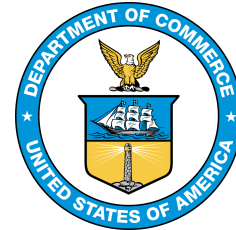


**NOAA Technical Information Series NESDIS
DSMR-00086 Version 1.0**

doi: 10.25923/2gs1-e539



**Data Stewardship Maturity Report for GHR SST v2 Level 3U Global Skin Sea
Surface Temperature from the Visible Infrared Imaging Radiometer Suite
(VIIRS) on the Suomi NPP satellite created by the NOAA Advanced Clear-Sky
Processor for Ocean (ACSPO) (GDS version 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 - 3.5	Data Quality Control/Monitoring - 3
Data Quality Assessment - 2	Transparency/Traceability - 3.5	Data Integrity - 3

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 GHR SST v2 Level 3U Global Skin Sea Surface Temperature from the Visible Infrared Imaging Radiometer Suite (VIIRS) on the Suomi NPP satellite created by the NOAA Advanced Clear-Sky Processor for Ocean (ACSPO) (GDS version 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, GHR SST v2 Level 3U Global Skin Sea Surface Temperature from the Visible Infrared Imaging Radiometer Suite (VIIRS) on the Suomi NPP satellite created by the NOAA Advanced Clear-Sky Processor for Ocean (ACSPO) (GDS version 2), is assessed based on a reference stewardship maturity framework. The current maturity ratings of GHR SST v2 Level 3U Global Skin Sea Surface Temperature from the Visible Infrared Imaging Radiometer Suite (VIIRS) on the Suomi NPP satellite created by the NOAA Advanced Clear-Sky Processor for Ocean (ACSPO) (GDS version 2) 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 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.

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Paul Lemieux III, Katy Luquire

NOAA's National Centers of Environmental Information (NCEI)

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

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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 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 v2 Level 3U Global Skin Sea Surface Temperature from the Visible Infrared Imaging Radiometer Suite (VIIRS) on the Suomi NPP satellite created by the NOAA Advanced Clear-Sky Processor for Ocean (ACSPO) (GDS version 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

The Joint Polar Satellite System (JPSS), starting with S-NPP launched on 28 October 2011, is the new generation of the US Polar Operational Environmental Satellites (POES). The Suomi National Polar-orbiting Partnership (S-NPP) is a collaboration between NASA and NOAA. The ACSPO SNPP/VIIRS L3U (Level 3 Uncollated) product is a gridded version of the ACSPO SNPP/VIIRS L2P product. The L3U output files are 10-minute granules in netCDF4 format, compliant with the GHR SST Data Specification version 2 (GDS2). There are 144 granules per 24hr interval, with a total data volume of 500MB/day. Fill values are reported at all invalid pixels, including pixels with >5 km inland. For each valid water pixel (defined as ocean, sea, lake or river, and up to 5 km inland), the following layers are reported: SSTs, ACSPO clear-sky mask (ACSM; provided in each grid as part of l2p_flags, which also includes day/night, land, ice, twilight, and glint flags), NCEP wind speed, and ACSPO SST minus reference (Canadian Met Centre 0.1deg L4 SST).

Only L2P SSTs with QL=5 were gridded, so all valid SSTs are recommended for the users. Per GDS2 specifications, two additional Sensor-Specific Error Statistics layers (SSES bias and standard deviation) are reported in each pixel with valid SST. The

ACSPO VIIRS L3U product is monitored and validated against iQuam in situ data (Xu and Ignatov, 2014) in SQUAM (Dash et al, 2010).

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	GHR SST v2 Level 3U Global Skin Sea Surface Temperature from the Visible Infrared Imaging Radiometer Suite (VIIRS) on the Suomi NPP satellite created by the NOAA Advanced Clear-Sky Processor for Ocean (ACSPO) (GDS version 2)
Dataset Information URL	https://doi.org/10.7289/V5KK98S8
Data Provider POC (Name; E-mail; Affiliation)	NOAA National Centers for Environmental Information (NCEI), NCEI.Info@noaa.gov
Dataset POC (Name; E-mail; Affiliation)	Alexander Ignatov, Alex.Ignatov@noaa.gov, NOAA Center for Satellite Applications and Research (STAR)
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)	V02r04
SMM Assessment Date (MM/DD/YYYY)	04/30/2019
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 / 5 / 3.5 / 3 / 2 / 3.5 / 3
SMM Original Assessment Date (MM/DD/YYYY)	08/02/2016
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)	09/27/2021
SMM Last Modification POC (Name; E-mail; Affiliation)	Katy Luquire, catherine.luquire@noaa.gov , CASE Consultants International
SMM Modified Date (MM/DD/YYYY)	04/30/2019
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
Preservability	<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>
Accessibility	<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/L3U/VIIRS_NPP/OSPO/▪ HTTP: https://www.ncei.noaa.gov/data/oceans/ghrsst/L3U/VIIRS_NPP/OSPO/▪ THREDDS:▪ https://www.ncei.noaa.gov/thredds-ocean/catalog/ghrsst/L3U/VIIRS_NPP/OSPO/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 GHR SST 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
Usability	<p>Level 4.5</p> <ul style="list-style-type: none"> ▪ Community standard interoperable format: NetCDF ▪ GHR SST User’s guide [GHR SST, 2011] is available online at: https://www.nodc.noaa.gov/archive/arc0072/0123222/1.1/data/0-data/GHR SSTUserGuidev91.pdf ▪ A GHR SST User Guide, Quick Start Guide, GHR SST Data Specification (GDS) manual, and other relevant documents describing GHR SST data sets can be found in the archive accession, Documentation for The Group for High Resolution Sea Surface Temperature (GHR SST) data archived at NODC (NODC Accession 0123222), https://www.ncei.noaa.gov/access/metadata/landing-page/bin/iso?id=gov.noaa.nodc:0123222 ▪ Interface Control Document [Ignatov, Sapper, Petrenko, et al., 2014] available online here: ftp://ftp.star.nesdis.noaa.gov/pub/sod/osb/aignatov/ACSPO/ ▪ VIIRS ASCPO SST retrieval algorithm is described in literature [Gladkova, Kihai, Ignatov, et al., 2015] available online here: https://doi.org/10.1016/j.rse.2015.01.003 ▪ Aggregating granules is possible via THREDDS server. ▪ All GHR SST collections have error estimates. ▪ All GHR SST collections have enhanced online capability (e.g., visualization, multiple data formats) : TDS, DAP (*data servers maintained at NCEI); access from metadata main landing page <p>Comments: No algorithm documents are present here for GHR SST. Data providers have them, but these are not available at NCEI. Will be planned for the future.</p>
Production Sustainability	<p>Level 5</p> <ul style="list-style-type: none"> ▪ Long-term commitment in place for the VIIRS instrument and S-NPP platform. ACSPO SST products see very high use from users, even more so than the VIIRS EDR SST product. Long-term archiving plan in place for historical data at NCEI-MD. ▪ NOAA NCEI-MD supporting long term stewardship of GHR SST collections as part of LTSRF: https://www.ncei.noaa.gov/access/ghrsst-long-term-stewardship-and-reanalysis-facility/ ▪ Long-term international commitment (GHR SST is an international collaboration). <p>Comments: Changes for technology are available from individual dataset producers. NOAA does not have them documented.</p>
Data Quality Assurance	<p>Level 3.5</p> <ul style="list-style-type: none"> ▪ DQA procedure defined and documented in the GHR SST Data Specification user’s guide [GHR SST, 2011] available online here https://www.nodc.noaa.gov/archive/arc0072/0123222/1.1/data/0-data/GHR SSTUserGuidev91.pdf ▪ DQA procedures are outlined in this data paper [Petrenko, Ignatov, Kihai, et al., 2014] available online here: https://doi.org/10.1002/2013JD020637 ▪ File level quality flags exist which can be considered limited data quality assurance metadata. <p>Comments: 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 3</p> <ul style="list-style-type: none"> ▪ Limited Quality Control metrics are available: https://www.star.nesdis.noaa.gov/sod/sst/squam ▪ Sampling and analysis are frequent and systematic but not automatic ▪ Procedure documented [GHR SST, 2011] and available online here: https://www.nodc.noaa.gov/archive/arc0072/0123222/1.1/data/0-data/GHR SSTUserGuidev91.pdf <p>Comments: No comments</p>
Data Quality Assessment	<p>Level 2</p> <ul style="list-style-type: none"> ▪ The SST retrieval algorithm is explained and the research product is assessed in this paper [Petrenko, Ignatov, Kihai, et al., 2014] available online here: https://doi.org/10.1002/2013JD020637 <p>Comments: No known quality metadata assessments</p>
Transparency / Traceability	<p>Level 3.5</p> <ul style="list-style-type: none"> ▪ Algorithm and product information available in literature [Petrenko, Ignatov, Kihai, et al., 2014] available online here: https://doi.org/10.1002/2013JD020637 ▪ DOI assigned: https://doi.org/10.7289/V5KK98S8 ▪ OID assigned: GHR SST-VIIRS_NPP-OSPO-L3U ▪ GHR SST datasets are under configuration management principles: https://doi.org/10.5281/zenodo.4700465 <p>Comments: No OAD available.</p>
Data Integrity	<p>Level 3</p> <ul style="list-style-type: none"> ▪ Data archive integrity verifiable ▪ Checksum technology is available, each GHR SST_OSPO_VIIRS_NPP_L3U 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/arc0101/0157437/0157437.1.1.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: Checksum file available for download from PODAAC FTP: ftp://podaac-ftp.jpl.nasa.gov/allData/ghrsst/data/GDS2/L3U/VIIRS_NPP/OSPO/v2.4/</p>

3. Acknowledgment

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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.

GHR SST User Guide version 9.1, (2011), retrieved online: <https://www.nodc.noaa.gov/archive/arc0072/0123222/1.1/data/0-data/GHR SST User Guide v91.pdf> (Accessed December 22, 2016)

Ignatov, A., Sapper, J., Petrenko, B., Liang, X., Kihai, Y., Stroup, J., (2014), Advanced Clear-Sky Processor for Oceans (ACSPO) Version 2.31 Interface Control Document (ICD), NOAA Center for Satellite Applications and Research (STAR), Greenbelt, MD., retrieved online: <ftp://ftp.star.nesdis.noaa.gov/pub/sod/osb/ignatov/ACSPO/> (Accessed 07 February 2017).

Gladkova, I., Kihai, Y., Ignatov, A., Shahriar, F., Petrenko, B., (2015), SST pattern test in ACSPO clear-sky mask for VIIRS, *Remote Sensing of Environment*, 160, 87—98, doi:10.1016/j.rse.2015.01.003.

Petrenko, B., Ignatov, A., Kihai, Y., Stroup, J., Dash, P., (2014), Evaluation and selection of SST regression algorithms for JPSS VIIRS, *Journal of Geophysical Research Atmospheres*, 119(8), 4580—4599, doi:10.1002/2013JD020637.

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

<i>Usability</i> <i>(The state of being easy to use)</i>	<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>
<i>Production Sustainability</i> <i>(The state of data production being sustainable and extendable)</i>	<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</p> <p>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>
<i>Data Quality Assurance</i> <i>(The state of data quality being assured)</i>	<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>

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

<i>Data Integrity</i> <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