

	Analysis Ready Data	Product Family Specification: Synthetic Aperture Radar
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Synspective self-assessment for CEOS-ARD SAR v1.2 compliance

CEOS-ARD SAR product type: Normalised Radar Backscatter

Mission: StriX series

Dataset 1: IMG-VV-STRIX4-20250515T141605Z-SMORT (StriX-4, Stripmap 5 m)

- **VV backscatter image:** IMG-VV-STRIX4-20250515T141605Z-SMORT-gamma0.tif
- **Data Mask image:** IMG-VV-STRIX4-20250515T141605Z-SMORT-lsmap.tif
- **Local Incidence Angle image:** IMG-VV-STRIX4-20250515T141605Z-SMORT-incmap.tif ● **XML metadata in CEOS-ARD SAR format:**
IMG-VV-STRIX4-20250515T141605Z-SMORT-gamma0-metadata.xml

Dataset 2: MG-VV-STRIX3-20260309T154126Z-SMORT (StriX-3, Stripmap 5 m)

- MG-VV-STRIX3-20260309T154126Z-SMORT-gamma0.tif
- MG-VV-STRIX3-20260309T154126Z-SMORT-lsmap.tif
- MG-VV-STRIX3-20260309T154126Z-SMORT-incmap.tif
- MG-VV-STRIX3-20260309T154126Z-SMORT-gamma0-metadata.xml

Dataset 3: IMG-VV-STRIX3-20260310T044445Z-SLORT (StriX-3, Sliding Stripmap 1.25 m)

- IMG-VV-STRIX3-20260310T044445Z-SLORT-gamma0.tif
- IMG-VV-STRIX3-20260310T044445Z-SLORT-lsmap.tif
- IMG-VV-STRIX3-20260310T044445Z-SLORT-incmap.tif
- IMG-VV-STRIX3-20260310T044445Z-SLORT-gamma0-metadata.xml

The datasets are available for download at:

Google Drive link will be added after evaluation license is approved by CEOS reviewers.

Evaluation Data License [https://synspective.com/evaluation-
license-2/](https://synspective.com/evaluation-license-2/)

Note: In addition to the data layers above, each product package also includes supplementary datasets. These are not required for CEOS-ARD compliance and should thus not be part of the assessment:

- Sigma-0 backscatter image (GeoTiff)
- Sigma-0 metadata (xml)
- Gamma-0 and Sigma-0 quick look images (GeoTiff)
- Gamma-0 low resolution browse image (jpeg)

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	Remarks/Requirements/Modifications
1.1	Traceability	[NRB] [POL] [ORB] [GSLC] [InSAR]	<u>Threshold (Minimum) Requirements</u> Not required.	Achieved level: THRESHOLD NOT REQUIRED	Not required
			<u>Goal (Desired) Requirements</u> Data must be traceable to SI reference standard. <i>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.</i>		
1.2	Metadata Machine Readability	[NRB] [POL] [ORB] [GSLC] [InSAR]	<u>Threshold (Minimum) Requirements</u> 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_v1.2.xlsx”>	Verified at Threshold
			<u>Goal (Desired) Requirements</u> As threshold, but metadata is formatted in accordance with CEOS-ARD SAR Metadata Specifications, v.1.0, 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	Remarks/ Requirements/ Modifications
1.3	Product Type	[NRB] [POL] [ORB] [GSLC] [InSAR]	<u>Threshold (Minimum) Requirements</u> 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. <u>Goal (Desired) Requirements</u> As threshold.	<u>Achieved level: THRESHOLD</u> <Product> in XML metadata file	Verified at Threshold
1.4	Document Identifier	[NRB] [POL] [ORB] [GSLC] [InSAR]	<u>Threshold (Minimum) Requirements</u> Reference to CEOS-ARD for Synthetic Aperture Radar PFS document as URL. <u>Goal (Desired) Requirements</u> As threshold.	<u>Achieved level: THRESHOLD</u> <DocumentIdentifier> Link to CEOS-ARD PFS	Verified at Threshold.
1.5	Data Collection Time	[NRB] [POL] [ORB] [GSLC] [InSAR]	<u>Threshold (Minimum) Requirements</u> 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 case of composite products, the dates/times of the first and last data takes and the per-pixel metadata 2.8 (Acquisition ID Image) is provided with the product. <u>Goal (Desired) Requirements</u> As threshold.	<u>Achieved level: THRESHOLD</u> <DataCollectionTime> <NumberOfAcquisitions> <FirstAcquisitionDate> <LastAcquisitionDate>	Verified at Threshold.

1.6	Source Data Attributes		Subsection describing (detailing) <u>each SAR acquisition</u> used to generate the ARD product. <i>Note 1: Source data attribute information is described for each acquisition and sequentially identified, e.g. as acqID= 1, 2, 3, ...</i> <i>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).</i>	Achieved level: THRESHOLD <SourceAttributes> Single source product: acqID=1	Verified at Threshold
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#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Remarks/ Requirements/ Modifications
1.6.1	Source Data Access	[NRB] [POL] [ORB] [GSLC] [InSAR]	<u>Threshold (Minimum) Requirements</u> The metadata identifies the location from where the source data can be retrieved, expressed as a URL or DOI. <u>Goal (Desired) Requirements</u> 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> Commercial data not provided in open repository. URL provided to Synspective main www	Verified at Threshold
1.6.2	Instrument	[NRB] [POL] [ORB] [GSLC] [InSAR]	<u>Threshold (Minimum) Requirements</u> The instrument used to collect the data is identified in the metadata: - Satellite name - Instrument name <u>Goal (Desired) Requirements</u> As threshold, but including a reference to the relevant CEOS Missions, Instruments and Measurements Database record.	Achieved level: THRESHOLD <Satellite> <Instrument> <SatelliteReference>	Verified at Threshold

1.6.3	Source Data Acquisition Time	[NRB] [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] [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)	Achieved level: THRESHOLD <SourceDataAcquisitionParameters> <RadarBand> <RadarCenterFrequency> <ObservationMode> <Polarizations> <AntennaPointing> <BeamID>	Verified at Threshold

			Goal (Desired) Requirements As threshold.		
#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Remarks/ Requirements/ Modifications

1.6.5	Source Data Orbit Information	[NRB] [POL] [ORB] [GSLC] [InSAR]	<u>Threshold (Minimum) Requirements</u> Information related to the platform orbit used for data processing: - Pass direction [asc/desc] * - Orbit data source [e.g., predicted/ definite/ precise/ downlinked, etc.] - Relative orbit number (for [GSLC] and [InSAR] only) <i>* 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.</i> <u>Goal (Desired) Requirements</u> 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 <i>before</i> start time to 10% of scene length <i>after</i> stop time) - Platform (mean) altitude. - Absolute orbit number - For [GSLC], perpendicular baseline to virtual orbit or reference orbit used for phase correction	<u>Achieved level:</u> THRESHOLD <OrbitInformation> <PassDirection> <OrbitDataSource> <PlatformHeading>	Verified at Threshold
1.6.6	Source Data Processing Parameters	[NRB] [POL] [ORB] [GSLC] [InSAR]	<u>Threshold (Minimum) Requirements</u> 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	<u>Achieved level:</u> THRESHOLD <SourceProcParam> <ProcessingFacility> <ProcessingDate> <SoftwareVersion> <ProductID> <ProductLevel> <AzimuthNumberOfLooks> <RangeNumberOfLooks>	Verified at Threshold

			<u>Goal (Desired) Requirements</u> As threshold, plus additional relevant processing parameters, e.g., range- and azimuth look bandwidth and LUT applied.		
#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Remarks/Requirements/Modifications
1.6.7	Source Data Image Attributes	[NRB] [POL] [ORB] [GSLC] [InSAR]	<u>Threshold (Minimum) Requirements</u> 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.	<u>Achieved level:</u> THRESHOLD <SourceDataImageAttributes> <SourceDataGeometry> <SourceGeographicalExtent> (WKT) <AzimuthPixelSpacing> <RangePixelSpacing> <AzimuthResolution> <RangeResolution> <IncAngleNearRange> <IncAngleFarRange>	Verified at Threshold
1.6.8	Sensor Calibration	[NRB] [POL] [ORB]	<u>Goal (Desired) Requirements</u> Geometry of the image footprint expressed in WGS84 in a standardised format (e.g., WKT).	<u>Achieved level:</u> THRESHOLD	Not required

		[GSLC] [InSAR]	<u>Goal (Desired) Requirements</u> 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.	NOT REQUIRED	
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#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Remarks/ Requirements/ Modifications
1.6.9	Performance Indicators	[NRB] [POL] [ORB] [GSLC] [InSAR]	<u>Threshold (Minimum) Requirements</u> Provide performance indicators on data intensity noise level (NE^0 and/or $NE\beta^0$ and/or $NE\gamma^0$) (noise equivalent Sigma- and/or Beta- and/or Gamma-Nought)). σ 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.	<u>Achieved level:</u> THRESHOLD <PerformanceIndicators> <NoiseEquivalentIntensity> <Estimates> Provided as minimum Noise Equivalent Sigma-0 expressed in dB.	Verified at Threshold
			<u>Goal (Desired) Requirements</u> Provide additional relevant performance indicators (e.g., ENL, PSNR, ISLR, and performance reference DOI or URL).		
1.6.10	Source Data Polarimetric	[NRB] [POL]	<u>Threshold (Minimum)</u>	<u>Achieved level:</u> THRESHOLD	Not required

	Calibration Matrices	[ORB] [GSLC] [InSAR]	Requirements Not required.	NOT REQUIRED	
			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: THRESHOLD NOT REQUIRED	Not required
			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] [POL] [ORB] [GSLC] [InSAR]	Threshold (Minimum) Requirements Not required.	Achieved level: THRESHOLD NOT REQUIRED	Not required

			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.		
#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Remarks/ Requirements/ Modifications

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] [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
1.7.2	Auxiliary Data	[NRB] [POL] [ORB] [GSLC] [InSAR]	Threshold (Minimum) Requirements Not required.	Achieved level: THRESHOLD NOT REQUIRED	Not required
			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.		
			Goal (Desired) Requirements The metadata identifies the sources of auxiliary data used in the generation process, ideally expressed as DOIs. <i>Note: Auxiliary data includes DEMs, etc., and any additional data sources used in the generation of the product.</i>		

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Remarks/ Requirements/ Modifications
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1.7.3	Product Sample Spacing	[NRB] [POL] [ORB] [GSLC] [InSAR]	<u>Threshold (Minimum) Requirements</u> CEOS-ARD product processing parameters details: - Pixel (column) spacing - Line (row) spacing	<u>Achieved level:</u> THRESHOLD <ProductSampleSpacing> <ProductColumnSpacing> <ProductRowSpacing>	Verified at Threshold
			<u>Goal (Desired) Requirements</u> As threshold.		
1.7.4	Product Equivalent Number of Looks	[NRB] [POL] [ORB] [InSAR]	<u>Threshold (Minimum) Requirements</u> Not required.	<u>Achieved level:</u> THRESHOLD NOT REQUIRED	Not required
			<u>Goal (Desired) Requirements</u> Equivalent Number of Looks (ENL)		
1.7.5	Product Resolution	[NRB] [POL] [ORB] [GSLC] [InSAR]	<u>Threshold (Minimum) Requirements</u> Not required.	<u>Achieved level:</u> THRESHOLD NOT REQUIRED	Not required
			<u>Goal (Desired) Requirements</u> Average spatial resolution of the CEOS-ARD product along: - Columns - Rows		

1.7.6	Product Filtering	[NRB] [POL] [ORB]	<u>Threshold (Minimum) Requirements</u> Flag if speckle filter has been applied [True/False]. Metadata should include: - Reference to algorithm as DOI or URL - Input filtering parameters - o Type - o Window size in pixel units - o Any other parameters defining the speckle filter used Mandatory for [POL]: Advanced polarimetric filter preserving covariance matrix properties should be applied.	<u>Achieved level:</u> THRESHOLD <Filtering> <FilterApplied> Flag set to False	Verified at Threshold
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			<u>Goal (Desired) Requirements</u> As threshold.		
#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Remarks/ Requirements/ Modifications
1.7.7	Product Bounding Box	[NRB] [POL] [ORB] [GSLC] [InSAR]	<u>Threshold (Minimum) Requirements</u> 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.	<u>Achieved level:</u> THRESHOLD <ProductBoundingBox> UL and LR corners of raster extent provided for both UTM (<Northing> <Easting>) and WGS84 UTM (<Latitude> <Longitude>)	Verified at Threshold
			<u>Goal (Desired)</u>		

			<u>Requirements</u> As threshold.		
1.7.8	Product Geographical Extent	[NRB] [POL] [ORB] [GSLC] [InSAR]	<u>Threshold (Minimum) Requirements</u> The geometry of the SAR image footprint expressed in longitude/latitude based on WGS84 (EPSG 4326), in a standardised format (e.g., WKT Polygon).	<u>Achieved level: THRESHOLD</u> <ProductGeographicalExtent> Provided as WKT for WGS84 Additional custom parameters (not required for CEOS-ARD): <ProductGeographicalExtentUTM> <ImageFootprintAttributes>	Verified at Threshold
1.7.9	Product Image Size	[NRB] [POL] [ORB] [GSLC] [InSAR]	<u>Threshold (Minimum) Requirements</u> 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.)	<u>Achieved level: THRESHOLD</u> <ProductImageSize> <NumberLines> <NumPixelsPerLine>	Verified at Threshold
			<u>Goal (Desired) Requirements</u> As threshold.		

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Remarks/ Requirements/ Modifications
1.7.10	Product Pixel Coordinate	[NRB] [POL] [ORB]	<u>Threshold (Minimum) Requirements</u>	<u>Achieved level: THRESHOLD</u> <PixelCoordinateConvention>	Verified at Threshold

	Convention	[GSLC] [InSAR]	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]. <u>Goal</u> <u>(Desired)</u> <u>Requirements</u> As threshold.		
1.7.11	Product Coordinate Reference System	[NRB] [POL] [ORB] [GSLC] [InSAR]	<u>Threshold (Minimum) Requirements</u> 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. <u>Goal</u> <u>(Desired)</u> <u>Requirements</u> As threshold.	Achieved level: THRESHOLD <CoordinateReferenceSystem> Provided in WKT format. EPSG also provided	Verified at Threshold

1.7.12	Look Direction Polynomials	[ORB]	<u>Threshold (Minimum) Requirements</u> 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: $\text{LookDir} = a_1\text{Lat}^2 + a_2\text{Lon}^2 + a_3\text{LatLon} + a_4\text{Lat} + a_5\text{Lon} + a_6$ where: a_i = polynomial coefficients Lat = latitude Lon = longitude Lat and Lon are the related coordinates in the product map units ['m', 'deg', 'arcsec'] <i>* 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.</i>	Not applicable for NRB	N/A
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			<u>Goal (Desired) Requirements</u> As threshold.		
#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Remarks/ Requirements/ Modifications

1.7.13	Radar Unit Look Vector	[GSLC] [InSAR]	<u>Threshold (Minimum) Requirements</u> 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. <u>Goal (Desired) Requirements</u> As threshold.	Not applicable for NRB	N/A
1.7.14	Slant Range Sensor to Surface	[GSLC]	<u>Threshold (Minimum) Requirements</u> 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. <u>Goal (Desired) Requirements</u> As threshold.	Not applicable for NRB	N/A
1.7.15	Reference Orbit	[NRB] [POL] [GSLC]	<u>Threshold (Minimum) Requirements</u> Not required.	Achieved level: THRESHOLD	Not required

			<u>Goal (Desired) Requirements</u> 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. Provide scene-centred perpendicular baseline for the for the source data relative to the reference orbit used (for approximate use only).	NOT REQUIRED	
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#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Remarks/ Requirements/ Modifications
1.7.16	InSAR Pair	[InSAR]	<u>Threshold (Minimum) Requirements</u> 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 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.	Not applicable for NRB	N/A

			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		
			<u>Goal (Desired) Requirements</u> 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.		
1.7.17	InSAR Pair Co registration	[InSAR]	<u>Threshold (Minimum) Requirements</u> 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. <u>Not required when the InSAR product is generated from [GSLC] products</u>	Not applicable for NRB	N/A

			<u>Goal</u> <u>(Desired)</u> <u>Requirements</u> As threshold.		
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#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Remarks/ Requirements/ Modifications
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1.7.18	Local InSAR Phase Quality	[InSAR]	<u>Threshold (Minimum) Requirements</u> Local InSAR phase quality estimation information • Methodology name [ex.: Coherence, DespeckKS, 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 DespeckKS [Ferretti <i>et al.</i> 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 should be listed. <u>Goal (Desired)</u>	Not applicable for NRB	N/A
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			<u>Requirements</u> As threshold.	
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#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Remarks/ Requirements/ Modifications
1.7.19	Interferogram Filtering	[InSAR]	<u>Threshold (Minimum) Requirements</u> If applied, interferogram filtering information - Methodology name - Reference to methodology [text or DOI] • Filtering parameters used.	Not applicable for NRB	N/A
			<u>Goal (Desired) Requirements</u> As threshold.		
1.7.20	Phase Unwrapping	[InSAR]	<u>Threshold (Minimum) Requirements</u> If 3.10-Unwrapped Interferogram Image is provided, technique used for InSAR phase unwrapping - Methodology name - Reference to methodology [text or DOI] - Unwrapping parameters - Coherence threshold - Number of iterations - Stable reference point coordinates or multi-point approach information	Not applicable for NRB	N/A
			<u>Goal (Desired)</u>		

			<u>Requirements</u> As threshold.		
1.7.21	Atmospheric Phase Correction	[GSLC] [InSAR]	<u>Threshold (Minimum) Requirements</u> Not required.	Not applicable for NRB	N/A
			<u>Goal (Desired) Requirements</u> If applied, reference to atmospheric phase correction technique and parameters used. - Methodology name - Reference to methodology [text or DOI]		
#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Remarks/ Requirements/ Modifications
1.7.22	Ionospheric Phase Correction	[GSLC] [InSAR]	<u>Threshold (Minimum) Requirements</u> Not required.	Not applicable for NRB	N/A
			<u>Goal (Desired) Requirements</u> If applied, reference to ionospheric phase correction technique and parameters used. - Methodology name - Reference to methodology [text or DOI]		
1.7.23	Displacement Modelling	[InSAR]	<u>Threshold (Minimum) Requirements</u> Not required.	Not applicable for NRB	N/A

			<u>Goal (Desired) Requirements</u> 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.		
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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.

Cloud optimized file formats are recommended.

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Remarks/ Requirements/ Modifications
2.1	Metadata Machine Readability	[NRB] [POL] [ORB] [GSLC] [InSAR]	<u>Threshold (Minimum) Requirements</u> 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.	<u>Achieved level:</u> THRESHOLD (GOAL) Metadata in separate metadata file in XML format, formatted in accordance with “CEOS-ARD_Metadata-spec_Synthetic_Aperture_Radar_v1.2.xlsx”	Verified at Threshold
			<u>Goal (Desired) Requirements</u> As threshold, but metadata is formatted in accordance with CEOS-ARD SAR Metadata Specifications, v.1.0, 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	Remarks/ Requirements/ Modifications
2.2	Data Mask Image	[NRB] [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: 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.	<u>Achieved level:</u> THRESHOLD <DataMask> <FileName> <SampleType> <DataFormat> <DataType> <BitsPerSample> > <BitValues> <NoData> <ValidData> <Layover> <Shadow> <Layover_shadow> <InvalidData>	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	Remarks/ Requirements/ Modifications
2.3	Scattering Area Image	[NRB] [POL] [ORB] [GSLC] [InSAR]	Threshold (Minimum) Requirements Not required.	Achieved level: THRESHOLD	Not required
			Goal (Desired) Requirements 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 β^0_T is best understood as β^0 divided by the local scattering area. γ 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: 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.	NOT REQUIRED	

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Remarks/ Requirements/ Modifications
2.4	Local Incident Angle Image	[NRB] [POL] [ORB] [GSLC]	<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. <i>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</i>	<u>Achieved level:</u> THRESHOLD < LocalIncAngle> <FileName> <DataFormat> <SampleType> <DataType> <BitsPerSample> <ByteOrder> <ConversionEq> added to indicate scaling to accommodate angles with one decimal precision	Verified at Threshold
		[GSLC]	<u>Goal (Desired) Requirements</u> As threshold.		
#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Remarks/ Requirements/ Modifications

2.5	Ellipsoidal Incident Angle Image	[GSLC] [InSAR]	<u>Threshold (Minimum) Requirements</u> 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: THRESHOLD NOT REQUIRED	Not required
		[NRB] [POL] [ORB] [GSLC]	<u>Goal (Desired) Requirements</u> 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	Remarks/ Requirements/ Modifications
2.6	Noise Power Image	[NRB] [POL] [ORB] [GSLC] [InSAR]	<u>Threshold (Minimum) Requirements</u> Not required.	Achieved level: THRESHOLD NOT REQUIRED	Not required
			<u>Goal (Desired) Requirements</u> Estimated Noise Equivalent σ^0 (or β^0 or $\gamma\gamma^0$, as applicable) used for noise removal, if applied, for each channel. $NE\sigma^0$ and NE 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		
2.7	Gamma-to-	[NRB] [POL]	<u>Threshold (Minimum) Requirements</u> Not required.	Achieved level: THRESHOLD	Not required

	Sigma Ratio Image	[GSLC] [InSAR]	<u>Goal (Desired) Requirements</u> Ratio of the integrated area in the Gamma projection over the integrated area in the Sigma projectionσ_T (ground). Multiplying γ^{0T} by this ratio results in an σ estimate of RTC. 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.	NOT REQUIRED	
#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Remarks/ Requirements/ Modifications

2.8	Acquisition ID Image	[NRB] [POL] [ORB] [GSLC]	<u>Threshold (Minimum) Requirements</u> Note: Required for multi-source product only. Acquisition ID, or acquisition date, for each pixel is identified. In case of multi-temporal image stacks, use source acquisition IDs (e.g., 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 metadata. Pixels not representing a unique date (e.g., pixels averaged in image overlap zones) are flagged with a pre-set pixel value 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 <u>Goal (Desired) Requirements</u> In case of image composites, the sources for each pixel are uniquely identified.	<u>Achieved level:</u> THRESHOLD NOT REQUIRED	Not required
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#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Remarks/ Requirements/ Modifications
2.9	Per-pixel DEM	[NRB] [POL] [GSLC] [InSAR]	<u>Threshold (Minimum) Requirements</u> Not required.	Achieved level: THRESHOLD NOT REQUIRED	Not required
			<u>Goal (Desired) Requirements</u> 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. Can also be provided with [ORB] products containing land areas. 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]	<u>Threshold (Minimum) Requirements</u> Not required.	Not applicable for NRB	N/A

			<u>Goal (Desired) Requirements</u> 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]	<u>Threshold (Minimum) Requirements</u> Not required. <u>Goal (Desired) Requirements</u> 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.	Not applicable for NRB	N/A

2.12	Radar Unit Look Vector Grid Image	[GSLC] [InSAR]	<u>Threshold (Minimum) Requirements</u> Not required.	Not applicable for NRB	N/A
			<u>Goal (Desired) Requirements</u> 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.		

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Remarks/ Requirements/ Modifications
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2.13	Slant Range Sensor to Surface Image	[GSLC] [InSAR]	<u>Threshold (Minimum) Requirements</u> Not required. <u>Goal (Desired) Requirements</u> 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.	Not applicable for NRB	N/A
2.14	InSAR Phase Uncertainty Image	[GSLC] [InSAR]	<u>Threshold (Minimum) Requirements</u> Not required.	Not applicable for NRB	N/A

			Goal (Desired) 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	
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#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Remarks/ Requirements/ Modifications
2.15	Atmospheric Phase Correction Image	[GSLC] [InSAR]	<u>Threshold (Minimum) Requirements</u> Not required.	Not applicable for NRB	N/A
			<u>Goal (Desired) Requirements</u> 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		
2.16	Ionospheric Phase Correction Image	[GSLC] [InSAR]	<u>Threshold (Minimum) Requirements</u> Not required.	Not applicable for NRB	N/A
			<u>Goal (Desired) Requirements</u> Phase correction value at each pixel, if applied. DOI/URL reference to algorithm or brief description is provided. 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	[InSAR]	<u>Threshold (Minimum) Requirements</u> Not required.	Not applicable for NRB	
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			<u>Goal (Desired) Requirements</u> 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		N/A
2.18	InSAR Perpendicular Baseline	[InSAR]	<u>Threshold (Minimum) Requirements</u> Not required. <u>Goal (Desired) Requirements</u> 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	Not applicable for NRB	N/A

2.19	InSAR Parallel Baseline	[InSAR]	<u>Threshold (Minimum) Requirements</u> Not required.	Not applicable for NRB	N/A
			<u>Goal (Desired) Requirements</u> 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 Points	[InSAR]	<u>Threshold (Minimum) Requirements</u> Not required. <u>Goal (Desired) Requirements</u> Data file(s) identifying pixels used for InSAR displacement modelling (items 3.11 to 3.14). As a suggestion, this information can be provided as a single multi-layer file, where each 1-bit 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	Not applicable for NRB	N/A

			- Byte Order		
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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. Cloud optimized file formats are recommended.

The column “CEOS-ARD product” indicates which CEOS-ARD SAR product (NRB, POL, ORB, GSLC) the parameter refers to.

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Remarks/ Requirements/ Modifications
3.1	Backscatter Measurements	[NRB]	<u>Threshold (Minimum) Requirements [NRB]</u> <u>"Terrain-flattened" Radiometrically Terrain Corrected (RTC)</u> 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 <i>*Note: Transformation to the logarithm decibel scale is not required or desired as this step can be completed by the user if necessary.</i>	<u>Achieved level: THRESHOLD</u> <BackscatterMeasurementData> <BackscatterMeasurement> <BackscatterConvention> <BackscatterConversionEq> <Polarization> <FileName> <DataFormat> <DataType> <BitsPerSample> <ByteOrder>	Verified at Threshold
			<u>Goal (Desired) Requirements</u> As threshold.		

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Remarks/ Requirements/ Modifications
3.2	Scaling Conversion	[NRB] [POL] [ORB] [GSLC] [InSAR]	<u>Threshold (Minimum) Requirements</u> 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 <BackscatterConvention> included above as part of (3.1) <BackscatterMeasurementData>	Verified at Threshold
			<u>Goal (Desired) Requirements</u> As threshold, but use of float32.		
3.3	Noise Removal	[NRB] [POL] [ORB] [GSLC] [InSAR]	<u>Threshold (Minimum) Requirements</u> 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. <i>*Note: Thermal noise removal and image border noise removal to remove overall scene noise and scene edge artefacts, respectively.</i>	Achieved level: THRESHOLD <NoiseRemoval> <NoiseRemovalApplied> Flag set to False	Verified at Threshold
			<u>Goal (Desired) Requirements</u> As threshold.		

3.4	Radiometric Terrain Correction Algorithm	[NRB] [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) $\gamma^0 T$ 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 <i>Note: Examples of technical documentation include an Algorithm, Theoretical Basis Document, product user guide, etc.</i>	<u>Achieved level:</u> THRESHOLD <RadiometricTerrainCorrections> <RTCAlgorithm> DOI to peer-reviewed publication provided.	Verified at Threshold
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		[GSLC] [InSAR]	Goal (Desired) Requirements As Threshold		
		[All]	Require resolution of DEM better than the output product resolution when applying terrain corrections.		
#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Remarks/ Requirements/ Modifications

3.5	Radiometric Accuracy	[NRB] [POL] [ORB] [GSLC] [InSAR]	<u>Threshold (Minimum)</u> <u>Requirements</u> Not required.	Achieved level: THRESHOLD NOT REQUIRED	Not required
			<u>Goal (Desired) Requirements</u> Uncertainty (e.g., bounds on σ^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]	<u>Threshold (Minimum)</u> <u>Requirements</u> Not required.	Not applicable for NRB	N/A

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Remarks/ Requirements/ Modifications
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			<u>Goal (Desired) Requirements</u> Usage: Only for Maritime scene 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 <i>et al.</i> (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 <i>Note: Reference wind model, wind speed and direction used for reference backscattering coefficient should be provided.</i>		
3.7	Flattened Phase	[NRB] [POL]	<u>Threshold (Minimum) Requirements</u> Not required.	Achieved level: THRESHOLD NOT REQUIRED	Not required
#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Remarks/ Requirements/ Modifications

			<u>Goal (Desired) Requirements</u> 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: $\text{GSLC} = \sqrt{\text{NRB}} \times \exp(j \text{ FlattenPhase})$ 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.		
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3.8	Coherence Image	[InSAR]	<u>Threshold (Minimum) Requirements</u> Not required.	Not applicable for NRB	Not required
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			<u>Goal (Desired) Requirements</u> 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 e - Standard deviation		
3.9	Interferogram Image	[InSAR]	<u>Threshold (Minimum) Requirements</u> Not required.	Not applicable for NRB	N/A

			<u>Goal (Desired) Requirements</u> 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		
3.10	Unwrapped Interferogram Image	[InSAR]	<u>Threshold (Minimum) Requirements</u> Not required. <u>Goal (Desired) Requirements</u> 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	Not applicable for NRB	N/A
3.11	InSAR Displacement	[InSAR]	<u>Threshold (Minimum) Requirements</u> Not required.	Not applicable for NRB	N/A

	Image		<u>Goal (Desired) Requirements</u> 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.		
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3.12	InSAR Displacement Residue Image	[InSAR]	<u>Threshold (Minimum) Requirements</u> Not required.	Not applicable for NRB	N/A
			<u>Goal (Desired) Requirements</u> 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]	<u>Threshold (Minimum) Requirements</u> Not required.	Not applicable for NRB	N/A
			<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.		

3.14	InSAR Displacement Rate Model Fit Image	[InSAR]	<u>Threshold (Minimum) Requirements</u> Not required.	Not applicable for NRB	N/A
			<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	Remarks/ Requirements/ Modifications
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4.1	Geometric Correction Algorithm	[NRB] [POL] [ORB] [GSLC] [InSAR]	<u>Threshold (Minimum) Requirements</u> Not required. <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. <i>Note: Examples of technical documentation can include e.g., an Algorithm Theoretical Basis Document (ATBD), a product user guide.</i>	<u>Achieved level: THRESHOLD</u> NOT REQUIRED	Not required
4.2	Digital Elevation Model	[NRB] [POL] [ORB] [GSLC] [InSAR]	<u>Threshold (Minimum) Requirements</u> Usage: For products including land areas - 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. - Provide reference to the Digital Elevation Model used for geometric terrain correction. - Provide reference to Earth Gravitational Model (EGM) if used for geometric correction.	<u>Achieved level: THRESHOLD</u> <DigitalElevationModel> <DEMReference> <DEMVersion> <EGMReference> Provided as URLs	Verified at Threshold

			<u>Goal (Desired) Requirements</u> 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.		
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#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Remarks/ Requirements/ Modifications
4.3	Geometric Accuracy	[NRB] [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 [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. <i>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.</i> <i>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 subset) of the generated products.</i>	<u>Achieved level:</u> THRESHOLD <GeoCorrAccuracy> <NorthernSTDev> <EasternSTDev> <NorthernBias> <EasternBias>	Verified at Threshold

			<i>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.</i>		
			<u>Goal (Desired) Requirements</u> Output product sub-sample accuracy should be less than or equal to 0.1 (slant range) pixel radial root mean square error (rRMSE).		

#	Parameter	CEOS-ARD product	Requirements	Self-Assessment	Remarks/ Requirements/ Modifications
4.4	Geometric Refined Accuracy	[NRB] [POL] [ORB] [GSLC] [InSAR]	<u>Threshold (Minimum) Requirements</u> Not required.	Achieved level: THRESHOLD	Not required
			<u>Goal (Desired) Requirements</u> 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.	NOT REQUIRED	
4.5	Gridding Convention	[NRB] [POL] [ORB] [GSLC] [InSAR]	<u>Threshold (Minimum) Requirements</u> 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*. <i>* 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.</i>	Achieved level: THRESHOLD <GriddingConvention> Scene Upper Left Corner coordinates (Northing and Easting) are aligned to multiples of 5.00 m, offset by half a pixel	Verified at Threshold

			<u>Goal (Desired) Requirements</u> 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.	
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Summary Self-Assessment Table

			Threshold	Goal
1	CEOS-ARD product	General Metadata		
1.1	[ALL]	Traceability	Not Required	Not Assessed
1.2	[ALL]	Metadata Machine Readability	Yes	Not Assessed
1.3	[ALL]	Product Type	Yes	Not Assessed
1.4	[ALL]	Document Identifier	Yes	Not Assessed
1.5	[ALL]	Data Collection Time	Yes	Not Assessed
1.6		Source Data Attributes		
1.6.1	[ALL]	Source Data Access	Yes	Not Assessed
1.6.2	[ALL]	Instrument	Yes	Not Assessed
1.6.3	[ALL]	Source Data Acquisition Time	Yes	Not Assessed
1.6.4	[ALL]	Source Data Acquisition Parameters	Yes	Not Assessed
1.6.5	[ALL]	Source Data Orbit Information	Yes	Not Assessed
1.6.6	[ALL]	Source Data Processing Parameters	Yes	Not Assessed
1.6.7	[ALL]	Source Data Image Attributes	Yes	Not Assessed
1.6.8	[ALL]	Sensor Calibration	Not Required	Not Assessed
1.6.9	[ALL]	Performance Indicators	Yes	Not Assessed
1.6.10	[ALL]	Source Data Polarimetric Calibration Matrices	Not Required	Not Assessed
1.6.11	[ALL]	Mean Faraday Rotation Angle	Not Required	Not Assessed
1.6.12	[ALL]	Ionosphere indicator	Not Required	Not Assessed
1.7		CEOS-ARD Product Attributes		
1.7.1	[ALL]	Product Data Access	Yes	Not Assessed
1.7.2	[ALL]	Auxiliary Data	Not Required	Not Assessed
1.7.3	[ALL]	Product Sample Spacing	Yes	Not Assessed
1.7.4	[NRB] [POL] [ORB] [InSAR]	Product Equivalent Number of Looks	Not Required	Not Assessed
1.7.5	[ALL]	Product Resolution	Not Required	Not Assessed

1.7.6	[NRB] [POL] [ORB]	Product Filtering	Yes	Not Assessed
1.7.7	[ALL]	Product Bounding Box	Yes	Not Assessed
1.7.8	[ALL]	Product Geographical Extent	Yes	Not Assessed
1.7.9	[ALL]	Product Image Size	Yes	Not Assessed
1.7.10	[ALL]	Product Pixel Coordinate Convention	Yes	Not Assessed
1.7.11	[ALL]	Product Coordinate Reference System	Yes	Not Assessed
1.7.12	[ORB]	Look Direction Polynomials	Not Product Relevant	Not Relevant
1.7.13	[GSLC] [InSAR]	Radar Unit Look Vector	Not Product Relevant	Not Relevant
1.7.14	[GSLC]	Slant Range Sensor to Surface	Not Product Relevant	Not Relevant
1.7.15	[NRB] [POL] [GSLC]	Reference Orbit	Not Required	Not Assessed
1.7.16	[InSAR]	InSAR Pair	Not Product Relevant	Not Relevant
1.7.17	[InSAR]	InSAR Pair Co registration	Not Product Relevant	Not Relevant
			Threshold	Goal
1.7.18	[InSAR]	Coherence	Not Product Relevant	Not Relevant
1.7.19	[InSAR]	Interferogram Filtering	Not Product Relevant	Not Relevant
1.7.20	[InSAR]	Phase Unwrapping	Not Product Relevant	Not Relevant
1.7.21	[GSLC] [InSAR]	Atmospheric Phase Correction	Not Product Relevant	Not Relevant
1.7.22	[GSLC] [InSAR]	Ionospheric Phase Correction	Not Product Relevant	Not Relevant
1.7.23	[InSAR]	Displacement Modelling	Not Product Relevant	Not Relevant
			Threshold	Goal
2	CEOS-ARD product	Per-Pixel Metadata		

2.1	[ALL]	Metadata Machine Readability	Yes	Not Assessed
2.2	[ALL]	Data Mask Image	Yes	Not Assessed
2.3	[ALL]	Scattering Area Image	Not Required	Not Assessed
2.4	[NRB] [POL] [ORB] [GSLC]	Local Incident Angle Image	Yes	Not Assessed
2.5	[ALL]	Ellipsoidal Incident Angle Image	Not Required	Not Assessed
2.6	[ALL]	Noise Power Image	Not Required	Not Assessed
2.7	[NRB] [POL] [GSLC]	Gamma-to-Sigma Ratio Image	Not Required	Not Assessed
2.8	[ALL]	Acquisition ID Image	Not Required	Not Assessed
2.9	[NRB] [POL] [GSLC] [InSAR]	Per-pixel DEM	Not Required	Not Assessed
2.10	[ORB]	Per-pixel Geoid	Not Product Relevant	Not Relevant
2.11	[ORB]	Look Direction Image	Not Product Relevant	Not Relevant
2.12	[GSLC] [InSAR]	Radar Unit Look Vector Grid Image	Not Product Relevant	Not Relevant
2.13	[GSLC] [InSAR]	Slant Range Sensor to Surface Image	Not Product Relevant	Not Relevant
2.14	[GSLC] [InSAR]	InSAR Phase Uncertainty Image	Not Product Relevant	Not Relevant
2.15	[GSLC] [InSAR]	Atmospheric Phase Correction Image	Not Product Relevant	Not Relevant
2.16	[GSLC] [InSAR]	Ionospheric Phase Correction Image	Not Product Relevant	Not Relevant
2.17	[InSAR]	Simulated Topographic Phase	Not Product Relevant	Not Relevant
2.18	[InSAR]	InSAR Perpendicular Baseline	Not Product Relevant	Not Relevant
2.19	[InSAR]	InSAR Parallel Baseline	Not Product Relevant	Not Relevant

2.20	[InSAR]	InSAR Displacement Model Points	Not Product Relevant	Not Relevant
			Threshold	Goal
3	CEOS-ARD product	Radiometrically Corrected Measurements		
3.1	[ALL]	Backscatter Measurements	Yes	Not Assessed
3.2	[ALL]	Scaling Conversion	Yes	Not Assessed
3.3	[ALL]	Noise Removal	Yes	Not Assessed
3.4	[NRB] [POL] [GSLC] [InSAR]	Radiometric Terrain Correction Algorithms	Yes	Not Assessed
3.5	[ALL]	Radiometric Accuracy	Not Required	Not Assessed
3.6	[ORB]	Mean Wind-Normalised Backscatter Measurements	Not Product Relevant	Not Relevant
3.7	[NRB] [POL]	Flattened Phase	Not Required	Not Assessed
3.8	[InSAR]	Coherence Image	Not Product Relevant	Not Relevant
3.9	[InSAR]	Interferogram Image	Not Product Relevant	Not Relevant
3.10	[InSAR]	Unwrapped Interferogram Image	Not Product Relevant	Not Relevant
3.11	[InSAR]	InSAR Displacement Image	Not Product Relevant	Not Relevant
3.12	[InSAR]	InSAR Displacement Residue Image	Not Product Relevant	Not Relevant
3.13	[InSAR]	InSAR Displacement Rate Image	Not Product Relevant	Not Relevant
3.14	[InSAR]	InSAR Displacement Rate Model fit Image	Not Product Relevant	Not Relevant
			Threshold	Goal
4	CEOS-ARD product	Geometric Corrections		
4.1	[ALL]	Geometric Correction Algorithms	Not Required	Not Assessed
4.2	[ALL]	Digital Elevation Model	Yes	Not Assessed
4.3	[ALL]	Geometric Accuracy	Yes	Not Assessed

4.4	[ALL]	Geometric Refined Accuracy	Not Required	Not Assessed
4.5	[ALL]	Gridding Convention	Yes	Not Assessed