

**NOAA Technical Information Series NESDIS
DSMR-00268 Version 1.0**

doi: 10.25923/1qhv-5p53



**Data Stewardship Maturity Report for GHRSSST Level 4 GAMSSA_28km Global
Foundation Sea Surface Temperature Analysis v1.0 dataset (GDS versions 1 and
2)**

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 - 5	Data Quality Assurance - 4.33	Data Quality Control/Monitoring - 4
Data Quality Assessment - 3	Transparency/Traceability - 2.5	Data Integrity - 4

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 4 GAMSSA_28km Global Foundation Sea Surface Temperature Analysis v1.0 dataset (GDS versions 1 and 2)

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 4 GAMSSA_28km Global Foundation Sea Surface Temperature Analysis v1.0 dataset (GDS versions 1 and 2), is assessed based on a reference stewardship maturity framework. The current maturity ratings of GHRSSST Level 4 GAMSSA_28km Global Foundation Sea Surface Temperature Analysis v1.0 dataset (GDS versions 1 and 2) are at Level 1 or higher for all nine key components with zero Level 1, one Level 2, one Level 3, four Level 4, and three 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	02/02/2022

NOAA Technical Information Series NESDIS DSMR-00268

Version 1.0

doi: 10.25923/1qhv-5p53

Data Stewardship Maturity Report for GHRSSST Level 4 GAMSSA_28km Global Foundation Sea Surface Temperature Analysis v1.0 dataset (GDS versions 1 and 2)

Frederick Gunther

NOAA's National Centers of Environmental Information (NCEI)

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

Recommended Citation

Frederick Gunther. (2021), Data Stewardship Maturity Report for GHRSSST Level 4 GAMSSA_28km Global Foundation Sea Surface Temperature Analysis v1.0 dataset (GDS versions 1 and 2), NOAA Technical Information Series NESDIS DSMR-00268 Version 1.0, 21pp., doi: 10.25923/1qhv-5p53

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)	18

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 measureable 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 4 GAMSSA_28km Global Foundation Sea Surface Temperature Analysis v1.0 dataset (GDS versions 1 and 2)

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 (GHR SST) Level 4 sea surface temperature analysis, produced daily on an operational basis at the Australian Bureau of Meteorology (BoM) using optimal interpolation (OI) on a global 0.25 degree grid. This Global Australian Multi-Sensor SST Analysis (GAMSSA) v1.0 system blends satellite SST observations from passive infrared and passive microwave radiometers with in situ data from ships, drifting buoys and moorings from the Global Telecommunications System (GTS). SST observations that have experienced recent surface wind speeds less than 6 m/s during the day or less than 2 m/s during night are rejected from the analysis. The processing results in daily foundation SST estimates that are largely free of nocturnal cooling and diurnal warming effects. Sea ice concentrations are supplied by the NOAA/NCEP 12.7 km sea ice analysis. In the absence of observations, the analysis relaxes to the Reynolds and Smith (1994) Monthly 1 degree SST climatology for 1961 - 1990.

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 4 GAMSSA_28km Global Foundation Sea Surface Temperature Analysis v1.0 dataset (GDS versions 1 and 2)
Dataset Information URL	https://www.ncei.noaa.gov/access/metadata/landing-page/bin/iso?id=gov.noaa.nodc:GHRSSST-GAMSSA_28km-ABOM-L4-GLOB
Data Provider POC (Name; Email; Affiliation)	National Centers for Environmental Information, NESDIS, NOAA, U.S. Department of Commerce 301-713-3277 NCEI.Info@noaa.gov
Dataset POC (Name; Email; Affiliation)	Leon Majewski ghrsst@bom.gov.au ABOM (Australian Bureau of Meteorology)
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)	V01r00
SMM Assessment Date (MM/DD/YYYY)	02/01/2022
SMM Assessment POC (Name; E-mail; Affiliation)	Frederick Gunther, Frederick.gunther@noaa.gov, Riverside Technology
Stewardship Maturity Ratings (each key component) (kc1/kc2/kc3/kc4/kc5/kc6/kc7/kc8/kc9)	5/5/4.5/5/4.33/4/3/2.5/4
SMM Original Assessment Date (MM/DD/YYYY)	02/01/2022
SMM Original Assessment POC (Name; E-mail; Affiliation)	Frederick Gunther, Frederick.gunther@noaa.gov, Riverside Technology
SMM Last Modified Date (MM/DD/YYYY)	02/01/2022
SMM Last Modification POC (Name; E-mail; Affiliation)	Frederick Gunther, Frederick.gunther@noaa.gov, Riverside Technology
SMM Modified Date (MM/DD/YYYY)	02/01/2022
SMM Modification POC (Name; E-mail; Affiliation)	Frederick Gunther, Frederick.gunther@noaa.gov, Riverside Technology

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 NOAA designated repository. NOAA is compliant to NARA standards ▪ Metadata following ISO 19115-2 standards. ▪ Compliant to OAIS RM ▪ Plans to update metadata to ISO 19115-1 at a later date ▪ Using NCEI Silver Spring Archive Management System, AMS. <p>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 ▪ THREDDS: https://www.ncei.noaa.gov/thredds-ocean/catalog/ghrsst/L4/GLOB/ABOM/GAMSSA/catalog.html ▪ HTTP: https://www.ncei.noaa.gov/data/oceans/ghrsst/L4/GLOB/ABOM/GAMSSA/ ▪ FTP: ftp://ftp-oceans.ncei.noaa.gov/pub/data.nodc/ghrsst/L4/GLOB/ABOM/GAMSSA/ ▪ These data are in NetCDF format following ACDD and/or CF conventions. ▪ Dissemination reports are available to the public https://www.ncei.noaa.gov/access/ghrsst-long-term-stewardship-and-reanalysis-facility/ ▪ Future technology changes are planned ▪ Data set is also accessible from NASA JPL PODAAC site: GDS 1: doi.org/10.5067/GHGAM-4FA01 ▪ GDS 2: doi.org/10.5067/GHGAM-4FA1A <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
<p>Usability</p>	<p>Level 4.5</p> <ul style="list-style-type: none"> ▪ The format is interoperable: nc.bz2 for granules ▪ User Guide [GHRSSST, 2011] is available online https://www.nodc.noaa.gov/archive/arc0072/0123222/1.1/data/0-data/GHRSSSTUserGuidev91.pdf ▪ GDS 2.0 User Manual [GHRSSST GDS, 2012] is available online https://www.nodc.noaa.gov/archive/arc0072/0123222/1.1/data/0-data/GDS20r5.pdf ▪ Algorithm document [Beggs, 2011] is available online http://doi.org/10.22499/2.6101.001 ▪ Error estimates described in Algorithm document: ▪ [Beggs, 2011] is available online http://www.bom.gov.au/jshess/docs/2011/beggs.pdf ▪ as well as in the article: ▪ [Zhong, 2008] is available online http://www.bom.gov.au/australia/charts/bulletins/apob77.pdf ▪ Error estimates are available ▪ Enhanced online capability available through multiple data servers maintained at NCEI: LAS, THREDDS. ▪ All GHRSSST collections have error estimate. ▪ No external ranking ▪ Data set is also accessible from NASA JPL PODAAC site: GDS 1: https://doi.org/10.5067/GHGAM-4FA01 ▪ GDS 2: https://doi.org/10.5067/GHGAM-4FA1A <p>Comments:</p>
<p>Production Sustainability</p>	<p>Level 5</p> <ul style="list-style-type: none"> ▪ The dataset is currently supported according to LTSRF Table: https://www.ncei.noaa.gov/access/ghrsst-long-term-stewardship-and-reanalysis-facility/ ▪ Long-term institutional commitment ABOM, Australian Bureau of Meteorology, Australia. ▪ Long-term international commitment (GHRSSST is an international group) ▪ Changes for technology are available from individual dataset producers. <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 ABOM, then RAMSSA AUS</p>
<p>Data Quality Assurance</p>	<p>Level 4.33</p> <ul style="list-style-type: none"> ▪ DQA procedure defined, documented and implemented based on this publication: [Beggs, 2011] is available online http://doi.org/10.22499/2.6101.001 ▪ File level quality flags exist which can be considered limited data quality assurance metadata. ▪ DQA procedure monitored and reported ▪ https://www.star.nesdis.noaa.gov/socd/sst/squam/ <p>Comments:</p> <p>No known external reviews of the data quality assurance</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 4</p> <ul style="list-style-type: none"> ▪ Limited Quality Control metrics are available: http://www.star.nesdis.noaa.gov/sod/sst/squam/ ▪ Procedure documented and available online ▪ Conforming to community quality metadata & standards ▪ Anomaly detection and documented in GDS 2.0 User Manual [GHRSSST GDS, 2012] is available online https://www.nodc.noaa.gov/archive/arc0072/0123222/1.1/data/0-data/GDS20r5.pdf ▪ Cross-validation documented in [Beggs, 2011] is available online http://doi.org/10.22499/2.6101.001 <p>Comments:</p>
Data Quality Assessment	<p>Level 3</p> <ul style="list-style-type: none"> ▪ Algorithm Based Documentation ▪ [Beggs, 2011] is available online http://www.bom.gov.au/jshess/docs/2011/beggs.pdf ▪ Research and operational product assessed, publications available: ▪ [Zhong, 2008] is available online http://www.bom.gov.au/australia/charts/bulletins/apob77.pdf ▪ [Beggs, 2011] is available online http://www.bom.gov.au/jshess/docs/2011/beggs.pdf <p>Comments:</p>
Transparency / Traceability	<p>Level 2.5</p> <ul style="list-style-type: none"> ▪ Limited product information available, metadata only on the GHRSSST GAMMSA landing page: https://www.ncei.noaa.gov/metadata/geoportal/rest/metadata/item/gov.noaa.nodc%3AGHRSSST-GAMSSA_28km-ABOM-L4-GLOB/html# ▪ Product information available in literature: [Beggs, 2011] is available online http://doi.org/10.22499/2.6101.001 ▪ GHRSSST datasets are under Configuration Management principles: https://doi.org/10.5281/zenodo.4700465 ▪ Dataset is a part of GHRSSST collection and maintained by NCEI ▪ GHRSSST datasets are under Configuration Management principles: ftp://ftp.nodc.noaa.gov/nodc/archive/arc0072/0123222/2.2/data/0-data/governance-documents/ ▪ OID assigned: gov.noaa.nodc%3AGHRSSST-GAMSSA_28km-ABOM-L4-GLOB ▪ No DOI assigned ▪ No formal ATBD <p>Comments:</p>
Data Integrity	<p>Level 4</p> <ul style="list-style-type: none"> ▪ Data archive integrity verifiable - Checksum technology is available, each GHRSSST L4 GAMSSA GFSSTA 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/arc0092/0155383/0155383.1.1.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 February 01, 2022)

The Recommended GHRSSST Data Specification (GDS) GDS 2.0 revision 5, 2012, retrieved online <https://www.nodc.noaa.gov/archive/arc0072/0123222/1.1/data/0-data/GDS20r5.pdf> (Accessed 01 February 2022)

Beggs, Helen, et al. (2011), RAMSSA - An operational, high-resolution, Regional Australian Multi-Sensor Sea surface temperature Analysis over the Australian region. *Australian Meteorological and Oceanographic Journal* 61.1 (2011): 1, retrieved online: <http://doi.org/10.22499/2.6101.001> (Accessed 01 February 2022)

Beggs, H. et al. (2011), RAMSSA - An operational, high-resolution, Regional Australian Multi-Sensor Sea surface temperature Analysis over the Australian region, *Australian Meteorological and Oceanographic Journal*, 61(1), 1-22, <http://www.bom.gov.au/jshess/docs/2011/beggs.pdf> (Accessed 01 February 2022)

Zhong, A., and H. Beggs (2008), Operational Implementation of Global Australian Multi-Sensor Sea Surface Temperature Analysis, *Analysis and Prediction Operations Bulletin*, 77, <http://www.bom.gov.au/australia/charts/bulletins/apob77.pdf> (Accessed 01 February 2022)

Beggs, Helen, et al. (2011), RAMSSA - An operational, high-resolution, Regional Australian Multi-Sensor Sea surface temperature Analysis over the Australian region. *Australian Meteorological and Oceanographic Journal* 61.1 (2011): 1, retrieved online: <http://doi.org/10.22499/2.6101.001> (Accessed 24 January 2022)

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