

Traceability and Uncertainty - Discussion

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CEOS ANALYSIS READY DATA

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

<https://ceos.org/ard/>

Current Product Family Specifications

PFS	Type	Version	Download	Metadata Spec	Last Updated
Surface Reflectance	Optical	5.0	PDF Word	-	8 June 2020
Surface Temperature	Optical	5.0	PDF Word	-	8 June 2020
Normalised Radar Backscatter	Radar	5.5	PDF Word	XLSX	13 May 2022
Polarimetric Radar	Radar	3.5	PDF Word	XLSX	13 May 2022
Aquatic Reflectance	Optical	1.0	PDF Word	-	23 February 2022

In-progress Product Family Specifications

PFS	Type	ETA
Nighttime Lights Surface Radiance	Optical	Q3 2021
Ocean Radar Backscatter	Radar	Q3 2022
Geocoded Single-Look Complex (GSLC)	Radar	2023
Interferometric Radar (INSAR)	Radar	2023
LiDAR Terrain and Canopy Top Height	Optical	2023

Surface Reflectance Requirements

1. General Metadata

- 1.1 Traceability
- 1.2 Metadata Machine Readability
- 1.3 Data Collection Time
- 1.4 Geographical Area
- 1.5 Coordinate Reference System
- 1.6 Map Projection
- 1.7 Geometric Correction Methods
- 1.8 Geometric Accuracy of the Data
- 1.9 Instrument
- 1.10 Spectral Bands
- 1.11 Sensor Calibration
- 1.12 Radiometric Accuracy
- 1.13 Algorithms
- 1.14 Auxiliary Data
- 1.15 Processing Chain Provenance
- 1.16 Data Access
- 1.17 Overall Data Quality

2. Per-Pixel Metadata

- 2.1 Metadata Machine Readability
- 2.2 No Data
- 2.3 Incomplete Testing
- 2.4 Saturation
- 2.5 Cloud
- 2.6 Cloud Shadow
- 2.7 Land/Water Mask
- 2.8 Snow/Ice Mask
- 2.9 Terrain Shadow Mask
- 2.10 Terrain Occlusion
- 2.11 Solar and Viewing Geometry
- 2.12 Terrain Illumination Correction
- 2.13 Aerosol Optical Depth Parameters

3. Radiometric and Atmospheric Corrections

- 3.1 Measurement
- 3.2 Measurement Uncertainty
- 3.3 Measurement Normalisation
- 3.4 Directional Atmospheric Scattering
- 3.5 Water Vapour Corrections
- 3.6 Ozone Corrections

4. Geometric Corrections

- 4.1 Geometric Correction

Surface Temperature Requirements

1. General Metadata

- 1.1 Traceability
- 1.2 Metadata Machine Readability
- 1.3 Data Collection Time
- 1.4 Geographical Area
- 1.5 Coordinate Reference System
- 1.6 Map Projection
- 1.7 Geometric Correction Methods
- 1.8 Geometric Accuracy of the Data
- 1.9 Instrument
- 1.10 Spectral Bands
- 1.11 Sensor Calibration
- 1.12 Radiometric Accuracy
- 1.13 Algorithms
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2. Per-Pixel Metadata

- 2.1 Metadata Machine Readability
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- 2.6 Cloud Shadow
- 2.7 Snow/Ice Mask
- 2.8 Solar and Viewing Geometry

3. Radiometric and Atmospheric Corrections

- 3.1 Measurement
- 3.2 Corrections for Atmosphere and Emissivity
- 3.3 Measurement Uncertainty

4. Geometric Corrections

- 4.1 Geometric Correction

CEOS ARD Verified Datasets

Product	CEOS-ARD Type	PFS Version	Agency	Mission(s)	Threshold Specification	Target Specification	Access (DOI)	Info	Self Assessment	Peer Review	Sample Products
EnMAP	Surface Reflectance	v5.0	DLR	EnMAP	● 100%	Not assessed	TBA	Link	PDF	PDF	Link
Landsat Collection 2	Surface Reflectance	v5.0	USGS	Landsat 4, 5, 7, 8, 9	● 100%	🟡 81%	Landsat 4-5, 7, 8	Link	PDF	PDF	Link
Landsat Collection 2	Surface Temperature	v5.0	USGS	Landsat 4, 5, 7, 8, 9	● 100%	🟡 83%	Landsat 4-5, 7, 8	Link	PDF	PDF	Link
Landsat Collection 2 U.S. ARD	Surface Reflectance	v5.0	USGS	Landsat 4, 5, 7, 8, 9	● 100%	Not assessed	Landsat 4-5, 7, 8	Link	PDF	PDF	Link
Landsat Collection 2 U.S. ARD	Surface Temperature	v5.0	USGS	Landsat 4, 5, 7, 8, 9	● 100%	Not assessed	Landsat 4-5, 7, 8	Link	PDF	PDF	Link
Sentinel-1 RTC	Normalised Radar Backscatter	v5.5	Sinergise & Digital Earth Africa	Sentinel-1 (A, B)	● 100%	Not assessed	Link	Link	PDF	PDF	Link
Sentinel-2 Level-2A	Surface Reflectance	v5.0	ESA	Sentinel-2A, 2B	● 100%	Not assessed	Link	Link	PDF	PDF	Link

Under Peer Review

Product	CEOS-ARD Type	PFS Version	Agency	Mission(s)	Access (DOI)	Info	Self Assessment	Peer Review	Sample Products
PROBA-V Collection 2	Surface Reflectance	v5.0	VITO / ESA	PROBA-V	TBA	Link	PDF	TBA	TBA
Sentinel-2 Level-2A (E84)	Surface Reflectance	v5.0	Element 84	Sentinel-2A, 2B	TBA	TBA	TBA	TBA	TBA
ALOS-2 PALSAR-2 Global Mosaics (RTC)	Normalised Radar Backscatter	v5.5	JAXA	ALOS-2 PALSAR-2	TBA	Link	DOC	TBA	TBA
ALOS-2 PALSAR-2 ScanSAR NRB	Normalised Radar Backscatter	v5.5	JAXA	ALOS-2 PALSAR-2	TBA	Link	DOC	TBA	TBA

Self Assessment Under Development

Product	CEOS-ARD Type	PFS Version	Agency	Mission(s)	Access (DOI)	Info	Self Assessment	Peer Review	Sample Products
DEGIS L2A	Surface Reflectance	v5.0	DLR	DEGIS-on-ISS	TBA	TBA	TBA	TBA	TBA
Envisat ASAR	Normalised Radar Backscatter	v5.5	ESA	Envisat	TBA	TBA	TBA	TBA	TBA
Envisat MERIS	Surface Reflectance	v5.0	ESA	Envisat	TBA	TBA	TBA	TBA	TBA
ERS ATSR	Surface Reflectance	v5.0	ESA	ERS-1,-2	TBA	TBA	TBA	TBA	TBA
ERS SAR	Normalised Radar Backscatter	v5.5	ESA	ERS-1,-2	TBA	TBA	TBA	TBA	TBA
Fused S-2 & L-8/9 (Level-2F)	Surface Reflectance	v5.0	ESA	Sentinel-2A, 2B; Landsat 8, 9	TBA	TBA	TBA	TBA	TBA
Harmonised S-2 & L-8/9 (Level-2H)	Surface Reflectance	v5.0	ESA	Sentinel-2A, 2B; Landsat 8, 9	TBA	TBA	TBA	TBA	TBA
LSTM L2A SR	Surface Reflectance	v5.0	ESA	LSTM	TBA	TBA	TBA	TBA	TBA
LSTM L2A ST	Surface Temperature	v5.0	ESA	LSTM	TBA	TBA	TBA	TBA	TBA
LSTM L2H/L2F SR	Surface Reflectance	v5.0	ESA	LSTM	TBA	TBA	TBA	TBA	TBA
LSTM L2H/L2F ST	Surface Temperature	v5.0	ESA	LSTM	TBA	TBA	TBA	TBA	TBA
NovaSAR-1 RTC	Normalised Radar Backscatter	v5.5	CSIRO	NovaSAR-1	TBA	Link	Ongoing	TBA	TBA
Sentinel-1 NRB	Normalised Radar Backscatter	v5.5	ESA	Sentinel-1 (A, B)	TBA	Link	TBA	TBA	TBA
Sentinel-2 L2A/B AR Layer	Aquatic Reflectance	v1.0	ESA	Sentinel-2A, 2B	TBA	TBA	TBA	TBA	TBA
SPOT 1-7 Surface Reflectance	Surface Reflectance	v5.0	SANSA	SPOT 1, 2, 3, 4, 5, 6, 7	TBA	TBA	TBA	TBA	TBA

CEOS ARD Surface Reflectance Requirements (cont.)

#	Item	Threshold (Minimum) Requirements	Target (Desired) Requirements
1.1	Traceability	Not required.	Data must be traceable to SI reference standard.
1.12	Radiometric Accuracy	Not required. The general metadata does not include information on the radiometric accuracy of the data.	The metadata includes metrics describing the assessed absolute radiometric uncertainty of the version of the data or product, expressed as absolute radiometric uncertainty relative to appropriate, known reference sites and standards (for example, pseudo-invariant calibration sites, rigorously collected field spectra, PICS, Rayleigh, DCC, etc.)
3.1	Measurement	Pixel values that are expressed as a measurement of the Surface Reflectance of the land. This is a dimensionless value.	Surface Reflectance measurements are SI traceable (see also 1.1).
3.2	Measurement Uncertainty	Not required. <i>Note 1: In current practice, users determine fitness for purpose based on knowledge of the lineage of the data, rather than on a specific estimate of measurement uncertainty.</i>	An estimate of the certainty of the values is provided in measurement units.