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**Data Stewardship Maturity Report for GHRSSST Level 2P Global Skin Sea
Surface Temperature from the Advanced Along Track Scanning Radiometer (AATSR)
on the ESA Envisat satellite produced by EUR (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 - 3.5	Data Quality Control/Monitoring - 1
Data Quality Assessment - 2	Transparency/Traceability - 2.75	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 GHRSSST Level 2P Global Skin Sea Surface Temperature from the Advanced Along Track Scanning Radiometer (AATSR) on the ESA Envisat satellite produced by EUR (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 Global Skin Sea Surface Temperature from the Advanced Along Track Scanning Radiometer (AATSR) on the ESA Envisat satellite produced by EUR (GDS version 1), is assessed based on a reference stewardship maturity framework. The current maturity ratings of GHRSSST Level 2P Global Skin Sea Surface Temperature from the Advanced Along Track Scanning Radiometer (AATSR) on the ESA Envisat satellite produced by EUR (GDS version 1) are at Level 1 or higher for all nine key components with one Level 1, three Level 2, two 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.

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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.

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Data Stewardship Maturity Report for GHRSSST Level 2P Global Skin Sea Surface Temperature from the Advanced Along Track Scanning Radiometer (AATSR) on the ESA Envisat satellite produced by EUR (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 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 2P Global Skin Sea Surface Temperature from the Advanced Along Track Scanning Radiometer (AATSR) on the ESA Envisat satellite produced by EUR (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

Launched in March 2002 by the European Space Agency (ESA), Envisat is the largest Earth Observation spacecraft ever built. It carries ten sophisticated optical and radar instruments to provide continuous observation and monitoring of the Earth's land, atmosphere, oceans and ice caps. The Advanced Along-Track Scanning Radiometer (AATSR) onboard the Envisat spacecraft is designed to meet the challenging task of monitoring and detecting the climate change signal of sea surface temperature (SST). It builds on the success of its predecessor instruments on the European Remote-Sensing Satellite (ERS)-1, and ERS-2 satellites, and will lead to a multi-decade record of precise and accurate global SST measurements, thereby making a valuable contribution to the long-term climate record. The exceptionally high radiometric accuracy and stability of AATSR data are achieved through a number of unique features. A comprehensive pre-launch calibration programme, combined with continuous in-flight calibration, ensures that the data are continually corrected for sensor drift and degradation.

A "dual-view" algorithm offering improved atmospheric correction by applying two different atmospheric path lengths is used to derive the SST_{skin} observations. The accuracies achieved with this configuration are further enhanced by using low-noise infrared detectors, cooled to their optimum operating temperature by a pair of Stirling-cycle coolers. With its high-accuracy, high-quality imagery and channels in the visible, near-infrared and thermal wavelengths, AATSR data will support many applications in addition to oceanographic and climate research, including a wide range of land-surface, cryosphere and atmospheric studies. See Llewellyn-Jones et al (2001) ESA bulletin 105, Feb 2001 for a full description. These AATSR L2P SST data are produced as part of the Group for High Resolution Sea Surface Temperature (GHRSSST) Project according to the GHRSSST-PP Data Processing Specification (GDS) version 1.5. This AATSR L2P dataset is the original product produced by the Medspiration Regional Data Assembly Facility (RDAC) from early 2005 to mid 2009.

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 Global Skin Sea Surface Temperature from the Advanced Along Track Scanning Radiometer (AATSR) on the ESA Envisat satellite produced by EUR (GDS version 1)
Dataset Information URL	https://www.ncei.noaa.gov/metadata/geoportal/rest/metadata/item/gov.noaa.nodc%3AGHRSSST-EUR-L2P-ATS_NR_2P/html
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)	Jean-Francois Piolle; jfpiolle@ifremer.fr IFREMER/CERSAT; 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)	v01r05
SMM Assessment Date (MM/DD/YYYY)	04/17/2019
SMM Assessment POC (Name; E-mail; Affiliation)	Raisa Ionin, raisa.ionin@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 /2 /3.5 /1 /2 /2.75/3
SMM Original Assessment Date (MM/DD/YYYY)	09/02/2016
SMM Original Assessment POC (Name; E-mail; Affiliation)	Raisa Ionin, raisa.ionin@noaa.gov, Earth Resources Technology, Inc.
SMM Last Modified Date (MM/DD/YYYY)	11/08/2021
SMM Last Modification POC (Name; E-mail; Affiliation)	Katy Luquire, catherine.luquire@noaa.gov , CASE Consultants International
SMM Modified Date (MM/DD/YYYY)	04/17/2019
SMM Modification POC (Name; E-mail; Affiliation)	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
<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 OIAS 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/L2P/ATS_NR_2P/EUR/catalog.html ▪ HTTP:https://www.ncei.noaa.gov/data/oceans/ghrsst/L2P/ATS_NR_2P/EUR/ ▪ FTP:ftp://ftp.nodc.noaa.gov/pub/data.nodc/ghrsst/L2P/ATS_NR_2P/EUR/ ▪ Data citation is also available from NASA PODAAC site: https://podaac.jpl.nasa.gov/dataset/EUR-L2P-ATS_NR_2P?ids=Collections:ProcessingLevel&values=GHRSSST:*2* ▪ 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 <p>Comments:</p>
<p>Usability</p>	<p>Level 4.5</p> <ul style="list-style-type: none"> ▪ The format is interoperable: NetCDF, .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 ▪ User Manual [GHRSSST, 2011] is available online https://www.nodc.noaa.gov/archive/arc0072/0123222/1.1/data/0-data/GDS20r5.pdf ▪ All GHRSSST collections have error estimate. ▪ 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 ▪ 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 ▪ Algorithm described in [Embury, 2012] and is available online ▪ No external ranking <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>Production Sustainability</p>	<p>Level 2</p> <ul style="list-style-type: none"> ▪ The dataset is not currently supported, according to LTSRF Table: https://www.ncei.noaa.gov/access/ghrsst-long-term-stewardship-and-reanalysis-facility/ . The end date is 2009. ▪ <p>Comments: Changes for technology are available from individual dataset producers. NOAA does not have them documented. From LTSRF table, the product is listed first under EUR, then ATS_NR_2P.</p>
<p>Data Quality Assurance</p>	<p>Level 3.5</p> <ul style="list-style-type: none"> ▪ Data quality procedure defined, documented and partially implemented. Error validation is addressed in this article [Embury, 2012] and is available online ▪ File level quality flags exist which can be considered limited data quality assurance metadata. <p>Comments:</p>
<p>Data Quality Control/ Monitoring</p>	<p>Level 1</p> <ul style="list-style-type: none"> ▪ No Quality Control metrics are available. <p>Comments:</p>
<p>Data Quality Assessment</p>	<p>Level 2</p> <ul style="list-style-type: none"> ▪ Algorithm described in [Embury, 2012] and is available online ▪ Research product assessed in the following article:[Embury, 2012] and is available online ▪ Operational product is not assessed. <p>Comments:</p>
<p>Transparency / Traceability</p>	<p>Level 2.75</p> <ul style="list-style-type: none"> ▪ Limited product information available, metadata only on the GHRSSST_L2P_GSSST_AATSR_ESA_E_EUR landing page https://www.ncei.noaa.gov/metadata/geoportal/rest/metadata/item/gov.noaa.nodc%3AGHRSSST-EUR-L2P-ATS_NR_2P/html ▪ Product Information available in literature: [Embury, 2012] and is available online ▪ Algorithm described in [Embury, 2012] and is available online ▪ GHRSSST datasets are under Configuration Management principles: https://doi.org/10.5281/zenodo.4700465 ▪ Data citation DOI is available from NASA PODAAC site: 10.5067/GHATS-2PE01 <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 Integrity	<p>Level 3</p> <ul style="list-style-type: none"> ▪ Data archive integrity verifiable - Checksum technology is available, each GHRSSST_L2P_GSSST_AATSR_ESA_E_EUR 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/arc0002/0003985/0003985.1.1.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

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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)

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)

Embury, O., C. J. Merchant, and G. K. Corlett (2012), A reprocessing for climate of sea surface temperature from the along-track scanning radiometers: Initial validation, accounting for skin and diurnal variability effects, *_Remote Sensing of Environment_*, 116, 62–78, doi:10.1016/j.rse.2011.02.028

Embury, O., C. J. Merchant, and G. K. Corlett (2012), A reprocessing for climate of sea surface temperature from the along-track scanning radiometers: Initial validation, accounting for skin and diurnal variability effects, *_Remote Sensing of Environment_*, 116, 62–78, doi:10.1016/j.rse.2011.02.028

Embury, O., C. J. Merchant, and G. K. Corlett (2012), A reprocessing for climate of sea surface temperature from the along-track scanning radiometers: Initial validation, accounting for skin and diurnal variability effects, *_Remote Sensing of Environment_*, 116, 62–78, doi:10.1016/j.rse.2011.02.028

Embury, O., C. J. Merchant, and G. K. Corlett (2012), A reprocessing for climate of sea surface temperature from the along-track scanning radiometers: Initial validation, accounting for skin and diurnal variability effects, *_Remote Sensing of Environment_*, 116, 62–78, doi:10.1016/j.rse.2011.02.028

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