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# Product Definition Document (PDD)

## Product M-CM Product format version 11.01

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TROPOS

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# CHANGE LOG

Reason for change	Issue	Changes	Date
First version of M-CM PDD	1.0	Baseline	15-03-2015
Comments of Requirements Review and recent product updates considered	1.1		21-08-2015
Comments of PM3 and recent product updates considered	1.2		20-11-2015
Update after TRR1	1.3	Sec. 2, 5, 6	04-03-2016
Update after AR1	1.4	Sec. 1, 5.1; doc properties	04-05-2016
Update XML Header due to usage of GMV support library new product format following EarthCARE Level2 product conventions	2.0		16-12-2016
Remove version number	2.1	Title, new h5/hdf header	17-02-2017
Comment of AR2	2.2	460, 544, 545	13-04-2017
Solved/Updated	3.0	461 / hdf header	31-07-2017
Updated	3.1	585/578/547/573/572	25-09-2017
Update due to new GMV library 2.1	4.0	specific product header	27-11-2017
Update	4.1		31-01-2018
Update to CCN2-MTR	5.0		22-11-2018
Update to CCN3-FR	6.0		18-06-2019
Update to CCN4-MTR	6.1	ECAPRIL-210	20-01-2020
Update to CCN4-FR	7.0		05-06-2020
Update to CCN4-FR	7.1	ECAPRIL-276/277	24-07-2020
Update to CCN5-FR	8.0		20-01-2021
Add general quality_status to AR-A	9.0		30-08-2021
Update to AR-B	9.1	ECL2-1073	04-10-2021
Update to AR-C	10.0		08-10-2022
Update to AR-E	11.0	ECL2_1302	16-10-2023
Update to LRR	11.1		28-03-2024
Update of sec 6.4 to be in-line with output that is relying on gmvecl v4.3.0	11.2		02-05-2024

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## **1 PURPOSE AND SCOPE**

This document provides the format description for EarthCARE data product M-CM containing a binary cloud flag (M-CF), the retrieved cloud type (M-Ctyp) and cloud phase (M-CP).

It is applicable to the M-CM format version 11.01.

This is a draft version of the document as input for the development and implementation of the M-CLD processor. Open issues are indicated by TBC/TBD/TBW.

## **2 APPLICABLE AND REFERENCE DOCUMENTS**

### **2.1 Applicable documents**

- [AD0] EarthCARE Level 2 Processor Scientific Developments: Generic Work Description Document, EC-SOW-ESA-SYS-0587, issue 2, 13 Mar 2014
- [AD1] EarthCARE Ground Processors General Requirements Baseline, EC-RS-ESA-SY-0152, issue 6, 18 Dec 2020
- [AD2] EarthCARE Product Definitions, Vol. 1: Common Product Definitions, EC.ICD.ASD.SY.00005, issue 12, 25 Jul 2018
- [AD3] MSI l1 Product Definitions Vol. A: Nominal Products, EC.ICD.GMV.MSI.00001, issue 3.1, 29 Jun 2022
- [AD4] MSI l1 Product Definitions Vol. B: Calibration Products, EC.ICD.GMV.MSI.00002, issue 3.1, 29 Jul 2022
- [AD5] EarthCARE PDGS Generic IPF Interface Specifications, EACA-GSEG-EOPG-TN-15-0001, issue 1.4, 1 Sep 2017
- [AD6] EarthCARE product conventions, EC-TN-ESA-SYS-859, issue 3, 2 Mar 2017
- [AD7] PDD vol. 8, X-MET, Product format version 1.3, EC-ICD-ESA-SYS-555, issue 6, (11 Jun 2018)
- [AD8] EarthCARE PDGS Processing Files Format Specification, EACA-GSEG-EOPG-IC-14-0031, issue 1.5, 24 Nov 2020

### **2.2 Reference documents**

- [RD1] Earth Observation Ground Segment File Format Standard, PE-TN-ESA-GS-0001, issue 2.0, 3 May 2012
- [RD2] Tailoring of the Earth Observation File Format Standard for the EarthCARE Ground Segment, EC-TN-ESA-GS-0218, issue 4, 2 Mar 2017
- [RD3] EarthCARE Production Model, EC-TN-ESA-SYS-0380, issue 7, 12 Feb 2018
- [RD4] EarthCARE ESA Product List, EC-ICD-ESA-SYS-0314, issue 5, 30 May 2017

## 2.3 Scientific documents

[SD1] Rossow, W. B. und R. A. Schiffer, 1999: Advances in understanding clouds from ISCCP. Bull. Am. Meteorol. Soc., 80, 2261-2288.

## 3 PRODUCT OVERVIEW

The requirements for the MSI are the identification and classification of the observed scene for the broadband radiometric measurements and the active techniques. With the broader swath, MSI can quantify how (in)homogeneous the observed scene is. The variability of the clouds is needed for the scene identification to the retrieval process from BBR and can be merged with vertically resolved products (from the active instrument) to generate a 3D cloud field. First of all, a cloud mask algorithm from MSI is retrieved to identify the existence, sometimes partly, of clouds. The cloud mask gives also information in the field of view of the ATLID, CPR and BBR instruments to verify the scene. The second step is to identify the cloud phase (water or ice).

### Cloud mask: Cloud Flag (M-CF) and Cloud Type (M-CTYP)

The cloud flag will allow to distinguish between clear-sky and cloudy pixels for the entire swath. Additionally, the cloud type classifier will differentiate between thin and thick clouds, as well as describing ISCCP (SD1, Fig.1) related cloud type.

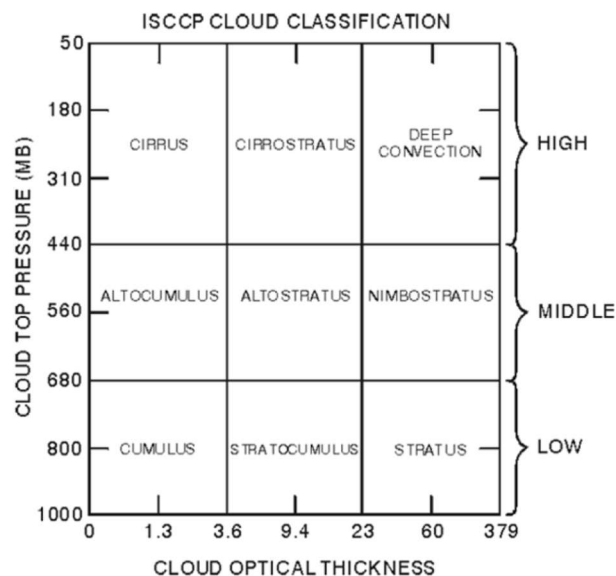


Figure 1 ISCCP cloud classification based on cloud optical thickness and cloud top heights (SD1).

### Cloud thermodynamic phase (M-CP)

The thermodynamical cloud phase approach will distinguish between water, ice phased clouds. In the case of cloud flagging and if the phase cannot be determined, an undefined cloud phase will also be provided.

The products will be delivered on a pixel basis (500x500m) per frame for the entire swath of the imager (150km).

## 4 INPUT LIST

### Cloud mask (M-CM)

The MSI Level 1c [AD5] calibrated radiances for all channels as well as geolocation fields and observation geometry are needed by the retrieved parameters. In retrieving the parameters additional inputs are required. Those are the digital elevation model (DEM), the X-Met data [RD6] and the ecosystem classification (IGBP) [RD?? tbd].

## 5 PRODUCT CHARACTERISTICS

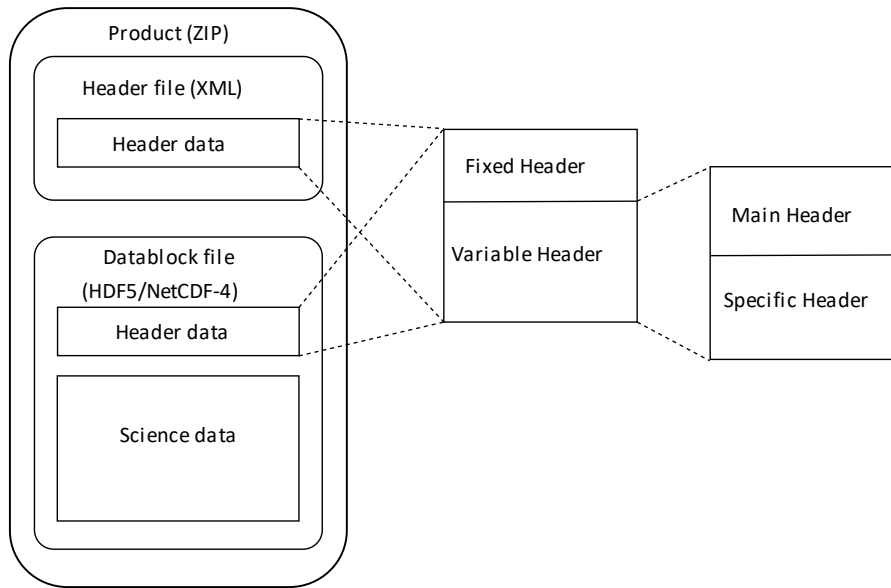
### 5.1 Overview

Identifier	<b>M-CM</b>
Descriptive name	MSI cloud mask, type and phase
Product level	2a
File name pattern	ECA_EXAA_MSI_CM__2A_yyyymmddThhmmssZ_yyyymmddThhmmssZ_oooooF
Format version	11.01
Metaformat	NetCDF4/HDF5.
Granularity	1 frame (= 1/8 orbit) per file
Frame margin	0 km
File size	230 MB (TBC) (without compression, incl. 100% safety margin) horizontal
Spatial extent	5000/150 km (along/across track)
Spatial sampling	500/500 m (along/across track)
Spatial resolution	500/500 m (along/across track)
Data volume per day	30 GB (TBC) (without compression, incl. 100% safety margin)

## 6 PRODUCT FORMAT

### 6.1 Overview

The product format follows the conventions in [RD1], [RD2], and [AD2]. In particular, each product consists of two files, a NetCDF4/HDF5 data block file and an XML header file, packaged into a zip archive (zip without compression). For convenience, a copy of the header data is provided in the data block file as well. These header parameters are defined in [AD2] and in section 6.2.1 below. They should not be confused with headers internally generated by HDF5/NetCDF-4 for describing the file structure.



Below the overall structure of the data block file is shown. The hierarchical structure is reflected in the XML header file by nesting of XML tags (see [RD1]).

Element		Format reference
Header data	Fixed Header	[AD2]
	Variable Header	Main Product Header
		Specific Product Header
Science data		this doc, section 6.2.2

## 6.2 Detailed format

This shows the full product format in tabular form, listing groups and variables with their names, units, dimensions, data types, and descriptions. The table is preceded by a definition of the dimensions used.

Only the specific product header and science data are defined here. Refer to [AD2] for the definitions of fixed and main product header.

Dimensions:

Dimension	Description	Number of elements (exact/typical)
along_track	Size of MSI frame along the track	10000
across_track	Size of MSI frame across the track	384

### 6.2.1 Specific Product Header

ConfigurationParameters:

Name	Data type	Description
<b>group: compression</b>		

deflate_level	int	The gzip compression level from 0 to 9. 0 indicates no compression. 9 is best compression/slowest
Shuffle	int	If non-zero (and deflate_level > 0), turn on the shuffle filter. This might improve compression ratios
<b>group: logging</b>		
logging_output_file	string	file_name_for_logging_messages
logging_level	int	DEBUG = 0, INFO = 1, PROGRESS = 2, WARN = 3, ERROR = 4
<b>group: output_frame_margins</b>		
config_margins	int	set margins from config-xml: 0=no, 1=yes, 2=not applied
margin_before_frame_start	double	distance margin before frame start
margin_after_frame_stop	double	distance margin behind frame stop
<b>group: snr</b>		
snr_vis_min	double	signal-to-noise for low signal
snr_vis_max	double	signal-to-noise for high signal
snr_nir_min	double	signal-to-noise for low signal
snr_nir_max	double	signal-to-noise for high signal
snr_swir1_min	double	signal-to-noise for low signal
snr_swir1_max	double	signal-to-noise for high signal
snr_swir2_min	double	signal-to-noise for low signal
snr_swir2_max	double	signal-to-noise for high signal
<b>group: cm thresholds</b>		
brightness_temperature_low_confidence	float	Low confidence threshold for brightness temperature test at $T_{B\_10.8}$
brightness_temperature_high_confidence	float	High confidence threshold for brightness temperature test at $T_{B\_10.8}$
visible_reflectance_test_low_confidence_land	float	Low confidence threshold for visible reflectance test for land
visible_reflectance_test_high_confidence_land	float	High confidence threshold for visible reflectance test for land
visible_reflectance_test_low_confidence_desert	float	Low confidence threshold for visible reflectance test for desert
visible_reflectance_test_high_confidence_desert	float	High confidence threshold for visible reflectance test for desert
visible_reflectance_test_low_confidence_ocean_no_sunlight	float	Low confidence threshold for visible reflectance test for ocean no sunlint
visible_reflectance_test_high_confidence_ocean_no_sunlight	float	High confidence threshold for visible reflectance test for ocean no sunlint

visible_reflectance_test_low_confidence_ocean_sunlint_0_5	float	cloud-free low confidence value visible reflectance test over ocean with sunlint angle 0° - 5°
visible_reflectance_test_high_confidence_ocean_sunlint_0_5	float	High confidence threshold for visible reflectance test for ocean with sunlint 0°-5°
visible_reflectance_test_low_confidence_ocean_sunlint_5_10	float	Low confidence threshold for visible reflectance test for ocean with sunlint 5°-10°
visible_reflectance_test_high_confidence_ocean_sunlint_5_10	float	High confidence threshold for visible reflectance test for ocean with sunlint 5°-10°
visible_reflectance_test_var_confidence_ocean_sunlint_5_10	float	Variability confidence threshold for visible reflectance test for ocean with sunlint 5°-10°
visible_reflectance_test_low_confidence_ocean_sunlint_10_15	float	Low confidence threshold for visible reflectance test for ocean with sunlint 10°-15°
visible_reflectance_test_high_confidence_ocean_sunlint_10_15	float	High confidence threshold for visible reflectance test for ocean with sunlint 10°-15°
visible_reflectance_test_var_confidence_ocean_sunlint_10_15	float	Variability confidence threshold for visible reflectance test for ocean with sunlint 10°-15°
visible_reflectance_test_low_confidence_ocean_sunlint_15_20	float	Low confidence threshold for visible reflectance test for ocean with sunlint 15°-20°
visible_reflectance_test_high_confidence_ocean_sunlint_15_20	float	High confidence threshold for visible reflectance test for ocean with sunlint 15°-20°
visible_reflectance_test_var_confidence_ocean_sunlint_15_20	float	Variability confidence threshold for visible reflectance test for ocean with sunlint 15°-20°
visible_reflectance_test_low_confidence_ocean_sunlint_20_25	float	Low confidence threshold for visible reflectance test for ocean with sunlint 20°-25°
visible_reflectance_test_high_confidence_ocean_sunlint_20_25	float	High confidence threshold for visible reflectance test for ocean with sunlint 20°-25°
visible_reflectance_test_var_confidence_ocean_sunlint_20_25	float	Variability confidence threshold for visible reflectance test for ocean with sunlint 20°-25°
visible_reflectance_test_low_confidence_ocean_sunlint_25_30	float	Low confidence threshold for visible reflectance test for ocean with sunlint 25°-30°
visible_reflectance_test_high_confidence_ocean_sunlint_25_30	float	High confidence threshold for visible reflectance test for ocean with sunlint 25°-30°
visible_reflectance_test_var_confidence_ocean_sunlint_25_30	float	Variability confidence threshold for visible reflectance

		test for ocean with sunglint 25°-30°
visible_reflectance_test_low_confidence_ocean_sunglint_30_36	float	Low confidence threshold for visible reflectance test for ocean with sunglint 30°-36°
visible_reflectance_test_high_confidence_ocean_sunglint_30_36	float	High confidence threshold for visible reflectance test for ocean with sunglint 30°-36°
visible_reflectance_test_var_confidence_ocean_sunglint_30_36	float	Variability confidence threshold for visible reflectance test for ocean with sunglint 30°-36°
reflectance_ratio_test_low_confidence_ocean_no_sunglint	float	Low confidence threshold for reflectance ratio test over ocean, no sun glint
reflectance_ratio_test_high_confidence_ocean_no_sunglint	float	High confidence threshold for reflectance ratio test over ocean, no sun glint
reflectance_ratio_test_low_confidence_ocean_sunglint_0_5	float	cloud-free low confidence value reflectance ratio test over ocean with sunglint angle 0 - 5
reflectance_ratio_test_high_confidence_ocean_sunglint_0_5	float	cloud-free high confidence value reflectance ratio test over ocean with sunglint angle 0 - 5
reflectance_ratio_test_low_confidence_ocean_sunglint_5_10	float	cloud-free low confidence value reflectance ratio test over ocean with sunglint angle 5 - 10
reflectance_ratio_test_high_confidence_ocean_sunglint_5_10	float	cloud-free high confidence value reflectance ratio test over ocean with sunglint angle 5 - 10
reflectance_ratio_test_low_confidence_ocean_sunglint_10_15	float	cloud-free low confidence value reflectance ratio test over ocean with sunglint angle 10 - 15
reflectance_ratio_test_high_confidence_ocean_sunglint_10_15	float	cloud-free high confidence value reflectance ratio test over ocean with sunglint angle 10 - 15
reflectance_ratio_test_low_confidence_ocean_sunglint_15_20	float	cloud-free low confidence value reflectance ratio test over ocean with sunglint angle 15 - 20
reflectance_ratio_test_high_confidence_ocean_sunglint_15_20	float	cloud-free high confidence value reflectance ratio test over ocean with sunglint angle 15 - 20
reflectance_ratio_test_low_confidence_ocean_sunglint_20_25	float	cloud-free low confidence value reflectance ratio test over ocean with sunglint angle 20 - 25
reflectance_ratio_test_high_confidence_ocean_sunglint_20_25	float	cloud-free high confidence value reflectance ratio test over ocean with sunglint angle 20 - 25

reflectance_ratio_test_low_confidence_ocean_sunglint_25_30	float	cloud-free low confidence value reflectance ratio test over ocean with sunglint angle 25 - 30
reflectance_ratio_test_high_confidence_ocean_sunglint_25_30	float	cloud-free high confidence value reflectance ratio test over ocean with sunglint angle 25 - 30
reflectance_ratio_test_low_confidence_ocean_sunglint_30_36	float	cloud-free low confidence value reflectance ratio test over ocean with sunglint angle 30 - 36
reflectance_ratio_test_high_confidence_ocean_sunglint_30_36	float	cloud-free high confidence value reflectance ratio test over ocean with sunglint angle 30 - 36
reflectance_ratio_test_low_confidence_land	float	Low confidence threshold for reflectance ratio test over land
reflectance_ratio_test_high_confidence_land	float	High confidence threshold for reflectance ratio test over land
<b>group:ndvi ndsi thresholds</b>		
ndvi_threshold	float	the NDVI threshold for vegetation detection
ndsi_threshold	float	the NDSI threshold for snow detection
forest_reflectance_o67_threshold	float	threshold for detecting forest with snow feature
water_reflectance_o86_threshold	float	threshold for detecting water with snow feature
<b>group: valid range</b>		
brightness_temperature_min_valid	float	valid range minimum of brightness temperature in the 10.8 $\mu\text{m}$ -channel
brightness_temperature_max_valid	float	valid range maximum of brightness temperature in the 10.8 $\mu\text{m}$ -channel
reflectance_min_valid	float	valid range minimum reflectance of all solar channels
reflectance_max_valid	float	valid range maximum reflectance of all solar channels
scantime_threshold	float	scantime threshold for gap finding
<b>group: copretrieval</b>		
cop_inverse_method	int	Choose the inverse method: 0 iterative and 1 optimal estimation method
rttov_with_emissivity_map	short	Use emissivity maps in the RTTOV model. If 'o' then constant values are used.
emissivity_fix	float	User specified constant emissivity value for land surfaces
cth_init	float	First guess for cloud top height for COP retrieval
tau_init	float	First guess for cloud optical thickness for COP retrieval

reff_init	float	First guess for cloud effective radius for COP retrieval
max_iterations	float	number of iteration in COP
reduced_cop	int	Reduces Area of COP retrieval for debugging 0-FullFrame 1-SingleLine
<b>group: oeretrieval</b>		
cot_background_covariance	float	Define background covariance for cot
reff_background_covariance	float	Define background covariance for reff
ctt_background_covariance	float	Define background covariance for ctt
measure_err_covariance_067	float	Measurement error covariance
measure_err_covariance_165	float	Measurement error covariance
measure_err_covariance_108	float	Measurement error covariance
apriori_cot	float	a priori values for state vector cot
apriori_reff_water	float	a priori values for state vector reff liquid clouds
apriori_ctt_water	float	a priori values for state vector ctt liquid clouds
apriori_reff_ice	float	a priori values for state vector reff ice clouds
apriori_ctt_ice	float	a priori values for state vector ctt ice clouds
max_iterations_oe	int	Max Number of Iterations in OE retrieval
convergence_test_threshold	float	Convergence test threshold

**InputFileList:**

ECA_EXAA_MSI_RGR_1C_yyyymmddThhmmssZ_yyyymmddThhmmssZ_0000F.h5
ECA_EXAA_AUX_MET_1D_yyyymmddThhmmssZ_yyyymmddThhmmssZ_0000F.h5
ECA_EXAA_CFG_MCLD___YYYYMMDDThhmmssZ_20990101T000000Z_1100.EOF
ECA_EXAA_AUX_MLCSTA_00000000T000000Z_99999999T999999Z_0001.nc
ECA_EXAA_AUX_CMSAF_20160101T000000Z_99999999T999999Z_0001.h5
ECA_EXAA_AUX_CLDPHT_00000000T000000Z_99999999T999999Z_0001.nc
ECA_EXAA_AUX_CLIM_20120229T000000Z_99999999T999999Z_0001.h5
ECA_EXAA_AUX_RTTOV_00000000T000000Z_99999999T999999Z_0002

**6.2.2 Science Data**

**Variables:**

Name	Sym bol	Data Type	Dimensio ns	Description	Notes	Units
time	t	dou ble	along_tra ck	Time		Second s since 2000-1-1

						00:00: 00.0 0:00
latitude	lat	double	along_track × across_track	Latitude of MSI grid point		degree _north
longitude	lon	double	along_track × across_track	Longitude of MSI grid point		degree _east
Geoid_offset		float	Along_track	Height of the geoid over the ellipsoid		m
missing_lines_before_flag		byte	Along_track	Missing lines before flag	0: no gap between the prior and this line,1:a gap of unknown size between the prior an this line	
quality_status		byte	along_track × across_track	Quality status	0: valid, 1: valid, quality may be degraded due to snow/sea ice/sunglint, 2:valid, degraded quality due to twilight/night conditions, 3: invalid pixel no retrieval attempted	
cloud_mask	$CM$	byte	along_track × across_track	Cloud mask	1:confident clear, 2:probably clear, 3: probably cloudy, 4: confident cloudy	
cloud_type	$CM_{typ}$	byte	along_track × across_track	Cloud type	ISCCP types 1:cumulus, 2: altocumuls, 3:cirrus, 4:stratocumulus, 5:altostratus, 6:cirrostratus, 7:stratus, 8:nimbostratus, 9: deep convection	
cloud_phase	$CP$	byte	along_track × across_track	Cloud thermodynam ic phase	1:water,2: ice, 3:supercooled, 4:overlap	
surface_classification	$F_{LM}$	short	along_track × across_track	Surface classes	bit0: defined, bit1:water, bit2:land, bit3:desert,bit4:vegetation_ NDVI, bit5: snow_X-Met, bit:6 snow_NDSI,bit:7 sea_ice_X-Met, bit:8 sun glint	
cloud_mask_quality_status	$F_{CM}$	byte	along_track × across_track	Quality status for the cloud mask	bit1:poor, bit2:low, bit3:medium bit4:high	

cloud_type_quality_status	$F_{CM\_b}$	byte	along_track × across_track	Quality status for the cloud mask and type	bit1:poor, bit3:medium bit4:high	bit2:low,	
cloud_phase_quality_status	$F_{CP}$	byte	along_track × across_track	Quality status for the cloud thermodynamic phase	bit1:poor, bit3:medium bit4:high	bit2:low,	

The M-CM product will be set to standard Netcdf fillValues if level MSI-RGR inputs are not valid or the condition for retrieval are not fulfilled.

### 6.3 Datablock file example (CDL header)

This shows the structure (declarations of dimensions, variables, attributes, groups, and types) of the datablock file in network Common Data form Language (CDL) as produced by running the command `ncdump -h` on the data product file.

```
netcdf ECA_EXAA_ref_MSI_CM__2A_2024123118 {

// global attributes:
    string :Conventions = "CF-1.6" ;
    string :title = "" ;
    string :history = "20240324T070442.117309 ../src/M-CLD
./JobOrder.NOM011.xml" ;

group: HeaderData {

    group: FixedProductHeader {
        variables:
            string File_Name ;
            string File_Description ;
            string Notes ;
            string Mission ;
            string File_Class ;
            string File_Type ;
            string File_Version ;

    group: Source {
        variables:
            string System ;
            string Creator ;
            string Creator_Version ;
            string Creation_Date ;
    } // group Source

    group: Validity_Period {
        variables:
            string Validity_Start ;
```

```

        string Validity_Stop ;
    } // group Validity_Period
} // group FixedProductHeader

group: VariableProductHeader {

    group: MainProductHeader {
        variables:
            string productName ;
            string originalProductName ;
            string missionID ;
            string fileClass ;
            string fileCategory ;
            string productType ;
            string productLevel ;
            string sensingStartTime ;
            string sensingStopTime ;
            byte degradedProductQualityFlag ;
            string description ;
            string processorName ;
            short processorMajorVersion ;
            short processorMinorVersion ;
            short executableMajorVersion ;
            short executableMinorVersion ;
            short formatMajorVersion ;
            short formatMinorVersion ;
            byte subsettedProduct ;
            string acquisitionStation ;
            string processingCentre ;
            string processingStartTime ;
            string processingStopTime ;
            uint orbitNumber ;
            string frameID ;
            string ANXTime ;
            double ANXLongitude ;
            string stateVectorSource ;
            string stateVectorTime ;
            double xPosition ;
            double yPosition ;
            double zPosition ;
            double xVelocity ;
            double yVelocity ;
            double zVelocity ;
            double orbitSemiMajorAxis ;
            double orbitEccentricity ;
            double orbitInclination ;
            double perigeeArgument ;
            double rightAscension ;
            double meanAnomaly ;
            string frameStartTime ;
            string frameStopTime ;
            double frameStartMargin ;

```

```

        double frameStopMargin ;

group: frameStartCoordinates {
    variables:
        float geographicLatitude ;
        float geographicLongitude ;
    } // group frameStartCoordinates

group: frameStopCoordinates {
    variables:
        float geographicLatitude ;
        float geographicLongitude ;
    } // group frameStopCoordinates
} // group MainProductHeader

group: SpecificProductHeader {
    variables:
        string InputFileList ;
        string ConfigurationParameters ;

        group: QualityStatistics {
            } // group QualityStatistics
        } // group SpecificProductHeader
    } // group VariableProductHeader
} // group HeaderData

group: ScienceData {
    dimensions:
        along_track = 11215 ;
        across_track = 384 ;
    variables:
        double time(along_track) ;
            time:long_name = "Time" ;
            time:notes = "" ;
            time:units = "seconds since 2000-1-1 00:00:00.0 0:00" ;
        double latitude(along_track, across_track) ;
            latitude:long_name = "Latitude" ;
            latitude:notes = "[-90:90]" ;
            latitude:units = "degree_north" ;
            latitude:_FillValue = 9.96920996838687e+36 ;
        double longitude(along_track, across_track) ;
            longitude:long_name = "Longitude" ;
            longitude:notes = "[-180:180]" ;
            longitude:units = "degree_east" ;
            longitude:_FillValue = 9.96920996838687e+36 ;
        float geoid_offset(along_track) ;
            geoid_offset:long_name = "Height of the geoid over the
ellipsoid" ;
            geoid_offset:units = "m" ;
        byte missing_lines_before_flag(along_track) ;
            missing_lines_before_flag:long_name = "missing lines before
flag" ;

```

```

        missing_lines_before_flag:notes = "[0,1]" ;
        missing_lines_before_flag:definition = "0: no gap between the
prior and this line, 1: a gap of unknown size between the prior an this
line" ;
    byte quality_status(along_track, across_track) ;
        quality_status:long_name = "quality status" ;
        quality_status:notes = "[0-3]" ;
        quality_status:definition = "0: valid, 1: valid, quality may be
degraded due to snow/sea ice/sun glint, 2:valid, degraded quality due to
twilight/night conditions, 3: invalid pixel no retrieval attempted" ;
    byte cloud_mask(along_track, across_track) ;
        cloud_mask:long_name = "Cloud mask" ;
        cloud_mask:notes = "[0-3,-127]" ;
        cloud_mask:definition = "0: confident clear, 1: probably
clear,2: probably cloudy, 3: confident cloudy, -127: not determined" ;
        cloud_mask:_FillValue = -127b ;
    byte cloud_type(along_track, across_track) ;
        cloud_type:long_name = "Cloud type" ;
        cloud_type:notes = "[0-9,-127]" ;
        cloud_type:definition = "0: clear, 1:cumulus, 2:altocumulus,
3:cirrus, 4:stratocumulus, 5:altostratus, 6:cirrostratus, 7:stratus,
8:nimbostratus, 9:deep convection, -127: not determined" ;
        cloud_type:_FillValue = -127b ;
    byte cloud_phase(along_track, across_track) ;
        cloud_phase:long_name = "Cloud phase" ;
        cloud_phase:notes = "[1-4,-127]" ;
        cloud_phase:definition = "1:water, 2:ice, 3:supercooled,
4:overlap, -127: not determined" ;
        cloud_phase:_FillValue = -127b ;
    short surface_classification(along_track, across_track) ;
        surface_classification:long_name = "Surface classification" ;
        surface_classification:notes = "[bitwise]" ;
        surface_classification:definition = "bit0:defined, bit1:water,
bit2:land, bit3:desert, bit4:vegetation_NDVI, bit5: snow_Xmet,
bit6:snow_NDSI, bit7:sea_ice_Xmet, bit8:sun glint" ;
        surface_classification:_FillValue = -32767s ;
    byte cloud_mask_quality_status(along_track, across_track) ;
        cloud_mask_quality_status:long_name = "Quality status for cloud
mask" ;
        cloud_mask_quality_status:notes = "[bitwise]" ;
        cloud_mask_quality_status:definition = "bit1:poor, bit2:low,
bit3:medium, bit4:high" ;
        cloud_mask_quality_status:_FillValue = -127b ;
    byte cloud_type_quality_status(along_track, across_track) ;
        cloud_type_quality_status:long_name = "Quality status for cloud
type" ;
        cloud_type_quality_status:notes = "[bitwise]" ;
        cloud_type_quality_status:definition = "bit1:poor, bit2:low,
bit3:medium, bit4:high" ;
        cloud_type_quality_status:_FillValue = -127b ;
    byte cloud_phase_quality_status(along_track, across_track) ;

```

```

        cloud_phase_quality_status:long_name = "Quality status for
cloud phase" ;
        cloud_phase_quality_status:notes = "[bitwise]" ;
        cloud_phase_quality_status:definition = "bit1:poor, bit2:low,
bit3:medium, bit4:high" ;
    } // group ScienceData
}

```

## 6.4 Header file example (XML)

```

<?xml version="1.0" encoding="UTF-8" standalone="no" ?>
<Earth_Explorer_Header xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">

  <Fixed_Header>
    <File_Name>ECA_EXAA_MSI_CM_2A_20241231T183449Z_20240430T093805Z_39316D</File_Name>
    <File_Description></File_Description>
    <Notes>Test Notes</Notes>
    <Mission>EarthCARE</Mission>
    <File_Class>EXAA</File_Class>
    <File_Type>MSI_CM_2A</File_Type>
    <Validity_Period>
      <Validity_Start>UTC=2024-12-31T18:34:49</Validity_Start>
      <Validity_Stop>UTC=2024-12-31T18:46:36</Validity_Stop>
    </Validity_Period>
    <File_Version>0001</File_Version>
    <Source>
      <System>TROPOSxxxx</System>
      <Creator>M_CLDxxxx</Creator>
      <Creator_Version>1101</Creator_Version>
      <Creation_Date>UTC=2024-04-30T09:38:05</Creation_Date>
    </Source>
  </Fixed_Header>

  <Variable_Header>
    <MainProductHeader>

<productName>ECA_EXAA_MSI_CM_2A_20241231T183449Z_20240430T093805Z_39316D</productName>
    <originalProductName></originalProductName>
    <missionID>ECA</missionID>
    <fileClass>EXAA</fileClass>
    <fileCategory>MSI </fileCategory>
    <productType>CM_ </productType>
    <productLevel>2A</productLevel>
    <sensingStartTime>UTC=2024-12-31T18:34:49</sensingStartTime>
    <sensingStopTime>UTC=2024-12-31T18:46:36</sensingStopTime>
    <degradedProductQualityFlag>0</degradedProductQualityFlag>
    <description></description>
    <processorName>M_CLD</processorName>
    <processorMajorVersion>11</processorMajorVersion>
    <processorMinorVersion>1</processorMinorVersion>
    <executableMajorVersion>11</executableMajorVersion>
    <executableMinorVersion>1</executableMinorVersion>
    <formatMajorVersion>11</formatMajorVersion>
    <formatMinorVersion>1</formatMinorVersion>
    <subsettingProduct>0</subsettingProduct>
    <acquisitionStation>Kiruna_ </acquisitionStation>
    <processingCentre>TROPOSxxxx</processingCentre>
    <processingStartTime>UTC=2024-04-30T09:38:05</processingStartTime>
    <processingStopTime>UTC=2024-04-30T09:39:14</processingStopTime>
    <orbitNumber>39316</orbitNumber>

```

```

</frameID>D</frameID>
<ANXTime>2024-12-31T18:06:11.452397</ANXTime>
<ANXLongitude>0.000000000000000E+00</ANXLongitude>
<stateVectorSource>ONBOARD_GPSxxxx</stateVectorSource>
<stateVectorTime>2024-12-31T18:46:36.000000</stateVectorTime>
<xPosition>2.2719518560000001E+06</xPosition>
<yPosition>-5.8383110209999997E+06</yPosition>
<zPosition>2.5759834700000002E+06</zPosition>
<xVelocity>-3.1846028999999999E+02</xVelocity>
<yVelocity>-3.2393467740000001E+03</yVelocity>
<zVelocity>-7.0302126909999997E+03</zVelocity>
<orbitSemiMajorAxis>0.000000000000000E+00</orbitSemiMajorAxis>
<orbitEccentricity>0.000000000000000E+00</orbitEccentricity>
<orbitInclination>0.000000000000000E+00</orbitInclination>
<perigeeArgument>0.000000000000000E+00</perigeeArgument>
<rightAscension>0.000000000000000E+00</rightAscension>
<meanAnomaly>0.000000000000000E+00</meanAnomaly>
<frameStartCoordinates>
  <GeographicCoordinates>
    <geographicLatitude>67.5000000</geographicLatitude>
    <geographicLongitude>-51.4822083</geographicLongitude>
  </GeographicCoordinates>
</frameStartCoordinates>
<frameStopCoordinates>
  <GeographicCoordinates>
    <geographicLatitude>22.5000000</geographicLatitude>
    <geographicLongitude>-68.7326355</geographicLongitude>
  </GeographicCoordinates>
</frameStopCoordinates>
<frameStartTime>UTC=2024-12-31T18:34:49</frameStartTime>
<frameStopTime>UTC=2024-12-31T18:46:36</frameStopTime>
<frameStartMargin>1000.00</frameStartMargin>
<frameStopMargin>1000.00</frameStopMargin>
</MainProductHeader>
<SpecificProductHeader>
  <InputFileList>ECA_EXAA_MSI_RGR_1C_20241231T183449Z_20240311T114657Z_39316D
ECA_EXAA_AUX_MET_1D_20241231T183449Z_20230623T060856Z_39316D
ECA_EXAA_CFG_MCLD_YYMMDDThhmmssZ_20990101T000000Z_1101
ECA_EXAA_AUX_MLCSTA_0000000T000000Z_9999999T999999Z_0001
ECA_EXAA_AUX_CMSAF_20160101T000000Z_9999999T999999Z_0001
ECA_EXAA_AUX_CLDPHT_0000000T000000Z_9999999T999999Z_0001
ECA_EXAA_AUX_CLIM_20120229T000000Z_9999999T999999Z_0001
ECA_EXAA_AUX_RTTOV_0000000T000000Z_9999999T999999Z_0002
</InputFileList>
  <ConfigurationParameters><![CDATA[<?xml version="1.0" encoding="UTF-8"?>
<Earth_Explorer_File>
  <Earth_Explorer_Header>
    <Fixed_Header>
      <File_Name>ECA_EXAA_CFG_MCLD</File_Name>
      <File_Description>M_CLD_2A Configuration file</File_Description>
      <Notes></Notes>
      <Mission>EarthCARE</Mission>
      <File_Class>EXAA</File_Class>
      <File_Type>AUX_B_CF01</File_Type>
      <Validity_Period>
        <Validity_Start>UTC=2018-01-01T01:01:01</Validity_Start>
        <Validity_Stop>UTC=2021-01-01T01:01:01</Validity_Stop>
      </Validity_Period>
      <File_Version>0001</File_Version>
      <Source>
        <System>EarthCARE Level 2</System>
        <Creator>Anja Hünerbein (TROPOS)</Creator>
        <Creator_Version>11.0</Creator_Version>
    </Fixed_Header>
  </Earth_Explorer_Header>
</Earth_Explorer_File>

```

```

    <Creation_Date>UTC=2020-11-27T10:00:00</Creation_Date>
  </Source>
  </Fixed_Header>
  <Variable_Header></Variable_Header>
</Earth_Explorer_Header>
<Data_Block type="xml">
  <Group name="Compression" description="Parameters controlling internal compression in
the NetCDF-4/HDF5 output products">
    <Parameter name="deflate_level" type="int" dims="1" description="The gzip
compression level from 0 to 9. 0 indicates no compression. 9 is best
compression/slowest">3</Parameter>
    <Parameter name="shuffle" type="int" dims="1" description="If non-zero (and
deflate_level > 0), turn on the shuffle filter. This might improve compression
ratios">1</Parameter>
  </Group>
  <Group name="logging" description="logging parameters">
    <Parameter type="string" name="logging_output_file" dims="1"
description="file_name_for_logging_messages">./mcl_d_logging.log</Parameter>
    <Parameter type="int" name="logging_level" dims="1" description="DEBUG = 0, INFO =
1, PROGRESS = 2, WARN = 3, ERROR = 4">0</Parameter>
  </Group>
  <Group name="output_frame_margins" description="Frame margins for processor output">
    <Parameter type="int" name="config_margins" dims="1" description="set margins from
config-xml: 0=no, 1=yes, 2=not applied">1</Parameter>
    <Parameter type="double" name="margin_before_frame_start" dims="1" units="km"
description="Output product margin before frame start">1000.0</Parameter>
    <Parameter type="double" name="margin_after_frame_stop" dims="1" units="km"
description="Output product margin after frame stop">1000.0</Parameter>
  </Group>
  <Group name="snr" description="msi snr parameters">
    <Parameter name="snr_vis_min" description="signal-to-noise for low signal"
type="double" dims="1" units="1">154.0</Parameter>
    <Parameter name="snr_vis_max" description="signal-to-noise for high signal"
type="double" dims="1" units="1">2110.0</Parameter>
    <Parameter name="snr_nir_min" description="signal-to-noise for low signal"
type="double" dims="1" units="1">135.0</Parameter>
    <Parameter name="snr_nir_max" description="signal-to-noise for high signal"
type="double" dims="1" units="1">1909.0</Parameter>
    <Parameter name="snr_swir1_min" description="signal-to-noise for low signal"
type="double" dims="1" units="1">29.0</Parameter>
    <Parameter name="snr_swir1_max" description="signal-to-noise for high signal"
type="double" dims="1" units="1">1301.0</Parameter>
    <Parameter name="snr_swir2_min" description="signal-to-noise for low signal"
type="double" dims="1" units="1">107.0</Parameter>
    <Parameter name="snr_swir2_max" description="signal-to-noise for high signal"
type="double" dims="1" units="1">4823.0</Parameter>
  </Group>
  <Group name="thresholds" description="thresholds for the threshold based cloud mask">
    <Parameter name="brightness_temperature_low_confidence" type="float" dims="1"
description="cloud-free low confidence value brightness temperature test"
units="K" >267.0</Parameter>
    <Parameter name="brightness_temperature_high_confidence" type="float" dims="1"
description="cloud-free high confidence value brightness temperature test"
units="K" >273.0</Parameter>
    <Parameter name="visible_reflectance_test_low_confidence_land" type="float" dims="1"
description="cloud-free low confidence value visible reflectance test over land"
units="" >0.22</Parameter>
    <Parameter name="visible_reflectance_test_high_confidence_land" type="float"
dims="1" description="cloud-free high confidence value visible reflectance test over land"
units="" >0.14</Parameter>
    <Parameter name="visible_reflectance_test_low_confidence_desert" type="float"
dims="1" description="cloud-free low confidence value visible reflectance test over desert"
units="" >0.62</Parameter>

```

```

    <Parameter name="visible_reflectance_test_high_confidence_desert" type="float"
    dims="1" description="cloud-free high confidence value visible reflectance test over
    desert" units="" >0.58</Parameter>
    <Parameter name="visible_reflectance_test_low_confidence_ocean_no_sunlint"
    type="float" dims="1" description="cloud-free low confidence value visible reflectance test
    over ocean without sunlint" units="" >0.08</Parameter>
    <Parameter name="visible_reflectance_test_high_confidence_ocean_no_sunlint"
    type="float" dims="1" description="cloud-free high confidence value visible reflectance
    test over ocean without sunlint" units="" >0.04</Parameter>
    <Parameter name="visible_reflectance_test_low_confidence_ocean_sunlint_0_5"
    type="float" dims="1" description="cloud-free low confidence value visible reflectance test
    over ocean with sunlint angle 0 - 5" units="" >0.4</Parameter>
    <Parameter name="visible_reflectance_test_high_confidence_ocean_sunlint_0_5"
    type="float" dims="1" description="cloud-free high confidence value visible reflectance
    test over ocean with sunlint angle 0 - 5" units="" >0.2</Parameter>
    <Parameter name="visible_reflectance_test_low_confidence_ocean_sunlint_5_10"
    type="float" dims="1" description="cloud-free low confidence value visible reflectance test
    over ocean with sunlint angle 5 - 10" units="" >0.3</Parameter>
    <Parameter name="visible_reflectance_test_high_confidence_ocean_sunlint_5_10"
    type="float" dims="1" description="cloud-free high confidence value visible reflectance
    test over ocean with sunlint angle 5 - 10" units="" >0.17</Parameter>
    <Parameter name="visible_reflectance_test_var_confidence_ocean_sunlint_5_10"
    type="float" dims="1" description="cloud-free confidence variability visible reflectance
    test over ocean with sunlint angle 5 - 10" units="" >0.1</Parameter>
    <Parameter name="visible_reflectance_test_low_confidence_ocean_sunlint_10_15"
    type="float" dims="1" description="cloud-free low confidence value visible reflectance test
    over ocean with sunlint angle 10 - 15" units="" >0.17</Parameter>
    <Parameter name="visible_reflectance_test_high_confidence_ocean_sunlint_10_15"
    type="float" dims="1" description="cloud-free high confidence value visible reflectance
    test over ocean with sunlint angle 10 - 15" units="" >0.13</Parameter>
    <Parameter name="visible_reflectance_test_var_confidence_ocean_sunlint_10_15"
    type="float" dims="1" description="cloud-free confidence variability visible reflectance
    test over ocean with sunlint angle 10 - 15" units="" >0.01</Parameter>
    <Parameter name="visible_reflectance_test_low_confidence_ocean_sunlint_15_20"
    type="float" dims="1" description="cloud-free low confidence value visible reflectance test
    over ocean with sunlint angle 15 - 20" units="" >0.13</Parameter>
    <Parameter name="visible_reflectance_test_high_confidence_ocean_sunlint_15_20"
    type="float" dims="1" description="cloud-free high confidence value visible reflectance
    test over ocean with sunlint angle 15 - 20" units="" >0.106</Parameter>
    <Parameter name="visible_reflectance_test_var_confidence_ocean_sunlint_15_20"
    type="float" dims="1" description="cloud-free confidence variability visible reflectance
    test over ocean with sunlint angle 15 - 20" units="" >0.01</Parameter>
    <Parameter name="visible_reflectance_test_low_confidence_ocean_sunlint_20_25"
    type="float" dims="1" description="cloud-free low confidence value visible reflectance test
    over ocean with sunlint angle 20 - 25" units="" >0.106</Parameter>
    <Parameter name="visible_reflectance_test_high_confidence_ocean_sunlint_20_25"
    type="float" dims="1" description="cloud-free high confidence value visible reflectance
    test over ocean with sunlint angle 20 - 25" units="" >0.09</Parameter>
    <Parameter name="visible_reflectance_test_var_confidence_ocean_sunlint_20_25"
    type="float" dims="1" description="cloud-free confidence variability visible reflectance
    test over ocean with sunlint angle 20 - 25" units="" >0.01</Parameter>
    <Parameter name="visible_reflectance_test_low_confidence_ocean_sunlint_25_30"
    type="float" dims="1" description="cloud-free low confidence value visible reflectance test
    over ocean with sunlint angle 25 - 30" units="" >0.09</Parameter>
    <Parameter name="visible_reflectance_test_high_confidence_ocean_sunlint_25_30"
    type="float" dims="1" description="cloud-free high confidence value visible reflectance
    test over ocean with sunlint angle 25 - 30" units="" >0.076</Parameter>
    <Parameter name="visible_reflectance_test_var_confidence_ocean_sunlint_25_30"
    type="float" dims="1" description="cloud-free confidence variability visible reflectance
    test over ocean with sunlint angle 25 - 30" units="" >0.01</Parameter>
    <Parameter name="visible_reflectance_test_low_confidence_ocean_sunlint_30_36"
    type="float" dims="1" description="cloud-free low confidence value visible reflectance test
    over ocean with sunlint angle 30 - 36" units="" >0.076</Parameter>

```

```

    <Parameter name="visible_reflectance_test_high_confidence_ocean_sunlint_30_36"
type="float" dims="1" description="cloud-free high confidence value visible reflectance
test over ocean with sunlint angle 30 - 36" units="" >0.06</Parameter>
    <Parameter name="visible_reflectance_test_var_confidence_ocean_sunlint_30_36"
type="float" dims="1" description="cloud-free confidence variability visible reflectance
test over ocean with sunlint angle 30 - 36" units="" >0.01</Parameter>
    <Parameter name="reflectance_ratio_test_low_confidence_ocean_no_sunlint"
type="float" dims="1" description="cloud-free low confidence value reflectance ratio test
ocean no sun glint" units="" >0.95</Parameter>
    <Parameter name="reflectance_ratio_test_high_confidence_ocean_no_sunlint"
type="float" dims="1" description="cloud-free high confidence value reflectance ratio test
ocean no sun glint" units="" >0.85</Parameter>
    <Parameter name="reflectance_ratio_test_low_confidence_ocean_sunlint_0_5"
type="float" dims="1" description="cloud-free low confidence value reflectance ratio test
over ocean with sunlint angle 0 - 5" units="" >1.20</Parameter>
    <Parameter name="reflectance_ratio_test_high_confidence_ocean_sunlint_0_5"
type="float" dims="1" description="cloud-free high confidence value reflectance ratio test
over ocean with sunlint angle 0 - 5" units="" >0.98</Parameter>
    <Parameter name="reflectance_ratio_test_low_confidence_ocean_sunlint_5_10"
type="float" dims="1" description="cloud-free low confidence value reflectance ratio test
over ocean with sunlint angle 5 - 10" units="" >1.16</Parameter>
    <Parameter name="reflectance_ratio_test_high_confidence_ocean_sunlint_5_10"
type="float" dims="1" description="cloud-free high confidence value reflectance ratio test
over ocean with sunlint angle 5 - 10" units="" >0.97</Parameter>
    <Parameter name="reflectance_ratio_test_low_confidence_ocean_sunlint_10_15"
type="float" dims="1" description="cloud-free low confidence value reflectance ratio test
over ocean with sunlint angle 10 - 15" units="" >1.11</Parameter>
    <Parameter name="reflectance_ratio_test_high_confidence_ocean_sunlint_10_15"
type="float" dims="1" description="cloud-free high confidence value reflectance ratio test
over ocean with sunlint angle 10 - 15" units="" >0.95</Parameter>
    <Parameter name="reflectance_ratio_test_low_confidence_ocean_sunlint_15_20"
type="float" dims="1" description="cloud-free low confidence value reflectance ratio test
over ocean with sunlint angle 15 - 20" units="" >1.07</Parameter>
    <Parameter name="reflectance_ratio_test_high_confidence_ocean_sunlint_15_20"
type="float" dims="1" description="cloud-free high confidence value reflectance ratio test
over ocean with sunlint angle 15 - 20" units="" >0.93</Parameter>
    <Parameter name="reflectance_ratio_test_low_confidence_ocean_sunlint_20_25"
type="float" dims="1" description="cloud-free low confidence value reflectance ratio test
over ocean with sunlint angle 20 - 25" units="" >1.04</Parameter>
    <Parameter name="reflectance_ratio_test_high_confidence_ocean_sunlint_20_25"
type="float" dims="1" description="cloud-free high confidence value reflectance ratio test
over ocean with sunlint angle 20 - 25" units="" >0.90</Parameter>
    <Parameter name="reflectance_ratio_test_low_confidence_ocean_sunlint_25_30"
type="float" dims="1" description="cloud-free low confidence value reflectance ratio test
over ocean with sunlint angle 25 - 30" units="" >1.02</Parameter>
    <Parameter name="reflectance_ratio_test_high_confidence_ocean_sunlint_25_30"
type="float" dims="1" description="cloud-free high confidence value reflectance ratio test
over ocean with sunlint angle 25 - 30" units="" >0.87</Parameter>
    <Parameter name="reflectance_ratio_test_low_confidence_ocean_sunlint_30_36"
type="float" dims="1" description="cloud-free low confidence value reflectance ratio test
over ocean with sunlint angle 30 - 36" units="" >1.00</Parameter>
    <Parameter name="reflectance_ratio_test_high_confidence_ocean_sunlint_30_36"
type="float" dims="1" description="cloud-free high confidence value reflectance ratio test
over ocean with sunlint angle 30 - 36" units="" >0.85</Parameter>
    <Parameter name="reflectance_ratio_test_low_confidence_land" type="float" dims="1"
description="cloud-free low confidence value reflectance ratio test land"
units="" >1.95</Parameter>
    <Parameter name="reflectance_ratio_test_high_confidence_land" type="float" dims="1"
description="cloud-free high confidence value reflectance ratio test land"
units="" >1.85</Parameter>
</Group>
<Group name="ndvi_ndsi_thresholds" description="ndvi and ndsi thresholds">

```

```

    <Parameter name="ndvi_threshold" type="float" dims="1" description="the NDVI
threshold for vegetation detection " units="1" >0.3</Parameter>
    <Parameter name="ndsi_threshold" type="float" dims="1" description="the NDSI
threshold for snow detection " units="1" >0.4</Parameter>
    <Parameter name="forest_reflectance_067_threshold" type="float" dims="1"
description="threshold for detecting forest with snow feature" units="W/m2/sr/mum"
>0.1</Parameter>
    <Parameter name="water_reflectance_086_threshold" type="float" dims="1"
description="threshold for detecting water with snow feature " units="W/m2/sr/mum"
>0.11</Parameter>
  </Group>
  <Group name="valid_range" description="valid ranges for input values in nominal
product">
    <Parameter name="brightness_temperature_min_valid" type="float" dims="1"
description="valid range minimum of brightness temperature in the 10.8 mum-channel"
units="K" >10.0</Parameter>
    <Parameter name="brightness_temperature_max_valid" type="float" dims="1"
description="valid range maximum of brightness temperature in the 10.8 mum-channel"
units="K" >400.0</Parameter>
    <Parameter name="reflectance_min_valid" type="float" dims="1" description="valid
range minimum reflectance of all solar channels" units="W/m2/sr/mum" >0.0</Parameter>
    <Parameter name="reflectance_max_valid" type="float" dims="1" description="valid
range maximum reflectance of all solar channels" units="W/m2/sr/mum" >2.5</Parameter>
    <Parameter name="scantime_threshold" type="float" dims="1" description="scantime
threshold for gap finding" units="s" >0.20</Parameter>
  </Group>
  <Group name="copretrieval" description="parameters for the iterative cloud optical
properties retrieval">
    <Parameter name="cop_inverse_method" type="int" dims="1" description="Choose the
inverse method: 0=iterative, 1=optimal estimation">1</Parameter>
    <Parameter name="rttov_with_emissivity_map" type="int" dims="1" description="Use
emissivity map in the RTTOV model. If '0' then constant values are used." units="-"
>1</Parameter>
    <Parameter name="emissivity_fix" type="float" dims="1" description="User specified
fix emissivity value for land surfaces" units="-" >0.98</Parameter>
    <Parameter name="cth_init" type="float" dims="1" description="First guess for
cloud top height in COP retrieval" units="m" >1000</Parameter>
    <Parameter name="tau_init" type="float" dims="1" description="First guess for
optical thickness in COP retrieval" units="1" >2.0</Parameter>
    <Parameter name="reff_init" type="float" dims="1" description="First guess for
effective radius in COP retrieval" units="m" >1.0e-5</Parameter>
    <Parameter name="max_iterations" type="int" dims="1" description="Number of
Iterations in COP retrieval" units="-" >5</Parameter>
    <Parameter name="reduced_cop" type="int" dims="1" description="Reduces Area of
COP retrieval for debugging 0-FullFrame 1-SingleLine" units="-" >0</Parameter>
  </Group>
  <Group name="oeretrieval" description="parameters for the optimal estimation based
cloud optical properties retrieval">
    <Parameter name="cot_background_covariance" type="float" dims="1"
description="define background covariance for cot" units="1" >677.1</Parameter>
    <Parameter name="reff_background_covariance" type="float" dims="1"
description="define background covariance for reff" units="mum " >12.85</Parameter>
    <Parameter name="ctt_background_covariance" type="float" dims="1"
description="define background covariance for ctt" units="K" >8100.0</Parameter>
    <Parameter name="measure_err_covariance_067" type="float" dims="1"
description="measurement error covariance 670nm" units="W/m2/sr/mum"
>0.11664</Parameter>
    <Parameter name="measure_err_covariance_165" type="float" dims="1"
description="measurement error covariance 1.65 mum" units="W/m2/sr/mum"
>0.064</Parameter>
    <Parameter name="measure_err_covariance_108" type="float" dims="1"
description="measurement error covariance 10.8 mum" units="K" >0.9</Parameter>

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    <Parameter name="apriori_cot" type="float" dims="1" description="a priori
values for state vector cot" units="1" >4.0</Parameter>
    <Parameter name="apriori_reff_water" type="float" dims="1" description="a priori
values for state vector reff - liquid phase" units="mum" >3.3</Parameter>
    <Parameter name="apriori_ctt_water" type="float" dims="1" description="a priori
values for state vector ctt - liquid phase" units="K" >270.0</Parameter>
    <Parameter name="apriori_reff_ice" type="float" dims="1" description="a priori
values for state vector reff - ice phase" units="mum" >4.32</Parameter>
    <Parameter name="apriori_ctt_ice" type="float" dims="1" description="a priori
values for state vector ctt - ice phase" units="K" >250.0</Parameter>
    <Parameter name="max_iterations_oe" type="int" dims="1" description="Max Number
of Iterations in OE retrieval" units="-" >10</Parameter>
    <Parameter name="convergence_test_threshold" type="float" dims="1"
description="Convergence test threshold" units="-" >0.01</Parameter>
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