



Oak Ridge National Laboratory Distributed Active Archive Center

Notes Before Completing the Application

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

True

Reviewer Entry

Reviewer 1

Comments:

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, National repository system; including governmental, Research project repository

Reviewer Entry

Reviewer 1

Comments:

Reviewer 2

Comments:

Accept

Brief Description of Repository

The Oak Ridge National Laboratory Distributed Active Archive Center (ORNL DAAC) is one of the 12 Distributed Active Archive Centers (DAACs) within the United States National Aeronautics and Space Administration (NASA) Earth Observing System Data and Information System (EOSDIS), as described at <https://earthdata.nasa.gov/eosdis/daacs>. Each of the DAACs has a specific discipline focus, and the focus for the ORNL DAAC is terrestrial ecology and biogeochemical dynamics. Additional information about the mission and scope for the ORNL DAAC can be found at <https://daac.ornl.gov/about/>.

The ORNL DAAC is hosted at Oak Ridge National Laboratory (ORNL), which is one of 17 national laboratories operated by the United States Department of Energy (DOE), as described at <https://www.energy.gov/national-laboratories>. The ORNL DAAC is funded by an interagency agreement between NASA and DOE.

The ORNL DAAC primarily archives and distributes data from NASA-funded terrestrial ecology programs and other programs funded by the NASA Carbon Cycle and Ecosystems focus area. Data from outside this scope is considered on a case-by-case basis, requiring the approval of the NASA Earth Science Data Systems (ESDS) program. The data scope and acceptance policy are described at <https://daac.ornl.gov/submit/>

The ORNL DAAC is operated under an Interagency Agreement (IAA) between NASA and the US Department of Energy (DOE). The ORNL DAAC has been in operation, under a series of IAAs, since 1994. The present IAA covers the period 1 August 2019 through 31 July 2024. Successor IAAs are negotiated between DOE and NASA contingent upon satisfactory performance under the existing IAA.

Oak Ridge National Laboratory is operated by UT-Battelle (<https://ut-battelle.org/>) for DOE. The present contract covers the period of 1 April 2020 – 31 March 2025. The Department of Energy determines the process for renewal and selection of the Prime Contracts for the operation of the DOE National Laboratories. See <https://science.osti.gov/lp/Management-and-Operating-Contracts> for additional details.

Reviewer Entry

Reviewer 1

Comments:

Reviewer 2

Comments:
Accept

Brief Description of the Repository's Designated Community.

As discussed above, the ORNL DAAC primarily archives data from NASA-funded terrestrial ecology programs. Scientists funded by those programs are our primary data provider community, and we work with those data providers to ensure the long-term findability, accessibility, interoperability, and reusability of their data.

Data held at the ORNL DAAC are available to the general public without restriction, as described in the EOSDIS Data Use Policy (<https://earthdata.nasa.gov/earth-observation-data/data-use-policy>). From a practical perspective, the primary user community for the ORNL DAAC is terrestrial ecology researchers. ORNL DAAC data is, however, used in a wide range of research, applied science, policy, and education applications. ORNL DAAC users also cover a wide range of expertise with remote sensing and ecological data products. A particular user community for the ORNL DAAC is site-based ecological researchers, such as those operating flux tower sites, such as those in FLUXNET (<https://en.wikipedia.org/wiki/FLUXNET>).

Reviewer Entry

Reviewer 1

Comments:

Reviewer 2

Comments:
Accept

Level of Curation Performed. Select all relevant types from:

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:

Reviewer 2

Comments:
Accept

Comments

The ORNL DAAC follows the NASA Earth Science Data Systems Level of Service (LoS) model described at <https://earthdata.nasa.gov/collaborate/new-missions/level-of-service>. Our default corresponds to the Standard LoS, which

is roughly comparable to the C level of curation. In some cases, we may provide a Basic LoS, particularly for lower level of processing data

(<https://earthdata.nasa.gov/collaborate/open-data-services-and-software/data-information-policy/data-levels>). Even at a standard LoS, we perform a quality assurance check of the data, which may result in additional editing of deposited data to clarify significant figures, ensure consistent treatment of fill values across files, and (with data provider concurrence) correction of erroneous values.

This formal Level of Service model is relatively new for the ORNL DAAC, and we are still developing the processes by which we will clearly communicate with data providers about the level of service they should expect for their data products. Our current process is based on the fact that most data coming to the ORNL DAAC is coming from a small set of currently active NASA projects, such as the Arctic-Boreal Vulnerability Experiment (ABOVE, <https://above.nasa.gov>). At project initiation, we generally discuss with project leaders the services that we can provide to their data. This more formal LoS model will help clarify the communications, both at the project level and with the individual data providers.

Reviewer Entry

Reviewer 1

Comments:

Reviewer 2

Comments:

Accept

Insource/Outsource Partners. If applicable, please list them.

The ORNL DAAC does not have any outsource partners. The relationship with the NASA ESDIS Project is regarded as “Insource Partnership” due to the close connections with the NASA ESDIS Project and the other DAACs that are part of the network. Annual work plans submitted to the ESDIS Project define the work priorities. Certain technical capabilities that are common among DAACs are developed by the ESDIS Project and provided for use by the DAACs (<https://earthdata.nasa.gov/eosdis/science-system-description/eosdis-components>), while capabilities specific to a given DAAC are developed by the individual DAAC. There are also collaborations among DAACs for development of shared capabilities. The ESDIS Project is a Network Member of the WDS, while all the DAACs are Regular Members, that have been certified either via WDS or CoreTrustSeal. A close relationship is maintained among the DAACs and the ESDIS Project through regular weekly teleconferences and periodic detailed meetings to discuss technical as well as administrative/management issues.

All computing infrastructure in the ornl.gov namespace, including daac.ornl.gov and affiliated websites, is operated under a Federal Information System Management Act (FISMA) Authority To Operate (ATO) which is authorized by DOE. Under that ATO, ORNL is responsible for the basic computing services (e.g. DNS, routing, and firewalls) which underlie ORNL DAAC operations, as well as for ensuring cybersecurity compliance. ORNL provides regular cybersecurity testing of all ORNL DAAC systems. ORNL also provides an internally-hosted GitLab instance, which the ORNL DAAC uses for configuration management and source code revision control. ORNL also provides a number of base cyberinfrastructure components supporting the operation of the ORNL DAAC.

Reviewer Entry

Reviewer 1

Comments:

Reviewer 2

Comments:

Accept

Summary of Significant Changes Since Last Application (if applicable).

The ORNL DAAC has begun a migration of using Amazon Web Services as infrastructure for providing data and services to its community. All ORNL DAAC data will remain available without restriction, consistent with the EOSDIS Data Use Policy at <https://earthdata.nasa.gov/earth-observation-data/data-use-policy>. This migration is part of the broader EOSDIS Earthdata Cloud Evolution. Further information on Earthdata cloud can be found at <https://earthdata.nasa.gov/eosdis/cloud-evolution>.

The ORNL DAAC has begun the implementation of a formal Level of Service model, as described in the Level of Curation section of this application.

The ORNL DAAC has formalized what used to be called a “manuscript dataset” into what we now term preprint datasets, as described in the About Preprint Datasets section on <https://daac.ornl.gov/about/#preprints>. Preprint datasets provide better support for data providers who need to make their data available as part of the scientific publication process, particularly in the cases where the data provider has an immediate need for the data to be publicly available and have a resolvable DOI for that data.

Effective 1 April 2021, the ORNL DAAC has clarified its data revision policy to clarify that we will assign a new DOI for data reprocessing, as well as for changes to data algorithms. The ORNL DAAC will generally continue to use the same DOI for append operations to data (such as extending the spatial or temporal extent), as well as for metadata modifications which do not significantly affect the scientific interpretation. As described in the Data Integrity and Authenticity Section (R7), all changes to data are described in user-facing documentation, such as the User Guide.

The ORNL DAAC is operating under a different Interagency Agreement between NASA and DOE, for the period of 1 August 2019 through 31 July 2024. The new agreement has not substantively affected ORNL DAAC operations.

The ORNL DAAC has changed the location for its off-site backup. As of 1 January 2021, the ORNL DAAC’s offsite backup is now in Amazon Glacier. It was previously maintained using an ORNL Dropbox for Enterprise account.

Reviewer Entry

Reviewer 1

Comments:

Reviewer 2

Comments:
Accept

Other Relevant Information.

none

Reviewer Entry

Reviewer 1

Comments:

Reviewer 2

Comments:

ORGANIZATIONAL INFRASTRUCTURE

1. 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
Accept.

Reviewer 2

Comments:

4 – The guideline has been fully implemented in the repository

Response:

As one of the DAACs within EOSDIS, the ORNL DAAC's mission is to be a custodian of NASA Earth science terrestrial ecology and biogeochemical dynamics data and ensure that data will be easily accessible to users. Acting in concert, the DAACs provide reliable, robust services to users whose needs may cross the traditional boundaries of a science discipline, while supporting the particular needs of users within the discipline communities.

(<https://earthdata.nasa.gov/about/daacs>).

Each of the DAACs complies with by the "Requirements for Archiving, Distribution and User Services in EOS Data and Information System (EOSDIS)" available at https://cdn.earthdata.nasa.gov/conduit/upload/6355/423-10-69_ADURD_RevB.docx.

The specific mission for the ORNL DAAC is at <https://daac.ornl.gov/about/#mission>. The ORNL DAAC's data scope and acceptance policy can be found at https://daac.ornl.gov//submit/#scope_and_acceptance_policy.

Reviewer Entry

Reviewer 1

Comments:

Reviewer 2

Comments:

Accept

2. 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
Accept.

Reviewer 2

Comments:

4 – The guideline has been fully implemented in the repository

Response:

The ORNL DAAC conforms to NASA's Data Use Policy at

<https://earthdata.nasa.gov/earth-observation-data/data-use-policy> and provides free and open access to scientific data.

The users of data are expected to comply with the Data Use Policy -

<https://earthdata.nasa.gov/earth-observation-data/data-use-policy>. The ORNL 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 ORNL DAAC requests users to include data citations in their publications and provides tools on dataset landing pages to simplify that process, such as pre-formatted citations, downloads of bibliographic information in common formats (e.g. RIS and BibTeX), and a link to the Crosscite citation formatting tool.

Because NASA Earth Science data is available without restriction, citation of data is a request, rather than a formal license requirement. As such our actions are to educate users about citation expectations and encourage the practice through making it as easy as practical. We are also actively engaged with journal publishing groups to shape journal expectations that authors cite source data.

If the ORNL DAAC becomes aware of practices that violate the NASA EOSDIS Data Use Policy, such as someone falsely claiming copyright of NASA data, or NASA data being used in a way that implies endorsement, these would be referred to EOSDIS project leadership for action.

Reviewer Entry

Reviewer 1

Comments:

Reviewer 2

Comments:

Accept

3. 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

Accept.

Reviewer 2

Comments:

4 – The guideline has been fully implemented in the repository

Response:

As described in response to R0, the ORNL DAAC has been in operation, under a series of IAAs between NASA and the US DOE, since 1994. The present IAA covers the period 1 August 2019 through 31 July 2024.

The long-term stability of the ORNL DAAC depends on funding from NASA, our sponsoring agency. NASA has clearly stated that it believes long term stewardship of NASA collected remote sensing and field campaign data is essential. The NASA ESDIS Project, a Network Member of WDS, is responsible for funding and managing all the 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 (not publicly available), the functional and performance requirements for the ESDIS Project include:

- 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 at https://cdn.earthdata.nasa.gov/conduit/upload/6355/423-10-69_ADURD_RevB.docx. This document states that "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 National Aeronautics and Space Administration (NASA) notifies the DAAC that it is appropriate to do so."

In the unlikely event that the NASA-EOSDIS ORNL DAAC is relocated to a different host institution, the ORNL DAAC will follow NASA procedures for activity transition.

Reviewer Entry

Reviewer 1

Comments:

Reviewer 2

Comments:

Accept

4. 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:

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
Accept.

Reviewer 2

Comments:

4 – The guideline has been fully implemented in the repository

Response:

The ORNL DAAC does not archive any data that requires explicit disclosure risk. All data are available for free and are open to public. The data archived from the ORNL DAAC are information about the environment, and ORNL DAAC staff are well trained to handle such data. Personal/Sensitive information are not published in the ORNL DAAC archive system.

Reviewer Entry

Reviewer 1

Comments:

Reviewer 2

Comments:

Accept.

5. 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
Accept.

Reviewer 2

Comments:

4 – The guideline has been fully implemented in the repository

Response:

The ORNL DAAC is housed at the Oak Ridge National Laboratory (Oak Ridge, Tennessee, United States of America), which is one of the 17 laboratories managed by the US Department of Energy. As previously indicated, the ORNL DAAC is funded through a series of 5-year Interagency Agreements between DOE and NASA, which provides funding for core activities. Additional funding is provided through special project funding, such as for archival of data from specific missions that are not part of the core ORNL DAAC mission or for special efforts such as the Earthdata Cloud migration. This funding translates to approximately 15 person-years of effort annually, which is spread across approximately 20 individuals employed at ORNL. ORNL processes require regular attestation by the ORNL DAAC Manager that NASA funding is sufficient to accomplish the scope and activities defined within the interagency agreement and work plans. 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 ORNL DAAC staff includes the ORNL DAAC manger, deputy manager, lead scientist, data architect, systems engineer, data publication lead, user services staff, developers, and data curation experts. As needed, ORNL DAAC staff may include subcontractors for specific tasks and student interns. The staff members are well qualified and collectively have over 250 years of experience in this field. ORNL DAAC staff participate in a range of professional and scientific organizations, including the American Geophysical Union, the Association for Computing Machinery (ACM), the Institute of Electrical and Electronics Engineers (IEEE), the Earth Science Information Partners, the American Association for the Advancement of Science, the American Society for Photogrammetry and Remote Sensing, and the US Research Software Engineers Association. The ORNL DAAC's staff includes one Senior Member of the ACM and one Senior Member of the IEEE. ORNL DAAC staff members regularly participate in the activities of these organizations for professional development, as well as workshops and training sessions run by other organizations.

Reviewer Entry**Reviewer 1**

Comments:

Reviewer 2

Comments:

Accept

6. 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:

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
Accept.

Reviewer 2

Comments:

4 – The guideline has been fully implemented in the repository

Response:

The ORNL DAAC uses a User Working Group (UWG) as one method for ongoing expert guidance and feedback, as described at <https://daac.ornl.gov/about/#uwg>. The UWG meets for a multi-day meeting once per year (typically in April or May) to review ORNL DAAC accomplishments and provide suggestions and guidance for future activities. The UWG meets via teleconference (typically in November or December) to review the ORNL DAAC's annual work plan. The UWG is consulted for any community data archival requests (request to archive data outside the projects and missions formally assigned to the ORNL DAAC). UWG members are also consulted, on an ad hoc basis, throughout the year for feedback or testing of new and improved capabilities developed by the ORNL DAAC or ESDIS.

UWG members serve one or two 3-year terms. At present, there are 15 UWG members, with approximately 1/3rd rotating off or renewing for a second term each year. UWG members are not compensated for their participation, though the ORNL DAAC pays all travel expenses for any in-person meetings. UWG members are selected based on the input of current UWG members and in consultation with the NASA Program Executive for the Terrestrial Ecology Program (currently Hank Margolis).

The ORNL DAAC maintains a User Services Office (USO) whose personnel directly interact with the ORNL DAAC user community. The USO is staffed with people skilled in both Earth science and geospatial data which they use to support users with data selection, usage, and interpretation. Users can also provide feedback or request help using the "Feedback" button on all ORNL DAAC web pages and at <https://earthdata.nasa.gov/> which is the mechanism the NASA ESDIS Project uses to route enquiries to the appropriate DAAC.

The ORNL 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 CFI, an external independent organization. The results from the survey provide a numerical index of customer satisfaction as well as detailed comments and suggestions for improvement of systems and services. These inputs are assessed regularly by the NASA ESDIS Project and the

DAACs and changes implemented as appropriate.

The ORNL DAAC regularly partners with other DAACs on data management and data services related activities. The ORNL DAAC also participates in expert communities such as the Earth Science Data System Working Groups (ESDSWG) and Earth Science Information Partners (ESIP). 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 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. Through these partnerships ORNL DAAC stays informed about the evolutions in data science and adopts new and latest technology as needed.

ORNL DAAC staff regularly participate in Science Team meetings for the projects and missions assigned to the ORNL DAAC. These meetings provide opportunities for informal advice to the ORNL DAAC on needs relevant to that project or mission's science community.

By being hosted at ORNL, which is the largest and most diverse of the DOE Office of Science laboratories, the ORNL DAAC has ready access to domain expertise across a wide range of disciplines, as needed to augment the existing staff expertise. Within ORNL, the ORNL DAAC is hosted in the Earth Science Informatics and Data Analysis Section of the Environmental Sciences Division. This section includes another World Data System Regular Member (the DOE-funded Atmospheric Radiation Measurement Climate Research Facility), as well as three other Earth science-related data management facilities. These projects use matrixed staff, formal meetings, and informal meetings as means to exchange information about current developments in data management.

Reviewer Entry

Reviewer 1

Comments:

Reviewer 2

Comments:

Accept

DIGITAL OBJECT MANAGEMENT

7. 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
Accept.

Reviewer 2

Comments:

4 – The guideline has been fully implemented in the repository

Response:

The ORNL DAAC goes through a rigorous quality assurance checklist, described at https://daac.ornl.gov/PI/qa_checklist.html

Data Files are checked for integrity as follows:

1. Check for integrity of files (Checksum, file size, number of files)
2. Filenames are descriptive and consistent, Action: Rename data files, if needed
3. Check if file format is appropriate and can be opened, Action: Modify to archive format (non-proprietary) if needed
4. File organization is consistent and appropriate
5. Table header information complete and consistent with documentation
6. Properly versioned, if needed

Documentation files are verified as follows:

1. Documentation matches files received.
2. Dataset and its contents are clearly described
3. Geospatial and temporal information are complete and described
4. Variables and units follow standards or are well defined
5. Publication or manuscript describing the data is provided
6. Methodology, calibrations, and algorithms provided
7. Known issues/limitations clearly described
8. Statements are properly referenced

Parameter Values are checked as follows:

1. Check to ensure valid range
2. Visualize (plot, map, or both)
3. Code(s) for missing values defined and used
4. Values for coded fields defined
5. Are accuracy and precision stated and reasonable?

Geospatial Information is checked as follows:

1. Spatial Reference System is well-defined for mapped data products
2. Projection, datum, resolution, etc.
3. Spatial coordinates are well-defined, following standards
4. Latitude / longitude match description (geopolitical location, land vs water, correct hemisphere)

Temporal Information is verified as follows:

1. Date and Time (calendar, time units and temporal extent, resolution, and boundary) are defined according to standards.

The ORNL DAAC prepares metadata for discovery and compiles comprehensive documentation with a target of being usable 20 years from now by a user with at least a college-level general expertise in one or more Earth science disciplines. The ORNL DAAC also generates citation and registers a Digital Object Identifier (DOI) for the dataset. These metadata are verified for quality as well and registered with the EOSDIS network Common Metadata Repository (CMR). The ORNL DAAC infrastructure captures changes to the metadata within a database. The information is logged as well. Details on the ORNL DAAC publication and curation process are outlined in the following journal publications:

- S. Vannan et al. A Semi-Automated Workflow Solution for Data Set Publication. ISPRS International Journal of Geo-Informatics. 2016, 5(3), 30 <http://dx.doi.org/10.3390/ijgi5030030>.
- R. Cook et al. Implementation of data citations and persistent identifiers at the ORNL DAAC. Ecological Informatics <http://dx.doi.org/10.1016/j.ecoinf.2016.03.003>.
- LA Hook, SKS Vannan, TW Beaty, RB Cook, BE Wilson "Best Practices for Preparing Environmental Data Sets to Share and Archive. Oak Ridge National Laboratory Distributed Active Archive" <http://daac.ornl.gov/PI/BestPractices-2010.pdf>.

The ORNL DAAC uses multiple steps to verify the identity of depositors (data providers). The deposit process starts with either a Submit Data Form (<https://daac.ornl.gov/submit/form/>) submitted through the ORNL DAAC's website or a pre-agreed process defined ahead of time with the leaders of projects or missions assigned to the ORNL DAAC. In most cases, data providers are known to ORNL DAAC staff members, either through work on prior datasets or through our participation in project Science Teams. Where the ORNL DAAC does not have prior knowledge of a data provider and/or project requesting to archive data with us, we verify through public information and through NASA that the project is within our approved scope and that the person requesting to submit data is a representative of that project.

Once we have determined that the data is within our funded scope and that the data provider is an authorized representative of the project, we ensure that the person has an account within ORNL's eXternal Credential, Access, and Management System (XCAMS), which conforms to Identity Assurance Level 1 and Authenticator Assurance Level 1 as defined in NIST Special Publication 800-63-3 <https://pages.nist.gov/800-63-3/>. We also provide the data provider with an upload URL which is randomly generated and unique to this specific data submission. Once the data provider indicates that all of the data has been submitted, we verify the number of files, filenames, sizes, and checksums with the data provider before beginning the data quality assurance and documentation processes.

The ORNL DAAC uses multiple methods to protect the integrity of data files and code, exceeding the baseline for Moderate Integrity defined in the US National Institutes of Standards and Technology (NIST) Special Publication 800-53

<https://csrc.nist.gov/publications/detail/sp/800-53/rev-5/final> and specified in the ORNL Unclassified Cybersecurity Program Plan (CSPP; not a publicly available document, but one which is reviewed and approved by a cognizant DOE civil servant). These protections include:

- At least three copies of all managed data files, with at least one copy maintained off-site.
- SHA-256 checksums of all managed data files are published as part of the public metadata.
- Fixity checks are performed against all managed data files and validated against the stored and published checksums.
- All in-house developed software for ORNL DAAC operations is managed through git-based revision control (an internally-hosted GitLab instance for on-prem systems and a NASA-managed Bitbucket instance for components in Earthdata Cloud).
- The ORNL DAAC practices configuration control management for all public-facing systems, such as by using Puppet.
- The ORNL DAAC practices the principle of Least User Privilege, with most changes to production systems made by scripts and software tools managed through the software revision control system and only a very limited number of ORNL DAAC staff having permissions to even log into user-facing production systems.
- Credential segmentation, so that no credential can be used to modify both the live (public facing) and backup copies of any managed data file.

Where changes are necessary to data or metadata after publication, the ORNL DAAC follows the following procedures:

- If the change involves an update to the algorithm used to create the data, the ORNL DAAC has always assigned a new DOI to the updated data and changed the major version of the data. In effect, the updated data is treated as a new dataset. The landing page and metadata for the older data are updated to provide pointers to the new dataset. In most cases, the older data is moved to a restricted status – available upon request, under the premise that the newer data should be used. In some cases, the data provider and the ORNL DAAC may decide that both versions should remain available, either for a specific period of time (to allow intercomparison) or indefinitely. In this case, the landing page for the older data will still have a link to the newer version, but the older data is available for download upon demand.
- Where the change involves alterations to existing published data values, the ORNL DAAC now treats this in the same way as described above – a new DOI is created, although we may only update the dataset minor version number (e.g., 2.0 to 2.1), depending on the preferences of the data provider and the ORNL DAAC's sense of the magnitude of the changes. Prior to 1 April 2021, the ORNL DAAC would generally not assign a new DOI to this sort of change. The user guide would describe the changes, and the older data would be available upon request, but the DOI would not change.
- Where the change involves appending to an existing dataset, such as extending the temporal or spatial extent, the ORNL DAAC will generally maintain the same DOI. We update the metadata to reflect the changes, and the changes are described in either the user guide or a dataset changelog.
- Where the change involves metadata changes, such as updating science keywords, changes to an author's name, or adding clarifying language to documentation, we maintain the same DOI and track the changes in internal systems.
- In all cases, any new or changed data files or documentation files go through the quality assurance steps described earlier in this section.
- In all cases, metadata changes go through internal revision control processes that ensure that the Ingest Lead has approved the changes and multiple staff members are notified that a change has been made.

Reviewer Entry

Reviewer 1

Comments:

Reviewer 2

Comments:

Accept

8. 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

Accept.

Reviewer 2

Comments:

4 – The guideline has been fully implemented in the repository

Response:

****Selection of data for archiving**:**

The datasets submitted for archiving and distribution at the ORNL DAAC are produced by science teams funded by NASA as a part of a satellite or aircraft mission, a field experiment, or a research project. In all cases, NASA assigns the datasets to the appropriate DAAC based on the Earth science discipline user community served by the DAAC. Given the rigorous review processes used by NASA in the selection of the science teams, the datasets produced by them are assured to be relevant to the users served by the DAACs.

In some cases, science investigators may submit datasets to the ORNL DAAC directly for archiving and distribution, outside of the projects and missions specifically assigned to us. To cover such cases the NASA ESDIS Project has an established procedure for assessment and acceptance of the datasets. The procedure involves an internal review by the ORNL DAAC, a review by the ORNL DAAC's User Working Group, and then a formal Special Accession Request which requires approval by the ESDIS Project and the NASA Headquarters Earth Science Data Systems Program.

****Quality Control Checks**:**

The data submitted to the ORNL DAAC are required to have documentation of scientific quality, appropriate quality flags

embedded in the data files, caveats about known issues, etc. The ORNL DAAC verifies that these conditions are met through the quality assurance processes documented in the previous section. Where data do not meet the quality assurance criteria, we iterate with the data provider, other members of the project team, and/or NASA program representatives to resolve any issues.

****Metadata required to interpret and use the data**:**

Data producers submitting data to the EOSDIS DAACs are required to conform to community standards for formats, interfaces, metadata, etc. These are indicated at <https://earthdata.nasa.gov/user-resources/standards-and-references>. The metadata standards employed have been evolving over the many years that the DAACs have been operating, and the set of acceptable standards are listed on the web page linked above. The metadata in the datasets submitted to the DAACs are verified to ensure that they meet the standards, which are sufficient for interpreting and using the data. The ORNL 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) - <https://earthdata.nasa.gov/about/science-system-description/eosdis-components/common-metadata-repository>.

Also, the ORNL DAAC provides consultation and assistance to data producers to ensure that they meet the metadata requirements.

Ensuring that the metadata provided are sufficient for long-term preservation: Ensuring that the metadata comply with the standards indicated above will support long-term preservation as well. In addition, the documentation and other artefacts needed for long-term preservation have been called out in NASA's Earth Science Data Preservation Content Specification (<https://earthdata.nasa.gov/user-resources/standards-and-references/preservation-content-spec>). The specification is being applied to data from missions to ensure that such materials are collected and archived at the ORNL DAAC.

****List of preferred formats, Quality control checks**:**

A list of data and metadata formats is available at <https://earthdata.nasa.gov/user-resources/standards-and-references>. Data providers are required to conform to these. The DAAC checks the data flows as they are initially set up to ensure that conformance. Periodic checks are made that the data and metadata comply with the standards.

The ORNL DAAC advises data providers on best practices for planning, collecting, and storing data and metadata, <https://daac.ornl.gov/PI/manage.shtml>

The ORNL DAAC also conducts workshops on a regular basis to make sure that the community is well trained on good data management practices, <https://daac.ornl.gov/workshops/workshops.shtml>

In addition to the above efforts ORNL DAAC also goes through a rigorous data appraisal process. ORNL DAAC's data publication can be broken down into the following high-level tasks:

(1) Accepting the data package from the data providers, ensuring the full integrity of the transferred data files (through checksums, file counts etc.);

- (2) Identifying and fixing data quality issues;
- (3) Assembling detailed metadata and documentation, including file-level details, processing methodology, and characteristics of data files;
- (4) Developing a discovery tool that allows users to search metadata for the data sets needed;
- (5) Setting up data access mechanisms;
- (6) Re-packaging data files to better suit the end user's research/application needs
- (7) Setup of the data in data tools and services for improved data discovery and dissemination
- (8) Registering the dataset in online search and discovery catalogues;
- (9) Provide a permanent identifier through Digital Object Identifiers (DOI).

Long-term storage, data stewardship, and user support are also considered while publishing a dataset into an archive. The nine tasks described here form the critical 5-Ps of data archive: Presentation, Preservation, Persistence, Publication, and Protection. The 5-Ps are essential elements for digital repositories.

More details are available at <https://daac.ornl.gov/PI/>

Reviewer Entry

Reviewer 1

Comments:

Reviewer 2

Comments:

Accept

9. 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

Accept.

Reviewer 2

Comments:

4 – The guideline has been fully implemented in the repository

Response:

As one of the DAACs within the NASA ESDIS Network, the ORNL DAAC is governed by the Requirements for Archiving, Distribution and User Services in EOS Data and Information System (EOSDIS) (a.k.a. ADURD <https://earthdata.nasa.gov/esdis/esdis-policy/adurd>).

Record copies of ORNL DAAC published data and documentation in at least three locations:

- The on-prem data pool, which utilizes a Redundant Array of Independent Disk (RAID) topology to protect against errors from media degradation
- An on-prem backup, which also uses a RAID topology to protect against errors from media degradation
- An off-site backup maintained in AWS Glacier

For data made available through Earthdata Cloud, a fourth copy is in S3 buckets in AWS West 2.

Fixity and consistency checks are run at least monthly to ensure that all copies of data are complete and match the published SHA256 hashes for the files. Given that all record and backup copies of ORNL DAAC published data and documentation are maintained using on-line media, monitoring of off-line storage media for degradation is not needed.

The ORNL DAAC replaces its on-prem storage system roughly every 5 years. File checksums and inventories are used to ensure that the record copies are correctly migrated to the new storage system.

ORNL, as part of obtaining an Authority to Operate (ATO) an information system under the US Federal Information System Management Act (FISMA), conducts annual risk assessments as defined in NIST Special Publication 800-30 <https://csrc.nist.gov/publications/detail/sp/800-30/rev-1/final> for all elements of the Information System, as part of the ATO renewal process. These risk assessments are reviewed by ORNL's Cybersecurity Policy office and the DOE ORNL Site Office (which is responsible for the oversight of all ORNL operations). The results of this risk assessment are reflected in the ORNL Unclassified Cybersecurity Program Plan. While this is not a public document, it is provided to the NASA officials responsible for the oversight of the ORNL DAAC.

The ORNL DAAC annually conducts a risk review as part of the renewal of the Operational Security Agreement between the ORNL DAAC and ESDIS. This is also not a public document, but it is reviewed by cognizant NASA officials.

Reviewer Entry

Reviewer 1

Comments:

Reviewer 2

Comments:

Accept

10. 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
Accept.

Reviewer 2

Comments:

4 – The guideline has been fully implemented in the repository

Response:

The ORNL DAAC follows the preservation specification document provided by NASA

(<https://earthdata.nasa.gov/user-resources/standards-and-references/preservation-content-spec>). As indicated in that document:

The data resulting from NASA's missions are a valuable resource that needs to be preserved for the benefit of future generations. In the near-term, as long as the missions' data are being used actively for scientific research, it continues to be important to provide easy access to data and services commensurate with current information technology. For the longer term, when the research community focus shifts toward new missions and observations, it is essential to preserve the previous mission data and the information needed so that a new user in the future will be able to understand how the data were used for deriving information, knowledge and policy recommendations, and to be able to "repeat the experiment" to ascertain the validity and possible limitations of conclusions reached in the past and to provide confidence in long term trends that depended on data from multiple missions. While NASA is not legislatively mandated to preserve data permanently as are other agencies such as the U.S. Geological Survey (USGS), National Oceanic and Atmospheric Administration (NOAA) and National Archives and Records Administration (NARA), it is essential for NASA to preserve all the data and associated content beyond the lives of NASA's missions to meet NASA's near-term objective of providing access to data and services for active scientific research. Also NASA has to ensure that the data and associated content are preserved for transition to permanent archival agencies. To fulfill this responsibility, identification of the specific content items that need to be preserved from each of NASA's missions is essential.

The ORNL DAAC's Data Management Plan includes plans and processes used for collecting software, documentation,

etc., as called for in the above Preservation Content Specification to ensure that the contents are captured before the end of missions/projects that provided data products to the DAAC. Providing such information to the respective DAACs is a requirement placed by NASA on the data providers. The data providers and the DAACs meet this requirement collaboratively.

All of the data and associated items held at the ORNL DAAC are governed by NASA's Earth Science Data and Information Policy (<https://earthdata.nasa.gov/earth-science-data-systems-program/policies/data-information-policy>).

The high-level requirements provided by NASA to the data producers include the requirement to transfer data to a designated DAAC according to an agreed upon schedule. The requirement also includes compliance with the NASA Earth Science Data Preservation Content Specification mentioned above. Details of data and metadata standards are worked out between the ORNL DAAC and the data producers, and they are compatible with those specified at <https://earthdata.nasa.gov/user-resources/standards-and-references#ed-standards>.

NASA's program management, regular reviews and reporting are used to ensure that the specified actions are taken.

Reviewer Entry

Reviewer 1

Comments:

Reviewer 2

Comments:

Accept

11. 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

Accept.

Reviewer 2

Comments:

4 – The guideline has been fully implemented in the repository

Response:

As indicated earlier, the ORNL DAAC uses a rigorous data quality checklist, https://daac.ornl.gov/PI/qa_checklist.html

Periodically, ORNL DAAC metadata are reviewed, and changes are made to ensure quality. In addition, each dataset is sent to the data provider for review before publication. The review allows the data provider to check the curation and value additions provided by the ORNL DAAC. All published datasets have a data citation that includes a DOI.

As part of the ORNL DAAC documentation process, we include pointers to related datasets and related publications in the User Guide for each dataset. User Guides also contain a Quality Assessment section that describes the scientific data quality assessment procedures, results, and/or any known quality limitations of the datasets. Dataset landing pages also provide links to all scholarly works of which the ORNL DAAC is aware that cite that specific dataset.

The ORNL DAAC does not have a process for the community to rate or otherwise publicly comment on the quality of datasets. However, the Feedback mechanisms previously discussed are used when data users identify quality issues or have questions that the documentation does not answer. The ORNL DAAC's User Services Office (USO) receives all of these comments and works with ORNL DAAC scientists to resolve the questions. This resolution may lead to data, metadata, and/or documentation updates, which are managed through the previously described change management process.

The ESDS Program and the ESDIS project regularly review metadata quality for all data published through the DAACs. These checks are primarily to improve the discoverability of data and compliance with current CMR best practices. ESDS reviews are done by the Analysis and Review of CMR (ARC) team (<https://earthdata.nasa.gov/esds/impact/arc>).

Given the relatively wide range of data published through the ORNL DAAC, there is no single approach or applicable standard for representing data quality, apart from our requirements that data providers give us as much information as they have on uncertainties and potential sources of errors, which we use to inform the Data Quality section in the User Guide. Where it is appropriate to represent data in netCDF files using the Climate and Forecasting (CF) convention (<https://cfconventions.org/cf-conventions/cf-conventions.html>) we do ensure that the quality representation standards in CF are followed, to the extent quality information is provided.

Reviewer Entry

Reviewer 1

Comments:

Reviewer 2

Comments:

Accept.

12. 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
Accept.

Reviewer 2

Comments:

4 – The guideline has been fully implemented in the repository

Response:

The ORNL DAAC primarily archives data resulting from ecological field research campaigns. This is a highly heterogeneous collection of data, involving interactions with hundreds of different data providers over the course of any given year. While some aspects of the workflow to archive and publish this type of data, other aspects require human judgement and/or decisions made on a per-dataset basis. The ORNL DAAC makes use of a Semi-Automated ingest System (SAuS), as described in Vannan et al “A Semi-Automated Workflow Solution for Data Set Publication” ISPRS International Journal of Geo-Informatics (2016) vol 5, p 30 (<http://dx.doi.org/10.3390/ijgi5030030>).

The process starts with a data provider completing the Submit Data form (<https://daac.ornl.gov/submit/form/>) on the ORNL DAAC’s website, or through a pre-agreed process defined ahead of time with leaders of projects or missions assigned to the ORNL DAAC. Once the ORNL DAAC confirms the identity of the data provider and that the data is within the ORNL DAAC’s defined scope, a Submission is opened, with a unique submission identifier. That submission identifier is communicated to the data provider and is the identifier through which the data provider submits the data and documentation to the ORNL DAAC, as well as tracks the progress of the submission through the ORNL DAAC’s workflow.

Once the data provider confirms that all data have been submitted and completes a second form (the Data Provider Questions form), the ORNL DAAC checks to ensure that number and types of files are as expected. The file inventory is also sent back to the data provider as a double check. The ORNL DAAC then validates whether this is a new dataset, or an update to an existing dataset. The Submission is assigned to one of the ORNL DAAC’s projects, and dataset identifiers are assigned.

The dataset then moves into the Quality Assurance process, where the ORNL DAAC validates that the data are as described, and (in consultation with the data provider) makes any adjustments to the data that are needed to bring the data into compliance with NASA standards. These adjustments may include things like changing variable names for consistency with NASA standards, updating “no data” and fill values for consistency with NASA standards, and creating additional versions of data in more broadly-usable forms, such as GeoTIFF and netCDF. The ORNL DAAC always retains a copy of the as-submitted data, which can be made available upon request. The data provider is always informed of any data transformation operations, and is generally consulted prior to such steps.

As the last step of the QA process, the ORNL DAAC uses an internal tool called Granulemeta, to determine the file-level metadata for the files in this Submission. This metadata includes the spatial and temporal extent for each file (where applicable), as well as file type, size, and hash values.

Following QA, the Submission moves into the Documentation phase, where the User Guide is developed (for a new dataset) or updated. SAuS is used to ensure that the User Guide is reviewed by at least one ORNL DAAC staff member not involved in developing the User Guide.

Once Documentation is completed, the Submission is sent for final internal review by one of the ORNL DAAC’s scientific staff. In most cases, the data is then sent for final review by the data provider. Where the Submission is an update that is simply adding files to an existing dataset, this final data provider review is generally skipped. Once the data provider has given final approval, the dataset is published, with the dataset being searchable in the ORNL DAAC’s systems, the NASA Earthdata Search, and Internet search engines.

In some cases, a data provider needs the data to be publicly available, with a resolvable DOI, before the QA and Documentation processes are complete, such as to make the data available for journal article reviewers. In these cases, the ORNL DAAC makes the as-submitted data publicly available as a Data Preprint, as describe in <https://daac.ornl.gov/about/#preprints>.

All changes to datasets and all steps in the publication process are tracked through SAuS and the ORNL DAAC-internal Dataset Publication Dashboard.

Changes to SAuS itself, and the workflows it embodies, are tracked through an ORNL-internal instance of Gitlab, with Puppet used to manage and deploy changes to the production ORNL DAAC servers.

Reviewer Entry

Reviewer 1

Comments:

Reviewer 2

Comments:

Accept

13. 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
Accept.

Reviewer 2

Comments:

4 – The guideline has been fully implemented in the repository

Response:

All the DAACs within the NASA ESDIS Network provide the metadata for their respective archives to the Common Metadata Repository (CMR), managed by the ESDIS Project. The CMR is a high-performance, high-quality, continuously evolving metadata system that catalogs all data and service metadata records for the EOSDIS system and will be the authoritative management system for all EOSDIS metadata. These metadata records are registered, modified, discovered, and accessed through programmatic interfaces leveraging standard protocols and APIs. (See <https://earthdata.nasa.gov/about/science-system-description/eosdis-components/common-metadata-repository>).

To facilitate users' search for data, the DAACs offer several methods. At the ESDIS Network level, the Earthdata Search provides search, preview, download and access capabilities for all the DAAC holdings. It also serves as a platform to feature planned EOSDIS services as they become available. (See <https://earthdata.nasa.gov/learn/user-resources/earthdata-search>). In addition, the search and order tools listed at <https://earthdata.nasa.gov/earth-observation-data/tools>, many of which are DAAC-specific, are available for users with various specialized capabilities.

The ORNL DAAC's website also provides a search functionality, which leverages the Earthdata Search API.

The ORNL DAAC assigns Digital Object Identifiers to all published data and has been doing so since 2007. DOIs resolve to a dataset landing page, which provides human- and machine-interpretable information about the dataset.

Metadata for ORNL DAAC datasets can be harvested through API calls to the NASA CMR as well as schema.org

metadata provided on each dataset landing page.

The Dataset landing pages include a suggested citation for the dataset. In addition, the dataset landing page provides the ability to download the dataset bibliographic data in RIS, BibTeX, and XML formats to enable citation formatting to meet target journal formats. Finally, the dataset landing page includes a link to the Crosscite citation formatting tool, which leverages the underlying DOI metadata to provide citations in a few hundred different journal formats.

Reviewer Entry

Reviewer 1

Comments:

Reviewer 2

Comments:

Accept

14. 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

Accept.

Reviewer 2

Comments:

4 – The guideline has been fully implemented in the repository

Response:

To ensure long-term data reuse, the ORNL DAAC ensures that all data are published in formats which are “archive stable”, meaning that the file formats are well-described and that open-source tools are available for reading the data. Accepted file formats are described in the Detailed Submission Guidelines at <https://daac.ornl.gov/submit/#guidelines>.

The ORNL DAAC prepares metadata conforming to the NASA Unified Metadata Model (UMM);

<https://earthdata.nasa.gov/esdis/eso/standards-and-references/eso-umm-information>) and submits this metadata to the NASA Common Metadata Repository (CMR). (UMM) is an extensible metadata model which provides a cross-walk for mapping between CMR-supported metadata standards, which includes ISO 19115-1 and ISO 19115-2.

In some cases, the ORNL DAAC will reformat historical data into newer formats, such as converting from netCDF 3 to netCDF 4, mostly where the datasets are of high value, and reformatting the data to support newer tools is valuable to the community. Decisions about what data to reformat are made in consultation between ORNL DAAC staff, the User Working Group, and ESDIS program management.

As a part of the ESDIS project, the ORNL DAAC works with the ESDIS Standards Office (ESO), which formulates standards policy for the NASA Earth Science Data Systems and coordinates standards activities within ESDIS (c.f. <https://earthdata.nasa.gov/about/esdis-project/esdis-standards-office-eso>).

Reviewer Entry

Reviewer 1

Comments:

Reviewer 2

Comments:

Accept.

TECHNOLOGY

15. 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

Accept.

Reviewer 2

Comments:

4 – The guideline has been fully implemented in the repository

Response:

As discussed in R15, the ORNL DAAC works with the ESDIS Standards Office in assessing which data and protocol standards are most appropriate to the broader ESDIS user community, as well as the more specific community for the ORNL DAAC. As part of the annual American Customer Satisfaction Index (ACSI) survey administered by the CLaes Fornell International (CFI) Group across the 12 EOSDIS DAACs, the ORNL DAAC gets input on the data and protocol formats of broadest interest to the user community.

As discussed above, the ORNL DAAC makes use of the NASA Unified Metadata Model for metadata standardization and uses the file formats standards describe in the Detailed Submission Guidelines <https://daac.ornl.gov/submit/#guidelines>. The ORNL DAAC uses standard Layer 3 and Layer 4 transport layer protocols, such as https. The ORNL DAAC uses standard application layer protocols, such as the Open Geospatial Consortium (OGC) standards for geospatial data, the Data Access Protocol (DAP, such as implemented in the Unidata Thematic Real-time Environmental Distributed Data Services (THREDDS)), and REpresentational State Transfer (REST) web services with OpenAPI discovery methods.

The ORNL DAAC regularly assesses the hardware and software infrastructure, as part of the annual Work Plan. The Work Plan is reviewed by the ORNL DAAC's User Working Group (UWG) and is reviewed and approved by the ESDIS project.

The ORNL DAAC does make substantial use of open-source and community developed software. At a high level, the ORNL DAAC's infrastructure is Linux-based, using the Apache web server. As noted above, the ORNL DAAC uses the Unidata THREDDS as one data delivery vehicle, and it makes use of Minnesota Map Server as the basis for the Spatial Data Access Tool (SDAT). All production ORNL DAAC servers are managed using Puppet for configuration management, which provides an internal assessment of the software in use for its production environment.

By virtue of being hosted at Oak Ridge National Laboratory, the ORNL DAAC makes use of the Department of Energy's ESNet dedicated science network (<https://www.es.net/>) for connectivity. This provides more than adequate bandwidth for the needs of the designated community. Over the past fiscal year (1 October 2020 through 30 September 2021), the ORNL DAAC has achieved approximately 99.95% uptime, as measured by an external monitoring service. Most of the downtime has been planned outages, which are advertised to users through web site banners at least a few days in advance.

There are multiple layers to the disaster and continuity plans for the ORNL DAAC. At a high level, ORNL has disaster and continuity plans which are part of the Unclassified Cybersecurity Program Plan (CSPP) necessary for a Federal Information System Management Act (FISMA) Authority To Operate (ATO). This CSPP is reviewed and approved annually by a Department of Energy civil servant (the Authorizing Official). The CSPP disaster and continuity plans cover the underlying infrastructure for the ORNL DAAC, including network connectivity, server rooms, and cybersecurity incident response.

As part of the NASA ESDIS project, the ORNL DAAC also maintains an Operational Security Agreement (OSA) which delineates responsibilities and communications channels between ORNL, the Department of Energy, and NASA. This OSA is reviewed annually by the ESDIS Project Security Office. As part of this OSA, the ORNL DAAC has defined the disaster recovery and continuity of operations plans. These documents are designated as Confidential Unclassified Information (CUI) and Official Use Only (OUO), and are therefore not public, but they are reviewed at least annually by cognizant officials outside of the ORNL DAAC itself.

Reviewer Entry

Reviewer 1

Comments:

Reviewer 2

Comments:

Accept.

16. 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

Accept.

Reviewer 2

Comments:

4 – The guideline has been fully implemented in the repository

Response:

Security for the ORNL DAAC is a shared responsibility between ORNL DAAC staff, ORNL, the Department of Energy, and NASA. These responsibilities are defined in the OSA discussed in R15. As previously described, the ORNL DAAC's operations are covered by the FISMA ATO issued by a DOE Authorizing Official for the ORNL Unclassified Information System. Within that Information System, the ORNL DAAC's servers operate within the Open Research enclave.

ORNL's Information Technology Services Division (ITSD) operates a wide range of intrusion prevention and detection systems designed to minimize the risks of adversarial actions. ORNL also leverages cybersecurity tools provided by the Department of Energy and by the US Cybersecurity and Infrastructure Security Agency (CISA).

The ORNL DAAC maintains an Incident Response Plan, which describes the response to any unplanned event which causes, or may cause, disruption to one or more ORNL DAAC internal or external services. This incident response plan is a part of the OSA, and is reviewed annually by ORNL DAAC staff, ORNL Cybersecurity, and ESDIS Cybersecurity.

ORNL DAAC data is publicly accessible, so authentication is not required for data read operations. A user registration system (Earthdata Login; <https://urs.earthdata.nasa.gov/>) is used to help the ESDIS Project better understand NASA Earth science data users resulting in improved user experience and better services. However, there is no validation of any user identity or identity attribute – so data access is effectively pseudonymous.

For data submitters, the ORNL DAAC validates identity as described in R7. The data submitter is then given a network location in which the data may be deposited. The nature of this process is consistent with Identity Assurance Level (IAL) 2 and Authenticator Assurance Level (AAL) 1 as defined in NIST Special Publication 800-63-3 (<https://pages.nist.gov/800-63-3/>). All data submitted through this process is validated by ORNL DAAC staff prior to publication on any public-facing web site.

Authentication for ORNL DAAC staff meet IAL and AAL 3, which are the highest levels defined in NIST 800-63-3. These require in person validation of asserted identity with at least two forms of independently validated, government-issued identification and hardware-based certificate authentication.

Reviewer Entry

Reviewer 1

Comments:

Reviewer 2

Comments:

Accept

APPLICANT FEEDBACK

Comments/feedback

These Requirements are not seen as final, and we value your input to improve the CoreTrustSeal certification procedure. Any comments on the quality of the Requirements, their relevance to your organization, or any

other contribution, will be considered as part of future iterations.

Response:

Reviewer Entry

Reviewer 1

Comments:

Reviewer 2

Comments:

Overall, this is an excellent application and shows substantively more detail and demonstrated improvements from the previous certification application in 2018.