

**NOAA Technical Information Series NESDIS
DSMR-00096 Version 1.0**

doi: 10.25923/a4v1-rk88



**Data Stewardship Maturity Report for GHRSSST Level 2P Regional Subskin Sea
Surface Temperature from the Tropical Rainfall Mapping Mission (TRMM)
Microwave Imager (TMI) for the Atlantic Ocean (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 - 3.5	Data Quality Assurance - 3.5	Data Quality Control/Monitoring - 3
Data Quality Assessment - 0	Transparency/Traceability - 2.5	Data Integrity - 3.0

NOAA National Centers for Environmental Information January 2020



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

Cover Image: Data Stewardship Rating Diagram for GHRSSST Level 2P Regional Subskin Sea Surface Temperature from the Tropical Rainfall Mapping Mission (TRMM) Microwave Imager (TMI) for the Atlantic Ocean (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, GHRSSST Level 2P Regional Subskin Sea Surface Temperature from the Tropical Rainfall Mapping Mission (TRMM) Microwave Imager (TMI) for the Atlantic Ocean (GDS version 1), is assessed based on a reference stewardship maturity framework. The current maturity ratings of GHRSSST Level 2P Regional Subskin Sea Surface Temperature from the Tropical Rainfall Mapping Mission (TRMM) Microwave Imager (TMI) for the Atlantic Ocean (GDS version 1) are at Level 1 or higher for all nine key components with zero Level 1, one Level 2, four Level 3, one Level 4, and two Level 5 key components.

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.

Publication in the NOAA Technical Memorandum series does not preclude later publication in scientific journals in expanded or modified form. The NESDIS series of NOAA Technical Reports is a continuation of the former NESS and EDIS series of NOAA Technical Reports and the NESC and EDS series of Environmental Science Services Administration (ESSA) Technical Reports.

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

Revision	Description	Date
V01r00	Initial Release	12/08/2021

NOAA Technical Information Series NESDIS DSMR-00096

Version 1.0

doi: 10.25923/a4v1-rk88

Data Stewardship Maturity Report for GHRSSST Level 2P Regional Subskin Sea Surface Temperature from the Tropical Rainfall Mapping Mission (TRMM) Microwave Imager (TMI) for the Atlantic Ocean (GDS version 1)

Paul Lemieux III, Katy Luquire

NOAA's National Centers of Environmental Information (NCEI)

151 Patton Avenue, Asheville, NC 28801, (828) 271-4800

Recommended Citation

Paul Lemieux III, Katy Luquire. (2021), Data Stewardship Maturity Report for GHRSSST Level 2P Regional Subskin Sea Surface Temperature from the Tropical Rainfall Mapping Mission (TRMM) Microwave Imager (TMI) for the Atlantic Ocean (GDS version 1)

NOAA Technical Information Series NESDIS DSMR-00096 Version 1.0, 20pp.,
doi: 10.25923/a4v1-rk88

Table of Contents

List of Tables	7
Preface	8
1. Introduction	9
2. Results	10
3. Acknowledgment	15
4. References	16
Appendix I The Scientific Data Stewardship Maturity Matrix (DSMM)	17

List of Tables

Table 1. Scores for the Nine DSMM Key Components at a Glance	1
Table 2. Dataset and Data Stewardship Maturity Assessment Metadata	11
Table 3. Stewardship Maturity Levels and Detailed Justifications for Each of Nine DSMM Key Components for the Dataset.	12

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 GHR SST Level 2P Regional Subskin Sea Surface Temperature from the Tropical Rainfall Mapping Mission (TRMM) Microwave Imager (TMI) for the Atlantic Ocean (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

The Tropical Rainfall Measuring Mission (TRMM) Microwave Imager (TMI) is a well calibrated passive microwave radiometer, similar to SSM/I, that contains lower frequency channels required for sea surface temperature (SST) retrievals. The TRMM is a joint venture between NASA and the Japan Aerospace Exploration Agency (JAXA) to measure precipitation, water vapor, SST and wind in the global tropical regions and was launched in November 1997. The TRMM satellite travels west to east in a 402 km altitude semi-equatorial precessing orbit that results in day-to-day changes in the observation time of any given earth location between 38S and 38N.

This Group for High Resolution Sea Surface Temperature (GHR SST) dataset is derived from Remote Sensing Systems BMAPS (binary) format TMI SST subskin data. Data were downloaded for the North Atlantic region from Remote Sensing Systems every hour to capture the latest TMI observations. L2P data products were then produced to the GHR SST Data Processing Specification (GDS) version 1.5. Ascending (daytime) and descending (nighttime) orbits are packaged into separate netCDF files.

Although the dataset designation is "L2P" it is actually a "L3C" dataset (gridded Level 3 collated) as defined by the GHRSSST Data Processing Specification version 2.0. This dataset was originally produced for the GHRSSST Pilot Project, the precursor to GHRSSST, by the Medspiration Regional Data Assembly Center (RDAC) in Europe. As one of the first datasets produced as a prototype for GHRSSST-PP it assumed an incorrect designation of "L2P".

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	
Dataset Title	GHRSSST Level 2P Regional Subskin Sea Surface Temperature from the Tropical Rainfall Mapping Mission (TRMM) Microwave Imager (TMI) for the Atlantic Ocean (GDS version 1)
Dataset Information URL	https://www.ncei.noaa.gov/metadata/geoportal/rest/metadata/item/gov.noaa.nodc%3AGHRSSST-EUR-L2P-TMI/html#
Data Provider POC (Name; E-mail; Affiliation)	NOAA National Centers for Environmental Information (NCEI), NCEI.Info@noaa.gov
Dataset POC (Name; E-mail; Affiliation)	Jean-Francois Piolle, jfpiolle@ifremer.fr, Institut Francais de Recherche pour l'Exploitation de la Mer, Center d'Exploitation et de Recherche Satellitaire
SMM Version (Document ID and Version Number)	NCDC-CICS-SMM_0001_Rev.1 12/09/2014
SMM POC (Name; E-mail; Affiliation)	Ge Peng, ge.peng@uah.edu, University of Alabama-Huntsville
SMM Template Version (Document ID and Version Numbers)	NCDC-CICS-SMM_0001_Rev.1 v4.0 06/23/2015
SMM Template POC	Ge Peng, ge.peng@uah.edu, University of Alabama-Huntsville
SMM Assessment Version (v<nn>r<mm>, e.g., v01r00)	V01r06
SMM Assessment Date (MM/DD/YYYY)	04/29/2019
SMM Assessment POC (Name; E-mail; Affiliation)	Paul Lemieux III, Paul.Lemieux@noaa.gov, Earth Resources Technology, Inc.
Stewardship Maturity Ratings (each key component) (kc1/kc2/kc3/kc4/kc5/kc6/kc7/kc8/kc9)	5 / 5 / 4.5 / 3.5 / 3.5 / 3 / 0 / 2.5 / 3.0
SMM Original Assessment Date (MM/DD/YYYY)	08/25/2016
SMM Original Assessment POC (Name; E-mail; Affiliation)	Paul Lemieux III, Paul.Lemieux@noaa.gov, Earth Resources Technology, Inc.
SMM Last Modified Date (MM/DD/YYYY)	09/23/2021
SMM Last Modification POC (Name; E-mail; Affiliation)	Katy Luquire, catherine.luquire@noaa.gov , CASE Consultants International
SMM Modified Date (MM/DD/YYYY)	04/29/2019
SMM Modification POC (Name; E-mail; Affiliation)	Paul Lemieux III, Paul.Lemieux@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
<p>Preservability</p>	<p>Level 5</p> <ul style="list-style-type: none"> ▪ Archived by NCEI which is a NOAA designated archive compliant to NARA standards. ▪ Metadata following ISO 19115-2. ▪ Compliant to OIAS RM. ▪ Plans to update metadata to ISO 19115-1 at a later date and will be a pilot dataset for the OneStop initiative. ▪ Multiple access points provide several layers of redundancy. ▪ Using NCEI Silver Spring Archive Management System, AMS. <p>Comments: No comments</p>
<p>Accessibility</p>	<p>Level 5</p> <ul style="list-style-type: none"> ▪ Collection level searchable online ▪ Granule level is searchable online ▪ Additional search options available from collection level site ▪ Direct file download available from ▪ FTP: ftp://ftp-oceans.ncei.noaa.gov/pub/data.nodc/ghrsst/L2P/TMI/EUR/ ▪ HTTP: https://www.ncei.noaa.gov/data/oceans/ghrsst/L2P/TMI/EUR/ ▪ THREDDS: ▪ https://www.ncei.noaa.gov/thredds-ocean/catalog/ghrsst/L2P/TMI/EUR/catalog.html ▪ Dissemination reports are available to the public https://www.ncei.noaa.gov/access/ghrsst-long-term-stewardship-and-reanalysis-facility/ ▪ New technology for OneStop search and discovery planned (i.e. ElasticSearch, Hyrax Servers, etc.) This is part of the GHRSSST data group that will be OneStop ready. ▪ Additional enhanced data server performance (TDS, DAP) are maintained by NCEI and accessible from the metadata landing page. <p>Comments: No 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
<p>Usability</p>	<p>Level 4.5</p> <ul style="list-style-type: none"> ▪ Community standard interoperable format: NetCDF ▪ 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), https://www.ncei.noaa.gov/access/metadata/landing-page/bin/iso?id=gov.noaa.nodc:0123222 ▪ GHRSSST User’s guide [GHRSSST, 2011] is available online at: https://www.nodc.noaa.gov/archive/arc0072/0123222/1.1/data/0-data/GHRSSSTUserGuidev91.pdf ▪ Aggregating granules is possible via THREDDS server. ▪ All GHRSSST collections have error estimates. ▪ 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 ▪ 17 year climatology [Wentz, 2015] of TRMM SST retrievals available online here: https://doi.org/10.1175/JCLI-D-15-0155.1 <p>Comments: The ATBDs are unavailable online. The data creators have them, but they were not submitted to the archive. No known external ranking</p>
<p>Production Sustainability</p>	<p>Level 3.5</p> <ul style="list-style-type: none"> ▪ NOAA NCEI-MD supporting long term stewardship of GHRSSST collections as part of LTSRF: https://www.ncei.noaa.gov/access/ghrsst-long-term-stewardship-and-reanalysis-facility/ ▪ Medspiration is no longer producing this dataset and is encouraging users to use a newer product from OSI-SAF. <p>Comments: No more product improvement processes in place since Medspiration is no longer producing this dataset. Long-term international commitment (GHRSSST is an international collaboration).</p>
<p>Data Quality Assurance</p>	<p>Level 3.5</p> <ul style="list-style-type: none"> ▪ DQA procedure defined and documented in the GHRSSST Data Specification user’s guide [GHRSSST, 2011] here https://www.nodc.noaa.gov/archive/arc0072/0123222/1.1/data/0-data/GHRSSSTUserGuidev91.pdf ▪ L2 and L3 File level quality flags exist which can be considered limited data quality assurance metadata. <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
Data Quality Control/ Monitoring	<p>Level 3</p> <ul style="list-style-type: none"> ▪ Limited Quality Control metrics are available: http://sharaku.eorc.jaxa.jp/trmm/RT/index_e.html ▪ Sampling and analysis are frequent and systematic but not automatic ▪ Procedure documented and available online <p>Comments: SST estimations are compared over time with in situ (drifting buoys) data and stats are updated every day and displayed at the CERSAT project page: http://cersat.ifremer.fr/data/products/cal-val/quality-monitoring-of-myoccean-sst-products</p>
Data Quality Assessment	<p>Level 0</p> <ul style="list-style-type: none"> ▪ Unable to locate any documentation online that describes Medspiration’s TMI SST retrieval algorithms. <p>Comments: Operational assessment available {Ffield, 2005}</p>
Transparency / Traceability	<p>Level 2.5</p> <ul style="list-style-type: none"> ▪ Product information available in literature [Ffield, 2005] available online here: https://doi.org/10.1016/j.dsr.2004.05.013 ▪ OID Assigned: GHRSSST-EUR-L2P-SEVIRI_SST ▪ GHRSSST datasets are under configuration management principles: https://doi.org/10.5281/zenodo.4700465 <p>Comments: No DOI assigned No OAD available Unable to locate any documentation that describes the SST retrieval algorithm.</p>
Data Integrity	<p>Level 3</p> <ul style="list-style-type: none"> ▪ Data archive integrity verifiable ▪ Checksum technology is available, each GHRSSST_TMI_TRMM_REG_L2P 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. https://www.nodc.noaa.gov/archive/arc0056/0107446/0107446.1.1.xml ▪ Data authenticity is verifiable (since data can be downloaded via HTTPS and HTTPS uses certificates to prove site authenticity) ▪ NCEI-MD does not provide digital signatures for data dissemination <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>

Peng, G. (2015) The scientific data stewardship maturity assessment model template, Version: NCDC-CICS-SMM-0001-Rev.1 v4.0 6/23/2015. doi:10.6084/m9.figshare.1211954.

Peng, G., J.L. Privette, E.J. Kearns, N.A. Ritchey, and S. Ansari (2015), A unified framework for measuring stewardship practices applied to digital environmental datasets, *Data Science Journal*, 13, 231-253, doi: 10.2481/dsj.14-049.

Peng, G., J. Lawrimore, V. Toner, C. Lief, R. Baldwin, N. Ritchey, D. Brinegar, and S. A. Delgreco (2016) assessing stewardship maturity of the global historical climatology network-monthly (GHCN-M) dataset: use case study and lessons learned, *D-Lib Magazine*, 22, doi:10.1045/november2016-peng.

GHRSSST User Guide version 9.1, (2011), retrieved online: <https://www.nodc.noaa.gov/archive/arc0072/0123222/1.1/data/0-data/GHRSSSTUserGuidev91.pdf> (Accessed December 22, 2016)

Wentz, F., (2015), A 17-Yr climate record of environmental parameters derived from the Tropical Rainfall Measuring Mission (TRMM) microwave imager, *Journal of Climate*, 28(9), 6882—6902, doi:10.1175/JCLI-D-15-0155.1.

Ffield, A., (2005), North Brazil current rings viewed by TRMM microwave imager SST and the influence of the Amazon Plume, *Deep Sea Research Part I: Oceanographic Research Papers*, 52(1), 137—160, doi:10.1016/j.dsr.2004.05.013.

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
<i>Preservability</i> <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
<i>Accessibility</i> <i>(The state of being searchable and accessible publicly)</i>	Not publically available person-to-person	Publically 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>Usability</p> <p><i>(The state of being easy to use)</i></p>	<p>Extensive product-specific knowledge required</p> <p>No documentation online</p>	<p>Non-standard data format</p> <p>Limited documentation (e.g., user's guide online)</p>	<p>Community standard-based interoperable format & metadata</p> <p>Documentation (e.g. source code, product algorithm document, processing or/and data flow diagram) online</p>	<p>Level 3 +</p> <p>Basic capability (e.g., subsetting, aggregating) & data characterization overall/global,</p> <p>e.g., climatology, error estimates) available online</p>	<p>Level 4 +</p> <p>Enhanced online capability (e.g., visualization, multiple data formats)</p> <p>Community metrics of data characterization (regional/cell) online</p> <p>External ranking</p>
<p>Production Sustainability</p> <p><i>(The state of data production being sustainable and extendable)</i></p>	<p>Ad Hoc or Not applicable</p> <p>To obligation or deliverable requirement</p>	<p>Short-term</p> <p>Individual PI's commitment (grant obligations)</p>	<p>Medium-term</p> <p>Institutional commitment (contractual deliverables with specs and schedule defined)</p>	<p>Long-term Institutional commitment</p> <p>Product improvement process in place</p>	<p>Level 4 +</p> <p>National or international commitment</p> <p>Changes for echnology planned</p>
<p>Data Quality Assurance</p> <p><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</p> <p>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</p> <p>Limited data quality assurance metadata</p>	<p>Level 4 +</p> <p>DQA procedure monitored and reported</p> <p>Conforming to community quality metadata & standards</p> <p>External review</p>

<p>Data Quality Control/Monitoring</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 & 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 & spatial characteristics</p> <p>Physical consistency check</p> <p>Conforming to community quality metadata & standards</p>
<p>Data Quality Assessment</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 & standards</p> <p>External ranking</p>
<p>Transparency/Traceability</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) & 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>

<p>Data Integrity</p> <p><i>(The state of data integrity being verifiable)</i></p>	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