Committee on Earth Observation Satellites	**CEOS-ARD Product Self-Assessment** ***User Guide***	**Steps for Completing Analysis Ready Data Product Family Specification Self-Assessments**

Document History

Version	Date	Description of Change	Author
1.0	18/04/2023	Initial draft	Peter Harrison
1.1	20/04/2023	Edits to draft	Medhavy Thankappan
1.2	10/5/2023	Edits to draft	PH & MT
1.3	5/6/2023	Edits to draft	PH & MT
1.4	2/4/2024	Edits to match new Combined SAR PFS	PH & MT
1.5	23/11/2026	Edits to wording to reflect current process	Alex Brooks & MT

Introduction

The CEOS Analysis Ready Data (CEOS-ARD) Product Family Specifications (PFSs) are the core component of the CEOS-ARD concept. They describe Analysis Ready Data specifications for particular remotely sensed measurement types. A PFS details specific requirements that a dataset must satisfy to be identified as CEOS-ARD compliant at either the minimal (Threshold) and/or desired (Goal) level. Each PFS has the following core requirement elements:

- General Metadata: allow the user to assess overall suitability of the dataset;
- Per-Pixel Metadata: allow users to choose which observations (e.g., pixels) to use or discard;
- Radiometric Corrections and Atmospheric Corrections: specify any corrections that must be made to the data to reach a measurement and accuracy requirements for the data to be analysis-ready;
- Geometric Corrections: specify geometric corrections that must be made and geometric accuracy required for the data to be analysis-ready.

Each PFS has the core elements mentioned above. However, the exact form of the Specification (i.e., which items / parameters appear in the PFS) differ among PFSs because the measurement, instrumentation, mode of observation, levels of maturity, expectation of the user community, etc., differ among product types.

The PFSs are intended to be self-contained documents, with both the requirements listed for each parameter as well as a location for the associated response from the self-assessor. This allows data providers to complete their self-assessments by including information detailing how their products meet the specifications as well as recording feedback on the specifications, if any. The PFS details requirements at two levels – 'Threshold' and 'Goal'. The Threshold level requirement is the minimum to meet the CEOS-ARD specification. The Goal level represents a higher level of specification and more stringent criteria to be met compared to the Threshold. Goal level requirements are intended to increase the quality of the product as well as interoperability with other datasets.

PFS self-assessment submissions at the Threshold level are evaluated through a simple Peer Review by nominated Points of Contact within the CEOS Working Group on Calibration and Validation (WGCV), facilitating a quick turnaround. PFS self-assessment submissions at the Goal level undergo a longer, more stringent review by a Panel of CEOS experts drawn from the WGCV.

A checklist is provided at the end of this document for data providers to use during the PFS selfassessment and to avoid incomplete or incorrect submissions. Once complete, self-assessments are submitted to the CEOS-ARD Oversight Group Secretariat for evaluation.

General Guidelines

Sample Data

Provide links to two downloadable sample products, each with its associated metadata. Where possible, choose samples from different locations and acquisition times. When providing sample datasets, ensure that only the datasets and associated metadata to be evaluated for CEOS-ARD compliance are provided in a stand-alone directory for downloading via ftp or equivalent. To reduce file sizes, the samples can be zipped. This prevents assessments being carried out using incorrect datasets or documents being difficult to locate for evaluators. The two samples will be made available to the public via the CEOS-ARD web page where possible. As part of the submission Include an Access link to the page or portal where users can obtain the products and an Info link to a public dataset description, preferably a DOI landing page.

Supporting Ancillary Data

Along with the sample datasets, relevant documentation required for the assessment must be provided. This may include Product User Manuals, Product Guides, Algorithm Description Documentation, etc.

If available on the web, a URL or Digital Object Identifier (DOI) is required as a minimum to access these documents and should be included in the self-assessment document. If not available via a web link, the documents are to be included as attachments in the submission email.

DOI Landing Page

Where there is a specific requirement, a DOI landing page must be provided. The page can be:

- live with active links;
- live with inactive links (documents to be provided as part of the sample data package); or
- a mock-up of how the page will look when it goes live, including any hyperlinks for accessing relevant information related to the evaluation.

A “mock-up” of the landing page or hyperlink to the landing page and DOI embedded in the metadata can be provided as shown in Figure 1. Provide a public Info link to the dataset description alongside any mock-up used for the assessment.

General information on the PROBA-V Collection 2 products and DOI landing page

The PROBA-V products comprise the following elements:

- **Segment products (Level-1C and Level-2A, both consisting of TOA reflectances)**
  The Level-1C product contains the raw, non-projected observations in segments, as well as calibration information, while the Level-2A (L-2A) products contain the projected segment data. The latter were named "P products" for SPOT-VGT.

- **Synthesis products (Level-3, both TOA and TOC)**
  These products contain daily (S1, available at all resolutions) and multi-daily (S5 for 100 m) TOA reflectances that are composed of cloud, shadow, and snow/ice screened observations. Additionally, Top-of-Canopy (TOC) reflectance and Normalized Difference Vegetation Index (NDVI) products are corrected for atmospheric reflectance contributions, such as aerosols and gaseous absorption. For the TOC reflectances, also 10-daily composites are available (S10 for 300 m and 1 km) next to the S1 (for all resolutions) and 5-daily (S5) for the 100 m products. Synthesis products were previously known as S products for SPOT-VGT.

In Collection 1, all product metadata were CF-1.6-compliant. To further facilitate the access for non-experienced users, Collection 2 aims to follow the CARD4L specifications. However **only the PROBA-V Level 3 TOC products are Surface Reflectance Products** and are subject to the current self assessment for compliance against the Surface Reflectance Product Family Specifications.

VITO has implemented DOI landing pages for hosting all the PROBA-V Collection 2 reprocessing information and documentation. The registration of the DOIs is handled via ESA on the ISO 26324 DOI System website. The DOI pages will be activated at PROBA-V C2 release.

Only the DOI and landing page describing the Level3-TOC products is relevant for the current self assessment document and listed in the table below.

PROBA-V C2 Level	DOI (To be activated)	Landing page	# collections
Level3-TOC	10.5270/PRV-7dte3c2	https://proba-v.vgt.vito.be/en/product-types/c2/level-3TOC	6 collections (S1-1Km, S1-333m, S1-100m, S5-100m, S10-1km, S10-333m)

Table 1: DOI landing page

```
            </gmd:date>
          - <gmd:dateType>
              <gmd:CI_DateTypeCode codeListValue="creation" codeList="https://standards.iso.org/iso/19139/resources/M
            </gmd:dateType>
        </gmd:CI_Date>
      </gmd:date>
    - <gmd:identifier>
      - <gmd:RS_Identifier>
        - <gmd:code>
            <gco:CharacterString>PROBAV_S5_TOC_20180521_100M_V201</gco:CharacterString>
          </gmd:code>
        - <gmd:codeSpace>
            <gco:CharacterString>urn:eop</gco:CharacterString>
          </gmd:codeSpace>
        </gmd:RS_Identifier>
      </gmd:identifier>
    - <gmd:otherCitationDetails>
        <gco:CharacterString>https://doi.org/10.5270/PRV-7dte3c2</gco:CharacterString>
      </gmd:otherCitationDetails>
  </gmd:CI_Citation>
</gmd:citation>
- <gmd:abstract>
  - <gco:CharacterString>
    - <![CDATA[

        Level 3 data products are variables mapped on uniform space-time grid scales and are the result of combining multiple scenes (
      ]]>
  </gco:CharacterString>
</gmd:abstract>
```

Figure 1. DOI Landing Page Examples

If multiple hyperlinks are being provided, highlight relevant sections on the page for evaluators to refer. Figure 2 shows an example of the DOI landing pages from the USGS Landsat Collection 2 datasets (Landsat Collection 2 | U.S. Geological Survey (usgs.gov)).

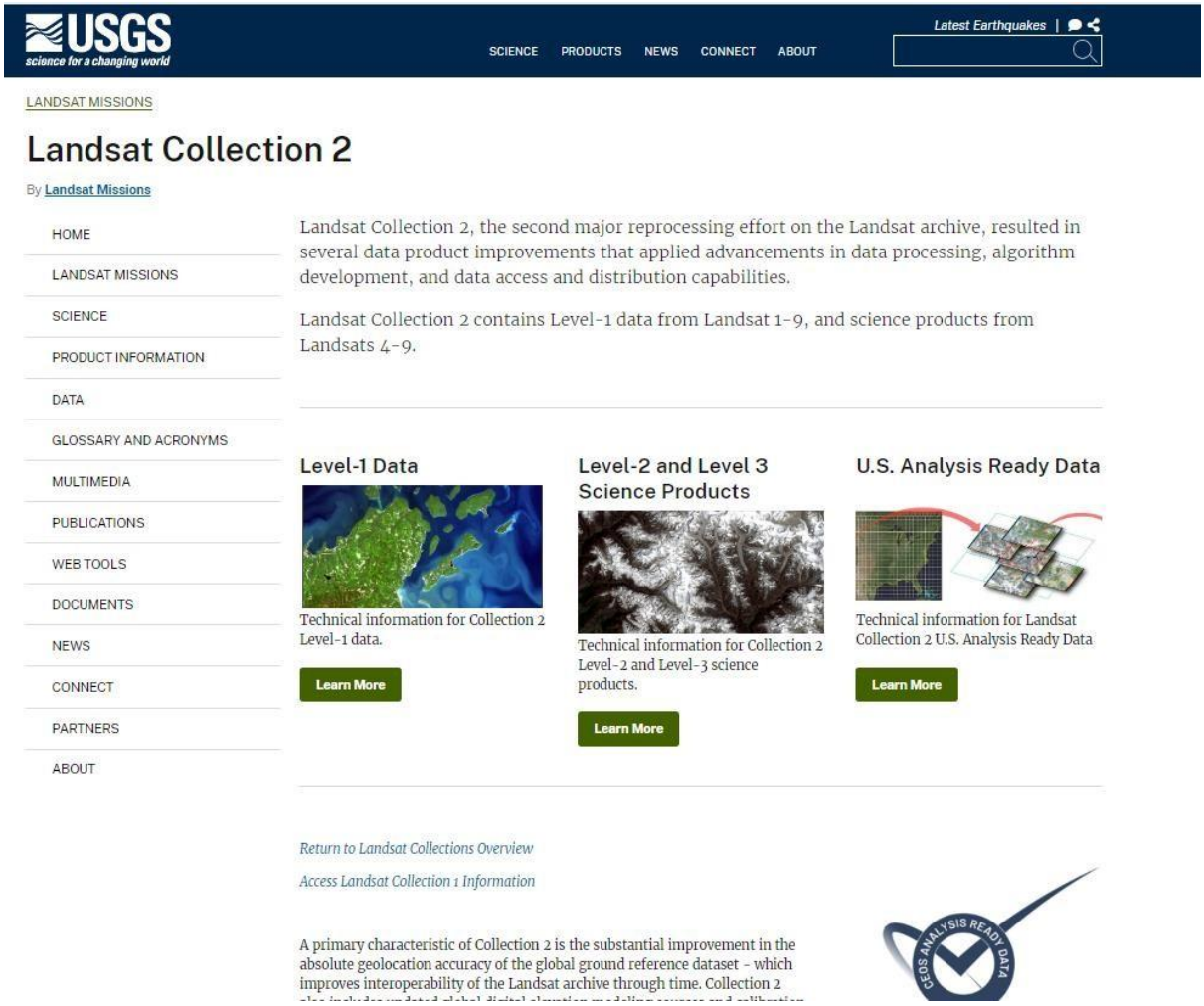

Figure 2 Landing Page for Landsat Missions

Various Landsat algorithm and auxiliary data landing pages can be found via the following link and are shown in Figure 3: Landsat 8-9 [USGS EROS Archive - Landsat Archives - Landsat 8-9 OLI/TIRS Collection 2 Level-2 Science Products | U.S. Geological Survey]

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USGS science for a changing world

SCIENCE PRODUCTS NEWS CONNECT ABOUT

Latest Earthquakes

EARTH RESOURCES OBSERVATION AND SCIENCE (EROS) CENTER | SCIENCE

USGS EROS Archive - Landsat Archives - Landsat 8-9 OLI/TIRS Collection 2 Level-2 Science Products

ACTIVE

By Earth Resources Observation and Science (EROS) Center November 27, 2020

Overview | Web Tools

Landsat 8-9 Operational Land Imager (OLI) and Thermal Infrared (TIRS) Collection 2 Level-2 Science Products 30-meter multispectral data.

Landsat 9 Collection 2 Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS) data from the first year of operations will be reprocessed starting Wednesday, March 1, 2023. This reprocessing effort will take advantage of calibration updates identified by the USGS/NASA Calibration and Validation team. Reprocessing is expected to take approximately 4-6 weeks.

Landsat 9 Announcement

Back to Products Overview

The U.S. Geological Survey (USGS) provides Landsat 8-9 Operational Land Imager/Thermal Infrared Sensor (OLI/TIRS) Collection 2 Level-2 Science Products (L2SP) through EarthExplorer or LandsatLook. The L2SP include Surface Reflectance and Surface Temperature scene-based products.

Surface Reflectance

Surface reflectance provides an estimate of the Earth's surface spectral reflectance as it would be measured at ground level in the absence of atmospheric scattering or absorption. The Landsat Surface Reflectance products are generated at the Earth Resources Observation and Science (EROS) Center at a 30-meter spatial resolution.

Landsat 8 Surface Reflectance data are generated from the Land Surface Reflectance Code (LaSRC). LaSRC makes use of the coastal aerosol band to perform aerosol inversion tests, uses auxiliary climate data from MODIS and uses a unique radiative transfer model. Additionally, LaSRC hardcodes the view zenith angle to "0", and the solar zenith and view zenith angles are used for calculations as part of the atmospheric correction. Details about LaSRC and Landsat 8 Surface Reflectance data products can be found in the Landsat 8 Surface Reflectance Code Product Guide.

Visit the Collection 2 Landsat Surface Reflectance webpage for additional documentation and information

Surface Temperature

Surface Temperature measures the temperature of the surface of the Earth in Kelvin (K). The Surface Temperature products are generated at the Earth Resources Observation and Science (EROS) Center at a 30-meter spatial resolution.

The Landsat Surface Temperature product is generated from Landsat Collection 2 Level-1 thermal infrared bands, Top of Atmosphere (TOA) Reflectance, TOA Brightness temperature, Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Global Emissivity Database (GED) data, ASTER Normalized Difference Vegetation Index (NDVI) data, and atmospheric profiles of geopotential height, specific humidity, and air temperature extracted from reanalysis data.

Visit the Collection 2 Landsat Surface Temperature webpage for additional documentation and information.

Product Availability

L2SPs are available for the following Landsat 8-9 OLI/TIRS acquisition dates:

- Landsat 8 OLI/TIRS: April 2013 to Present
- Landsat 9 OLI II/TIRS II: January 31, 2022 to Present

Most Landsat 8-9 Collection 2 Level-1 scenes in the USGS archive can be processed to L2SP. If a ST cannot be produced, an SR-only product is created. Landsat Science Products inherit characteristics of the Landsat Collection 2 Level-1 data products. Newly acquired Landsat 8 Level-2 science products are typically available within 24 hours after a scene has been processed into Level-1 Tier 1 or Tier 2 product. Landsat 7 and Landsat 8 both utilize NASA's Goddard Earth Observing System Model Version 5 Forward Processing for Instrument Teams (GOES-5 FP-IT) Atmospheric Assimilation Products for Level-2 product generation. Visit Landsat Collection 2 Generation Timeline for an estimate of this product generation latency.

Please note the following caveats:

Surface Reflectance

- Landsat 8-9 OLI/TIRS data cannot be processed to surface reflectance for a limited number of acquisition dates due to auxiliary data gaps. The most up-to-date information regarding these data gaps is available in the "Constraints and Caveats " section of the Landsat Surface Reflectance Product Page.
- Landsat 8 OLI Band 8 (panchromatic band) is not processed to Top-of Atmosphere or Surface Reflectance.
- Surface reflectance is computed on scenes with a solar zenith angle >76 degrees. The primary physical issues with retrieving surface reflectance from high solar zenith angles (low sun angle) include:
  - Solar elevation varies more near the poles, especially when relying upon sun-synchronous observations
  - Lower solar elevations at high latitudes results in longer atmospheric paths (i.e., more scattering)
  - The degree of uncertainty in surface reflectance retrieval greatly increases, from being negligible to highly inaccurate, at solar zenith angle >76 degrees.
- For reasons mentioned above, the data acquired over high latitudes (>65 degrees) will not be processed to surface reflectance.
- Corrections from OLI Bands 1 and 2 (coastal aerosol and blue bands, respectively) should not be used for analysis, as they are already used within the algorithm to perform aerosol inversion tests, making them potentially unreliable.
- Users are cautioned against using pixels flagged as high aerosol content.
- Aerosol retrieval is attempted over all pixels, although a separate routine is used for pixels flagged by LaSRC as water. These conditions are detailed in the Aerosol QA band.
- There are additional adverse conditions that can affect the efficacy of Landsat surface reflectance retrievals, such as:
  - Hyper-arid or snow-covered regions
  - Low sun angle conditions
  - Coastal regions where land area is small relative to adjacent water
  - Areas with extensive cloud contamination

Contacts

USGS EROS Customer Services

Email: custserv@usgs.gov
Phone: 1-800-252-4547

Explore Search

Landsat
Products and Datasets
Remote Sensing
Climate
Information Systems
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Committee on Earth Observation Satellites (CEOS) Analysis Ready Data for Land (CARD4L) compliance stamp logo. This internationally-recognized certification recognizes satellite data that have been processed to a minimum set of requirements and organized into a structure that allows for immediate analysis with minimum user effort and interoperability both through time and with other datasets. Image used with permission by CEOS.

Download Site Link

Product Guide Link

Surface Temperature

- Landsat 8 TIRS-only data (LT08) cannot be processed to TOA Brightness Temperature or Surface Temperature.
- The Advanced Spaceborne Thermal Emission and Reflection Radiometer Global Emissivity Dataset (ASTER GED) by Land Processes Distributed Active Archive Center (LP DAAC) is used in the ST algorithm for OLI data. Where ASTER GED data is missing, there will be missing data in the Landsat Surface Temperature product.
- Goddard Earth Observing System, Version 5 (GEOS-5) Forward Processing for Instrument Teams (FP-IT) data are used in the Single Channel surface temperature algorithm for atmospheric correction. If GEOS data are unavailable (for acquisitions before Jan 1, 2000), NASA's Modern-Era Retrospective analysis for Research and Application (MERRA-2) reanalysis data are used in its place.
- Atmospheric auxiliary data used for processing a Level 1 product into a surface temperature product are described in the Landsat Atmospheric Auxiliary Data Format Control Book.
- Data products must contain both sunlit optical and thermal data (e.g., LC08 products for Landsat 8) to be successfully processed to surface temperature, as Landsat Normalized Difference Vegetation Index (NDVI) and Normalized Difference Snow Index (NDSI) are required to temporally adjust the ASTER GED product to the target Landsat scene. Therefore, nighttime acquisitions cannot be processed to surface temperature.
- A known error exists in the Landsat Surface Temperature retrievals relative to clouds and possibly cloud shadows. The characterization of these issues has been documented by Cook et al., 2014

Auxiliary Data Site Link

Additional Information

- Land Surface Reflectance Code (LaSRC) Product Guide
- Landsat 8 OLI/TIRS Collection 2 Level 2 Data Format Control Book
- Landsat 8 Collection 2 Level-2 Science Product Guide
- Landsat Cloud Optimized GeoTIFF (COG) Data Format Control Book
- Landsat Collection 2 Level-2 Science Product webpage
- CEOS Missions, Instruments, and Measurements (MIM) Database Record (OLI)
- CEOS Missions, Instruments, and Measurements (MIM) Database Record (TIRS)
- Landsat Collection 2 Geometric and Radiometric Information
- Landsat Spectral Characteristics Viewer
- Landsat Band Designations
- Landsat Collections

Geometry/Radiometric Link

Algorithm Citation

- Land Surface Reflectance Code (LaSRC) Journal Article
- Single-Channel Surface Temperature Code Journal Article

Algorithm Papers Link

Access Data

Please note: All Landsat 9 Collection 2 Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS) data will be reprocessed at the beginning of 2023 to take advantage of calibration updates identified during the first year of operation.

The Landsat Collection 2 Landsat 8-9 OLI (Operational Land Imager) and TIRS (Thermal Infrared Sensor) Level-2 Science Products (Surface Reflectance and Surface Temperature) are available for download from EarthExplorer or LandsatLook.

The data are located under the "Landsat" category, "Landsat Collection 2 Level-2 subcategory", as "Landsat 8 OLI/TIRS C2 L2".

After reviewing the search results and selecting a scene, users will be able to download all bands or select and download selected bands. The original Landsat scene mapping grid, Universal Transverse Mercator (UTM) or Polar Stereographic (PS), is retained for the Collection 2 L2SP.

The USGS Landsat no-cost and open data policy remains intact since its inception in 2008.

Digital Object Identifier (DOI)

Collection 2 Landsat 8-9 OLI (Operational Land Imager) and TIRS (Thermal Infrared Sensor) Level-2 Science Product Digital Object Identifier (DOI) number: /10.5066/P9OGBGM6

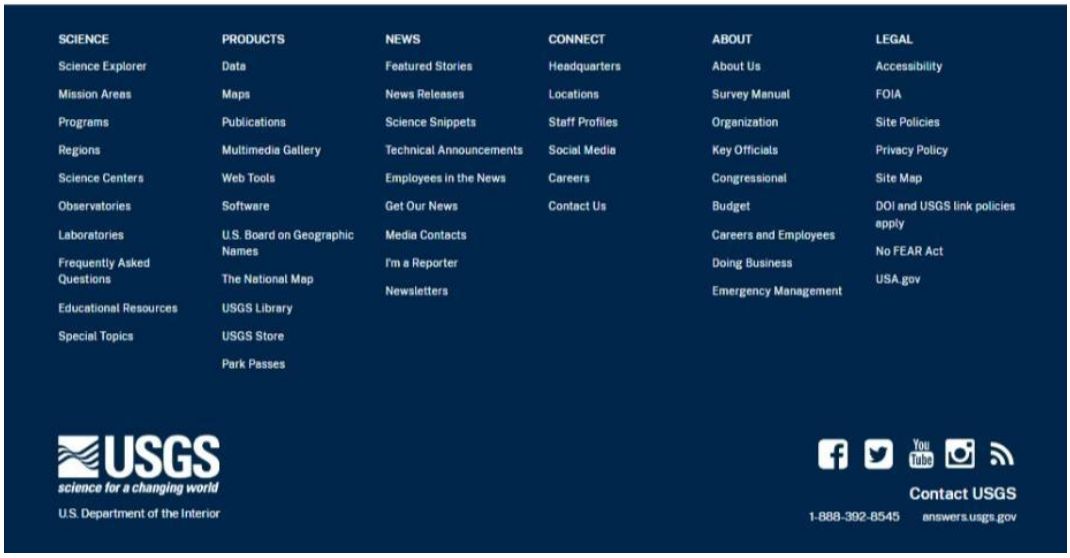


Figure 3 Landing Page for Landsat 8-9 Level-2 Products

Guidelines for Self-Assessment

View and download the latest version of the relevant self-assessment PFS document, which is available from the CEOS-ARD web page. The PFS can be found and downloaded from the "Current Product Family Specifications" links. For evaluators to note any feedback on the form, please complete the PFS self-assessment and submit in a Word format (.doc or .docx). A screenshot of the web page with links to the latest versions (as of April 2024) of all available PFS's is shown in Figure 4.

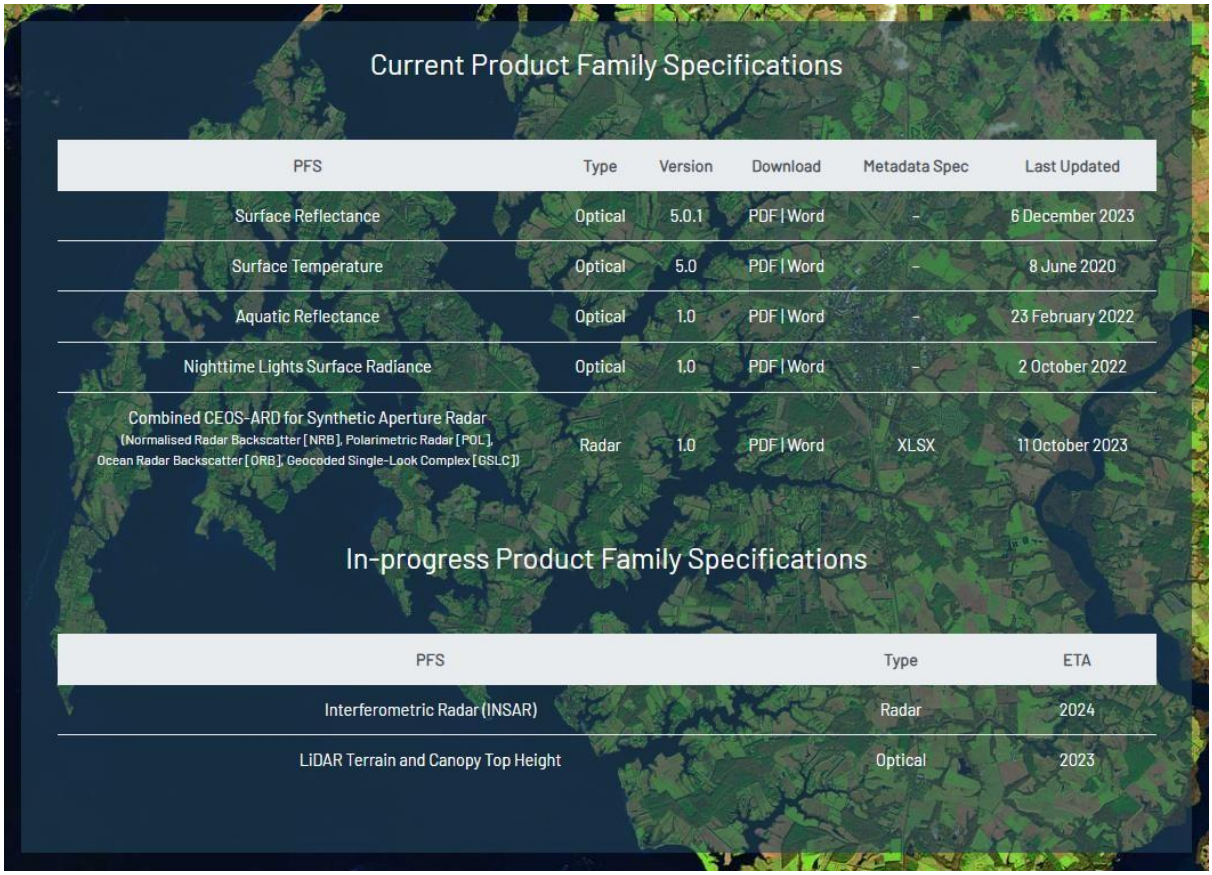


Figure 4 Screenshot of Web Page for PFS Documents

In October 2023, the 4 existing SAR PFS's for Normalised Radar Backscatter (NRB), Polarimetric Radar (POL), Oceanic Radar Backscatter (ORB) and Geocoded Single-Look Complex (GSLC) were combined into a single PFS. Associated with the PFS is a Metadata Specification document (an excel table) which defines the XML tags to be used for the different parameters/items. Both documents are now available through the CEOS-ARD website.

The data provider is to complete a self-assessment of the product at the appropriate level for the peer review. Threshold level is the minimum, and it is up to the data provider to ensure that all requirements under the Threshold level are met before it is submitted for evaluation. Incomplete self-assessments with requirements that are not met should not be submitted for evaluation. At the Threshold level, not all items are required to be met and are clearly identified as such in the PFS. Any Goal level self-assessment items included at Threshold level will be ignored during the review.

If a self-assessment is carried out for Goal level requirements, the same conditions apply, whereby all requirements need to be assessed and justified / explained before it can be submitted for evaluation. A panel of experts drawn from the CEOS WGCV will be assembled for such a review, which will be an elaborate process. Self-assessment submissions at both levels need to cite the justification and evidence of how each requirement is met either as an extract from the metadata or reference to a document, a self-assessment note without justification and evidence is difficult to evaluate.

The self-assessment is carried out against a number of individual Items that are divided into four general metadata categories (with some nomenclature differences among PFS documents).

1. General Metadata
2. Per-Pixel Metadata
3. Radiometric and Atmospheric Corrections
4. Geometric Corrections

Item Requirements

Items are grouped into four general categories, with the requirements for each item being outlined in the CEOS-ARD PFS. Requirements are divided into Threshold (minimum) and Goal (Desired) requirements. Each PFS defines the parameters for each item required to meet the self-assessment at both levels for verification. While there are some commonalities, the parameters covered in each PFS will vary depending on the product type. Figure 5 and 6 show the generic template and how each item is to be self-assessed in a PFS for a reflectance product. Figures 7 and 8 show how items are to be self-assessed in the SAR PFS. Figure 9 shows the XML tags to be used for the associated SAR metadata file (obtained from the Metadata Specification spreadsheet). **It is important to note that XML is case sensitive.**

General Metadata

These are metadata records describing a distributed collection of products. The collection of pixels referred to must be contiguous in space and time. ***General metadata should allow the user to assess the overall suitability of the dataset, and must meet the following requirements:***

#	Item (Term)	Threshold (Minimum) Requirements	Target (Desired) Requirements	Threshold Self-Assessment	Target Self-Assessment	Self-Assessment Explanation/ Justification	Recommended Requirement Modification
	The items are the things that, for this product family, need to be included.	*Threshold requirements are the MINIMUM that is needed for the data to be analysis ready. This must be practical and accepted by the data producers*	*Target requirements are the ideal; where we would like to be. Some providers may be able to meet these already.*	*This is used by a data provider, to indicate if they think they meet the threshold*	*This is used by a data provider, to indicate if they think they meet the target*	*This is used by a data provider, to explain why they self-assess in the way they have*	*This is used to capture recommended changes to the specification, based on consideration of stakeholder feedback.*
1.8	**Algorithms***	All algorithms, and the sequence in which they were applied in the generation process, are identified in the metadata. For example, these may be available through Algorithm Theoretical Basis documents. Note 1: Information on algorithms should be available in the metadata as a single DOI landing page.	As threshold, but only algorithms that have been published in a peer-reviewed journal. Note 1: It is possible that high quality corrections are applied through non-disclosed processes. CARD4L does not per-se require full and open data and methods. Note 2: Information on algorithms should be available in the metadata as a single DOI landing page.				

Figure 5 Item 1.8 Algorithms in the Surface Reflectance PFS with Threshold/Goal requirement descriptions ***NOTE: Target is now Goal.***

¤	Land/Water Mask¤	Not required.¤	The metadata indicates whether a pixel is assessed as being land or water. Information on land/water mask should be available in the metadata as a single DOI landing page.¤	¤	¤	¤	¤

Figure 6 Item 2.x Per-Pixel Metadata - Mask in the Surface Reflectance PFS with no Threshold requirements

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment
1.7.11¤	Product Coordinate Reference System¤	[NRB]¶ [POL]¶ [ORB]¶ [GSLC]¤	**Threshold (Minimum) Requirements**¶ The metadata lists the map projection (or geographical coordinates, if applicable) that was used and any relevant parameters required to geolocate data in that map projection, expressed in a standardised format (e.g., WKT).¶ ¶ Indicate EPSG code, if defined for the CRS.¤	Achieved level: Threshold / Goal¶ Explanation / Justification: …¶ Other feedback: …¤
			Goal (Desired) Requirements¶ As threshold.¤	

Figure 7 Item 1.7.11 Product Coordinate Reference System in the Combined SAR PFS with Threshold/Goal requirement descriptions (NOTE: Required for all SAR product types)

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment
1.7.13¤	Radar Unit Look Vector¤	[GSLC]¤	**Threshold (Minimum) Requirements**¶ 3-D components radar unit look vector, specified at centre of scene, in an Earth-Centred Earth-Fixed (ECEF) coordinate system (also called Earth Centred Rotating – ECR) is provided. It consists of unit vectors from antenna to surface pixel (i.e., positive Z component).¶ ¶ Only required if per-pixel metadata 2.12 (Radar Unit Look Vector Grid Image) is not provided.¤	Achieved level: Threshold / Goal¶ Explanation / Justification: …¶ Other feedback: …¤
			Goal (Desired) Requirements¶ As threshold.¤	

Figure 8 Item 1.7.13 Radar Unit Look Vectors in the Combined SAR PFS with Threshold/Goal requirement descriptions which is required for only the GSLC SAR product.

#	Item	CEOS-ARD product	Threshold Requirements <parameters>	Goal Requirements <parameters>	itemAttribute	Type [and list of values]	Notes
1.7.11	Coordinate Reference System	[ALL]	<CoordinateReferenceSystem>		type=["WKT" or "PROJ4", or other standard format]	String	
			<CoordinateReferenceSystem>		type="EPSG"	Integer	Provide EPSG code, if defined for the Coordinate Reference System, as separate <CoordinateReferenceSystem>
1.7.12	Look Direction Polynomials	[ORB]	<LookDirectionPolynomials>		units=["deg", "rad"]	Float (6 coefficients or more separated by space, in the order specified by the data provider)	
			<LookDirPolyDesc>		coord=["samples","MapUnits"]	String [ex.: " p1 *x^2 + p2*y^2 + p3*xy + p4*x + p5*y + p6"]	
			<LookDirAccuracy>		units=["deg", "rad"]	Float	
1.7.13	Radar Unit Look Vector	[GSLC]	<RadarUnitLookVector>				
			<X_UnitLook>			Float	
			<Y_UnitLook>			Float	
			<Z_UnitLook>			Float	

Figure 9 Combined SAR Metadata Specifications defining the XML tags and attributes for the metadata file.

Threshold Requirements

At the Threshold level, a number of items might not be required as part of the PFS self-assessment. These are identified in the relevant PFS document as “Not required”. When self-assessing items with no requirements, the Threshold level self-assessment column should be marked “Not required”. In these instances, a justification or explanation is not needed and can be left blank. In the Combined SAR PFS, some of the metadata parameters relate solely to a particular SAR Product type. If these are not required, these are identified in the self-assessment document as **“Not Relevant”** (Figure 10). In the Summary Self-Assessment Table, these parameters should not be removed and marked as **“Not Relevant”**.

#	Parameter	CEOS-ARD Product	Requirements	Self Assessment	Remarks/ Requirements/ Modifications
2.13	Slant Range Sensor to Surface Image	[GSLC]	**Threshold (Minimum) Requirements** Not required.	Not Relevant	Not Relevant to NRB SAR Products
			Goal (Desired) Requirements Slant range distance from the sensor to the surface, specified at each pixel in an Earth-Centred Earth-Fixed (ECEF) coordinate system (also called Earth Centred Rotating – ECR) is provided. File format specifications/ contents provided in metadata: - Sample Type [Distance] - Data Format [Raw/GeoTIFF/NetCDF, ...] - Data Type [Float, ...] - Bits per Sample Byte Order		

			Threshold	Goal
3	**CEOS-ARD product**	**Radiometrically Corrected Measurements**		
3.1	[ALL]	Backscatter Measurements	Verified	Not Assessed
3.2	[ALL]	Scaling Conversion	Verified	Not Assessed
3.3	[ALL]	Noise Removal	Verified	Not Assessed
3.4	[NRB] [POL] [GSLC]	Radiometric Terrain Correction Algorithms	Verified	Not Assessed
3.5	[ALL]	Radiometric Accuracy	Not Required	Not Assessed
3.6	[ORB]	Mean Wind-Normalised Backscatter Measurements	Not Product Relevant	Not Relevant
3.7	[NRB] [POL]	Flattened Phase	Not Required	Not Assessed

Figure 10. Combined SAR Self-Assessment for parameters not required for the product type (an example for an NRB product)

If an Item is required at Threshold level in the PFS and self-assessed as being met, then the SelfAssessment column for Threshold should be marked as ‘Requirement Met’. It is vital that items

having assessed as meeting a requirement have a justification or explanation in the SelfAssessment Explanation/Justification column, with the appropriate evidence. An example of the justification and form of evidence is provided in Figure 11.

The explanation / justification is usually:

- an extract from the metadata file that corresponds to the item; or
- reference to a document, journal paper or a DOI / URL (section or page if possible).

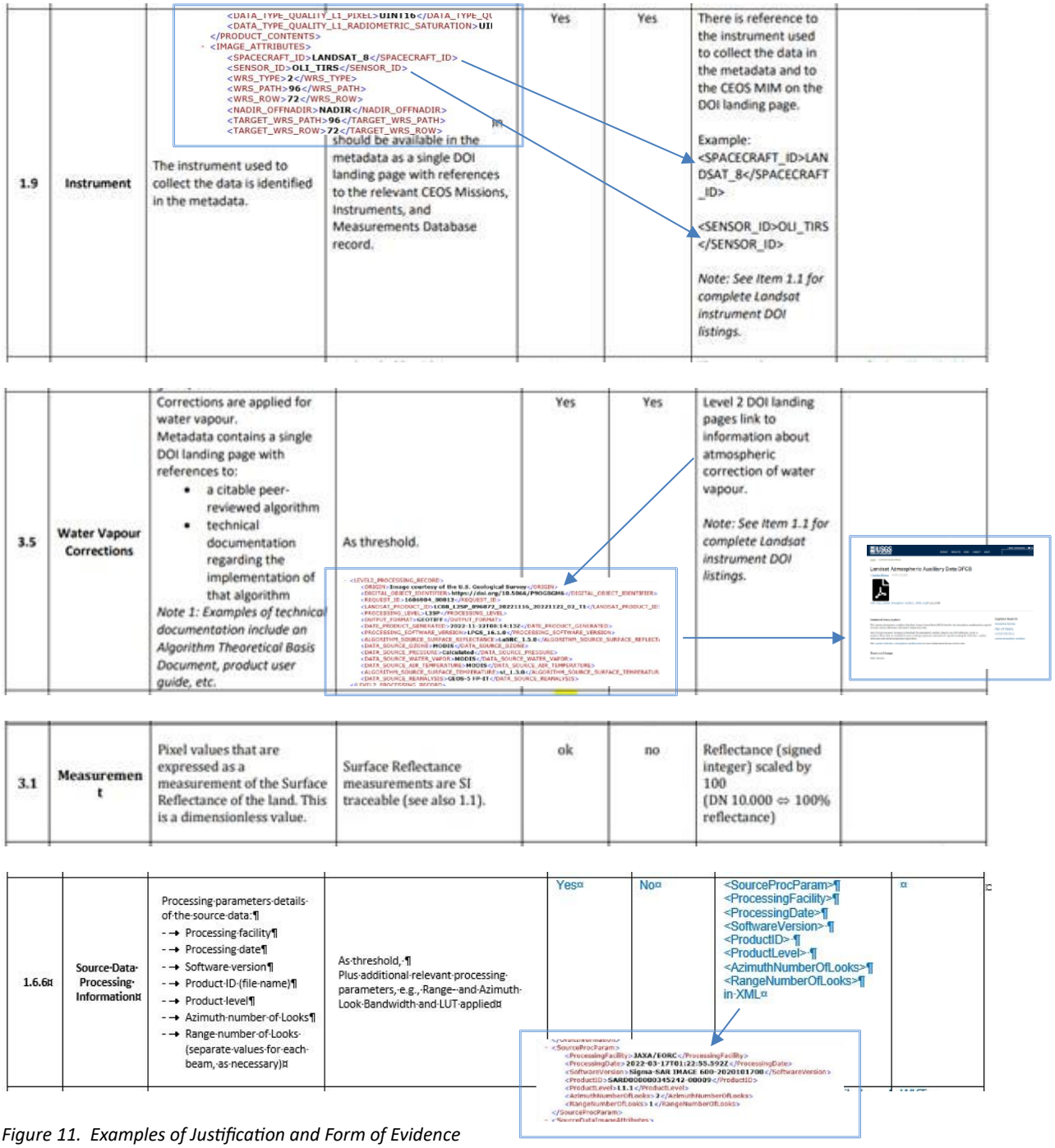
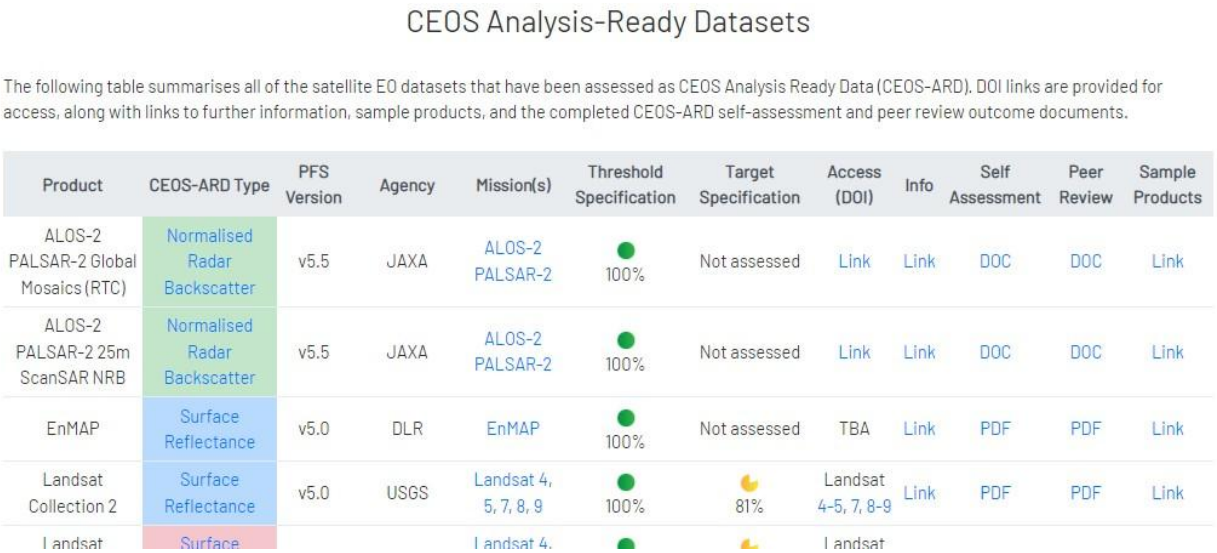


Figure 11. Examples of Justification and Form of Evidence

In the case where no explanation or justification is provided, the submission will be considered incomplete.

Examples of successful Threshold level self-assessments that have been peer evaluated and accepted can be found on the CEOS-ARD website datasets table, as shown in Figure . These should be used for reference.



CEOS Analysis-Ready Datasets

The following table summarises all of the satellite EO datasets that have been assessed as CEOS Analysis Ready Data (CEOS-ARD). DOI links are provided for access, along with links to further information, sample products, and the completed CEOS-ARD self-assessment and peer review outcome documents.

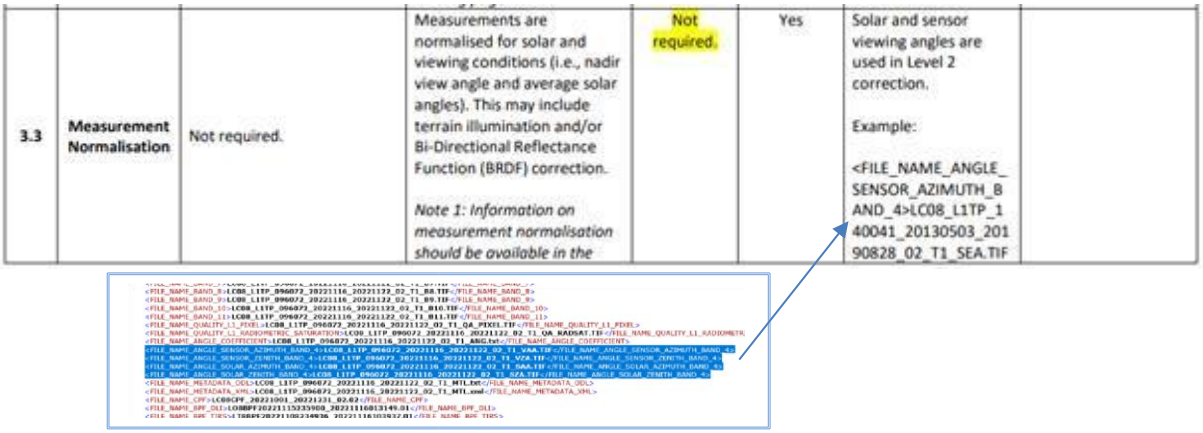
Product	CEOS-ARD Type	PFS Version	Agency	Mission(s)	Threshold Specification	Target Specification	Access (DOI)	Info	Self Assessment	Peer Review	Sample Products
ALOS-2 PALSAR-2 Global Mosaics (RTC)	Normalised Radar Backscatter	v5.5	JAXA	ALOS-2 PALSAR-2	100%	Not assessed	Link	Link	DOC	DOC	Link
ALOS-2 PALSAR-2 25m ScanSAR NRB	Normalised Radar Backscatter	v5.5	JAXA	ALOS-2 PALSAR-2	100%	Not assessed	Link	Link	DOC	DOC	Link
EnMAP	Surface Reflectance	v5.0	DLR	EnMAP	100%	Not assessed	TBA	Link	PDF	PDF	Link
Landsat Collection 2	Surface Reflectance	v5.0	USGS	Landsat 4, 5, 7, 8, 9	100%	81%	Landsat 4-5, 7, 8-9	Link	PDF	PDF	Link
Landsat	Surface			Landsat 4,			Landsat				

Figure 12. Sample Self-Assessments Available Online

The web page shown in Figure also provides a summary of the product with ARD type and PFS versions with hyperlinks to landing pages and sample dataset(s) that could be used as guidance for submitting a self-assessed PFS.

Goal Level Requirements

On the 6th of December 2023, the term Target was replaced with Goal in the CEOS-ARD PFS documentation. For Goal level acceptance, all item Goal requirements need to be met prior to submission. Again, as per the Threshold level self-assessment, the Goal self-assessment column should be noted with **"Requirement Met"**. It is also important that a Self-Assessment Explanation/Justification is given as per Threshold self-assessment justifications – that is to say, either as a DOI or metadata extract (Figure 13).



3.3	**Measurement Normalisation**	Not required.	Measurements are normalised for solar and viewing conditions (i.e., nadir view angle and average solar angles). This may include terrain illumination and/or Bi-Directional Reflectance Function (BRDF) correction. *Note 1: Information on measurement normalisation should be available in the*	Not required.	Yes	Solar and sensor viewing angles are used in Level 2 correction. Example: <FILE_NAME_ANGLE_SENSOR_AZIMUTH_BAND_4>LC08_L1TP_140041_20130503_20190828_02_T1_SEA.TIF	

Figure 13 Example of Self-Assessed Item at Goal Level

Submission to CEOS-ARD

Once the self-assessment PFS has been completed, it needs to be formally submitted for review. This is done by email.

Email submissions are to be sent to ARD-CONTACT@LISTS.CEOS.ORG and must include both sample datasets, the Data access and Info links, and all relevant attachments.

For full details on attachments and content, refer to the Checklist on the next page.

Acceptance and Notification

Once all self-assessed items have been validated by the peer review process as meeting the specification, the product will be endorsed as compliant with CEOS-ARD by evaluators.

The self-assessment evaluation result will be communicated to the CEOS-ARD Oversight Group Secretariat, who then will notify the data provider of the outcome. The dataset will be listed on the CEOS-ARD website as part of the suite of compliant datasets.

CEOS-ARD Compliant Logo

Once a data provider's product has been endorsed at the Threshold or Goal level, they are permitted to use the "CEOS-ARD" logo on webpages and other dataset promotional materials. Various configurations of the CEOS-ARD logo can be downloaded from the Logo and Branding web page.

Checklist

	Complete
1. Version of the PFS template used for the self-assessment is current (check https://ceos.org/ard/)	
2. Data Access link and public Info link provided (preferably a DOI landing page for Info)	
3. Two sample datasets with metadata provided	
4. Ensure ALL requirements are assessed at Threshold or Goal level	
5. Ensure ALL items assessed have a justification (metadata extract or reference)	
6. Support documentation provided (if applicable)	
6a. Product User Manual	
6b. Algorithm Theoretical Basis Document	
6c. Auxiliary/Ancillary Data Sources	
6d. Journal Papers (Cited reference as a minimum)	