Committee on Earth Observation Satellites	**Analysis Ready Data**	**Product Family Specification:** **Synthetic Aperture Radar**

Daejeon, September 4, 2026

KARI self-assessment for CEOS-ARD for SAR, v1.3.1 compliance [product type: Normalised Radar Backscatter]

Valid for the following KOMPSAT-5 products:

- Enhanced Standard (ES) mode. HH single-polarisation. 5 m resolution, MGRS tile-based single-date products, gridded in UTM (WGS 84) at 5 m sample spacing.
- Sample product base name: 12SUC33_20231008013527_K5_ES02_NRB.zip
- The sample products are available for download from: https://www.kari.re.kr/eng/sub/567

Dong Hyun Kim (Korea Aerospace Research Institute)

e-mail: kiyaes@kari.re.kr

Document Status

Product Family Specification, Synthetic Aperture Radar

Proposed revisions may be provided to: ard-contact@lists.ceos.org

Document History

Version	Date	Description of change	Affected CEOS-ARD product	Author
0.1	14-12-2022	Zero Draft based on the CARD4L NRB PFS v5.5, POL PFS 3.5, ORB PFS v1.0 and draft GSLC v0.1	-	Charbonneau Rosenqvist, Truckenbrodt, Small, Zhou, Albinet, Tadono, Chapman, Logan, Yuan, Repse, Dadamia, Lavalle, Miranda, Mayer, Kellndorfer, Valentino, Lewis, Pinheiro, Siqueira, Deschamps, Hajduch
0.2	13-02-2023	Reformat to CEOS-ARD PFS template. Change “CARD4L” to “CEOS-ARD” Change “Target” to “Goal”	-	Rosenqvist
0.3	29-07-2023	Refinement of GSLC specifications and alignment with NRB, POL and ORB parameters. New items: 1.7.13 (Radar Unit Look Vector) , 1.7.14 (Slant Range Sensor to Surface), 2.12 (Radar Unit Look Vector Grid Image), 2.13 (Slant Range Sensor to Surface Image), 2.14 (InSAR Phase Uncertainty Image), 2.15 (Atmospheric Phase Correction image), 2.16 (Ionospheric Phase Correction Image). Annex reorganisation and ORB and GSLC examples added	[GSLC]	Charbonneau, Zebker, Rosenqvist, Albinet, Small, Truckenbrodt
0.3.1	26-09-2023	New items 1.7.15 (Reference orbit) and 3.7 (Flattened Phase) added as Goal	[NRB] [POL]	Charbonneau

Version	Date	Description of change	Affected CEOS-ARD product	Author
0.4	26-09-2023	Item 4.3 (Geometric accuracy). Clarification added to indicate whether absolute location accuracy (ALE) estimates refer to source data, ARD product, or both.	[NRB] [POL] [ORB] [GSLC]	Small, Chapman, Charbonneau, Rosenqvist, Albinet, Truckenbrodt
0.4.1	11-10-2023	Add product code in summary table		Rosenqvist
1.0	11-10-2023	CEOS-ARD for SAR PFS – including Geocoded Single-Look Complex v1.0 – endorsed at LSI-VC-14		LSI-VC
1.0.1	07-12-2023	Drafting InSAR product addition to PFS	[InSAR]	Charbonneau
1.0.2	17-05-2024	Item 1.6.7 (Source Data Image Attributes): Azimuth Pixel Spacing can be provided in units of metres or seconds. Item 1.7.9 (Product Image Size): Text clarification of Number of pixels per line Item 2.1 (Metadata Machine Readability): Alignment of with description in Item 1.2. Items 2.2–2.16, 3.1, 3.6, 3.7: RAW removed and HDF5 added to suggested data formats. New items: 1.7.16 (InSAR Pair), 1.7.17 (InSAR Pair Co-Registration), 1.7.18 (Local In SAR Phase Quality, 1.7.19 (Interferogram Filtering), 1.7.20 (Phase Unwrapping). Items 1.6.4 (Source Data Orbit Information/Relative orbit number) and 2.5 (Ellipsoid Incidence Angle Image) moved from Goal to Threshold for [GSLC].	[NRB] [POL] [ORB] [GSLC]	Charbonneau, Small, Chapman, Logan, Shiroma, Brancato
1.0.3	10-07-2024	Completion of the InSAR addition	[InSAR]	Charbonneau, Rosenqvist, Small, De Zan, Brancato, Shiroma
1.1	23-07-2024	CEOS-ARD for SAR PFS, update v1.1 endorsed at LSI-VC teleconference		LSI-VC
1.1.1	05-09-2024	New Item: 1.7.23 (Displacement Modelling) and addition and [InSAR] refinement to Item 1.7.16 (InSAR Pair).	[InSAR]	Charbonneau, Garthwaite, Rosenqvist, De Zan, Hawkins, Chapman, Zhou, Staniewicz, Shiroma, Jayasri,

Version	Date	Description of change	Affected CEOS-ARD product	Author
				Truckenbrodt, Valentino
1.2	14-04-2025	CEOS-ARD for SAR PFS, update v1.2 endorsed at LSI-VC-17		LSI-VC
1.2.1	04-03-2026	Items 1.2 and 2.1 (Metadata Machine Readability). Changed to reference “the latest corresponding” PFS rather than version number. Added CB product description in PFS background section. New Items: 1.7.24 (Composite Backscatter Processing), 2.21 (Contributing Observation Image), 2.22 (Composite Quality Map)	All [CB]	Small, Rosenqvist, Charbonneau, Valentino, Zhou, Albinet, Jayasri, Truckenbrodt, Shiroma, Sundari, Tadono, Baldry, Chapman, Kennedy
1.2.2	16-04-2026	1.6.5 (Source Data Orbit Information). Separating Goal requirements for GSLC and InSAR. 4.3 (Geometric Accuracy). InSAR Threshold requirement to specify SAR acquisition used for geocoding moved to Goal.	[GSLC] [InSAR]	Small, Rosenqvist, Charbonneau, Mohr
1.2.3	24-04-2026	4.2 (Digital Elevation Model). Added description to clarify case where more than one DEM or EGM have been used to generate a mosaic or composite product.	All	Rosenqvist, Charbonneau, Small, Mohr
1.3	24-04-2026	CEOS-ARD for SAR PFS v1.3 endorsed at LSI-VC-19	[CB] All	LSI-VC
1.3.1	07-07-2026	2.21 (Contributing Observation Image). Description corrected.	[CB]	Rosenqvist, Mohr

Contributing Authors

François Charbonneau, Natural Resources Canada, Canada
Ake Rosenqvist, soloEO / Japan Aerospace Exploration Agency, Japan
John Truckenbrodt, German Aerospace Centre (DLR), Germany
Clément Albinet, European Space Agency (ESA), Italy
David Small, University of Zurich, Switzerland
Bruce Chapman, Jet Propulsion Laboratory, USA
Howard Zebker, Stanford University, USA
Zheng-Shu Zhou, CSIRO, Australia
Kimberlee Baldry, Geoscience Australia, Australia
David Bekaert, Jet Propulsion Laboratory, USA
Virginia Brancato, Jet Propulsion Laboratory, USA
Danilo Dadamia, CONAE, Argentina
Benjamin Deschamps, Environment and Climate Change, Canada
Matt Garthwaite, CSIRO, Australia
Guillaume Hajduch, Collecte Localisation Satellites, France
Jayasri Poludasu, ISRO, India
Josef Kellndorfer, Earth Big Data, USA
Joseph Kennedy, Alaska Satellite Facility, USA
Marco Lavalle, Jet Propulsion Laboratory, USA
Thomas Logan, Alaska Satellite Facility, USA
Franz Meyer, Alaska Satellite Facility, USA
Nuno Miranda, European Space Agency (ESA), Italy
Matthias Mohr, Radiant Earth Foundation, Germany
Muriel Pinheiro, European Space Agency (ESA), Italy
Marko Repse, Sinergise, Slovenia
HariPriya Sakethapuram, ISRO, India
Gustavo H. X. Shiroma, Jet Propulsion Laboratory, USA
Usha Sundari, ISRO, India
Andreia Siqueira, Geoscience Australia, Australia
Scott Staniewicz, Jet Propulsion Laboratory, USA
Takeo Tadono, Japan Aerospace Exploration Agency, Japan
Medhavy Thankappan, Geoscience Australia, Australia
Antonio Valentino, Starion *for* European Space Agency (ESA), Italy
Anna Wendleder, German Aerospace Centre (DLR), Germany
Fang Yuan, Digital Earth Africa, Australia
Francesco De Zan, Delta-Phi Remote Sensing GmbH, Germany

CEOS Analysis Ready Data Definition

"CEOS Analysis Ready Data (CEOS-ARD) are satellite data that have been processed to a minimum set of requirements and organised into a form that allows immediate analysis with a minimum of additional user effort and interoperability both through time and with other datasets."

Description

Product Family Specification Title: Synthetic Aperture Radar (CEOS-ARD SAR)

Applies to: Data collected by Synthetic Aperture Radar sensors

Background to CEOS-ARD for Synthetic Aperture Radar:

The CEOS Analysis Ready Data (CEOS-ARD) Product Family Specification (PFS) for Synthetic Aperture Radar (SAR) data is specifically aimed at users interested in exploring the potential of SAR but who may lack the expertise or facilities for SAR processing.

This CEOS-ARD for Synthetic Aperture Radar PFS incorporates, into a single generic document, the following five CEOS-ARD SAR specifications endorsed by CEOS Land Surface Imaging-Virtual Constellation (CEOS LSI-VC):

- Normalised Radar Backscatter [version 5.5]
- Polarimetric Radar [version 3.5]
- Ocean Radar Backscatter [version 1.0]
- Geocoded Single-Look Complex [SAR version 1.1]
- Interferometric SAR [SAR version 1.2]
- Composite Backscatter [SAR version 1.3]

The **CEOS-ARD Normalised Radar Backscatter [NRB]** specification describes products that have been subject to Radiometric Terrain Correction (RTC) and are provided in the Gamma-Nought (γ^0_T) backscatter convention (Small, 2011), which mitigates the variations from diverse observation geometries and is recommended for most land applications. An additional metadata layer can be optionally provided for conversion of γ^0_T to Sigma-Nought (σ^0_T) backscatter layer for compatibility with legacy software or numerical models.

As the **[NRB]** product contains backscatter values only, it cannot be directly used for SAR polarimetry or interferometric applications that require relative polarization phase or local phase estimates respectively. However, as an option, a "flattened" phase data layer can be provided with an **[NRB]** product for enabling InSAR analysis. The flattened phase is the interferometric phase, with respect to a reference orbit and to a digital elevation model (DEM), for which the topographic phase contribution is removed.

The **[NRB]** specification accommodates basic mosaic products generated from more than one input data source, where each pixel value in the **[NRB]** product uniquely corresponds to the pixel value of *one* of its input data sources, indicated in the Acquisition ID per-pixel metadata. For products where the pixel value is dependent on multiple input sources, see the Composite backscatter **[CB]** product below.

The **CEOS-ARD Composite Backscatter [CB]** product is a composite backscatter product generated from a set of SAR images acquired over a time-window, and where each pixel value is derived from two or more of the input data sources (e.g. by local resolution weighting [Small et al., 2022]). (Note the difference with respect to the basic mosaic products accommodated by **[NRB]** above). **[CB]** datasets can be derived from a set of **[NRB] or [POL] or [GSLC]** inputs, making further use of those products' backscatter estimates and scattering area per-pixel metadata that were used to normalise them. The **[CB]** source image layers are arranged in a set of input products acquired within a defined time-window, and a single composite backscatter product is the output. It may contain multiple channels (wavelengths, polarisations). It is generally assumed that a single composite backscatter image layer will be generated from a set of inputs sharing a common polarisation and wavelength. The set of input products can be either from a single satellite or mission, or even from multiple missions, given a high standard of geometric and radiometric calibration in all contributing missions. Further quality per-pixel metadata may also be provided, such as (a) the Contributing Observations image (2.21) or (b) Composite Quality Map (2.22).

The **CEOS-ARD Polarimetric Radar [POL]** product format is an extension of the CEOS-ARD Normalised Radar Backscatter format **[NRB]**. This extension is required in order to better support Level-1 SLC polarimetric data, including full-polarimetric modes (e.g., RADARSAT-2, ALOS-2/4, SAOCOM-1 and future missions), and hybrid or linear dual-polarimetric modes (i.e., Compact Polarimetric mode available on RCM, SAOCOM and the upcoming NISAR mission). The **[POL]** product can be defined in two processing levels:

- The normalised covariance matrix **[CovMat]** representation (C2 or C3) which preserves the inter-channel polarimetric phase(s) and maximizes the available information for users. Interoperability within current CEOS-ARD SAR backscatter definition is preserved, since diagonal elements of the covariance matrix are backscatter intensities. Scattering information enhancement can be achieved by applying incoherent polarimetric decomposition techniques (e.g., Freeman-Durden, van Zyl, Cloude-Pottier, Yamaguchi-based) directly on the C2 or C3 matrix.
- Polarimetric Radar Decomposition **[PRD]** refers to ARD products where polarimetric information is broken down into simplified parameters to facilitate user interpretation of the data. They are derived from coherent or incoherent polarimetric decomposition techniques.

Notice and Limitations [POL].

For Polarimetric Radar [POL] products, optimal incoherent Polarimetric Radar Decomposition [PRD] should be performed under the slant range projection (Gens et al., 2013, Toutin et al., 2013). In order to minimise bias in the CEOS-ARD SAR Level-2a covariance matrix product, speckle filtering and averaging of the covariance matrix should be applied in the slant range projection, and nearest neighbour method is recommended for resampling the data to the geocoded format. Specifically, nearest-neighbour resampling ensures that the averaged covariance matrix elements in slant range and in geocoded ground projection are exactly the same. Consequently, the polarimetrically derived parameters are exactly equal in both approaches (assuming that no further averaging is performed on the ARD product for decomposing the polarimetric information). Bilinear and average resampling methods are also suitable for resampling the covariance matrix, but some differences with polarimetric parameters generated in slant range and then resampled (bilinear) might be observed on sloped terrains. Even if Sinc interpolation may be more robust for spatial resampling, it does not preserve covariance matrix integrity, and should consequently not be used for this ARD product.

It is recommended that ARD providers who desire to distribute **[PRD]** products decompose the polarimetric information starting from Level-1 SLC data and then geocode the derived parameters rather than use the **[CovMat]** ARD product. Resampling can be performed using any of the supported methods (nearest-neighbour, bilinear, average, bi-cubic spline or Lanczos are recommended), which need to be indicated in the product metadata. Note that coherent decomposition techniques cannot be performed on **[CovMat]** ARD products.

Covariance matrix products contain a variable number of layers (or bands) with different data types depending on the polarimetric mode (full or dual) and decomposition technique. The **[CovMat]** products for the C2 matrix have 3 layers (2 real-valued diagonal elements and 1 complex-valued off-diagonal element). **[CovMat]** products for the C3 matrix have 6 layers (3 real-valued diagonal elements and 3 complex-valued off-diagonal elements). Layers that can be obtained via a complex conjugation of other layers are not provided within the product. Polarimetric Decomposition products contain typically 2 to 4 (or more) real-valued layers depending on the particular decomposition algorithm. Within the **[CovMat]** product files, ARD layers are organized in order to reduce access delays and maximize efficiency in extracting the desired information. In **[CovMat]** products, geographically contiguous samples for each layer may be stored next to each other and organized “layer by layer”. Alternatively, samples belonging to the same covariance matrix might be stored next to each other and organized “matrix by matrix”. **[PRD]** products are organized “layer by layer”, i.e., with bands corresponding to the output of the polarimetric decomposition stored next to each other).

The **CEOS-ARD Ocean Radar Backscatter [ORB]** product specification describes products that have been projected on a geoid and are provided in the Sigma-Nought (σ^0) backscatter

convention, which is recommended for most ocean applications. Backscatter may be calibrated to the ellipsoid (σ^0_E) or radiometrically terrain corrected (σ^0_T) prior to geometric terrain correction. As the basic **[ORB]** product contains backscatter values only, it *cannot* be directly used for SAR polarimetry or interferometric applications that require local phase estimates. Nonetheless, an advanced **[ORB]** product could include the upper diagonal of the polarimetric σ^0 covariance matrix for enabling advanced polarimetric analysis (similar to the **[POL]** product).

The **CEOS-ARD Geocoded Single-Look Complex (GSLC)** product is relevant to interferometric studies. The **[GSLC]** product is derived from the range-Doppler (i.e. slant range) Single-Look Complex (SLC) product using a DEM and the orbital state vectors and output in the map projected system. The phase of a geocoded SLC is "flattened" with respect to a reference orbit and to a DEM, to eliminate topographic phase contributions [Zebker *et al*., 2017 and Zheng and Zebker, 2017]. The sample spacing of the **[GSLC]** product in the map coordinate directions is comparable to the full resolution original SLC product. The **[GSLC]** product can be directly overlaid on a map or combined with other similar **[GSLC]** products to derive interferograms and create change maps, for example. Since the **[GSLC]** phase is flattened, the phase difference between two **[GSLC]** products acquired on a same relative orbit produces an interferogram referring only to surface displacement and noise (i.e., no topographic fringes). The **[GSLC]** product may optionally be radiometrically terrain corrected such that the squared amplitude yields γ^0_T.

The **CEOS-ARD Interferometric SAR [InSAR]** product format specification describes products resulting from InSAR processing steps. Two levels of product categories are supported: 1) The first level includes InSAR coherence and wrapped interferogram images derived from a pair (or several pairs) of SLC or GSLC source data listed in the product metadata file. The product metadata file reports the processing information (parameters and methods) used to produce them. The PFS also supports unwrapped interferograms, but their inclusion is not a threshold requirement for this product level. An InSAR pair identification label allows support of InSAR time series products derived from several repeated pass SAR source combinations. A Boolean flag is used to indicate whether the interferometric phases due to Earth curvature and to the surface topography are removed from interferograms. This **[InSAR]** product level can then serve as input in temporal coherence analysis techniques or as input in production of time series displacement products by distributed target approaches like Small BAseline Subset (SBAS) technique [Lanari *et al.* 2004]. 2) InSAR displacement belongs to the second level of **[InSAR]** products. Displacement products can be expressed as InSAR displacement from a pair of SAR acquisitions and/or from a time series of SAR acquisitions, as a displacement and/or as displacement rate products over a time period. Since several different InSAR displacement approaches exist in the literature for which, each have their own criteria and parameters, it is not possible to prescribe specific metadata details. Nonetheless, it is required that main

processing steps (with reference to methodologies), with their chosen parameters (criteria like statistical thresholds and estimation window sizes) are well defined in the displacement product metadata, in order to preserve traceability for the end users. For [InSAR] displacement products generated from first level CEOS-ARD **[InSAR]**, listed "source" products in the metadata can refer to those first level CEOS-ARD **[InSAR]** described above. In accordance with other CEOS-ARD products, per-pixel metadata and data are terrain geocoded products.

As can be seen from the above PFS descriptions, only a few minor details in terms of generated parameters and/or the addition of supplemental data distinguish these CEOS-ARD products. In part, they are to a large extent all backward-compatible. For example, **[POL]** products implicitly include **[NRB]** products, while a coastal **[NRB]** or **[POL]** product can simply be made compatible with other **[ORB]** products by applying gamma-to-sigma conversion. Just as **[GSLC]** can be converted to **[NRB]** (given that terrain-flattening was applied, a goal-requirement for GSLC), the inverse conversion can be made true by including the optional topographically flattened phase. In this way a **[NRB]** or **[POL]** product can be used like a **[GSLC]** for InSAR applications. Consequently, it becomes obvious that they all can follow a common approach, in terms of content and structure, in order to optimize their interoperability.

For this combined **CEOS-ARD for Synthetic Aperture Radar** PFS, as for the individual **[NRB]**, **[CB], [POL]**, **[ORB]**, **[GSLC]**, and **[InSAR]** PFSs, metadata requirements are defined under two categories: Threshold and Goal. **Threshold requirements** refer to metadata parameters or data files which are mandatorily required in a product in order to be CEOS-ARD compliant. **Goal requirements** (formerly referred to as Target) are complementary metadata parameters or data files that are desirable or more accurate but more constraining/challenging to achieve depending on the SAR missions and the data provider constraints. Since this document integrates four CEOS-ARD PFSs, it is worth noting that some requirements have been "relaxed" for a few Threshold parameters, depending on the applications/environment of the CEOS-ARD product. Exceptions are identified in the tables by specifying the usage.

Definitions and Abbreviations

ALE	Absolute Localisation Error
Ancillary Data	Data other than instrument measurements, originating in the instrument itself or from the satellite, required to perform processing of the data. They include orbit data, attitude data, time information, spacecraft engineering data, calibration data, data quality information, and data from other instruments.
Auxiliary Data	The data required for instrument processing, which does not originate in the instrument itself or from the satellite. Some auxiliary data will be generated in the ground segment, whilst other data will be provided from external sources.
CB	Composite Backscatter
CEOS-ARD	Committee on Earth Observation Satellites - Analysis Ready Data
Composite Product	Product where samples (or pixels) are generated from more than one input data source, e.g. by local resolution weighting or by backscatter averaging.
CovMat	Normalised Radar Covariance Matrix
DOI	Digital Object Identifier
GSLC	Geocoded Single-Look Complex
InSAR	Interferometric Synthetic Aperture Radar
Metadata	Structured information that describes other information or information services. With well-defined metadata, users should be able to get basic information about data without a need to have knowledge about its entire content.
Mosaic Product	Product generated from more than one input data source and where a pixel value in the product uniquely corresponds to the pixel value of one of its input data sources.
NRB	Normalised Radar Backscatter
Pixel Spacing	Processed sample distance
POL	Polarimetric Radar
PRD	Polarimetric Radar Decomposition
RTC	Radiometrically Terrain Corrected
Spatial Resolution	The smallest size objects that can be distinguished by the sensor at the ground surface.
Spatial Sampling Distance	Spatial sampling distance is the great circle distance on the reference surface distance between adjacent spatial samples on the Earth's surface.

Requirements

General Metadata

These are metadata records describing a distributed collection of pixels. 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 requirements listed below. The column "CEOS-ARD product" indicates to which CEOS-ARD SAR product (NRB, POL, ORB, GSLC) the parameter refers.

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
1.1	**Traceability**	[NRB] ~~[CB]~~ ~~[POL]~~ ~~[ORB]~~ ~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** Not required.	**Achieved level: Not required**	**Not Required at Threshold**
			Goal (Desired) Requirements Data must be traceable to SI reference standard. *Note 1: Relationship to 3.5. Traceability requires an estimate of measurement uncertainty.* *Note 2: Information on traceability should be available in the metadata as a single DOI landing page.*		
1.2	**Metadata Machine Readability**	[NRB] ~~[CB]~~ ~~[POL]~~ ~~[ORB]~~ ~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** Metadata is provided in a structure that enables a computer algorithm to be used to consistently and automatically identify and extract each component/variable for further use.	**Achieved level: Threshold** Metadata in separate metadata file in XML format, formatted in accordance with "CEOS-ARD_Metadata-spec_Synthetic_Aperture_Radar_v1.3.xlsx"	**Verified at Threshold** **XML metadata per CEOS-ARD SAR Metadata spec v1.3**
			Goal (Desired) Requirements As threshold, but metadata is formatted in accordance with the latest corresponding CEOS-ARD SAR Metadata Specifications, or in a community endorsed standard that facilitates machine-readability, such as ISO 19115-2, Climate and Forecast (CF) convention and the Attribute Convention for Data Discovery (ACDD), etc.		

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
1.3	**Product Type**	[NRB] ~~[CB]~~ ~~[POL]~~ ~~[ORB]~~ ~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** CEOS-ARD product type name – or names in case of compliance with more than one product type – and, if required by the data provider, copyright.	**Achieved level: Threshold**	Verified at Threshold
			Goal (Desired) Requirements As threshold.		
1.4	**Document Identifier**	[NRB] ~~[CB]~~ ~~[POL]~~ ~~[ORB]~~ ~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** Reference to CEOS-ARD for Synthetic Aperture Radar PFS document as URL.	**Achieved level: Threshold** <DocumentIdentifier>	Verified at Threshold
			Goal (Desired) Requirements As threshold.		
1.5	**Data Collection Time**	[NRB] ~~[CB]~~ ~~[POL]~~ ~~[ORB]~~ ~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** Number of source data acquisitions of the data collection is identified. The start and stop UTC time of data collection is identified in the metadata, expressed in date/time. In the case of composite or mosaic products, the dates/times of the first and last data takes is provided with the product.	**Achieved level: Threshold** <DataCollectionTime> <NumberOfAcquisitions> <FirstAcquisitionDate> <LastAcquisitionDate>	Verified at Threshold
			Goal (Desired) Requirements As threshold, but using ISO 8601 time format.		
1.6	**Source Data Attributes**		Subsection describing (detailing) each SAR acquisition used to generate the ARD product. *Note 1: Source data attribute information are described for each acquisition and sequentially identified e.g. as acqID= 1, 2, 3, …* *Note 2: Source data attribute information can refer to [NRB], [POL], [ORB], [InSAR] or [GSLC] products for higher level ARD derived from those, under the condition of their availability (item 1.6.1).*	<SourceAttributes> AcqID provided for each datatake	Verified at Threshold

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
1.6.1	**Source Data Access**	[NRB] ~~[CB]~~ ~~[POL]~~ ~~[ORB]~~ ~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** The metadata identifies the location from where the source data can be retrieved, expressed as a URL or DOI. **Goal (Desired) Requirements** The metadata identifies an online location from where the data can be consistently and reliably retrieved by a computer algorithm without any manual intervention being required.	**Achieved level: Threshold** <SourceDataRepository> incl. URL	**Verified at Threshold**
1.6.2	**Instrument**	[NRB] ~~[CB]~~ ~~[POL]~~ ~~[ORB]~~ ~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** The instrument used to collect the data is identified in the metadata: - Satellite name - Instrument name **Goal (Desired) Requirements** As threshold, but using CEOS Mission-Instruments-Measurements (MIM) database (https://ceos.org/mim-database) as reference .	**Achieved level: Threshold** <Satellite> <Instrument> <SatelliteReference>	**Verified at Threshold**
1.6.3	**Source Data Acquisition Time**	[NRB] ~~[CB]~~ ~~[POL]~~ ~~[ORB]~~ ~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** The start date and time of source data is identified in the metadata, expressed in UTC in date and time, at least to the second. **Goal (Desired) Requirements** As threshold.	**Achieved level: Threshold** <SourceDataAcquisitionTime> <StartTime> <EndTime>	**Verified at Threshold**
1.6.4	**Source Data Acquisition Parameters**	[NRB] ~~[CB]~~ ~~[POL]~~ ~~[ORB]~~ ~~[GSLC]~~ ~~[InSAR~~]	**Threshold (Minimum) Requirements** Acquisition parameters related to the SAR antenna: - Radar band - Centre frequency - Observation mode (i.e., Beam mode name) - Polarization(s) (listed as in original product) - Antenna pointing [Right/Left] - Beam ID (i.e., Beam mode Mnemonic) **Goal (Desired) Requirements** As threshold.	**Achieved level: Threshold** <SourceDataAcquisitionParameters> <RadarBand> <RadarCenterFrequency> <ObservationMode> <Polarizations> <AntennaPointing> <BeamID>	**Verified at Threshold**

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
1.6.5	**Source Data Orbit Information**	[NRB] ~~[CB]~~ ~~[POL]~~ ~~[ORB]~~ ~~[GSLC]~~	**Threshold (Minimum) Requirements** Information related to the platform orbit used for data processing: - Pass direction [asc/desc] * - Orbit data source [e.g., predicted/ definite/ precise/ downlinked, etc.] ** For source data crossing the North or South Pole, it is recommended to produce two distinct CEOS-ARD products and to use the appropriate "Pass direction" in each.* **Goal (Desired) Requirements** As threshold, including also: - Platform heading angle expressed in degrees [0 360] from North - Orbit data file containing state vectors (minimum of 5 state vectors, from 10% of scene length *before* start time to 10% of scene length *after* stop time) - Platform (mean) altitude. - Absolute orbit number - Relative orbit number	**Achieved level: Threshold** <OrbitInformation> <PassDirection> <OrbitDataSource> <AbsoluteOrbitNumber> Absolute orbit number is provided in the metadata file.	**Verified at Threshold**
1.6.6	**Source Data Processing Parameters**	[NRB] ~~[CB]~~ ~~[POL]~~ ~~[ORB]~~ ~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** Processing parameters details of the source data: - Processing facility - Processing date - Software version - Product level - Product ID (file name) - Azimuth number of looks - Range number of looks (separate values for each beam, as necessary) Note: Azimuth and Range number of looks are not required when sources are CEOS-ARD or any other geocoded products	**Achieved level: Threshold** <SourceProcParam> <ProcessingFacility> <ProcessingDate> <SoftwareVersion> <ProductID> <ProductLevel> <AzimuthNumberOfLooks> <RangeNumberOfLooks>	**Verified at Threshold**

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
			Goal (Desired) Requirements As threshold, plus additional relevant processing parameters, e.g., range- and azimuth look bandwidth and LUT applied.		
1.6.7	**Source Data Image Attributes**	[NRB] ~~[CB]~~ ~~[POL]~~ ~~[ORB]~~ ~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** Image attributes related to the source data: - Source Data geometry (slant range/ground range/geocoded) - Azimuth pixel spacing [m] (alternatively, Azimuth pixel spacing can be provided in second [s], equivalent to the azimuth time sample interval) - Range pixel spacing - Azimuth resolution - Range resolution - Near range incident angle - Far range incident angle Note: For geocoded sources ([GSLC] and [InSAR]), Azimuth and Range pixel spacing are replaced by line (row) and pixel (column) spacing information. Spatial resolution information is not required for geocoded sources.	**Achieved level: Threshold** <SourceDataImageAttributes> <SourceDataGeometry> <SourceGeographicalExtent> <AzimuthPixelSpacing> <RangePixelSpacing> <AzimuthResolution> <Beam> <RangeResolution> <Beam> <IncAngleNearRange> <IncAngleFarRange> WKT formatting used	**Verified at Threshold**
			Goal (Desired) Requirements Geometry of the image footprint expressed in WGS84 in a standardised format (e.g., WKT).		
1.6.8	**Sensor Calibration**	[NRB] ~~[POL]~~ ~~[ORB]~~ ~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** Not required.	**Achieved level: Not required**	**Not Required at Threshold**
			Goal (Desired) Requirements Sensor calibration parameters are identified in the metadata or can be accessed using details included in the metadata. Ideally this would support machine to machine access.		

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
1.6.9	**Performance Indicators**	[NRB] ~~[CB]~~ ~~[POL]~~ ~~[ORB]~~ ~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** Provide performance indicators on data intensity noise level (NEσ^0 and/or NEβ^0 and/or NEγ^0 (noise equivalent Sigma and/or Beta and/or Gamma-Nought)). Provided for each polarization channel when available. Parameter may be expressed as the mean and/or minimum and maximum noise equivalent values of the source data. Values do not need to be estimated individually for each product, but may be estimated once for each acquisition mode, and annotated on all products.	**Achieved level: Threshold** <PerformanceIndicators> <NoiseEquivalentIntensity> <Estimates>	**Verified at Threshold**
			Goal (Desired) Requirements Provide additional relevant performance indicators (e.g., ENL, PSLR, ISLR, and performance reference DOI or URL).		
1.6.10	**Source Data Polarimetric Calibration Matrices**	[NRB] ~~[CB]~~ ~~[POL]~~ ~~[ORB]~~ ~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** Not required.	**Achieved level: Not required**	**Not Required at Threshold**
			Goal (Desired) Requirements The complex-valued polarimetric distortion matrices with the channel imbalance and the cross-talk applied for the polarimetric calibration.		
1.6.11	**Mean Faraday Rotation Angle**	[NRB] ~~[POL]~~ ~~[ORB]~~ ~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** Not required.	**Achieved level: Not required**	**Not Required at Threshold**
			Goal (Desired) Requirements The mean Faraday rotation angle estimated from the polarimetric data and/or from models with reference to the method or paper used to derive the estimate.		
1.6.12	**Ionosphere Indicator**	[NRB] ~~[CB]~~ ~~[POL]~~	**Threshold (Minimum) Requirements** Not required.	**Achieved level: Not required**	**Not Required at Threshold**

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
			Goal (Desired) Requirements Flag indicating whether the backscatter imagery is "significantly impacted" by the ionosphere (0 – false, 1 – true). Significant impact would imply that the ionospheric impact on the backscatter exceeds the radiometric calibration requirement or goal for the imagery.		
1.7	**CEOS-ARD Product Attributes**		Subsection containing information related to the CEOS-ARD product generation procedure and geographic parameters.	<CEOS-ARDProductAttributes>	**Verified at Threshold**
1.7.1	**Product Data Access**	[NRB] ~~[CB]~~ ~~[POL]~~ ~~[ORB]~~ ~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** Processing parameters details of the CEOS-ARD product: - Processing facility - Processing date - Software version - Location from where CEOS-ARD product can be retrieved, expressed as a URL or DOI.	**Achieved level: Threshold** <DataAccess> <ProcessingFacility> <ProcessingTime> <SoftwareVersion> <Repository>	**Verified at Threshold**
			Goal (Desired) Requirements The metadata identifies an online location from where the data can be consistently and reliably retrieved by a computer algorithm without any manual intervention being required.		
1.7.2	**Auxiliary Data**	[NRB] ~~[CB]~~ ~~[POL]~~ ~~[ORB]~~	**Threshold (Minimum) Requirements** Not required.	**Achieved level: Not required**	**Not Required at Threshold**

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
			Goal (Desired) Requirements The metadata identifies the sources of auxiliary data used in the generation process, ideally expressed as DOIs. *Note: Auxiliary data includes DEMs, etc., and any additional data sources used in the generation of the product.*		
1.7.3	**Product Sample Spacing**	[NRB] ~~[CB]~~ ~~[POL]~~ ~~[ORB]~~ ~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** CEOS-ARD product processing parameters details: - Pixel (column) spacing - Line (row) spacing	**Achieved level: Threshold** <ProductSampleSpacing> <ProductColumnSpacing> <ProductRowSpacing>	**Verified at Threshold**
			Goal (Desired) Requirements As threshold.		
1.7.4	**Product Equivalent Number of Looks**	[NRB] ~~[CB]~~ ~~[POL]~~ ~~[ORB]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** Not required.	**Achieved level: Not required**	**Not Required at Threshold**
			Goal (Desired) Requirements Equivalent Number of Looks (ENL)		
1.7.5	**Product Resolution**	[NRB] ~~[CB]~~ ~~[POL]~~ ~~[ORB]~~ ~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** Not required.	**Achieved level: Not required**	**Not Required at Threshold**
			Goal (Desired) Requirements Average spatial resolution of the CEOS-ARD product along: - Columns - Rows		

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes

1.7.6	**Product Filtering**	[NRB]
		~~[CB]~~
		~~[POL]~~
		~~[ORB]~~
			Threshold (Minimum) Requirements
			Flag if speckle filter has been applied [True/False].
			
			Metadata should include:
			- Reference to algorithm as DOI or URL
			- Input filtering parameters
			  ○ Type
			  ○ Window size in pixel units
			  ○ Any other parameters defining the speckle filter used
			
			Mandatory for [POL]: Advanced polarimetric filter preserving covariance matrix properties shall be applied.
				Achieved level: Threshold
				
				<Filtering>
				<FilterApplied>
				
				Flag set to FALSE for all KOMPSAT-5 products
					Verified at Threshold

			Goal (Desired) Requirements As threshold.		
1.7.7	**Product Bounding Box**	[NRB] ~~[CB]~~ ~~[POL]~~ ~~[ORB]~~ ~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** Two opposite corners of the product file (bounding box, including any zero-fill values) are identified, expressed in the coordinate reference system defined in 1.7.11. Four corners of the product file are recommended for scenes crossing the Antemeridian, or the North or the South Pole.	**Achieved level: Threshold** <ProductBoundingBox> <Northing> <Easting> for UL corner	**Verified at Threshold**
			Goal (Desired) Requirements As threshold.		
1.7.8	**Product Geographical Extent**	[NRB] ~~[CB]~~ ~~[POL]~~ ~~[ORB]~~ ~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** The geometry of the SAR image footprint expressed in longitude/latitude based on WGS84 (EPSG 4326), in a standardised format (e.g., WKT Polygon).	**Achieved level: Threshold** <ProductGeographicalExtent>	**Verified at Threshold**
			Goal (Desired) Requirements As threshold.		

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
1.7.9	**Product Image Size**	[NRB] ~~[CB]~~ ~~[POL]~~ ~~[ORB]~~ ~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** Image attributes of the CEOS-ARD product: - Number of lines - Number of pixels per line - File header size (if applicable) - Number of no-data border pixels (if appl.)	**Achieved level: Threshold** <ProductImageSize> <NumberLines> <NumPixelsPerLine> <NumBorderPixels>	**Verified at Threshold**
			Goal (Desired) Requirements As threshold.		
1.7.10	**Product Pixel Coordinate Convention**	[NRB] ~~[CB]~~ ~~[POL]~~ ~~[ORB]~~ ~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** Coordinate referring to the Centre, or the Upper Left Corner or the Lower Left Corner of a pixel. Values are [pixel centre, pixel ULC or pixel LLC].	**Achieved level: Threshold** <PixelCoordinateConvention>	**Verified at Threshold**
			Goal (Desired) Requirements As threshold.		
1.7.11	**Product Coordinate Reference System**	[NRB] ~~[CB]~~ ~~[POL]~~ ~~[ORB]~~ ~~[GSLC]~~ ~~[InSAR]~~	**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** <CoordinateReferenceSystem> Provided both as EPSG and WKT	**Verified at Threshold**
			Goal (Desired) Requirements As threshold.		

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
1.7.12	**Look Direction Polynomials**	~~[ORB]~~	**Threshold (Minimum) Requirements** In case the per-pixel item 2.11 (Look Direction Image) is not provided, then a list of the polynomial coefficients a_i necessary to reconstruct the look direction angle*, together with an estimate of the added error from use of polynomial vs. per-pixel more accurate values, shall be provided. Example polynomial: $LookDir = a_1Lat^2 + a_2Lon^2 + a_3LatLon + a_4Lat + a_5Lon + a_6$ where: a_i = polynomial coefficients Lat = latitude Lon = longitude Lat and Lon are the related coordinates in the product map units ['m', 'deg', 'arcsec'] ** The look direction angle represents the planar angle between north and each range direction. It is not constant in range, especially close to the poles.*	**Achieved level: N/A FOR NRB**	**Not Relevant to NRB SAR Products**
			Goal (Desired) Requirements As threshold.		
1.7.13	**Radar Unit Look Vector**	~~[GSLC]~~ ~~[InSAR]~~	**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: N/A FOR NRB**	**Not Relevant to NRB SAR Products**
			Goal (Desired) Requirements As threshold.		

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
1.7.14	**Slant Range Sensor to Surface**	~~[GSLC]~~	**Threshold (Minimum) Requirements** Slant range distance from the sensor to the surface, specified at centre of scene. Only required if per-pixel metadata 2.13 (Slant Range Sensor to Surface Image) is not provided.	**Achieved level: N/A FOR NRB**	**Not Relevant to NRB SAR Products**
			Goal (Desired) Requirements As threshold.		
1.7.15	**Reference Orbit**	[NRB] ~~[POL]~~ ~~[GSLC]~~	**Threshold (Minimum) Requirements** Not required.	**Achieved level: Not required**	**Not Required at Threshold**
			Goal (Desired) Requirements Usage: For [NRB] & [POL] only when per-pixel metadata 3.7 (Flattened phase) is provided. For [GSLC] when a reference orbit is used instead of a virtual orbit (see Annex A 1.2). Provide the absolute orbit number used as reference for topographic phase flattening. In case a virtual orbit has been used, provide orbit parameters or orbit state vectors as DOI or URL.		

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
1.7.16	**InSAR Pair**	~~[InSAR]~~	**Threshold (Minimum) Requirements** InSAR baseline criteria information ● Baseline type: Single Reference, Multi-baseline or All ● Minimal and maximal perpendicular baselines (not required when type = "All") ● Minimal and maximal temporal baselines (not required when type = "All") When [InSAR] product contains image data derived from InSAR pairs, as defined under items 3.8, 3.9, and 3.10, provide list of source acquisition ID (e.g. as per item 1.6 acqID) for the InSAR pair (primary and secondary acquisitions). Repeat for multiple InSAR pair products and assign/specify InSAR pair ID number (e.g. insarID = 1,2,3 …). For multi-polarisation source acquisition, specify the polarisation used for the InSAR pair. Provide Perpendicular and Parallel orbit baseline information estimated at scene centre. In addition, orbital baseline information can be provided as per pixel metadata 2.18 and 2.19. Flag if orbital baseline refinement has been applied [true/false]. If true, specify refinement method (ex.: GCPs, FFT, …). Azimuth common band filtering and range spectral shift filtering flags.	**Achieved level: N/A FOR NRB**	**Not Relevant to NRB SAR Products**
			Goal (Desired) Requirements Source type format with value "GSLC" should be provided when InSAR analysis is performed from [GSLC] products generated from SLC source acquisitions listed under item 1.6. If GSLC data aren't provided with the InSAR product, provide the [GSLC] URL link(s) if it is available. If source acquisitions listed under 1.6 are [GSLC], discard this note.		

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
1.7.17	**InSAR Pair Co-registration**	~~[InSAR]~~	**Threshold (Minimum) Requirements** Co-registration information of source acquisitions with a reference source. Provide reference source ID (or filename if different from source list) and for each co-registered source, report the azimuth and range standard deviation error in metre or sample fraction. Not required when the InSAR product is generated from [GSLC] products (see product level in requirement 1.6.6).	**Achieved level: N/A FOR NRB**	**Not Relevant to NRB SAR Products**
			Goal (Desired) Requirements As threshold.		

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
1.7.18	**Local InSAR Phase Quality**	~~[InSAR]~~	**<u>Threshold (Minimum) Requirements</u>** Local InSAR phase quality estimation information ● Methodology name [ex.: Coherence, DespecKS, Persistent Scatterers [Temporal variability of intensity and/or Spectral diversity correlation], …) ● Reference to methodology [text or DOI] ● Estimation parameters and selection criteria used, as for examples: 1. For coherence ▪ Window size ▪ Weighting shape ▪ Coherence threshold for selection 2. For DespecKS [Ferretti *et al.* 2011] or similar statistical approach ▪ Window size ▪ Statistical test function (Kolmogorov-Smirnov, Anderson-Darling, …) ▪ Number of statistically homogeneous pixels (SHP) threshold for selection ▪ Phase triangulation coherence (γ_{PTA}) threshold 3. For Persistent Scatterers ▪ Temporal variability of intensity - Intensity mean/std ratio threshold - Relative intensity threshold - Spectral diversity correlation - Line and column spectral looks - Intensity minimal threshold - Spectral correlation threshold - Intensity mean/std ratio threshold All phase quality estimation techniques used shall be listed. **<u>Goal (Desired) Requirements</u>** As threshold.	**Achieved level: N/A FOR NRB**	**Not Relevant to NRB SAR Products**

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
1.7.19	**Interferogram Filtering**	~~[InSAR]~~	**Threshold (Minimum) Requirements** If applied, interferogram filtering information ● Methodology name ● Reference to methodology [text or DOI] ● Filtering parameters used.	**Achieved level: N/A FOR NRB**	**Not Relevant to NRB SAR Products**
			Goal (Desired) Requirements As threshold.		
1.7.20	**Phase Unwrapping**	~~[InSAR]~~	**Threshold (Minimum) Requirements** If 3.10-Unwrapped Interferogram Image is provided, technique used for InSAR phase unwrapping ● Methodology name ● Reference to methodology [text or DOI] ● Unwrapping parameters 1. Coherence threshold 2. Number of iterations 3. Stable reference point coordinates or multi-point approach information	**Achieved level: N/A FOR NRB**	**Not Relevant to NRB SAR Products**
			Goal (Desired) Requirements As threshold.		
1.7.21	**Atmospheric Phase Correction**	~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** If applied, reference to atmospheric phase correction technique and parameters used. ● Methodology name ● Reference to methodology [text or DOI]	**Achieved level: N/A FOR NRB**	**Not Relevant to NRB SAR Products**
			Goal (Desired) Requirements As threshold.		
1.7.22	**Ionospheric Phase Correction**	~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** If applied, reference to ionospheric phase correction technique and parameters used. ● Methodology name ● Reference to methodology [text or DOI]	**Achieved level: N/A FOR NRB**	**Not Relevant to NRB SAR Products**

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
			Goal (Desired) Requirements As threshold.		
1.7.23	**Displacement Modelling**	~~[InSAR]~~	**Threshold (Minimum) Requirements** Not required.	**Achieved level: N/A FOR NRB**	**Not Relevant to NRB SAR Products**
			Goal (Desired) Requirements Reference to displacement modelling technique used ● Methodology name ● Reference to methodology [text or DOI] ● Specific input parameters used If a temperature refinement model is used, indicate model and temperature data source.		
1.7.24	**CB Processing**	~~[CB]~~	**Threshold (Minimum) Requirements** Reference to composite backscatter generation method used ● Methodology name ● Reference to methodology [DOI] ● Specific input parameters used	**Achieved level: N/A FOR NRB**	**Not Relevant to NRB SAR Products**
			Goal (Desired) Requirements As threshold		

Per-Pixel Metadata

The following minimum metadata specifications apply to each pixel. Whether the metadata are provided in a single record relevant to all pixels or separately for each pixel is at the discretion of the data provider. Per-pixel metadata should allow users to discriminate between (choose) observations on the basis of their individual suitability for applications.

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
2.1	**Metadata Machine Readability**	[NRB] ~~[CB]~~ ~~[POL]~~ ~~[ORB]~~ ~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** Metadata is provided in a structure that enables a computer algorithm to be used to consistently and automatically identify and extract each component/variable for further use.	**Achieved level: Threshold(Goal)** Metadata in separate metadata file in XML format, formatted in accordance with "CEOS-ARD_Metadata-spec_Synthetic_Aperture_Radar_v1.3.xlsx"	**Verified at Threshold**
			Goal (Desired) Requirements As threshold, but metadata is formatted in accordance with the latest corresponding CEOS-ARD SAR Metadata Specifications, or in a community endorsed standard that facilitates machine-readability, such as ISO 19115-2, Climate and Forecast (CF) convention and the Attribute Convention for Data Discovery (ACDD), etc.		

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
2.2	**Data Mask Image**	[NRB] ~~[CB]~~ ~~[POL]~~ ~~[ORB]~~ ~~[GSLC]~~ ~~[InSAR]~~	**<u>Threshold (Minimum) Requirements</u>** Mask image indicating: - Valid data - Invalid data - No data File format specifications/ contents provided in metadata: - Sample Type [Mask] - Data Format [GeoTIFF/HDF5/NetCDF, …] - Data Type [Int, ...] - Bits per Sample - Byte Order - Bit Value Representation Note 1: All bit value representations included in the Data Mask Image should be indicated in the metadata. Note 2: For CEOS-ARD products created from repeat-pass acquisitions, with narrow orbital tube radius, a single static per pixel metadata file can be provided as a URL address of that unique metadata file.	**Achieved level: Threshold** <DataMask> <FileName> <SampleType> <DataFormat> <DataType> <BitsPerSample> <ByteOrder> <BitValues> <NoData> <Water> <Land> <Layover> <Shadow> <Foreshorten>	**Verified at Threshold**
			<u>Goal (Desired) Requirements</u> As threshold, including additional bit value representations, e.g.: - Layover (masked as invalid data in threshold) - Radar shadow (masked as invalid data in threshold) - Ocean water - Land (recommended for [ORB]) - RTC applied (e.g., for maritime scenes with land samples for which RTC has been applied) - DEM gap filling (i.e., interpolated DEM over gaps) - [InSAR] Unwrapped interferogram phase quality flag/score		

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
2.3	**Scattering Area Image**	[NRB] ~~[POL]~~ ~~[ORB]~~ ~~[GSLC]~~ ~~[InSAR]~~	**<u>Threshold (Minimum) Requirements</u>** Not required.	**Achieved level: Not required**	**Not Required at Threshold**
			<u>Goal (Desired) Requirements</u> **Usage:** Recommended for scenes that include land areas. DEM-based scattering area image used for Gamma-Nought terrain normalisation is provided. This quantifies the local scattering area used to normalise for radiometric distortions induced by terrain to the measured β^0 backscatter. The terrain~~-~~flattened γ^0_T is best understood as β^0 divided by the local scattering area. File format specifications/ contents provided in metadata: - Sample Type [Scattering Area] - Data Format [GeoTIFF/HDF5/NetCDF, …] - Data Type [Int/Float, ...] - Bits per Sample - Byte Order Note 1: For CEOS-ARD products created from repeat-pass acquisitions, with narrow orbital tube radius, a single static per pixel metadata file could be provided as a URL address of that unique metadata file. Note 2: Required for e.g. NRB/POL products if they are to be used as an input to production of composite backscatter (CB) when weighted averages based on the areas are used to generate composite backscatter.		

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
2.4	**Local Incident Angle Image**	[NRB] ~~[POL]~~ ~~[ORB]~~	**<u>Threshold (Minimum) Requirements</u>** DEM-based Local Incident angle image is provided. File format specifications/ contents provided in metadata: - Sample Type [Angle] - Data Format [GeoTIFF/HDF5/NetCDF, …] - Data Type [Int/Float, ...] - Bits per Sample - Byte Order Note: For CEOS-ARD products created from repeat-pass acquisitions, with narrow orbital tube radius, a single static per pixel metadata file can be provided as a URL address of that unique metadata file. *Note: For maritime [ORB] scenes when no land areas are covered, a geoid model could be used for the calculation of the local incident angle*	**Achieved level: Threshold** <LocalIncAngle> <FileName> <SampleType> <DataFormat> <DataType> <BitsPerSample> <ByteOrder>	**Verified at Threshold**
		~~[GSLC]~~	**<u>Goal (Desired) Requirements</u>** As threshold.		

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
2.5	**Ellipsoidal Incident Angle Image**	~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** Ellipsoidal incident angle is provided. File format specifications/ contents provided in metadata: - Sample Type [Angle] - Data Format [GeoTIFF/HDF5/NetCDF, …] - Data Type [Int/Float, ...] - Bits per Sample - Byte Order - Reference Ellipsoid Name Required when 2.12 Radar Unit Look Vector Grid Image is not provided Note: For CEOS-ARD products created from repeat-pass acquisitions, with narrow orbital tube radius, a single static per pixel metadata file can be provided as a URL address of that unique metadata file.	**Achieved level: Not required**	**Not Relevant to NRB SAR Products**
		[NRB] ~~[POL]~~ ~~[ORB]~~	**Goal (Desired) Requirements** As threshold. Note: For maritime [ORB] scenes when no land areas are covered, the ellipsoidal incident angle is nearly identical to the geoid based local incident angle.		

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
2.6	**Noise Power Image**	[NRB] ~~[CB]~~ ~~[POL]~~ ~~[ORB]~~ ~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** Not required.	**Achieved level: Not required**	**Not Required at Threshold**
			Goal (Desired) Requirements Estimated Noise Equivalent σ^0 (or β^0 or γ^0, as applicable) used for noise removal, if applied, for each channel. NEσ^0 and NEγ^0 are both based on either an ellipsoid Earth model or the local topography. File format specifications/ contents provided in metadata: - Sample Type [Gamma-Nought, Sigma-Nought, Beta-Nought] - Correction model type [Ellipsoid, Topography] - Data Format [GeoTIFF/HDF5/NetCDF, …] - Data Type [Int/Float, ...] - Bits per Sample - Byte Order Note: For [CB] the same compositing algorithm as for backscatter shall be used.		
2.7	**Gamma-to-Sigma Ratio**	[NRB] ~~[POL]~~	**Threshold (Minimum) Requirements** Not required.	**Achieved level: Goal**	**Verified at Goal**

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
			Goal (Desired) Requirements Ratio of the integrated area in the Gamma projection over the integrated area in the Sigma projection (ground). Multiplying RTC γ^0_T by this ratio results in an estimate of RTC σ^0_T. File format specifications/ contents provided in metadata: - Sample Type [Ratio] - Data Format [GeoTIFF/HDF5/NetCDF, …] - Data Type [Int/Float, ...] - Bits per Sample - Byte Order Note: For CEOS-ARD products created from repeat-pass acquisitions, with narrow orbital tube radius, a single static per pixel metadata file can be provided as a URL address of that unique metadata file.		

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
2.8	**Acquisition ID Image**	[NRB] ~~[POL]~~ ~~[ORB]~~ ~~[GSLC]~~	**<u>Threshold (Minimum) Requirements</u>** **Note: Required for mosaic products only.** Acquisition ID, or acquisition date, for each pixel is identified. In case of multi-temporal image stacks, use source acquisition ID (i.e., 1.6 acqID values) to list contributing images. In case of Date, data represent (integer or fractional) day offset to reference observation date [UTC]. Date used as reference ("Day 0") is provided in the meta-data. Pixels not representing a unique date or ID (e.g., pixels averaged in image overlap zones) are flagged with a pixel value referencing a date range that is provided in the metadata. File format specifications/ contents provided in metadata: - Sample Type [Day, Time, ID] - Data Format [GeoTIFF/HDF5/NetCDF, …] - Data Type [Int/Float, ...] - Bits per sample - Byte Order	**Achieved level: Theshold** <AcquisitionID> <FileName> <SampleType> <DataFormat> <DataType> <BitsPerSample> <ByteOrder>	**Verified at Threshold**
			<u>Goal (Desired) Requirements</u> As threshold.		
		~~[CB]~~	**<u>Threshold (Minimum) Requirements</u>** Not required.		

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
			Goal (Desired) Requirements The source IDs for each pixel are identified. File format specifications/ contents provided in metadata: - Sample Type [ID] - Data Format [GeoTIFF/HDF5/NetCDF, …] - Data Type [Int/Float, ...] - Bits per sample - Byte Order		
2.9	**Per-pixel DEM**	[NRB] ~~[CB]~~ ~~[POL]~~ ~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** Not required.	**Achieved level: Goal** <PerPixelDem> <FileName> <SampleType> <DataFormat> <DataType> <BitsPerSample> <ByteOrder>	**Verified at Goal**
			Goal (Desired) Requirements Provide DEM or DSM as used during the geometric and radiometric processing of the SAR data, resampled to an exact geometric match in extent and resolution with the CEOS-ARD SAR image product. File format specifications/ contents provided in metadata: - Sample Type [Height] - Data Format [GeoTIFF/HDF5/NetCDF, …] - Data Type [Int/Float, ...] - Bits per Sample - Byte Order Note: For CEOS-ARD products created from repeat-pass acquisitions, with narrow orbital tube radius, a single static per pixel metadata file can be provided as a URL address of that unique metadata file.		
2.10	**Per-pixel Geoid**	~~[ORB]~~	**Threshold (Minimum) Requirements** Not required.	**Achieved level: N/A FOR NRB**	**Not Relevant to NRB SAR Products**

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
			Goal (Desired) Requirements Provide Geoid as used during the geometric and radiometric processing of the SAR data, resampled to an exact geometric match in extent and resolution with the CEOS-ARD ORB image product. File format specifications/ contents provided in metadata: - Sample Type [Height] - Data Format [GeoTIFF/HDF5/NetCDF, …] - Data Type [Int/Float, ...] - Bits per Sample - Byte Order - Ground Sampling Distance		
2.11	**Look Direction Image**	~~[ORB]~~	**Threshold (Minimum) Requirements** Not required.	**Achieved level: N/A FOR NRB**	**Not Relevant to NRB SAR Products**
			Goal (Desired) Requirements Look Direction Image is provided. It represents the planar angle between north and each range direction. File format specifications/ contents provided in metadata: - Sample Type [Angle] - Data Format [GeoTIFF/HDF5/NetCDF, …] - Data Type [Int/Float, ...] - Bits per Sample - Byte Order Note: For CEOS-ARD products created from repeat-pass acquisitions, with narrow orbital tube radius, a single static per pixel metadata file can be provided as a URL address of that unique metadata file.		
2.12	**Radar Unit Look Vector Grid Image**	~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** Not required.	**Achieved level: N/A FOR NRB**	**Not Relevant to NRB SAR Products**

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
			Goal (Desired) Requirements 3-D components radar unit look vector, specified at each pixel in an Earth-Centred Earth-Fixed (ECEF) coordinate system (also called Earth Centred Rotating – ECR) is provided. It consists of unit vectors from the antenna to the surface pixel (i.e., positive Z component). In the case of [InSAR] product, 3-D components radar unit look vector of the reference acquisition. File format specifications/ contents provided in metadata: - Sample Type [3D unit vector] - Source acquisition ID (e.g. acqID) (for [InSAR] product only) - Data Format [GeoTIFF/HDF5/NetCDF, …] - Data Type [Double Float, ...] - Bits per Sample - Byte Order Note: For CEOS-ARD products created from repeat-pass acquisitions, with narrow orbital tube radius, a single static per pixel metadata file can be provided as a URL address of that unique metadata file.		
2.13	**Slant Range Sensor to Surface Image**	~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** Not required.	**Achieved level: N/A FOR NRB**	**Not Relevant to NRB SAR Products**

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
			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. In the case of [InSAR] product, the slant range distance of the reference acquisition File format specifications/ contents provided in metadata: - Sample Type [Length] - Source acquisition ID (e.g. acqID) (for [InSAR] product only) - Data Format [GeoTIFF/HDF5/NetCDF, …] - Data Type [Float, ...] - Bits per Sample - Byte Order Note: For CEOS-ARD products created from repeat-pass acquisitions, with narrow orbital tube radius, a single static per pixel metadata file can be provided as a URL address of that unique metadata file.		
2.14	**InSAR Phase Uncertainty Image**	~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** Not required.	**Achieved level: N/A FOR NRB**	**Not Relevant to NRB SAR Products**

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
			Goal (Desired)l Requirements Estimates of uncertainty in InSAR phase is provided, such as finite signal to noise ratio, quantization noise, platform state vector accuracy, or DEM error. Identification of which error sources are included will be provided as DOI/URL reference or brief description. It represents statistical variation from known noise sources only. In case both the wrapped and unwrapped interferograms are supplied, specify which interferogram the uncertainty image corresponds to. File format specifications/ contents provided in metadata: - Sample Type [Angle] - insarID number (for [InSAR] product only) - Corresponding interferogram (for [InSAR] product only) - Data Format [GeoTIFF/HDF5/NetCDF, …] - Data Type [Float, ...] - Bits per Sample - Byte Order		
2.15	**Atmospheric Phase Correction Image**	~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** Not required.	**Achieved level: N/A FOR NRB**	**Not Relevant to NRB SAR Products**
			Goal (Desired) Requirements Phase correction value at each pixel, if applied. File format specifications/ contents provided in metadata: - Sample Type [Angle] - insarID number (for [InSAR] product only) - Data Format [GeoTIFF/HDF5/NetCDF, …] - Data Type [Float, ...] - Bits per Sample - Byte Order		

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
2.16	**Ionospheric Phase Correction Image**	~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** Not required.	**Achieved level: N/A FOR NRB**	**Not Relevant to NRB SAR Products**
			Goal (Desired) Requirements Phase correction value at each pixel, if applied. File format specifications/ contents provided in metadata: - Sample Type [Angle] - insarID number (for [InSAR] product only) - Data Format [GeoTIFF/HDF5/NetCDF, …] - Data Type [Float, ...] - Bits per Sample - Byte Order		
2.17	**Simulated Topographic Phase Image**	~~[InSAR]~~	**Threshold (Minimum) Requirements** Not required.	**Achieved level: N/A FOR NRB**	**Not Relevant to NRB SAR Products**
			Goal (Desired) Requirements Simulated topographic phase image(s) used to remove topographic contribution to interferogram(s). File format specifications/ contents provided in metadata: - Sample Type [Angle] - insarID number (for [InSAR] product only) - Data Format [GeoTIFF/HDF5/NetCDF, …] - Data Type [Float, ...] - Bits per Sample - Byte Order		
2.18	**InSAR Perpendicular Baseline**	~~[InSAR]~~	**Threshold (Minimum) Requirements** Not required.	**Achieved level: N/A FOR NRB**	**Not Relevant to NRB SAR Products**

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
			Goal (Desired) Requirements Perpendicular orbital baseline between primary and secondary source acquisitions. File format specifications/ contents provided in metadata: - Sample Type [Length] - insarID number (for [InSAR] product only) - Data Format [GeoTIFF/HDF5/NetCDF, …] - Data Type [Float, ...] - Bits per Sample - Byte Order		
2.19	**InSAR Parallel Baseline Image**	~~[InSAR]~~	**Threshold (Minimum) Requirements** Not required.	**Achieved level: N/A FOR NRB**	**Not Relevant to NRB SAR Products**
			Goal (Desired) Requirements Parallel orbital baseline between primary and secondary source acquisitions. File format specifications/ contents provided in metadata: - Sample Type [Length] - insarID number (for [InSAR] product only) - Data Format [GeoTIFF/HDF5/NetCDF, …] - Data Type [Float, ...] - Bits per Sample - Byte Order		
2.20	**InSAR Displacement Model Point**	~~[InSAR]~~	**Threshold (Minimum) Requirements** Not required.	**Achieved level: N/A FOR NRB**	**Not Relevant to NRB SAR Products**

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
			Goal (Desired) Requirements Data file(s) identifying pixels used for InSAR displacement modeling (items 3.11 to 3.14). As a suggestion, this information can be provided as a single multi-layer file, where each 1bit layer, containing 0 (not used) and 1 (used) flags, refers to an insarID pair (for SBAS type InSAR) or Source ID (when insarIDs are not listed). Instead, a list of Dates identifying layers can be provided under this item. File format specifications/ contents provided in metadata: - Sample Type [Model Points] - Source ID or insarID number or Dates - Data Format [GeoTIFF/HDF5/NetCDF, …] - Data Type [1bit, 8bit, …] - Bits per Sample - Byte Order		
2.21	**Contributing Observations Image**	~~[CB]~~	**Threshold (Minimum) Requirements** Not required.	**Achieved level: N/A FOR NRB**	**Not Relevant to NRB SAR Products**

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
			Goal (Desired) Requirements The number of input products providing non-zero weights to the Local-Resolution-Weighting from a set of "Terrain-flattened" Radiometrically Terrain Corrected (RTC) Gamma-Nought backscatter coefficient (γ^0_T) image inputs (NRB, POL, or compliant (i.e. terrain–flattened) GSLC) is provided for each polarization. A separate "Contributing Observations image" is generated for each polarisation, as, in the general case, each may have a different number of inputs. File format specifications/ contents provided in metadata: - Quality Descriptor Type - dB-scaling Expression Convention [linear amplitude or linear power*] - Polarization [HH/HV/VV/VH/RR/…] - Data Format [GeoTIFF/HDF5/NetCDF, …] - Data Type [Int/Float, ...] - Bits per Sample - Byte Order		
2.22	**Composite Quality Map Image**	~~[CB]~~	**Threshold (Minimum) Requirements** Not required.	**Achieved level: N/A FOR NRB**	**Not Relevant to NRB SAR Products**

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
			Goal (Desired) Requirements From the methodology defined in [Small et al. 2022] , the quality layer describing the [CB] composite's achieved local resolution is provided (see Annex 5). A separate Composite Quality Map Image is generated for each polarisation, as, in the general case, each may have a different number of inputs. File format specifications/ contents provided in metadata: - Quality Descriptor Type - dB-scaling Expression Convention [linear amplitude or linear power*] - Polarization [HH/HV/VV/VH/RR/…] - Data Format [GeoTIFF/HDF5/NetCDF, …] - Data Type [Int/Float, ...] - Bits per Sample - Byte Order **Note: Transformation to the logarithmic decibel scale is not required or desired as this step can be completed by the user if necessary.*		

Radiometrically Corrected Measurements

The requirements indicate the necessary outcomes and, to some degree, the minimum steps necessary to be deemed to have achieved those outcomes. Radiometric corrections must lead to normalised measurement(s) of backscatter intensity and/or decomposed polarimetric parameters. As for the per-pixel metadata, information regarding data format specification needs to be provided for each record. The requirements below must be met for all pixels/samples/observations in a collection.

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
3.1	**Backscatter Measurements**	[NRB]	**<u>Threshold (Minimum) Requirements [NRB]</u>** "Terrain-flattened" Radiometrically Terrain Corrected (RTC) Gamma-Nought backscatter coefficient (γ^0_T) is provided for each polarization. File format specifications/contents provided in metadata: - Measurement Type [Gamma-Nought] - Backscatter Expression Convention [linear amplitude or linear power*] - Polarization [HH/HV/VV/VH] - Data Format [GeoTIFF/HDF5/NetCDF, …] - Data Type [Int/Float, ...] - Bits per Sample - Byte Order **Note: Transformation to the logarithm decibel scale is not required or desired as this step can be completed by the user if necessary.*	**Achieved level: Threshold** <BackscatterMeasurementData> <BackscatterMeasurement> <BackscatterConvention> <BackscatterConversionEq> <Polarization> <FileName> <DataFormat> <DataType> <BitsPerSample> <ByteOrder> Provided for each polarisation.	**Verified at Threshold**
			<u>Goal (Desired) Requirements</u> As threshold.		

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
3.1	**Backscatter Measurements**	~~[POL]~~	**Threshold (Minimum) Requirements [POL]** Measurements can be: Normalised Radar Covariance Matrix (CovMat) Diagonal (equivalent to [NRB]) and upper diagonal elements of the terrain-flattened Gamma-Nought (γ^0_T) Covariance Matrix are provided for coherent dual (e.g., HH-HV, VV-VH, or …) and fully polarimetric (e.g., HH- HV-VH-VV) acquisitions. And/or Polarimetric Radar Decomposition (PRD) The individual components of the polarimetric decomposition obtained from the terrain-flattened (Gamma-Nought (γ^0_T)) covariance matrix. File format specifications/contents provided in metadata: - Measurement Type [CovMat/PRD] - Measurement convention unit [linear amplitude or linear power*, or phase angle] - Individual covariance matrix element or/and Individual component of the decomposition [C3m11, C3m12, … or H, A, alpha, or ...] - Data Format [GeoTIFF/HDF5/NetCDF, …] - Data Type [Int/ Float/Complex, etc.] - Bits per Sample - Byte Order **Note 1: Transformation to the logarithm decibel scale is not required or desired as this step can be easily completed by the user if necessary.* *Note 2: It is recommended to keep CovMat or PRD measurement files separated. Else, specify the multi-channel format order [BIP, BIL, BSQ].*	**Achieved level: N/A FOR NRB**	**Not Relevant to NRB SAR Products**

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
			Goal (Desired) Requirements As threshold. —		
3.1	**Backscatter Measurements**	~~[ORB]~~	**Threshold (Minimum) Requirements [ORB]** Geoid-corrected Sigma-Nought backscatter coefficient (σ^0) is provided for each polarization. File format specifications/contents provided in metadata: - Measurement Type [Sigma-Nought] - Backscatter Expression Convention [linear amplitude or linear power*] - Polarization [HH/HV/VV/VH] - Data Format [GeoTIFF/HDF5/NetCDF, …] - Data Type [Int/Float, ...] - Bits per Sample - Byte Order **Note: Transformation to the logarithm decibel scale is not required or desired as this step can be easily completed by the user if necessary.*	**Achieved level: N/A FOR NRB**	**Not Relevant to NRB SAR Products**
			Goal (Desired) Requirements Radiometrically Terrain-corrected Sigma-Nought backscatter coefficient (σ_T^0) is provided for each polarization.		

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
3.1	**Backscatter Measurements**	~~[GSLC]~~	**<u>Threshold (Minimum) Requirements [GSLC]</u>** Backscatter coefficient, in complex number format, is provided for each polarization (e.g., HH, HV, VV, VH). GSLC phase is terrain-flattened using Earth ellipsoid and digital elevation or surface models. File format specifications/contents provided in metadata: - Measurement Type [Gamma-Nought, Sigma-Nought or Beta-Nought] - Backscatter Expression Convention [linear amplitude or linear power*] - Polarization [HH/HV/VV/VH] - Data Format [GeoTIFF/HDF5/NetCDF, …] - Data Type [Int/Float, ...] - Bits per Sample - Byte Order **Note: Transformation to the logarithm decibel scale is not required or desired as this step can be easily completed by the user if necessary.*	**Achieved level: N/A FOR NRB**	**Not Relevant to NRB SAR Products**
			<u>Goal (Desired) Requirements</u> **Radiometric and Phase Terrain-flattened** Gamma-Nought backscatter coefficient (γ^0_T), in complex number format, is provided for each polarization (e.g., HH, HV, VV, VH).		
3.1	**Backscatter Measurements**	~~[InSAR]~~	**<u>Threshold (Minimum) Requirements [InSAR]</u>** Not required.	**Achieved level: N/A FOR NRB**	**Not Relevant to NRB SAR Products**

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
			<u>Goal (Desired) Requirements</u> Terrain-flattened Radiometrically Terrain Corrected (RTC) Gamma-Nought backscatter coefficient (γ^0_T) is provided for each polarization. File format specifications/contents provided in metadata: - Measurement Type [Gamma-Nought] - Source ID (e.g. item 1.6 acqID) - Backscatter Expression Convention [linear amplitude or linear power*] - Polarization [HH/HV/VV/VH, …] - Data Format [GeoTIFF/HDF5/NetCDF, …] - Data Type [Int/Float, ...] - Bits per Sample - Byte Order *Note: Transformation to the logarithm decibel scale is not required or desired as this step can be completed by the user if necessary.		

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
3.1	**Backscatter Measurements**	~~[CB]~~	**Threshold (Minimum) Requirements** Composite Backscatter γ^0_c calculated (e.g. via LocalResolution–Weighting [Small et al., 2022]) from a set of Terrain-flattened" Radiometrically Terrain Corrected (RTC) Gamma-Nought backscatter coefficient (γ^0_T) image inputs (NRB, POL, or compliant (i.e. terrain–flattened) GSLC) is provided for each polarization. File format specifications/contents provided in metadata: - Measurement Type [Gamma-Nought] - Backscatter Expression Convention [linear amplitude or linear power*] - Polarization [HH/HV/VV/VH, …] - Data Format [GeoTIFF/HDF5/NetCDF, …] - Data Type [Int/Float, ...] - Bits per Sample - Byte Order *Note: Transformation to the logarithmic decibel scale is not required or desired as this step can be completed by the user if necessary.	**Achieved level: N/A FOR NRB**	Not Relevant to NRB SAR Products
			Goal (Desired) Requirements As threshold.		
3.2	**Scaling Conversion**	[NRB] ~~[CB]~~ ~~[POL]~~ ~~[ORB]~~ ~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** If applicable, indicate the equation to convert pixel linear amplitude/power to logarithmic decibel scale, including, if applicable, the associated calibration (dB offset) factor, and/or the equation used to convert compressed data (int8/int16/float16) to float32.	**Achieved level: Threshold** < BackscatterConversionEq> Parameter included in 3.1 above	Verified at Threshold
3.3	**Noise Removal**	[NRB] ~~[CB]~~ ~~[POL]~~ ~~[ORB]~~ ~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** Flag if noise removal* has been applied (Y/N). Metadata should include the noise removal algorithm and reference to the algorithm as URL or DOI. **Note: Thermal noise removal and image border noise removal to remove overall scene noise and scene edge artefacts, respectively.*	**Achieved level: Threshold** <NoiseRemoval> <NoiseRemovalApplied> Flag set to FALSE for all KOMPSAT-5 products	Verified at Threshold

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
			Goal (Desired) Requirements As threshold.		
			Goal (Desired) Requirements As threshold.		
		~~[InSAR]~~ ~~[GSLC]~~	**Threshold (Minimum) Requirements** Not required.		
			Goal (Desired) Requirements Require resolution of DEM better than the output product resolution when applying terrain corrections.		

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
3.4	**Radiometric Terrain Correction Algorithm**	[NRB] ~~[CB]~~ ~~[POL]~~	**Threshold (Minimum) Requirements** Adjustments were made for terrain by modelling the local contributing scattering area using the preferred choice of a published peer-reviewed algorithm to produce radiometrically terrain corrected (RTC) γ^0_T backscatter estimates. Metadata references, e.g.: - a citable peer-reviewed algorithm - technical documentation regarding the algorithm used to generate the backscatter estimates is expressed as URLs or DOIs - the sources of auxiliary data used to make corrections *Note: Examples of technical documentation include an Algorithm, Theoretical Basis Document, product user guide, etc.*	**Achieved level: Threshold** <RadiometricTerrainCorrections> <RTCAlgorithm>	**Verified at Threshold**
			Goal (Desired) Requirements As threshold.		
		~~[InSAR]~~ ~~[GSLC]~~	**Threshold (Minimum) Requirements** Not required.	**Achieved level: N/A FOR NRB**	**Not Relevant to NRB SAR Products**
			Goal (Desired) Requirements Require resolution of DEM better than the output product resolution when applying terrain corrections.		

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
3.5	**Radiometric Accuracy**	[NRB] ~~[CB]~~ ~~[POL]~~ ~~[ORB]~~ ~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** Not required.	**Achieved level: Not required**	**Not Required at Threshold**
			Goal (Desired) Requirements Uncertainty (e.g., bounds on γ^0 or σ^0) information is provided as document referenced as URL or DOI. SI traceability is achieved.		
3.6	**Mean Wind-Normalised Backscatter Measurements**	~~[ORB]~~	**Threshold (Minimum) Requirements** Not required.	**Achieved level: N/A FOR NRB**	**Not Relevant to NRB SAR Products**
			Goal (Desired) Requirements **Usage:** Only for Maritime scenes Mean wind-normalised (over ocean) backscatter coefficient is provided for each available polarization. It is calculated as the ratio between the backscatter intensity and a simulated backscatter intensity image generated using an ocean surface wind model such as, e.g., Quilfen et al. (1998) or Vachon and Dobson (2000) for VV and HH polarization respectively. File format specifications/contents provided in metadata: - Measurement Type [Wind-Normalised Backscatter] - Backscatter Expression Convention [intensity ratio] - Polarization [HH/HV/VV/VH] - Data Format [GeoTIFF/HDF5/NetCDF, …] - Data Type [Int/Float, ...] - Bits per Sample - Byte Order Note: Reference wind model, wind speed and direction used for reference backscattering coefficient should be provided.		

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
3.7	**Flattened Phase**	[NRB] ~~[POL]~~	**Threshold (Minimum) Requirements** Not required.	**Achieved level: Not required**	**Not Required at Threshold**
			Goal (Desired) Requirements **Usage: Alternative to [GSLC] product for [NRB] and [POL] products** The Flattened Phase is the interferometric phase for which the topographic phase contribution is removed. It is derived from the range-Doppler SLC product using a DEM and the orbital state vectors with respect to a reference orbit (see Annex A1.2). The use of the Flattened Phase with the **[NRB]** or **[POL]** intensity (3.1 Backscatter measurement) provides the [GSLC] equivalent, as follows: **GSLC** = sqrt(**NRB**) x exp(j FlattenPhase) File format specifications/contents provided in metadata: - Measurement Type [Flattened Phase] - Reference Polarization [HH/HV/VV/VH] - Data Format [GeoTIFF/HDF5/NetCDF, …] - Data Type [Int/Float, ...] - Bits per Sample - Byte Order In case of polarimetric data, indicate the reference polarization.		
3.8	**Coherence Image**	~~[InSAR]~~	**Threshold (Minimum) Requirements** Not required.	**Achieved level: N/A FOR NRB**	**Not Relevant to NRB SAR Products**

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
			Goal (Desired) Requirements InSAR coherence image for each InSAR pair defined under 1.7.16 File format specifications/contents provided in metadata: - Measurement Type [Coherence] - insarID number - Data Format [GeoTIFF/HDF5/NetCDF, …] - Data Type [Int/Float, Complex Float ...] - Bits per Sample - Byte Order Coherence image statistics - Average - Standard deviation		
3.9	**Interferogram Image**	~~[InSAR]~~	**Threshold (Minimum) Requirements** Not required.	**Achieved level: N/A FOR NRB**	**Not Relevant to NRB SAR Products**
			Goal (Desired) Requirements Interferogram image for each InSAR pair defined under 1.7.16.. Indicate if the InSAR simulated ellipsoid and topographic phases have been subtracted. File format specifications/contents provided in metadata: - Measurement Type [Interferogram] - insarID number - Subtracted Earth curvature phase flag [True/False] - Subtracted topographic phase flag [True/False] - Data Format [GeoTIFF/HDF5/NetCDF, …] - Data Type [Int/Float, ...] - Bits per Sample - Byte Order		

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
3.10	**Unwrapped Interferogram Image**	~~[InSAR]~~	**Threshold (Minimum) Requirements** Not required.	**Achieved level: N/A FOR NRB**	**Not Relevant to NRB SAR Products**
			Goal (Desired) Requirements Unwrapped interferogram image for each InSAR pair defined under 1.7.16.. File format specifications/contents provided in metadata: - Measurement Type [Unwrapped Interferogram] - insarID number - Component [Line of Sight, Vertical, East, North] - Data Format [GeoTIFF/HDF5/NetCDF, …] - Data Type [Int/Float, ...] - Bits per Sample - Byte Order		
3.11	**InSAR Displacement Image**	~~[InSAR]~~	**Threshold (Minimum) Requirements** Not required.	**Achieved level: N/A FOR NRB**	**Not Relevant to NRB SAR Products**

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
			Goal (Desired) Requirements Displacement map image(s) could be expressed as a single cumulative displacement map or a temporal series of incremental displacement maps. File format specifications/contents provided in metadata: - Measurement Type [InSAR Cumulative Displacement or InSAR Incremental Displacement] - Measurement projection [Line of Sight, Vertical, Horizontal, East, North] - Interval start time - Interval end time - Reference Polarization* [HH/HV/VV/VH/RH/RL/…] - Data Format [GeoTIFF/HDF5/NetCDF, …] - Data Type [Int/Float, ...] - Bits per Sample - Byte Order *In case of polarimetric data, indicate the reference polarization.		
3.12	**InSAR Displacement Residue Image**	~~[InSAR]~~	**Threshold (Minimum) Requirements** Not required.	**Achieved level: N/A FOR NRB**	**Not Relevant to NRB SAR Products**

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
			Goal (Desired) Requirements Displacement residue map images for each source acquisition generated from displacement model. File format specifications/contents provided in metadata: - Measurement Type [Displacement residues] - Measurement projection [Line of Sight, Vertical, Horizontal, East, North] - Source ID - Reference Polarization* [HH/HV/VV/VH/RH/RL/…] - Data Format [GeoTIFF/HDF5/NetCDF, …] - Data Type [Int/Float, ...] - Bits per Sample - Byte Order *In case of polarimetric data, indicate the reference polarization.		
3.13	**InSAR Displacement Rate Image**	~~[InSAR]~~	**Threshold (Minimum) Requirements** Not required.	**Achieved level: N/A FOR NRB**	**Not Relevant to NRB SAR Products**

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
			<u>Goal (Desired) Requirements</u> Mean linear displacement rate (velocity) estimate. File format specifications/contents provided in metadata: - Measurement Type [Displacement rate] - Measurement projection [Line of Sight, Vertical, Horizontal, East, North] - Interval start time - Interval end time - Rate (velocity) units [mm/year, cm/year, mm/month, …] - Reference Polarization* [HH/HV/VV/VH/RH/RL/…] - Data Format [GeoTIFF/HDF5/NetCDF, …] - Data Type [Int/Float, ...] - Bits per Sample - Byte Order *In case of polarimetric data, indicate the reference polarization.		

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
3.14	**InSAR Displacement Rate Model Fit Image**	~~[InSAR]~~	**<u>Threshold (Minimum) Requirements</u>** Not required.	**Achieved level: N/A FOR NRB**	**Not Relevant to NRB SAR Products**
			<u>Goal (Desired) Requirements</u> Goodness of fit for model defined in 3.13 File format specifications/contents provided in metadata: - Measurement Type [Model standard deviation, R-squared, RMSE …] - Measurement projection [Line of Sight, Vertical, Horizontal, East, North] - Interval start time - Interval end time - Reference Polarization* [HH/HV/VV/VH/RH/RL/…] - Data Format [GeoTIFF/HDF5/NetCDF, …] - Data Type [Int/Float, ...] - Bits per Sample - Byte Order *In case of polarimetric data, indicate the reference polarization.		

Geometric Corrections

Geometric corrections are steps that are taken to place the measurement accurately on the surface of the Earth (that is, to geolocate the measurement) allowing measurements taken through time to be compared. This section specifies any geometric correction requirements that must be met in order for the data to be analysis ready.

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
4.1	**Geometric Correction Algorithm**	[NRB] ~~[CB]~~ ~~[POL]~~ ~~[ORB]~~ ~~[GSLC]~~ ~~[InSAR]~~	**<u>Threshold (Minimum) Requirements</u>** Not required.	**Achieved level: Not required**	**Not Required at Threshold**
			<u>Goal (Desired) Requirements</u> Metadata references, e.g.: - A metadata citable peer-reviewed algorithm, - Technical documentation regarding the implementation of that algorithm expressed as URLs or DOIs - The sources of auxiliary data used to make corrections. - Resampling method used for geometric processing of the source data. *Note: Examples of technical documentation can include e.g., an Algorithm Theoretical Basis Document (ATBD), a product user guide*.		

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
4.2	**Digital Elevation Model**	[NRB] ~~[CB]~~ ~~[POL]~~ ~~[ORB]~~ ~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** **Usage:** For products including land areas a) During ortho-rectification, the data provider shall use the same DEM that was used for the radiometric terrain flattening to ensure consistency of the data stack. b) Provide reference to the Digital Elevation Model used for geometric terrain correction. For mosaic or composite products, specify the DEM used for each input data source, if different. c) Provide reference to Earth Gravitational Model (EGM) if used for geometric correction. For mosaic or composite products, specify the EGM used for each input data source, if different.	**Achieved level: Not required** <DigitalElevationModel> <DEMReference> <EGMReference> DEM reference provided as URL EGM reference provided as URL	**Verified at Threshold**
			Goal (Desired) Requirements a) A DEM with comparable or better resolution to the resolution of the output CEOS-ARD product shall be used if available. Else, the upsampled DEM is identified. b) Resampling method used for preparation of the DEM. c) Method used for resampling the EGM.		

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
4.3	**Geometric Accuracy**	[NRB] ~~[CB]~~ ~~[POL]~~ ~~[ORB]~~ ~~[GSLC]~~ ~~[InSAR]~~	**<u>Threshold (Minimum) Requirements</u>** Accurate geolocation is a prerequisite to radar processing to correct for terrain and to enable interoperability between radar sensors. The absolute geolocation error (ALE) for a sensor is typically assessed through analysis of Single Look Complex (SLC) imagery and measured along the slant range and azimuth directions (case A: SLC ALE). The end-to-end "ARD" ALE of the final CEOS-ARD product could be measured directly in the final image product in the chosen map projection, i.e., in the map coordinate directions: e.g., Northing and Easting (case B: ARD ALE). Providing accuracy estimates based on measurements following at least one scheme (A or B or both) meets the threshold requirement. Estimates of the ALE is provided as a bias and a standard deviation, with (Case A) SLC ALE expressed in slant range and azimuth, and (Case B) ARD ALE expressed in map projection dimensions. For [CB] products, when sources come from different SAR platforms or different beam modes, provide averaged ALE or averaged ARD ALE. *Note 1: This assessment is often made through comparison of measured corner reflector positions with their projected location in the imagery. In some cases, other mission calibration/validation results may be used.* *Note 2: The ALE is not typically assessed for every processed image, but through an ALE assessment by the data processing team characterizing all or (usually a suitably representative subset) of the generated products.* *Note 3: For new SAR missions, as long as calibration/validation reports are not available, values can be set to NaN and provide a DOI or URL link to pre-launch mission specification document.*	**Achieved level: Threshold** <GeoCorrAccuracy> <LineSTDev> <SampleSTDev> <LineBias> <SampleBias>	**Verified at Threshold**

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
			Goal (Desired) Requirements Output product sub-sample accuracy should be less than or equal to 0.1 (slant range) pixel radial root mean square error (rRMSE). For [InSAR] products, specify the SAR acquisition used for geocoding. SAR acquisition could be different from the two source acquisitions of the product when a stack of acquisitions is processed simultaneously. Provide documentation of estimates of ALE as DOI or URL.		
4.4	**Geometric Refined Accuracy**	[NRB] ~~[CB]~~ ~~[POL]~~ ~~[ORB]~~ ~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** Not required.	**Achieved level: Not required**	**Not Required at Threshold**
			Goal (Desired) Requirements Values provided under 4.3 Geometric accuracy are provided by the SAR mission Cal/Val team. CEOS-ARD processing steps could include method refining the geometric accuracy, such as cross-correlation of the SAR data in slant range with a SAR scene simulated from a DSM or DEM. Methodology used (name and reference), quality flag, geometric standard deviation values should be provided. For [CB] products, provide averaged ALE or averaged ARD ALE estimated from all sources.		
4.5	**Gridding Convention**	[NRB] ~~[CB]~~ ~~[POL]~~ ~~[ORB]~~ ~~[GSLC]~~ ~~[InSAR]~~	**Threshold (Minimum) Requirements** A consistent gridding/sampling frame is used. The origin is chosen to minimise any need for subsequent resampling between multiple products (be they from the same or different providers). This is typically accomplished via a "snap to grid" in relation to the most proximate grid tile in a global system*. ** If a product hierarchy of resolutions exists (or is planned), the multiple resolutions should nest within each other (e.g., 12.5m, 25m, 50m, 100m, etc.), and not be disjoint.*	**Achieved level: Threshold** <GriddingConvention>	**Verified at Threshold**

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Notes
			Goal (Desired) Requirements Provide DOI or URL to gridding convention used. When multiple providers share a common map projection, providers are encouraged to standardise the origins of their products among each other. In the case of UTM/UPS coordinates, the upper left corner coordinates should be set to an integer multiple of sample intervals from a 100 km by 100 km grid tile of the Military Grid Reference System's 100k coordinates (“snap to grid”). For products presented in geographic coordinates (latitude and longitude), the origin should be set to an integer multiple of samples in relation to the closest integer degree.		

Summary Self-Assessment Table

1	CEOS-ARD product	General Metadata	Threshold	Goal
1.1	[ALL]	Traceability	Not required	
1.2	[ALL]	Metadata Machine Readability	Yes	
1.3	[ALL]	Product Type	Yes	
1.4	[ALL]	Document Identifier	Yes	
1.5	[ALL]	Data Collection Time	Yes	
1.6		**Source Data Attributes**		
1.6.1	[ALL]	Source Data Access	Yes	
1.6.2	[ALL]	Instrument	Yes	
1.6.3	[ALL]	Source Data Acquisition Time	Yes	
1.6.4	[ALL]	Source Data Acquisition Parameters	Yes	
1.6.5	[ALL]	Source Data Orbit Information	Yes	
1.6.6	[ALL]	Source Data Processing Parameters	Yes	
1.6.7	[ALL]	Source Data Image Attributes	Yes	
1.6.8	[NRB] [POL] [ORB] [GSLC] [InSAR]	Sensor Calibration	Not required	
1.6.9	[ALL]	Performance Indicators	Yes	
1.6.10	[ALL]	Source Data Polarimetric Calibration Matrices	Not required	
1.6.11	[NRB] [POL] [ORB] [GSLC] [InSAR]	Mean Faraday Rotation Angle	Not required	
1.6.12	[ALL]	Ionosphere indicator	Not required	
1.7		**CEOS-ARD Product Attributes**		
1.7.1	[ALL]	Product Data Access	Yes	
1.7.2	[ALL]	Auxiliary Data	Not required	
1.7.3	[ALL]	Product Sample Spacing	Yes	
1.7.4	[NRB] [CB] [POL] [ORB] [InSAR]	Product Equivalent Number of Looks	Not required	
1.7.5	[ALL]	Product Resolution	Not required	
1.7.6	[NRB] [CB] [POL] [ORB]	Product Filtering	Yes	
1.7.7	[ALL]	Product Bounding Box	Yes	
1.7.8	[ALL]	Product Geographical Extent	Yes	
1.7.9	[ALL]	Product Image Size	Yes	
1.7.10	[ALL]	Product Pixel Coordinate Convention	Yes	
1.7.11	[ALL]	Product Coordinate Reference System	Yes	
1.7.12	[ORB]	Look Direction Polynomials	N/A for NRB	
1.7.13	[GSLC] [InSAR]	Radar Unit Look Vector	N/A for NRB	
1.7.14	[GSLC]	Slant Range Sensor to Surface	N/A for NRB	
1.7.15	[NRB] [POL] [GSLC]	Reference Orbit	Not required	
1.7.16	[InSAR]	InSAR Pair	N/A for NRB	

1.7.17	[InSAR]	InSAR Pair Co registration	N/A for NRB	
1.7.18	[InSAR]	Coherence	N/A for NRB	
1.7.19	[InSAR]	Interferogram Filtering	N/A for NRB	
1.7.20	[InSAR]	Phase Unwrapping	N/A for NRB	
1.7.21	[GSLC] [InSAR]	Atmospheric Phase Correction	N/A for NRB	
1.7.22	[GSLC] [InSAR]	Ionospheric Phase Correction	N/A for NRB	
1.7.23	[InSAR]	Displacement Modeling	N/A for NRB	
1.7.24	[CB]	CB Processing	N/A for NRB	
2	**CEOS-ARD product**	**Per-Pixel Metadata**	**Threshold**	**Goal**
2.1	[ALL]	Metadata Machine Readability	Yes	
2.2	[ALL]	Data Mask Image	Yes	
2.3	[NRB] [POL] [ORB] [GSLC] [InSAR]	Scattering Area Image	Not required	
2.4	[NRB] [POL] [ORB] [GSLC]	Local Incident Angle Image	Yes	
2.5	[NRB] [POL] [ORB] [GSLC] [InSAR]	Ellipsoidal Incident Angle Image	Not required	
2.6	[ALL]	Noise Power Image	Not required	
2.7	[NRB] [POL] [GSLC] [InSAR]	Gamma-to-Sigma Ratio Image	Not required	Yes
2.8	[NRB] [CB] [POL] [ORB] [GSLC]	Acquisition ID Image	Yes	
2.9	[NRB] [CB] [POL] [GSLC] [InSAR]	Per-pixel DEM	Not required	Yes
2.10	[ORB]	Per-pixel Geoid	N/A for NRB	
2.11	[ORB]	Look Direction Image	N/A for NRB	
2.12	[GSLC] [InSAR]	Radar Unit Look Vector Grid Image	N/A for NRB	
2.13	[GSLC] [InSAR]	Slant Range Sensor to Surface Image	N/A for NRB	
2.14	[GSLC] [InSAR]	InSAR Phase Uncertainty Image	N/A for NRB	
2.15	[GSLC] [InSAR]	Atmospheric Phase Correction Image	N/A for NRB	
2.16	[GSLC] [InSAR]	Ionospheric Phase Correction Image	N/A for NRB	
2.17	[InSAR]	Simulated Topographic Phase	N/A for NRB	
2.18	[InSAR]	InSAR Perpendicular Baseline	N/A for NRB	
2.19	[InSAR]	InSAR Parallel Baseline	N/A for NRB	
2.20	[InSAR]	InSAR Displacement Model Points	N/A for NRB	
2.21	[CB]	Contributing Observations Image	N/A for NRB	
2.22	[CB]	Composite Quality Map Image	N/A for NRB	
3	**CEOS-ARD product**	**Radiometrically Corrected Measurements**	**Threshold**	**Goal**
3.1	[ALL]	Backscatter Measurements	Yes	
3.2	[ALL]	Scaling Conversion	Not required	
3.3	[ALL]	Noise Removal	Yes	
3.4	[NRB] [CB] [POL] [GSLC] [InSAR]	Radiometric Terrain Correction Algorithms	Yes	
3.5	[ALL]	Radiometric Accuracy	Not required	

3.6	[ORB]	Mean Wind-Normalised Backscatter Measurements	N/A for NRB	
3.7	[NRB] [POL]	Flattened Phase	Not required	
3.8	[InSAR]	Coherence Image	N/A for NRB	
3.9	[InSAR]	Interferogram Image	N/A for NRB	
3.10	[InSAR]	Unwrapped Interferogram Image	N/A for NRB	
3.11	[InSAR]	InSAR Displacement Image	N/A for NRB	
3.12	[InSAR]	InSAR Displacement Residues Image	N/A for NRB	
3.13	[InSAR]	InSAR Displacement Rate Image	N/A for NRB	
3.14	[InSAR]	InSAR Displacement Rate Model fit Image	N/A for NRB	
4	**CEOS-ARD product**	**Geometric Corrections**	**Threshold**	**Goal**
4.1	[ALL]	Geometric Correction Algorithms	Not required	
4.2	[ALL]	Digital Elevation Model	Yes	
4.3	[ALL]	Geometric Accuracy	Yes	
4.4	[ALL]	Geometric Refined Accuracy	Not required	
4.5	[ALL]	Gridding Convention	Yes	