Comments:  
Accept

## XIII. Data discovery and identification

*R13. The repository enables users to discover the data and refer to them in a persistent way through proper citation.*

### ***Compliance Level:***

4 – The guideline has been fully implemented in the repository

#### *Reviewer Entry*

##### **Reviewer 1**

Comments:  
4 – The guideline has been fully implemented in the repository

##### **Reviewer 2**

Comments:  
4 – The guideline has been fully implemented in the repository

### ***Response:***

The LAADS DAAC offers several means to discover and access its data collections. Its archived data collections are accessible via LAADS Web, which is an in-house, custom-developed interface that provides both an extensive search-and-order capability as well as direct access to desired data products via HTTPS. The HTTPS portal provides an anonymous connection to the [ladsweb.nascom.nasa.gov](https://ladsweb.nascom.nasa.gov) server. An EOSDIS enterprise-wide process, called User Registration System (URS), provides a mechanism for user registration and profile management across all EOSDIS system components (i.e., DAAC interfaces, tools, and services). LAADS Web is configured to allow users to log in to LAADS Web using their URS credentials. The URS serves to both authorize and authenticate registered EOSDIS users.

Users also have a selection of Web services through which they may acquire specifically subset and/or transformed data products. LAADS Web orders support product selection, and a number of on-demand processing options. An instantiation of the Open-source Project for a Network Data Access Protocol (OPeNDAP: <https://www.opendap.org/>) data architecture protocol is also available to end-users.

Check the following URL for additional information regarding LAADS' tools and services:

<https://ladsweb.modaps.eosdis.nasa.gov/tools-and-services/>

All LAADS data collections are also discoverable and orderable via ESDIS' enterprise portal called EarthData (<https://earthdata.nasa.gov/>) using the Earthdata Search client. LAADS data collections are also exposed via NASA's

Earth Science browse-based Global Imagery Browse Services (GIBS) and its Worldview interface (<https://worldview.earthdata.nasa.gov/>).

As described earlier in Appraisal (Section-VIII), the CMR (Common Metadata Repository) is an ESDIS-managed metadata management system that stores metadata from a variety of science disciplines and domains, and enables broader use of NASA's EOS data by providing an enterprise-wide view of NASA's substantial and diverse data holdings. CMR facilitates varied and distributed science communities to more efficiently search, discover, and use data and services while also increasing the potential for interoperability with new tools and services. Hence, CMR provides a high-performance capability to facilitate search and discovery across a plethora of domain-specific Earth science products, tools, and services. Programmatic interfaces based on standard protocols and Application Programming Interfaces (API) are available as well. Check:

<https://earthdata.nasa.gov/about/science-system-description/eosdis-components/common-metadata-repository>

All LAADS DAAC's data collections are archived in conformance with NASA's specifications. One such requirement is Digital Object Identifiers (DOI), at the collection-level, that became standard practice since around 2014. LAADS offers suggestions for citation as well as credit attribution; Check the following URL for details:

[https://modaps.modaps.eosdis.nasa.gov/services/faq/LAADS\\_Data-Use\\_Citation\\_Policies.pdf](https://modaps.modaps.eosdis.nasa.gov/services/faq/LAADS_Data-Use_Citation_Policies.pdf)

#### *Reviewer Entry*

##### **Reviewer 1**

Comments:  
Accept

##### **Reviewer 2**

Comments:  
Accept

## **XIV. Data reuse**

***R14. The repository enables reuse of the data over time, ensuring that appropriate metadata are available to support the understanding and use of the data.***

### ***Compliance Level:***

4 – The guideline has been fully implemented in the repository

#### *Reviewer Entry*

##### **Reviewer 1**

Comments:

4 – The guideline has been fully implemented in the repository

**Reviewer 2**

Comments:

4 – The guideline has been fully implemented in the repository

***Response:***

All LAADS DAAC's data collections that span all product-levels consistently provide both collection-level and file- (or granule-) level metadata that facilitate data search and discovery, access, and various applications. The applications may include how data products are handled by open-source and proprietary software and image processing systems, how they are handled by APIs, Web services, OPeNDAP, etc., and how they facilitate interoperability (for instance to enable ingest at a receiving archive). All LAADS-produced metadata conform to ESDIS-specified metadata standards (<https://earthdata.nasa.gov/user-resources/standards-and-references>).

The ESDIS Standards Office (ESO) assists the ESDIS Project in formulating a standards policy for NASA Earth Science Data Systems (ESDS), and coordinates standards activities within ESDIS (See <https://earthdata.nasa.gov/about/esdis-project/esdis-standards-office-eso>). This provides a mechanism for evolving standards with a systematic review process, which involve members of the designated community that includes data producers and end-users.

The primary data formats for Levels-1 through -4 include Hierarchical Data Format 4 and 5 (HDF4 and HDF5), and Network Common Data Form (netCDF) along with supporting EOS conventions. Level-0 instrument packet data exist in Consultative Committee for Space Data Systems (CCSDS) format. Providing products in the netCDF4–HDF5 formats mark an evolution in leveraging common advantages of both formats as well as benefitting from their separate strengths. The netCDF libraries support a binary data format, which is widely used in the climate science and modelling communities, globally.

To help promote understandability of the LAADS DAAC's product portfolio, every public product is provided with documentation that describes each product, its science parameters and variables, quality information, validation status, and an algorithm summary. It further provides online links to more detailed documents that include the User Guide, the Algorithm Theoretical Basis Document (ATBD), File specifications, Known quality issues, and validation plan. An updated version of a peer-reviewed publications reference list specific to the LAADS DAAC's data collections exists as well.

***Reviewer Entry***

**Reviewer 1**

Comments:

Accept

**Reviewer 2**

Comments:

Accept

## TECHNOLOGY

## XV. Technical infrastructure

***R15. The repository functions on well-supported operating systems and other core infrastructural software and is using hardware and software technologies appropriate to the services it provides to its Designated Community.***

### ***Compliance Level:***

4 – The guideline has been fully implemented in the repository

#### ***Reviewer Entry***

##### **Reviewer 1**

Comments:

4 – The guideline has been fully implemented in the repository

##### **Reviewer 2**

Comments:

4 – The guideline has been fully implemented in the repository

### ***Response:***

The LAADS DAAC's technical infrastructure is based on open-source software including a CentOS-based operating system, Apache- and NGINX-based web servers, Perl and GCC (GNU Compiler Collection)-based software development, etc. All procedures for maintaining and installing our infrastructure are documented and stored in open-source Wiki pages with backups for use during emergency recovery or for routine maintenance. LAADS operates on a high bandwidth of 40 Gbps to disseminate all its output to our external stakeholders. LAADS' hardware systems are entirely based on commodity servers that routinely undergo technical refreshes. LAADS uses an HGST (Hitachi Global Storage Technologies) object storage system to store about 10 PB of data, which is a highly scalable implementation of an object-store.

In case of any power outages, our primary backup can be used immediately for continuity of limited operations. Additionally, backups of our system software are stored in different facilities that can facilitate restoring the system. Our main and backup facilities have enough bandwidth to support all our user's near-real-time data needs. We support most community standards for data distribution such as OGC, W3C and others. New standards are adopted as they are developed, and deemed useful to our community.

#### ***Reviewer Entry***

##### **Reviewer 1**



Comments:

Accept

**Reviewer 2**

Comments:

Accept

## **XVI. Security**

***R16. The technical infrastructure of the repository provides for protection of the facility and its data, products, services, and users.***

### ***Compliance Level:***

4 – The guideline has been fully implemented in the repository

#### ***Reviewer Entry***

**Reviewer 1**

Comments:

4 – The guideline has been fully implemented in the repository

**Reviewer 2**

Comments:

4 – The guideline has been fully implemented in the repository

### ***Response:***

The LAADS DAAC follows the NASA security policy guidelines. These guidelines include both physical and software procedures to protect our products and services. Physical protection includes 24/7 security of the campus for all employees in addition to badge- and PIN-based (Personal Identification Number) access to the facility for only the necessary staff. Software-based procedures include VPN-only-based (Virtual Private Network) access in addition to two-factor authentication and multiple layers of firewalls. Few services rely on password-based authentication alone. In those cases, password policies based on NASA and NIST (National Institute of Standards and Technology) guidelines are followed including password lengths, character groups, and password expiration.

All data collections are protected against accidental and superficially malicious loss via extensive check-summing. All distributed files are checksum-verified prior to being distributed to the end-user. Critical systems, such as databases are backed up nightly to secure servers, and backups are retained for 6 months. All the production software (i.e., PGEs) are version-controlled and backed up daily.

#### ***Reviewer Entry***

**Reviewer 1**

Comments:  
Accept

**Reviewer 2**

Comments:  
Accept

## APPLICANT FEEDBACK

### Comments/feedback

*These requirements are not seen as final, and we value your input to improve the core certification procedure. To this end, please leave any comments you wish to make on both the quality of the Catalogue and its relevance to your organization, as well as any other related thoughts.*

#### *Response:*

The application form contains some redundancies that are worth eliminating.

#### *Reviewer Entry*

**Reviewer 1**

Comments:

**Reviewer 2**

Comments: