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**DSMR-00118 Version 1.0**

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**Data Stewardship Maturity Report for GHRSSST Level 4 RTO Aqua MODIS-AMSRE**  
**Day North America Regional Blended Sea Surface Temperature Analysis (GDS**  
**version 1)**

Table 1 Legend				
Level 1	Level 2	Level 3	Level 4	Level 5
Ad Hoc	Minimal	Intermediate	Advanced	Optimal
Little or no management	Limited Management	Defined Management, partially implemented	Well-defined Management, fully implemented	Full Management, audited, measured, controlled

Table 1. Scores for the Nine DSMM Key Components at a Glance		
Preservability - 5	Accessibility - 5	Usability - 4.5
Production Sustainability - 2	Data Quality Assurance - 1	Data Quality Control/Monitoring - 1
Data Quality Assessment - 0	Transparency/Traceability - 1	Data Integrity - 3

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**U.S. DEPARTMENT OF COMMERCE**  
National Oceanic and Atmospheric Administration  
National Environmental Satellite, Data, and Information Service

Cover Image: Data Stewardship Rating Diagram for GHRSST Level 4 RTO Aqua MODIS-AMSRE Day North America Regional Blended Sea Surface Temperature Analysis (GDS version 1)

Shades of green are used to represent level 1 through level 5 ratings; denoting Ad Hoc, Minimal, Intermediate, Advanced, and Optimal stages for each of the nine key components, respectively. The dark green level indicates all the practices are completely satisfied. The lighter green levels indicate only some of the practices are satisfied. The lightest green level indicates none of the practices are satisfied.

The stewardship maturity of NCEI data product, GHRSST Level 4 RTO Aqua MODIS-AMSRE Day North America Regional Blended Sea Surface Temperature Analysis (GDS version 1), is assessed based on a reference stewardship maturity framework.

The current maturity ratings of GHRSST Level 4 RTO Aqua MODIS-AMSRE Day North America Regional Blended Sea Surface Temperature Analysis (GDS version 1) are at Level 1 or higher for all nine key components with three Level 1, one Level 2, one Level 3, one Level 4, and two Level 5 key components.

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The National Environmental Satellite, Data, and Information Service (NESDIS) manages the Nation's civil Earth-observing satellite systems, as well as global national data bases for meteorology, oceanography, geophysics, and solar-terrestrial sciences. From these sources, it develops and disseminates environmental data and information products critical to the protection of life and property, national defense, and the national economy, energy development and distribution, global food supplies, and the development of natural resources.

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Copies of earlier reports may be available by contacting NESDIS Chief of Staff, NOAA/NESDIS, 1335 East-West Highway, SSMC1, Silver Spring, MD 20910, (301) 713-3578.

## **ASSESSMENT REVISION HISTORY**

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Data Stewardship Maturity Report for GHRSST Level 4 RTO Aqua MODIS-AMSRE Day North America Regional Blended Sea Surface Temperature Analysis (GDS version 1)

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## Preface

In response to the President's Open Government Initiative and related policies, NOAA has committed to providing improved public access to all of its environmental information, to enable research and commercial innovation through ease of data discovery and use [Casey, 2016].

OneStop supports NOAA's efforts by leveraging existing access technologies and infusing specific innovations to provide improved discover, access, and visualization services for NOAA's data. Also, OneStop is viewed by a NESDIS as a pathfinder effort with an initial focus on selected high-priority datasets from NESDIS and other program data meeting OneStop standards, but eventually scalable across NOAA's data. Lastly, OneStop is implementing the USGEO Common Framework for Earth Observation Data and leveraging/supporting the NOAA Big Data Project (BDP) and Big Earth Data Initiative (BEDI) [Casey, 2016].

As with any process of improvement planning, agencies need to find out where they are in terms of their compliance to the federal regulations and what they need to do if any areas of non-compliance are identified. To this end, a unified framework would be beneficial for assessing the current stage of stewardship practices applied to individual datasets and for providing a road map that will guide future investments towards enhanced stewardship of environmental datasets. The value and quality of a dataset depends in part on the stewardship practices applied after its development and production. Therefore, a unified framework providing a holistic view of the quality of stewardship practices applied to individual datasets is beneficial to data stewards and users [Casey, 2016].

The Data Stewardship Maturity Matrix (DSMM), jointly developed by domain (data management, technology, and science) subject matter experts from NOAA's National Centers for Environmental Information (NCEI) and Cooperative Institute for Climate and Satellites – North Carolina (CICS-NC), provides such a consistent framework [Peng *et al.*, 2016]. The DSMM, leveraging institutional knowledge and community practices and standards, defines a graduated maturity scale for each of nine key components of scientific data stewardship to enable a consistent assessment of the measurable stewardship practices applied to a given data set or product.

The NOAA Data Stewardship Maturity Technical Series captures stewardship maturity assessment results for individual datasets, provides consistent representation and citable documents of those assessments, ensures transparency, and allows better data quality information integration and content-based search and discovery of NOAA data.

**Data Stewardship Maturity Report for GHRSST Level 4 RTO Aqua MODIS-AMSRE Day North America Regional Blended Sea Surface Temperature Analysis (GDS version 1)**

## **1. Introduction**

### **1.1 Purpose**

The purpose of this document is to describe the results of stewardship maturity assessment for NOAA Climate Data Record for Mean Layer Temperature (Upper Troposphere & Lower Stratosphere from UCAR, Version 2, utilizing the Scientific Data Stewardship Maturity Matrix or DSMM [Peng, et al, 2016]. DSMM defines levels of stewardship maturity stages for Preservability, Accessibility, Usability, Production Sustainability, Data Quality Assurance, Data Quality Control/Monitoring, Data Quality Assessment, Transparency/Traceability, and Data Integrity key components. Each of these components is ranked from 'Ad hoc' to 'Optimal' (see Appendix I). This report is based on evaluation performed by NOAA OneStop metadata specialists working with Subject Matter Experts and utilizing the DSMM template [Peng, 2016].

### **1.2 Scope**

Assessing stewardship maturity - the current state of how datasets are documented, preserved, stewarded, and made accessible publicly, is a critical step towards meeting U.S. federal regulations, organizational requirements, and user needs [Peng et al., 2016]. The goal of this document is to provide consistent and transparent stewardship maturity information to data users and decision-makers.

### **1.3 Dataset Abstract**

A Group for High Resolution Sea Surface Temperature (GHRSST) Level 4 sea surface temperature analysis produced daily on an operational basis at the JPL Physical Oceanography DAAC using weighted averages on a regional 0.011 degree grid over the oceans off North and Central America (62N- 20S, 165W - 30W). This Research to Operations (RTO) analysis is based upon a composite of either nighttime or daytime GHRSST L2P skin SST from the Moderate Resolution Imaging Spectroradiometer (MODIS) on the NASA Aqua and Terra platforms, and subskin SST observations from the Advanced Microwave Scanning Radiometer-EOS (AMSRE). Four unique products (composites) are created: MODIS Terra/AMSRE day and night, and MODIS Aqua/AMSRE day and night. This particular dataset represents a MODIS Aqua and AMSRE composite using daytime data. The algorithm is based on a weighting scheme and compositing whereby MODIS data are used if they exist to preserve the highest resolution possible. The product is categorized as blended because no attempt is made to correct for foundation or skin temperature.

## **1.4 Document Maintenance**

This document is generated and maintained by NOAA's National Centers for Environmental Information. More on policy is available at <https://www.ncei.noaa.gov/>.

## **2. Results**

The data stewardship maturity assessment information is summarized in Table 1. Each component is displayed along with its corresponding score in a color-coded table.

**Table 2. Dataset and Data Stewardship Maturity Assessment Metadata**

<b>Dataset Title</b>	GHRSST Level 4 RTO Aqua MODIS-AMSRE Day North America Regional Blended Sea Surface Temperature Analysis (GDS version 1)
<b>Dataset Information URL</b>	<a href="https://www.ncei.noaa.gov/metadata/geoportal/rest/metadata/item/gov.noaa.nodc%3AGHRSST-JPL-L4UHblend-NCAMERICA-RTO_SST_Ad/html">https://www.ncei.noaa.gov/metadata/geoportal/rest/metadata/item/gov.noaa.nodc%3AGHRSST-JPL-L4UHblend-NCAMERICA-RTO_SST_Ad/html</a>
<b>Data Provider POC (Name; Email; Affiliation)</b>	National Centers for Environmental Information, NESDIS, NOAA, U.S. Department of Commerce 301-713-3277 NCEI. Info@noaa.gov
<b>Dataset POC (Name; Email; Affiliation)</b>	Edward Armstrong; edward.m.armstrong@jpl.nasa.gov NASA/JPL/PODAAC; Physical Oceanography Distributed Active Archive Center, Jet Propulsion Laboratory, NASA
<b>SMM Version (Document ID and Version Number)</b>	NCDC-CICS-SMM_0001_Rev.1 12/09/2014
<b>SMM POC (Name; E-mail; Affiliation)</b>	Ge Peng, ge.peng@uah.edu, University of Alabama-Huntsville
<b>SMM Template Version (Document ID and Version Numbers)</b>	NCDC-CICS-SMM_0001_Rev.1 v4.0 06/23/2015
<b>SMM Template POC</b>	Ge Peng, ge.peng@uah.edu, University of Alabama-Huntsville
<b>SMM Assessment Version (v&lt;nn&gt;r&lt;mm&gt;, e.g., v01r00)</b>	v01r06
<b>SMM Assessment Date (MM/DD/YYYY)</b>	04/19/2019
<b>SMM Assessment POC (Name; E-mail; Affiliation)</b>	Raisa Ionin, raisa.ionin@noaa.gov, Earth Resources Technology, Inc.
<b>Stewardship Maturity Ratings (each key component) (kc1/kc2/kc3/kc4/kc5/kc6/kc7/kc8/kc9)</b>	5 / 5 / 4.5 / 2 / 1 / 1 / 0 / 1 / 3
<b>SMM Original Assessment Date (MM/DD/YYYY)</b>	07/29/2016
<b>SMM Original Assessment POC (Name; E-mail; Affiliation)</b>	Raisa Ionin, raisa.ionin@noaa.gov, Earth Resources Technology, Inc.
<b>SMM Last Modified Date (MM/DD/YYYY)</b>	11/08/2021
<b>SMM Last Modification POC (Name; E-mail; Affiliation)</b>	Katy Luquaire, catherine.luquaire@noaa.gov , CASE Consultants International
<b>SMM Modified Date (MM/DD/YYYY)</b>	04/19/2019
<b>SMM Modification POC (Name; E-mail; Affiliation)</b>	Raisa Ionin, raisa.ionin@noaa.gov, Earth Resources Technology, Inc.

Table 3. Stewardship Maturity Levels and Detailed Justifications for Each of Nine DSMM Key Components for the Dataset.

DSMM Key Component	Stewardship Maturity Rating, Justification, and Comments
<b>Preservability</b>	<p>Level 5</p> <ul style="list-style-type: none"> <li>▪ Archived by NCEI, which is NOAA designated repository. NOAA is compliant to NARA standards</li> <li>▪ Metadata following ISO 19115-2 standards.</li> <li>▪ Compliant to OIAS RM</li> <li>▪ Plans to update metadata to ISO 19115-1 at a later date</li> <li>▪ Using NCEI Silver Spring Archive Management System, AMS.</li> </ul> <p>Comments:</p>
<b>Accessibility</b>	<p>Level 5</p> <ul style="list-style-type: none"> <li>▪ Collection level searchable online</li> <li>▪ Granule level is searchable online</li> <li>▪ Additional search options available from collection level site</li> <li>▪ Direct file download available from</li> <li>▪ THREDDS: <ul style="list-style-type: none"> <li>▪ <a href="https://www.ncei.noaa.gov/thredds-ocean/catalog/ghrsst/L4/NCAMERICA/JPL/RTO_SST_Ad/catalog.html">https://www.ncei.noaa.gov/thredds-ocean/catalog/ghrsst/L4/NCAMERICA/JPL/RTO_SST_Ad/catalog.html</a></li> <li>▪ HTTP: <a href="https://www.ncei.noaa.gov/data/oceans/ghrsst/L4/NCAMERICA/JPL/RTO_SST_Ad/">https://www.ncei.noaa.gov/data/oceans/ghrsst/L4/NCAMERICA/JPL/RTO_SST_Ad/</a></li> <li>▪ FTP: <a href="ftp://ftp-oceans.ncei.noaa.gov/pub/data.nodc/ghrsst/L4/NCAMERICA/JPL/RTO_SST_Ad/">ftp://ftp-oceans.ncei.noaa.gov/pub/data.nodc/ghrsst/L4/NCAMERICA/JPL/RTO_SST_Ad/</a></li> </ul> </li> <li>▪ Data citation is also available from NASA PODAAC site: <a href="https://podaac.jpl.nasa.gov/dataset/JPL-L4UHblend-NCAMERICA-RTO_SST_Ad">https://podaac.jpl.nasa.gov/dataset/JPL-L4UHblend-NCAMERICA-RTO_SST_Ad</a></li> <li>▪ Dissemination reports are available to the public <a href="https://www.ncei.noaa.gov/access/ghrsst-long-term-stewardship-and-reanalysis-facility/">https://www.ncei.noaa.gov/access/ghrsst-long-term-stewardship-and-reanalysis-facility/</a></li> <li>▪ Future technology changes are planned</li> </ul> <p>Comments:</p>
<b>Usability</b>	<p>Level 4.5</p> <ul style="list-style-type: none"> <li>▪ The format is interoperable: nc.bz2 for granules</li> <li>▪ User Guide [GHRSSST, 2011] is available online <a href="https://www.nodc.noaa.gov/archive/arc0072/0123222/1.1/data/0-data/GHRSSSTUserGuidev91.pdf">https://www.nodc.noaa.gov/archive/arc0072/0123222/1.1/data/0-data/GHRSSSTUserGuidev91.pdf</a></li> <li>▪ User Manual [GHRSSST, 2011] is available online <a href="https://www.nodc.noaa.gov/archive/arc0072/0123222/1.1/data/0-data/GDS20r5.pdf">https://www.nodc.noaa.gov/archive/arc0072/0123222/1.1/data/0-data/GDS20r5.pdf</a></li> <li>▪ All GHRSSST collections have error estimate.</li> <li>▪ All GHRSSST collections have enhanced online capability (e.g., visualization, multiple data formats): TDS, DAP (*data servers maintained at NCEI); access from metadata main landing page.</li> <li>▪ A GHRSSST User Guide, Quick Start Guide, GHRSSST Data Specification (GDS) manual, and other relevant documents describing GHRSSST data sets can be found in the archive accession, Documentation for The Group for High Resolution Sea Surface Temperature (GHRSSST) data archived at NODC (NODC Accession 0123222), <a href="https://www.ncei.noaa.gov/access/metadata/landing-page/bin/iso?id=gov.noaa.nodc:0123222">https://www.ncei.noaa.gov/access/metadata/landing-page/bin/iso?id=gov.noaa.nodc:0123222</a></li> <li>▪ No Algorithm documentation is available.</li> <li>▪ No external ranking</li> </ul> <p>Comments:</p>

Table 3. Stewardship Maturity Levels and Detailed Justifications for Each of Nine DSMM Key Components for the Dataset.

DSMM Key Component	Stewardship Maturity Rating, Justification, and Comments
<b>Production Sustainability</b>	<p>Level 2</p> <ul style="list-style-type: none"> <li>The dataset is not currently supported, according to LTSRF Table: <a href="https://www.ncei.noaa.gov/access/ghrsst-long-term-stewardship-and-reanalysis-facility/">https://www.ncei.noaa.gov/access/ghrsst-long-term-stewardship-and-reanalysis-facility/</a> (Stopped in 2012)</li> </ul> <p>Comments:</p> <p>Changes for technology are available from individual dataset producers. NOAA does not have them documented.</p> <p>From LTSRF page, the product is listed under JPL, then RTO_SST_Ad NCAMERICA</p>
<b>Data Quality Assurance</b>	<p>Level 1</p> <ul style="list-style-type: none"> <li>Data quality assurance procedure is unknown.</li> </ul> <p>Comments:</p>
<b>Data Quality Control/ Monitoring</b>	<p>Level 1</p> <ul style="list-style-type: none"> <li>No Quality Control metrics are available: <a href="https://www.star.nesdis.noaa.gov/sod/sst/squam/">https://www.star.nesdis.noaa.gov/sod/sst/squam/</a></li> </ul> <p>Comments:</p>
<b>Data Quality Assessment</b>	<p>Level 0</p> <ul style="list-style-type: none"> <li>No Algorithm document is available.</li> </ul> <p>Comments:</p>
<b>Transparency / Traceability</b>	<p>Level 1</p> <ul style="list-style-type: none"> <li>Limited product information available, metadata only on GHRSST_L4_RTO_AQUA_MODIS_AMSRE_DNARBSSTA landing page: <a href="https://www.ncei.noaa.gov/metadata/geoportal/rest/metadata/item/gov.noaa.nodc%3AGHRSST-JPL-L4UHblend-NCAMERICA-RTO_SST_Ad/html">https://www.ncei.noaa.gov/metadata/geoportal/rest/metadata/item/gov.noaa.nodc%3AGHRSST-JPL-L4UHblend-NCAMERICA-RTO_SST_Ad/html</a></li> </ul> <p>Comments:</p>
<b>Data Integrity</b>	<p>Level 3</p> <ul style="list-style-type: none"> <li>Data archive integrity verifiable - Checksum technology is available, each GHRSST_L4_RTO_AQUA_MODIS_AMSRE_DNARBSSTA package is accompanied by a manifest in XML format containing hash digests generated using various algorithms, including MD5, SHA-1, SHA-384, etc. That includes checksums (.md5) for every file package. <a href="https://www.nodc.noaa.gov/archive/arc0037/0079815/0079815.1.1.xml">https://www.nodc.noaa.gov/archive/arc0037/0079815/0079815.1.1.xml</a></li> <li>Data authenticity is verifiable (since data can be downloaded via HTTPS and HTTPS uses certificates to prove site authenticity)</li> <li>NCEI-MD does not provide digital signatures for data dissemination</li> </ul> <p>Comments:</p>

### **3. Acknowledgment**

This work is supported by the NOAA OneStop Project.

We thank the dataset POCs for their valuable input, as well as the collaborative efforts of the OneStop teams, especially the Metadata team. We would also like to show appreciation to Ge Peng for her contributions.

The draft of this data stewardship maturity report is systematically generated by a tool created by Kieran Hodnett and populated with the stewardship maturity assessment done by the author(s) of this report. The tool was developed based on a Word template created collaboratively by Robert Partee II, Raisa Ionin, Paul Lemieux III, Ge Peng, Don Collins, and Sonny Zinn with helpful input from the NOAA Central Library and the NCEI Communication Team.

#### 4. References

Casey, K. (2016), The NOAA OneStop data discover and access framework project, Version:June 3, 2016. <https://cdn.ioos.noaa.gov/media/2017/12/OneStop-IOOS-DMAC-03-June-2016.pdf>

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(Accessed December 22, 2016)

The Recommended GHRSSST Data Specification (GDS) GDS 2.0 revision 5, 2011, retrieved online <https://www.nodc.noaa.gov/archive/arc0072/0123222/1.1/data/0-data/GDS20r5.pdf> (Accessed 22 December 2016)

## Appendix I: The Scientific Data Stewardship Maturity Matrix (DSMM)

Table A1: This matrix (Version: NCDC-CICS-SMM-0001-Rev.1. 12/09/2014) describes the criterion used to evaluate data stewardship maturity for each of the nine DSMM key components [Peng *et al.*, 2015].

DSMM Component	Level 1 <i>Ad hoc</i> Little or no management	Level 2 <i>Minimal</i> Limited management	Level 3 <i>Intermediate</i> Defined management, partially implemented	Level 4 <i>Advanced</i> Well-defined management, fully implemented	Level 5 <i>Optimal</i> Full management, audited, measured, controlled
<b>Preservability</b> <i>(The state of being preservable)</i>	Any storage location  Data only	Non-designated repository  Redundancy  Limited archiving metadata	Designated archive  Redundancy  Community-standard archiving metadata  Conforming to limited archiving standards	Level 3 +  Conforming to community archiving standards	Level 4 +  Archiving process performance controlled, measured, and audited  Future archiving standard changes planned
<b>Accessibility</b> <i>(The state of being searchable and accessible publicly)</i>	Not publicly available person-to-person  Collection or dataset level searchable online	Publicly available direct file download (e.g., via anonymous FTP server)  Collection or dataset level searchable online	Level 2 +  Non-standard data service  Limited data server performance  Granule/file level searchable  Limited search metrics	Level 3 +  Community-standard data service  Enhanced data server performance  Conforming to community search metrics  Dissemination report metrics defined and implemented internally	Level 4 +  Dissemination reports available online  Future technology and standard changes planned

<p><b>Usability</b> <i>(The state of being easy to use)</i></p>	<p>Extensive product-specific knowledge required  No documentation online</p>	<p>Non-standard data format  Limited documentation (e.g., user's guide online)</p>	<p>Community standard-based interoperable format &amp; metadata  Documentation (e.g. source code, product algorithm document, processing or/and data flow diagram) online</p>	<p>Level 3 + Basic capability (e.g., subsetting, aggregating) &amp; data characterization overall/global, e.g., climatology, error estimates) available online</p>	<p>Level 4 + Enhanced online capability (e.g., visualization, multiple data formats)  Community metrics of data characterization (regional/cell) online  External ranking</p>
<p><b>Production Sustainability</b> <i>(The state of data production being sustainable and extendable)</i></p>	<p>Ad Hoc or Not applicable  To obligation or deliverable requirement</p>	<p>Short-term Individual PI's commitment (grant obligations)</p>	<p>Medium-term Institutional commitment (contractual deliverables with specs and schedule defined)</p>	<p>Long-term Institutional commitment  Product improvement process in place</p>	<p>Level 4 + National or international commitment  Changes for technology planned</p>
<p><b>Data Quality Assurance</b> <i>(The state of data quality being assured)</i></p>	<p>Data quality assurance (DQA) procedure unknown or none</p>	<p>Ad Hoc and random  QA procedure not defined and documented</p>	<p>DQA procedure defined and documented and partially implemented</p>	<p>DQA procedure well documented, fully implemented and available online with master reference data Limited data quality assurance metadata</p>	<p>Level 4 + DQA procedure monitored and reported Conforming to community quality metadata &amp; standards  External review</p>

<p><b>Data Quality Control/ Monitoring</b></p> <p><i>The state of data quality being controlled and monitored</i></p>	<p>None or Sampling unknown or spotty</p> <p>Analysis unknown or random in time</p>	<p>Sampling and analysis are regular in time and space</p> <p>Limited product-specific metrics defined &amp; implemented</p>	<p>Level 2 +</p> <p>Sampling and analysis are frequent and systematic but not automatic</p> <p>Community metrics defined and partially implemented</p> <p>Procedure documented and available online</p>	<p>Level 3 +</p> <p>Anomaly detection procedure well-documented and fully implemented using community metrics, automatic, tracked and reported</p> <p>Limited quality monitoring metadata</p>	<p>Level 4 +</p> <p>Cross-validation of temporal &amp; spatial characteristics</p> <p>Physical consistency check</p> <p>Conforming to community quality metadata &amp; standards</p>
<p><b>Data Quality Assessment</b></p> <p><i>(The state of data quality being assessed)</i></p>	<p>Algorithm/ method/model</p> <p>Theoretical basis assessed (methods and results online)</p>	<p>Level 1 +</p> <p>Research product assessed (methods and results online)</p>	<p>Level 2 +</p> <p>Operational product assessed (methods and results online)</p>	<p>Level 3 +</p> <p>Quality metadata assessed</p> <p>Limited quality assessment metadata</p>	<p>Level 4 +</p> <p>Assessment performed on a recurring basis</p> <p>Conforming to community quality metadata &amp; standards</p> <p>External ranking</p>
<p><b>Transparency/ Traceability</b></p> <p><i>(The state of being transparent, trackable, and traceable)</i></p>	<p>Limited product information available</p> <p>Person-to-person</p>	<p>Product information available in literature</p>	<p>Algorithm Theoretical Basis Document (ATBD) &amp; source code online</p> <p>Dataset configuration managed (CM)</p> <p>Unique Object Identifier (OID) assigned (dataset, documentation, source code)</p> <p>Data citation tracked (e.g., utilizing Digital Object Identifier</p>	<p>Level 3 +</p> <p>Operational Algorithm Description (OAD) online, OID assigned, and under CM</p>	<p>Level 4 +</p> <p>System information online</p> <p>Complete data provenance online</p>

<b>Data Integrity</b> <i>(The state of data integrity being verifiable)</i>	Unknown or no data ingest integrity check	Data ingest integrity verifiable (e.g., checksum technology)	(DOI) system Level 2 + Data archive integrity verifiable	Level 3 + Data access integrity verifiable Conforming to community data integrity technology standard	Level 4 + Data authenticity verifiable (e.g., data signature technology) Performance of data integrity check monitored and reported