EUMETSAT

EPS-SG Multi-View, -Polarisation, -Spectral Imager (3MI) Level 1B Product Format Specification

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Document Change Record

Version	Date of Version *as on profile*	Document Change Request (DCR) *if applicable*	Description of changes
V1	15 December 2014	N/A	Provided as preliminary version 0
V1A	13 February 2015	N/A	Provided as version 0 for system PDR
V1B	15 September 2015	N/A	Provided as preliminary version 1
V1C	15 December 2015	N/A	Provided as version 1
V2	29 September 2016	N/A	Provided as preliminary version 2
			Sec 1.4 addition of [CF] reference Sec. 1.5 removal of TBW, UT1 acronyms Sec. 1.7, 1.8: Removed due to consolidation of open issues and assumptions with TBD, TBC lists. Update of the document structure
			Change of the units of the L1B image data from radiance to reflectance factor
			Change of the structure of the "data" group to include a "calibration data" group, and that the acquired image data is now time ordered through numbered "View" groups. Both "View" and "calibration data" groups have a substructure composed of individual groups for each channel.
			Implementation of the updates in the GPFS
			Link of the variables in the PGS via introduction of the "PGS symbol" column in the variable tables.
			Dimensions were changed to reflect the dimensionality of the product. Dimension names were chosen to be more expressive.
			Attributes to view and channel groups were added to carry small amounts of metadata.
			Due to redundancy, only one channel group is detailed both for the view groups and the calibration data groups. The full list is included in the XML description.

Version	Date of Version *as on profile*	Document Change Request (DCR) *if applicable*	Description of changes
			910_SWIR channel was removed from the L1B product.
			Pixel-wise flags are introduced Constant angular information was shifted from the view groups to the calibration data. Addition of orbit state data for each IQU triplet (polarised channels) or I image (non-polarised channels) Appendix D describes the content of the flags (further explanation in the PGS)
			Calibration data groups: Inclusion of high-resolution and instrument resolution solar irradiance spectra, including required dimensions Inclusion of bad/dead-pixel maps Calibration data / channel groups: Inclusion of data required to restore the L1B1 counts from the L1B Stokes vectors Inclusion of ISRF Inclusion of Instrument Incident and Instrument Azimuth Angles
			Based on in-house knowledge: Definition of the L1B1 product, including calculation of product size and definition of the XML file.
			Update of L1b product size considering the changes and of the XML file.
V2B	02 September 2016	EPSG_DCR_512	Provided as version 2
			Reference Documents: ID, title and reference for netCDF-CF were corrected.
			Sec. 4.2.4.1.2: description of units for the manoeuvre time stamps was corrected according to GPFS
			Sec. 4.2.4.2.2: description of units for the mode time stamps was corrected according to GPFS

Version	Date of Version *as on profile*	Document Change Request (DCR) *if applicable*	Description of changes
			"um" in units were replaced by "µm"
			4.2.5.4.4.1 Measurement Data: Dimensions : Dimensions were changed to reflect the actual dimensionality of the data. Prior to the change, the dimensions indicated erroneously the subsampling factor of 8.
			Update of Fig. 2 to reflect that the L1B1 product does not contain a Calibration data group.
			Addition of sec. 2.1 to explain the two numbering schemes using for description of 3MI data. Note: The table in this section corresponds to table 10 in the PGS.
			Removal of empty attribute or dimension tables
			Removal of the sunglint flag in accordance with the PGS.
			Update of the XML files to make them compliant with the GPFS XSD schema.
			Variables Err_I, Err_Q, Err_U in the L1B product changed from USHORT to UBYTE to save product size. Product size calculation and XML are updated accordingly.
V3	29 September 2017	N/A	Provided as preliminary version 3
			Consolidation of the PFS content. No major change to previous version, for both L1B1 and L1B data: - Variable shapes have been moved to dimensions - Tie point description has been added (only L1B) - Two counters have been added, one for the orbit rehearsal within 29 days and one for the view acquisition within one daylight orbit - Quality information and flag information has been consolidated

Version	Date of Version *as on profile*	Document Change Request (DCR) *if applicable*	Description of changes
V3A	21 December 2017	EPSG_DCR_876	Provided as version 3
			The comments of the internal review of V3 have been implemented. The data size have been consolidated accordingly: • L1B slightly increased to from 4.38 to 4.915 MB • L1B1 slightly decreased to from 36.7 to 31.687 GB The TBD/TBC tables have been consolidated with the open points.
			• In the xml files, shape="0", and shape="" of any variable were omitted. • Attribute values common to all channels were put into example table in this document. Attributes that don't have a common value for all channels a note was put.
V3A	15 February 2018		• Consistency between L1B and L1B1 tables and their respective xml files were verified and updated • Xml files names were updated • Table 45: Record Format Version Numbers was updated to reflect current version
V3B	13 March 2018	EPSG_DCR_955	Section 4.2.5.1, Table 11: Along track and across tack offsets are added. This makes the numbers of tie points obsolete (have been deleted)

Version	Date of Version *as on profile*	Document Change Request (DCR) *if applicable*	Description of changes
V3C	10 October 2018	N/A	Provided as preliminary version 3 • The ranges for the radiometric, angular and geometrical values have consolidated. • TBC and TBD have been updated/removed from the text. • In order to minimise transcription errors (structure, content) from xml files, the tables are provided using a xml conversion tool.
V3D	12 March 2019	EPSG_DCR_1146	Provided as Version 3 • DEM correction („delta_lat_N_dem" and „delta_lon_E_dem" has been added to the L1B1 (Table 33) and L1B products (Table 13). • L1B1 (Appendix B) and L1B datasize Appendix A) have been adapted considering the point above. • The overall quality flag (Table 23) has been consolidated adding two more bits on "Processing flag statistics" and "Quality of the vicarious calibration" • The XML files have updated considering the points above (Appendix C)
V3G	18 October 2019	EPSG_DCR_1448	Provided as version 3 delta (after 3MI L1B and MAP PGF WS#2) XML file has been updated considering the dynamic range of the Stokes parameters (I,Q,U) to cope with the expected range of reflectance factor. Some typos have been corrected and are visible through track changes, like e.g.: • The typo in the description of the flag content in Appendix D has been corrected and is now in line with the [3MI-L1B-PGS] (no impact on the XML). • Typo corrected in the L1B XML: remaining "_FillValue" will be replaced with "missing_value" • UTC time values defined consistently as "seconds since 2020-01-01 00:00:00.000",

Version	Date of Version *as on profile*	Document Change Request (DCR) *if applicable*	Description of changes
			as per GPFS.

Table of Contents

1   INTRODUCTION

1.1   Purpose and Scope

This document describes the Format Specification for EPS-SG Multi-Viewing, -Polarisation, -Spectral Image (3MI) Level 1B products generated centrally by the EPS-SG Ground Segment at the EUMETSAT Headquarters. It specifies the detailed format of the 3MI Level 1B products in agreement with the format and naming conventions set out in the Generic Product Format Specification [GPFS] applicable to all EPS-SG products.

This document addresses the native format of the products generated in the EPS-SG Ground Segment, which is netCDF-4 as specified in [GPFS]. Other user formats will be specified elsewhere.

The instrument specific Product Format Specification contains all the instrument specific netCDF details, including specific metadata. The common groups and metadata are defined in the [GPFS] .

1.2   Relation to other documents

The EPS-SG 3MI Level 1B Product Format Specification [3MI-L1B-PFS] is a System document in the System Specification Tree. It is called up in [SRD], [OGSRD], 3MI Level 1B Product Generation Specification [3MI-L1B-PGS], and EPS-SG System and Ground Segment documents including ICDs/IRDs wishing to convey information about the 3M Level 1B products format and content.

This document is derived from and compliant to [GPFS] for generic product format and naming conventions applicable to all EPS-SG products.

1.3   Applicable Documents

ID	Title	Reference and version
[GPFS]	EPS-SG Generic Product Format Specification (GPFS)	EUM/LEO-EPSSG/SPE/13/702108
[MCSD]	EPS-SG Mission Conventions and Standards Document	EUM/LEO-EPSSG/STD/14/745221
[DEV]	Development Logic for EPS-SG L0-L1-L2 Processing Specifications	EUM/LEO-EPSSG/TEN/14/763159
[HQ-BAS]	EPS-SG Data and Products Generation, Archiving and Dissemination Baseline at EUMETSAT HQ	EUM/LEO-EPSSG/SPE/15/819557

1.4   Reference Documents

ID	Title	Reference
[SRD]	EPS-SG System Requirements Document	EUM/LEO-EPSSG/SPE/13/735903

ID	Title	Reference
[OGSRD]	EPS-SG Overall Ground Segment Requirements Document	EUM/LEO-EPSSG/REQ/13/725156
[3MI-L1B-PGS]	EPS-SG Multi-View, -Polarisation, -Spectral Imager (3MI) Level 1B Product Generation Specification	EUM/LEO-EPSSG/SPE/14/757689
[netCDF-CF]	netCDF Climate and Forecast (CF) Metadata Conventions: Version 1.6, 5 December 2010	http://cfconventions.org/latest.html

1.5   Acronyms

The definition of conventions, terms and abbreviations applicable to the EPS-SG programme can be found in [MCSD]. Abbreviations specific to this document are listed in the following table.

Acronym	Definition
AOI	Area Of Interest
EPS-SG	EUMETSAT Polar System – Second Generation
3MI	Multi-Directional, Multi-Polarisation and Multi-Spectral Instrument
MoD	Mean of Date
netCDF	Network Common Data Form
NRT	Near Real Time
TBC	To Be Confirmed
TBD	To Be Defined
UTC	Universal Time Coordinated
WMO	World Meteorological Organization
XML	eXtensible Markup Language
XSD	XML Schema Definition

1.6   Conventions and Terminology

Generic conventions and terminology used in this document for EPS-SG products are those described in the [GPFS]. Generic terms and definitions applicable to the EPS-SG Programme can be found in [MCSD].

1.6.1   Meaning of Table Headings

time	Description
Filename	The name of the product (following naming convention described in **[GPFS]**).

time	Description
Product ID	The Product identifier of the product (global attribute: Productidentifier as described in the **[GPFS]**).
Product Description	A summary as defined in the relevant product format specification (global attribute: product_description described in the **[GPFS]**).
Format	Native format of the product (i.e. netCDF-4).
Size	Estimated size of the product (MByte/Orbit).
Duration	Duration of product disseminated to the user (To be defined during Phase C)
Group Name	The name of the NetCDF group
Variable Name	The name of NetCDF variable.
Attribute Name	The name of NetCDF attribute (see also http://www.unidata.ucar.edu/software/netcdf/docs/attribute _conventions.html) Attributes may be global or related to a group instead of a variable; in this case they must appear before dimensions.
Dimension Name	The name of NetCDF dimension.
Description	Description of the element; for a variable the description must coincide with its "long_name" attribute.
Range or value	Range or value of variables, or value of dimensions or attributes, must match the "valid_min", "valid_max", or "valid_range" attributes.
Unit	Unit type of variables or attributes, must coincide with "units" attribute.
Data Type or Type	Type of variables or attributes as defined in NetCDF Users Guide, not used for dimensions.
Dimension	Dimensions of the variables or attributes, in the same order as storage and with one dimension per line. Dimensions must be always defined before variables.
Usage	Usage of the product: - Internal: Product/Data is for use within the EPS-SG system. It is not made available to the end-users. - User: the product is disseminated to the end-users.

1.7 Document structure

Section Number	Title	Content
1	Introduction	The Scope and Purpose of the PFS document is described in this section, along with Open Issues, Assumptions, Applicable and Reference documents.
2	Overview of the instrument: 3MI	A description of the main features and characteristics of the 3MI is provided in this section

Section Number	Title	Content
3	EPS-SG 3MI Product Overview	A high-level overview on the 3MI Level 1B Products structure is presented in this section. The Product Tree and the Product Naming convention are also specified here.
4	EPS-SG 3MI Level 1B Product Detailed Format	The format of each 3MI Level 1B Product (detailed description of the NetCDF Data Files of each product) is described in this section.
6	EPS-SG 3MI Level 1B1 Product Detailed Format	The format of each 3MI Level 1B1 Product (detailed description of the NetCDF Data Files of each product) is described in this section.
APP A	Size of EPS-SG 3MI Level 1B products	In this section the size of each 3MI Level 1B Products is provided.
APP B	Size of EPS-SG 3MI Level 1B1 products	
APP C	XML Description of EPS-SG 3MI L1B Products Format	The .xml schemas for the 3MI Level 1B Products are provided in this section.
APP D	Description of flag contents	

2 OVERVIEW OF THE INSTRUMENT: 3MI

A description of the main features and characteristics of the 3MI is provided in the related
[3MI-L1B-PGS]. The [3MI-L1B-PGS] document also describes in detail the acquisition
modes generating data to be processed in the Ground Segment.

2.1 Numbering of channels and acquisitions

Table 1 shows the naming of the channels and their acquisition order. The assigned sequence
numbers (SN), which indicate the order of the acquisition (channels with the same SN are
acquired simultaneously), and the channel number k is assigned in order of increasing centre
wavelength. The channel numbers of the shutter acquisition are set to 0 and 14, and the 910
SWIR channel is set to 13, so that the L1B product contains contiguous channel number from
1 to 12.

*Table 1: Acquisition of different channels within a single view (about 22s allowing 4 wheel
turns of 5.5s each). "SN" stands for "sequence number" and allows to identify order and
simultaneity of acquisitions. k is the channel number.*

Turn 1					Turn 2	Turn 3			Turn 4
SN	**k**	**VNIR**	**SN**	**k**	**SWIR**	**No acquisitions**	**SN**	**k**	**Only SWIR**	**No acquisitions**
0	0	shutter	0	14	shutter		13	14	shutter	
		3MI_490_1								
1	3	3MI_490_2								
		3MI_490_3								
		3MI_555_1			3MI_1370_1				3MI_1370_1	
2	4	3MI_555_2	2	10	3MI_1370_2		10	10	3MI_1370_2	
		3MI_555_3			3MI_1370_3				3MI_1370_3	
		3MI_410_1								
3	1	3MI_410_2								
		3MI_410_3								
		3MI_670_1			3MI_2130_1				3MI_2130_1	
4	5	3MI_670_2	4	12	3MI_2130_2		11	12	3MI_2130_2	
		3MI_670_3			3MI_2130_3				3MI_2130_3	
		3MI_443_1								
5	2	3MI_443_2								
		3MI_443_3								
		3MI_865_1			3MI_1650_1				3MI_1650_1	
6	8	3MI_865_2	6	11	3MI_1650_2		12	11	3MI_1650_2	
		3MI_865_3			3MI_1650_3				3MI_1650_3	
7	6	3MI_763								

Turn 1						Turn 2	Turn 3			Turn 4
SN	**k**	**VNIR**	**SN**	**k**	**SWIR**	**No acquisitions**	**SN**	**k**	**Only SWIR**	**No acquisitions**
8	9	3MI_910VNIR	8	13	3MI_910SWIR (L1B1 only)					
9	7	3MI_765								

3   EPS-SG 3MI PRODUCT OVERVIEW

The 3MI Level 1B radiance and the 3MI Level 1B1 counts are generated centrally by the
EPS-SG Ground Segment at the EUMETSAT Headquarters.

3.1   Product List

Table 2: EPS-SG 3MI Level 1B Product List

Product ID	Product Description	Usage
3MI-1B-RAD	3MI Level 1B Top of Atmosphere Spectral Radiance in reflectance factor unit	Global/Regional
3MI-1B-PRE	3MI Level 1B1	Global/Regional

3.2   Naming Convention

The naming convention of EPS-SG products complies with the naming convention specified
in [GPFS] for all EPS-SG Ground Segment products generated in native format.

The product name of the 3MI products is according to the following convention:

> **(pflag) '_' (productidentifier) '_' (oflag) '_' (originator) '_'
> (YYYYMMDDhhmmss) '_' (freeformat)**

Where freeformat contains a number of product name fields separated by the underscore
symbol "_".

An example product name using netCDF formatting is provided (for illustrative purpose
only):

> **W_xx-eumetsat-darmstadt,SAT,SGA1-3MI-1B-RAD
> _C_EUMT_20220101121212_G_O_20220101103000_20220101104000_O_N____.nc**

This is a global L1B operational product, generated in NRT the context of the EPS-SG
Global mission, for the Multi-view, Multi-polarisation, Multi-spectral Imager (3MI mission)
embarked on the Metop-SG/A1 satellite (SGA1).

The product was created on the 01 January 2022 at 12:12:12 hours, with a sensing start date
of 01 January 2022 at 10:30:00 hours and a sensing end date of 01 January 2022 at 10:40:00
hours. The file was generated in the Ground Segment operational (O) environment. The
disposition mode indicates that it was produced during routine operations (O), in NRT
processing (N).

4 EPS-SG 3MI LEVEL 1B PRODUCT DETAILED FORMAT

4.1 Overall Structure of EPS-SG 3MI L1B Product

All EPS-SG product types generated by the EPS-SG Ground Segment are NetCDF-4 files complying with the generic structure and data model set out in the [GPFS]. Their high-level structure is presented in Figure 1 and consists of a *Root* group, holding global attributes defined in the [GPFS] and the following sub-groups: *Status, Data* and *Quality*.
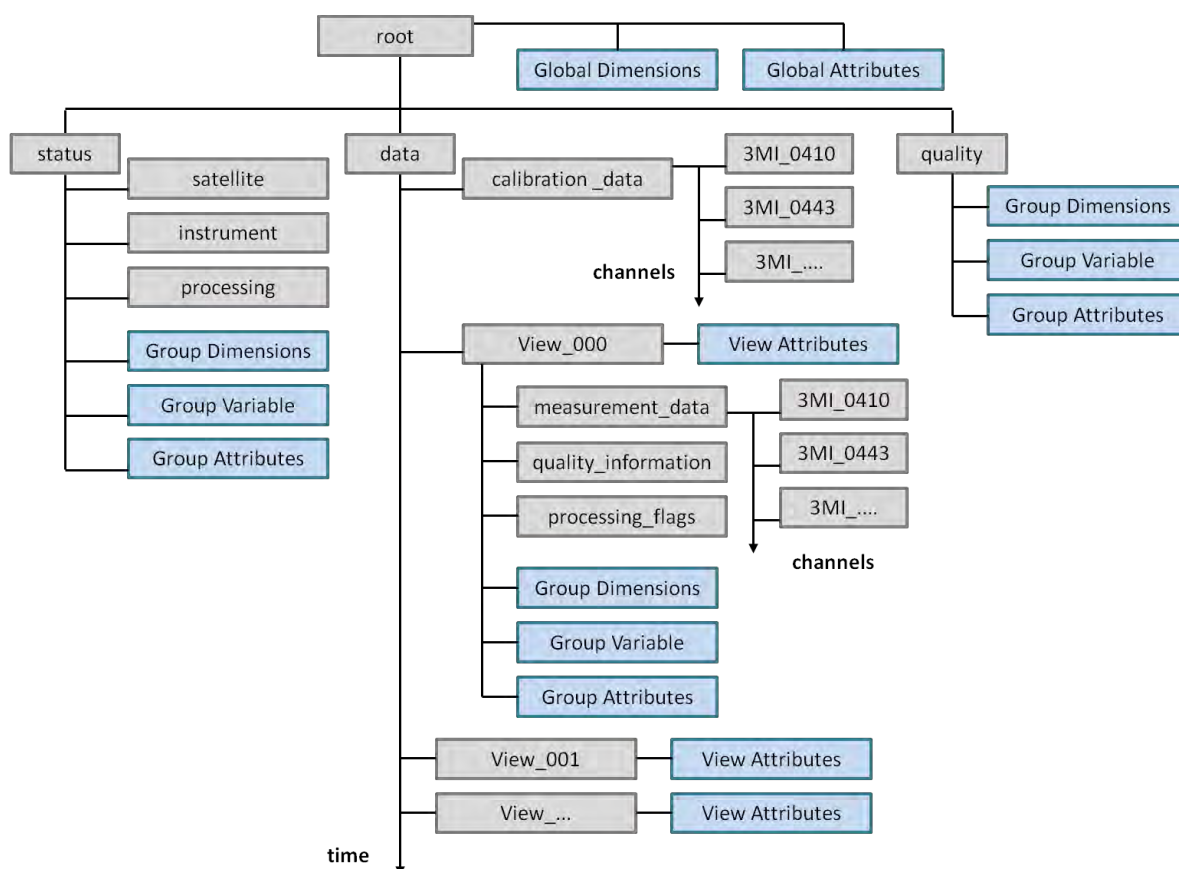
Figure 1: Overall Structure of EPS-SG 3MI L1B Product

In the following sections the physical composition is specified for the 3MI L1B radiance product.

4.2   3MI Level 1B Radiance

This section describes the detailed content of the NetCDF file, including groups, attributes, variables and dimensions applicable to the 3MI Level 1B radiance product.

4.2.1   Product Summary Sheet

The table below provides a summary for the 3MI L1B radiance product. The Level 1B filename in Table 3 is defined according to the conventions described in the [GPFS] and presented in Section 3.2 specifically for 3MI.

Table 3: 3MI radiance product summary sheet

Filename	**W_xx-eumetsat-darmstadt,SAT,SGA[1-3]-3MI-1B-RAD _C_EUMT_ YYYYMMDDhhmmss ___ YYYYMMDDhhmmss _ YYYYMMDDhhmmss __.nc**
Product ID	3MI-1B-RAD
Product Description	Top of Atmosphere Spectral Radiance in reflectance factor unit observed by 3MI (for the polarised channels they are the Stokes parameters on the native grid of the second polariser).
Format	netCDF-4
Size (MBytes/orbit)	6584 (Appendix A)
Duration	To be defined in Phase C

4.2.2   Overall Group Structure

The overall structure of 3MI L1B radiance is in accordance with [GPFS], as described in Section 4.1.

4.2.3   Group Name: Root

4.2.3.1   Attributes (global)

Table 4 describes the global attributes for the 3MI L1B radiance product in accordance with ones defined in [GPFS] .

Table 4: Global attributes for the 3MI radiance product

Name	**Type**	**Value**
Conventions	String	!--latest version of'The Climate and Forecast (CF) Metadata Conventions'. E.g: CF-1.7--
metadata_conventions	String	!--Applicable version of UDDC. E.g: Unidata Dataset Discovery v1.0--
product_name	String	e.g., W_xx-eumetsat-darmstadt,SAT,SGA1-3MI-1B-RAD_C_EUMT_20180713130713_G_D_20070912084309_200709120 84336_T_N____
title	String	3MI L1B Reflectance Factor

	Strin g	
summary	Strin g	!--A summary as defined in the relevant product format specification.--
doi	Strin g	!--Digital Object Identifier--
keywords	Strin g	!--3MI L1B keywords--
history	Strin g	!--original generated product | aggregated product | sub-setted product--
institution	Strin g	EUMETSAT
spacecraft	Strin g	SGA!--[1-3]--
instrument	Strin g	3MI
product_level	Strin g	1B
type	Strin g	RAD
mission_type	Strin g	!--Global|Regional|Local--
disposition_mode	Strin g	!--"Test" | "Commissioning" | "Operational" | "Validation"--
sensing_start_tim e_utc	Strin g	!--UTC time of start of sensing data formatted in CF date and time format with ms precision--
sensing_end_time_ utc	Strin g	!--UTC time of end of sensing data formatted in CF date and time format with ms precision--
environment	Strin g	!--Operational|Validation|Development|Integration and Verification|Engineering--
references	Strin g	www.eumetsat.int
orbit_start	int	!--Absolute orbit number at sensing_start_time_utc--
orbit_end	int	!--Absolute orbit number at sensing_end_time_utc--

4.2.3.2

4.2.3.2   Dimensions (global)

No common global dimensions are currently envisaged.

4.2.3.3   Variables (global)

No common global variables are currently envisaged.

4.2.4   Group Name: Status

This section describes the Status Group for the 3MI radiance product.

4.2.4.1   Group Name: Satellite

4.2.4.1.1   Satellite: Attributes

This section describes satellite Group Attributes for the 3MI radiance. No group attributes are currently defined.

4.2.4.1.2   Satellite: Dimensions

Table 5 describes the Satellite Status Group Dimensions for the 3MI L1B radiance product.

Table 5: Satellite Status: Dimensions for 3MI radiance product

Name	Length
manoeuvre_items	!--Number of manoeuvres occurring between product start and end. (0 ≤ N)--

4.2.4.1.3

4.2.4.1.3   Satellite: Variables

Table 6 describes the variables for the 3MI L1B radiance with their specific attributes.

Table 6: satellite: Variables for 3MI L1B radiance product

Name	Description	Type	Units/Values	Dimension
epoch_time_utc	Epoch time in UTC of the orbital elements	double	seconds since 2020-01-01 00:00:00.000	
	valid_max	double	1.e9	
	valid_min	double	-1.e9	
	missing_value	double	-9.0e9	
semi_major_axis	Semi major axis of orbit	double	m	
	valid_max	double	7.20e6	
	valid_min	double	7.19e6	
	missing_value	double	-9.0e6	
eccentricity	Orbit eccentricity	double	None	
	valid_max	double	0.1170e-2	
	valid_min	double	0.1160e-2	
	missing_value	double	-9.0e2	

		e		
inclination	Orbit inclination	double	degree	
	valid_max	double	98.75	
	valid_min	double	98.65	
	missing_value	double	-99.0	
perigee_argument	Orbit argument of perigee	double	degree	
	valid_max	double	360.0	
	valid_min	double	0.0	
	missing_value	double	-999.0	
right_ascension	Orbit right ascension	double	degree	
	valid_max	double	360.0	
	valid_min	double	0.0	
	missing_value	double	-999.0	
mean_anomaly	Orbit mean anomaly	double	degree	
	valid_max	double	360.0	
	valid_min	double	0.0	
	missing_value	double	-999.0	
earth_sun_distance_ratio	Earth-Sun distance ratio with respect to average distance	double		
	valid_max	double	1.017	
	valid_min	double	0.983	
	missing_value	double	-9999.0	
subsat_latitude_start	Latitude of sub-satellite point at start of product	double	degree	
	valid_max	double	90.0	
	valid_min	doubl	-90.0	

		e		
	missing_value	double	-99.0	
subsat_longitude_start	Longitude of sub-satellite point at start of product	double	degree	
	valid_max	double	360.0	
	valid_min	double	0.0	
	missing_value	double	-999.0	
subsat_latitude_end	Latitude of sub-satellite point at end of product	double	degree	
	valid_max	double	90.0	
	valid_min	double	-90.0	
	missing_value	double	-99.0	
subsat_longitude_end	Longitude of sub-satellite point at end of product	double	degree	
	valid_max	double	360.0	
	valid_min	double	0.0	
	missing_value	double	-999.0	
state_vector_time_utc	Time in UTC of the orbit state vector and attitude items	double	seconds since 2020-01-01 00:00:00.000	
	valid_max	double	1.0e9	
	valid_min	double	-1.e9	
	missing_value	double	-9.0e9	
x_position	X-Position of the orbit state vector	double	m	
	valid_max	double	7.2e6	
	valid_min	double	-7.2e6	
	missing_value	double	-9.0e6	
y_position	Y-Position of the orbit	double	m	

	state vector	e		
	valid_max	double	7.2e6	
	valid_min	double	-7.2e6	
	missing_value	double	-9.0e6	
z_position	Z-Position of the orbit state vector	double	m	
	valid_max	double	7.2e6	
	valid_min	double	-7.2e6	
	missing_value	double	-9.0e6	
x_velocity	X-Velocity of the orbit state vector	double	m/s	
	valid_max	double	8.e3	
	valid_min	double	-8.e3	
	missing_value	double	-9.0e3	
y_velocity	Y-Velocity of the orbit state vector	double	m/s	
	valid_max	double	8.e3	
	valid_min	double	-8.e3	
	missing_value	double	-9.0e3	
z_velocity	Z-Velocity of the orbit state vector	double	m/s	
	valid_max	double	8.e3	
	valid_min	double	-8.e3	
	missing_value	double	-9.0e3	
yaw_error	Yaw attitude error	double	degree	
	valid_max	double	360.0	
	valid_min	double	0.0	
	missing_value	double	-999.0	
roll_error	Roll attitude error	double	degree	

		e		
	valid_max	double	360.0	
	valid_min	double	0.0	
	missing_value	double	-999.0	
pitch_error	Pitch attitude error	double	degree	
	valid_max	double	360.0	
	valid_min	double	0.0	
	missing_value	double	-999.0	
leap_second_time_utc	Time at which leap second was introduced	double	seconds since 2020-01-01 00:00:00.000	
	valid_max	double	1.0e9	
	valid_min	double	-1.0e9	
	missing_value	double	-9.0e9	
leap_second_value	number of leap seconds introduced	short	s	
	valid_max	short	1	
	valid_min	short	-1	
	missing_value	short	-999	
manoeuvre_occurrence	Occurrence of manoeuvres between start and end times of the product: 1 = in-plane manoeuvre occurred 2 = out-of-plane manoeuvre occurred	byte		manoeuvre_items
	valid_max	byte	2	
	valid_min	byte	1	
	missing_value	byte	-9	
manoeuvre_start_time_utc	UTC time of start of manoeuvre	double	seconds since 2020-01-01 00:00:00.000	manoeuvre_items
	valid_max	double	1.0e9	
	valid_min	double	-1.0e9	
	missing_value	doubl	-9.0e9	

		e		
manoeuvre_end_time_utc	UTC time of end of manoeuvre	double	seconds since 2020-01-01 00:00:00.000	manoeuvre_items
	valid_max	double	1.0e9	
	valid_min	double	-1.0e9	
	missing_value	double	-9.0e9	

4.2.4.2 Group Name: Instrument

4.2.4.2.1 Instrument: Dimensions

Table 7 describes the Instrument Status Group Dimensions for the 3MI L1B radiance product.

Table 7: Instrument Status: Dimensions for 3MI radiance product

Name	Length
mode_items	!-- 1 ≤ N --

4.2.4.2.2 Instrument: Variables

Table 8 describes the instrument status group variables for the 3MI L1B radiance product with their specific attributes.

Table 8: Instrument Status: Variables for 3MI radiance product

Name	Description	Type	Units/Values	Dimension
mode_start_time_utc	Start time of the mode	double	seconds since 2020-01-01 00:00:00.000	mode_items
	valid_max	double	1.0e9	
	valid_min	double	-1.0e9	
	missing_value	double	-9.0e9	
mode_end_time_utc	End time of the mode	double	seconds since 2020-01-01 00:00:00.000	mode_items
	valid_max	double	1.0e9	
	valid_min	double	-1.0e9	
	missing_value	double	-9.0e9	
instrument_mode	Name of the instrument mode !--('OPER' | 'CALIBRATION')--	String		mode_items

4.2.4.3   Group Name: Processing

4.2.4.3.1   Processing: Attributes

Table 9 describes the Processing status group variables for the 3MI L1B radiance with their specific attributes.

Table 9: Processing: Attributes for 3MI L1B radiance product

Name	Type	Value
processor_name	String	3MI_L1B
processor_version	String	!--Version number of the processor--
processing_mode	String	!--Processing mode in which the product was generated ("NRT" | "Reprocessing")
format_version	String	!--Product format version control number--
pgs_reference_and_version	String	EUM/LEO-EPSSG/SPE/14/757689 Version !--version of the PGS--
pfs_reference_and_version	String	EUM/LEO-EPSSG/SPE/14/770461 Version !--version of the PFS--
atbd_reference_and_version	String	EUM/LEO-EPSSG/SPE/13/712112 Version !--version of the ATBD--
baseline	String	Climate data record collection version in reprocessed data – optional attribute
source	String	!--A scalar string as particularised in the relevant product format specification--

4.2.4.3.2   Processing: Dimensions

This section describes the processing Group Dimensions for the 3MI L1B radiance. No common group dimensions are currently defined.

4.2.4.3.3   Processing: Variables

Table 10 describes the processing group variables for the 3MI L1B radiance product with their specific attributes.

Table 10: processing: Variables for 3MI L1B radiance product

Name	Description	Type	Units/Values	Dimension
creation_time_utc	UTC time of the product creation	double	seconds since 2020-01-01 00:00:00	

4.2.5 Group Name: Data

4.2.5.1 Data: Dimensions

Table 11 describes the Measurement Data Group Dimensions for the 3MI L1B radiance.

Table 11 Data: Dimensions for 3MI L1B radiance product

Name	Length
lines_VNIR	509
columns_VNIR	509
lines_SWIR	255
columns_SWIR	499
step_size_act	8
step_size_alt	8
offset_act	0 to 7
offset_alt	0 to 7
num_tie_points_act_VNIR	Ceil((lines_VNIR + offset_act) / step_size_act) + 1
num_tie_points_alt_VNIR	Ceil((lines_VNIR + offset_alt) / step_size_alt) + 1
num_tie_points_act_SWIR	Ceil((lines_SWIR + offset_act) / step_size_act) + 1
num_tie_points_alt_SWIR	Ceil((lines_SWIR + offset_alt) / step_size_alt) + 1

4.2.5.2

4.2.5.2 Data: Attributes

Table 12 describes the data group attributes for the 3MI L1B radiance product.

Table 12: Data: Attributes for 3MI L1B radiance product

Name	Type	Value
views	int	!--xxx--

4.2.5.3

4.2.5.3 Data: Variables

No variables are currently envisaged for the Data group.

4.2.5.4 View Groups:

The name of the first View group is "View_000". The numeric suffix is incremented by 1 after each full data acquisition sequence, i.e. after four turns of the filter wheel.
Thus, the data group can contain many "View_nnn"-subgroups, which are all identical in structure. Within the view groups, the data is further structured by the channel groups.

Note that the underlying concept is that a complete View is the smallest amount of data provided as L1B product.

Due to the redundancy of the View groups, only the first one is defined in the XML description of the product.

4.2.5.4.1 View: Dimensions

No dimensions are currently envisaged for the View groups.

4.2.5.4.2 View: Variables

Table 13 View: Variables for 3MI L1B reflectance factor product

Name	Description	Type	Units/Values	Dimension
orbit_index	Orbit rehearsal counter !--(reset every 29 days)--	short		
	valid_max	short	412	
	valid_min	short	1	
	missing_value	short	32767	
view_index	Number of the view (in one orbit)!--Set to 0 at each phase transition within one orbit (day | night)--	byte		
	valid_max	byte	10	
	valid_min	byte	-128	
	scale_factor	float	1	
	add_offset	float	129	
	missing_value	byte	127	

4.2.5.4.3

4.2.5.4.3 View: attributes

No attributes are currently envisaged for the view groups.

TBC: Possible attributes to the group might be time stamps of first and last data acquisition within the view, number of missing frames.

4.2.5.4.4 Group Name: Measurement Data

4.2.5.4.4.1 Measurement Data: Dimensions

No dimensions are currently envisaged for the Measurement Data groups.

4.2.5.4.4.2 Measurement Data: Attributes

No attributes are currently envisaged for the Measurement Data groups.

4.2.5.4.4.3 Measurement Data: Variables

No variables are currently envisaged for the Measurement Data groups.

4.2.5.4.4.4 Channel Groups

All data acquired by a channel during a single acquisition within a view, together with the geolocation and viewing geometry data required for further processing, are stored in channel groups.

The group names correspond to the channel names, i.e. {3MI_0410, 3MI_0443, 3MI_0490, 3MI_0555, 3MI_0670, 3MI_0763, 3MI_0765, 3MI_0865, 3MI_0910_VNIR, 3MI_1370_A, 3MI_1650_A, 3MI_2130_A, 3MI_1370_B, 3MI_1650_B, 3MI_2130_B}. The subscripts "_A" and "_B" are added to distinguish the two acquisitions per SWIR channel per view.

Note: The 3MI_0910_SWIR channel is not part of the L1B product.

As these are all identical, only one channel group is listed explicitly in the PFS. The full list can be found in the XML file format description.

4.2.5.4.4.4.1.1 *Channel: Dimensions*

No dimensions are currently envisaged for the channel groups.

4.2.5.4.4.4.1.2 *Channel: Attributes*

Table 14 Channel: Attributes for 3MI L1B reflectance factor product

Name	Type	Value
sequence_number	byte	Sequence number of channel
channel_number	byte	Channel number
centre_wavelength	long	Channel wavelength centre
bandwidth	String	Channel bandwidth

4.2.5.4.4.4.1.3 *Channel: Variables*

The channel Group Variables for the 3MI L1B radiance product are listed in Table 15 with their specific attributes.

Fields that contain specific values for each channel are left blank. This information is contained in the XML description of the PFS.

The dimensions "lines columns" have to be replaced by "lines_VNIR columns_VNIR" or "lines_SWIR columns_SWIR" depending on the channel. The dimensions "num_tie_points_act num_tie_points_alt" have to be replaced by "num_tie_points_act_VNIR num_tie_points_alt_VNIR" or "num_tie_points_act_SWIR num_tie_points_alt_SWIR depending on the channel.

Note: non-polarised channels (3MI_0763, 3MI_0765, 3MI_0910_VNIR, channel numbers k={6,7,9}) do not include the "Q" and "U" variables.

Table 15 Channel Group: Variables for 3MI L1b product

Name	Description	Type	Units/Values	Dimension
I	TOA Reflectance Factor	short		lines columns
	valid_max	short		
	valid_min	short		
	scale_factor	float		
	add_offset	float		
	missing_value	short		
Err_I	Uncertainty on the TOA Reflectance Factor	short		lines columns
	valid_max	short		
	valid_min	short		
	scale_factor	float		
	add_offset	float		
	missing_value	short		
Q	Second component of Stokes Vector	short		lines columns
	valid_max	short		
	valid_min	short		
	scale_factor	float		
	add_offset	float		
	missing_value	short		
Err_Q	Uncertainty on Q due to noise	short		lines columns
	valid_max	short		
	valid_min	short		
	scale_factor	float		
	add_offset	float		
	missing_value	short		
U	Third component of Stokes Vector	short		lines columns

	valid_max	short		
	valid_min	short		
	scale_factor	float		
	add_offset	float		
	missing_value	short		
Err_U	Uncertainty on U due to noise	short		lines columns
	valid_max	short		
	valid_min	short		
	scale_factor	float		
	add_offset	float		
	missing_value	short		
t_int	Integration time	short	ms	
	valid_max	float	1000	
	valid_min	float	0	
	scale_factor	float	0.1	
	add_offset	float	0	
	missing_value	float	32767	
latitude	latitude in subsampled geo	int	degrees_north	num_tie_points_alt num_tie_points_act
	valid_max	float	1800000	
	valid_min	float	0	
	scale_factor	float	0.0001	
	add_offset	float	-90	
	missing_value	float	2147483647	
longitude	longitude in subsampled geo	int	degrees_east	num_tie_points_alt num_tie_points_act
	valid_max	float	3600000	
	valid_min	float	0	
	scale_factor	float	0.0001	
	add_offset	float	0	

	missing_value	float	2147483647	
delta_lat_N_dem	Orthorectified latitude using Raster Digital Elevation Model (9 arc-seconds)	short	metres_north	lines columns
	valid_max	short	800	
	valid_min	short	0	
	scale_factor	float	50	
	add_offset	float	-20000	
	missing_value	short	32767	
delta_lon_E_dem	Orthorectified longitude using Raster Digital Elevation Model (9 arc-seconds)	short	metres_east	lines columns
	valid_max	short	800	
	valid_min	short	0	
	scale_factor	float	50	
	add_offset	float	-20000	
	missing_value	short	32767	
SZA	Solar Zenith Angle in subsampled geo	short	degrees	num_tie_points_alt num_tie_points_act
	valid_max	float	18000	
	valid_min	float	0	
	scale_factor	float	0.01	
	add_offset	float	-90	
	missing_value	float	32767	
SAA	Solar Azimuth Angle in subsampled geo	short	degrees	num_tie_points_alt num_tie_points_act
	valid_max	float	3232	
	valid_min	float	-32768	
	scale_factor	float	0.01	
	add_offset	float	327.68	
	missing_value	float	32767	
OZA	Observational Zenith Angle in subsampled geo	short	degrees	num_tie_points_alt

				num_tie_points_act
	valid_max	float	7000	
	valid_min	float	0	
	scale_factor	float	0.01	
	add_offset	float	0	
	missing_value	float	32767	
OAA	Observational Azimuth Angle in subsampled geo	short	degrees	num_tie_points_alt num_tie_points_act
	valid_max	float	3232	
	valid_min	float	-32768	
	scale_factor	float	0.01	
	add_offset	float	327.68	
	missing_value	float	32767	
time_utc	UTC time of the acquisition	double	Seconds since 2020-01-01 00:00:00.000	unity
	missing_value	double	-9e9	
temp	temperature of the focal plane at time of the acquisition	short	K	unity
	valid_max	float	3232	
	valid_min	float	-32768	
	scale_factor	float	0.005	
	add_offset	float	323.84	
	missing_value	float	32767	
x_position	X position of the orbital vector in the orbit frame at ascending node [EARTH+FIXED]	int	km	unity
	valid_max	float	2000000	
	valid_min	float	0	
	scale_factor	float	0.01	
	add_offset	float	-10000	
	missing_value	double	2147483647	

y_position	y position of the orbital vector in the orbit frame at ascending node [EARTH+FIXED]	int	km	unity
	valid_max	float	2000000	
	valid_min	float	0	
	scale_factor	float	0.01	
	add_offset	float	-10000	
	missing_value	double	2147483647	
z_position	Z position of the orbital vector in the orbit frame at ascending node [EARTH+FIXED]	int	km	unity
	valid_max	float	2000000	
	valid_min	float	0	
	scale_factor	float	0.01	
	add_offset	float	-10000	
	missing_value	double	2147483647	
x_velocity	X velocity of the orbital vector in the orbit frame at ascending node [EARTH+FIXED]	int	km/s	unity
	valid_max	float	2000000	
	valid_min	float	0	
	scale_factor	float	0.00001	
	add_offset	float	-10	
	missing_value	double	2147483647	
y_velocity	Y velocity of the orbital vector in the orbit frame at ascending node [EARTH+FIXED]	int	km/s	unity
	valid_max	float	2000000	
	valid_min	float	0	
	scale_factor	float	0.00001	
	add_offset	float	-10	
	missing_value	double	2147483647	
z_velocity	Z velocity of the orbital vector in the orbit frame at ascending node [EARTH+FIXED]	int	km/s	unity

	valid_max	float	2000000		
	valid_min	float	0		
	scale_factor	float	0.00001		
	add_offset	float	-10		
	missing_value	double	2147483647		
yaw	Satellite attitude local orbital frame	int	degrees	unity	
	valid_max	float	6315790		
	valid_min	float	0		
	scale_factor	float	0.000057		
	add_offset	float	0		
	missing_value	double	2147483647		
pitch	Satellite attitude local orbital frame	int	degrees	unity	
	valid_max	float	3157895		
	valid_min	float	0		
	scale_factor	float	0.000057		
	add_offset	float	-90		
	missing_value	double	2147483647		
roll	Satellite attitude local orbital frame	int	degrees	unity	
	valid_max	float	3157895		
	valid_min	float	0		
	scale_factor	float	0.000057		
	add_offset	float	-90		
	missing_value	double	2147483647		

4.2.5.4.5 Group Name: Quality_Information

4.2.5.4.5.1 Quality_Information: Attributes

This section describes the quality information Group Attributes for the 3MI radiance. No attributes are currently defined.

4.2.5.4.5.2 Quality_Information: Dimensions

Table 16 Quality_Information: Dimensions for 3MI L1B reflectance factor product

Name	Length
geolocation_quality_dimension	1

4.2.5.4.5.3

4.2.5.4.5.3 Quality_Information: Variables

The quality_information Group Variables for the 3MI L1B reflectance factor product are listed in Table 17**Error! Reference source not found.**, with their specific attributes.

Each channel will have a geolocation quality control flag. As all are identical, only one geolocation_quality variable is listed explicitly in the PFS. The full list can be found in the XML file format description.

The variable name geolocation_quality should be replaced by geolocation_quality_channel, where "channel" is the correspondent channel name, i.e. {3MI_0410, 3MI_0443, 3MI_0490, 3MI_0555, 3MI_0670, 3MI_0763, 3MI_0765, 3MI_0865, 3MI_0910_VNIR, 3MI_1370_A, 3MI_1650_A, 3MI_2130_A, 3MI_1370_B, 3MI_1650_B, 3MI_2130_B}. The subscripts "_A" and "_B" are added to distinguish the two acquisitions per SWIR channel per view.

Table 17: Quality_Information: Variables for 3MI L1B radiance product

Name	Description	Type	Units/Values	Dimension
geolocation_quality	!-- Geolocation quality flag (0 | 1)--	byte		geolocation_quality_dimension

4.2.5.4.6

4.2.5.4.6 Group Name: Processing_Flags

4.2.5.4.6.1 Processing_Flags: Attributes
This section describes the processing_flags Group Attributes for the 3MI radiance. No common group attributes are currently defined.

4.2.5.4.6.2 Processing_Flags: Dimensions

This section describes the processing_flags Group Dimensions for the 3MI radiance View groups. Common group dimensions are currently defined in the Data group (§4.2.5).

4.2.5.4.6.3 Processing_Flags: Variables

This section describes the processing_flags Group Variables for the 3MI radiance with their specific attributes as given in Table 18.

Each channel will have a processing flag. Description of flag contents can be found in Appendix D.

As all processing flags are identical, only one processing _flag variable is listed explicitly in the PFS. The full list can be found in the XML file format description.

The variable name processing flag should be replaced by processing_flag_channel. Where "channel" is the correspondent channel of the flag, i.e. {3MI_0410, 3MI_0443, 3MI_0490, 3MI_0555, 3MI_0670, 3MI_0763, 3MI_0765, 3MI_0865, 3MI_0910_VNIR, 3MI_1370_A, 3MI_1650_A, 3MI_2130_A, 3MI_1370_B, 3MI_1650_B, 3MI_2130_B}. The subscripts "_A" and "_B" are added to distinguish the two acquisitions per SWIR channel per view.

The dimensions "lines columns" have to be replaced by "lines_VNIR columns_VNIR" or "lines_SWIR columns_SWIR" depending on the channel.

Table 18: Processing_Flags: Variables for 3MI L1B radiance product

Name	Description	Type	Units/Values	Dimension
processing_flag_channel	3MI processing flags	unsigned byte		lines columns
	valid_max	byte	254	
	valid_min	byte	0	
	missing_value	byte	255	

4.2.5.5

4.2.5.5 Group Name: Calibration Data

4.2.5.5.1 Calibration Data: Dimensions

Table 19 describes the Calibration Data Group Dimensions for the 3MI L1B radiance.

Table 19 Calibration Data Group: Dimensions for 3MI L1b product

Name	Length
HR_solar_irradiance_sampling	4800
channels	12
polarisers	3

4.2.5.5.2 Calibration Data: Variables

Table 20 describes the Calibration Data Group Variables for the 3MI L1B radiance with their specific attributes. Colours are used to differentiate variable and attributes: variables in light blue and attributes in white with name right-aligned.

Table 20 Calibration Data Group: Variables for 3MI L1b product

Name	Description	Type	Units/Values	Dimension
HR_solar_irradiance_wavelength	High-resolution spectral solar irradiance wavelength scale	float	nm	HR_solar_irradiance_sampling
	valid_max	float	1e9	
	valid_min	float	0	
	missing_value	float	-9e9	
HR_solar_irradiance	High-resolution spectral solar irradiance	float	W m^-2 um^-1	HR_solar_irradiance_sampling
	valid_max	float	1e9	
	valid_min	float	0	
	missing_value	float	-9e9	
channel_aquisition_time	Time of acquisition with respect to filter-wheel	double	ms	channels
	valid_max	double	16000	
	valid_min	double	0	
	missing_value	double	-9e9	
IIA_VNIR	Instrument Incident Angle in subsampled geo	unsigned int	degrees	num_tie_points_alt_VNIR num_tie_points_act_VNIR
	valid_max	int	2097150	
	valid_min	int	0	
	scale_factor	float	4.29154E-05	
	add_offset	float	0.0	
	missing_value	int	2097151	
IAA_VNIR	Instrument Azimuth Angle in subsampled	unsigned int	degrees	num_tie_points_alt_VNIR

				num_tie_points_act_VNIR
	geo			
	valid_max	int	8388606	
	valid_min	int	0	
	scale_factor	float	4.29154E-05	
	add_offset	float	0.0	
	missing_value	int	8388607	
IIA_SWIR	Instrument Incident Angle in subsampled geo	unsigned int	degrees	num_tie_points_alt_SWIR num_tie_points_act_SWIR
	valid_max	int	2097150	
	valid_min	int	0	
	scale_factor	float	4.29154E-05	
	add_offset	float	0.0	
	missing_value	int	2097151	
IAA_SWIR	Instrument Azimuth Angle in subsampled geo	unsigned int	degrees	num_tie_points_alt_SWIR num_tie_points_act_SWIR
	valid_max	int	8388606	
	valid_min	int	0	
	scale_factor	float	4.29154E-05	
	add_offset	float	0.0	
	missing_value	int	8388607	
pol_orientation	Orientation angle of the polariser (-60, 0, 60)	short	Degrees	polarisers

4.2.5.5.3   Channel groups:

For every channel, an individual group, containing the information used to perform the retrieval of the Stokes vector components, is defined. Since the structure and definitions are identical for each channel, only a single group is reproduced here. The full definitions can be found in the XML data format definition in Appendix C.

The group names correspond to the channel names, i.e. {3MI_0410, 3MI_0443, 3MI_0490, 3MI_0555, 3MI_0670, 3MI_0763, 3MI_0765, 3MI_0865, 3MI_0910_VNIR, 3MI_1370, 3MI_1650, 3MI_2130}.

4.2.5.5.3.1   **Channel groups: Dimensions**

Table 21 describes the Calibration Data Group Dimensions for the 3MI L1B radiance.

Table 21 Calibration channel: Dimensions for 3MI radiance product

Name	Length
ISRF_sampling	(detector dependent, see XML for details)
alpha_dimension	3

4.2.5.5.3.2 Channel groups: Variables

Table 22 describes the Calibration Data Group Variables for the 3MI L1B radiance.

The dimensions "ISRF_sampling" have to be replaced by "ISRF_sampling _VNIR or "ISRF_sampling _SWIR" depending on the channel.

Fields that contain specific values for each channel are left blank. This information is contained in the XML description of the PFS.

Table 22 Calibration channel: Variables for 3MI radiance product

Name	Description	Type	Units/Values	Dimension
ISRF_wavelength	ISRF wavelength scale	float	nm	ISRF_sampling
	valid_max	float		
	valid_min	float		
	missing_value	float		
ISRF	Normalised instrument spectral response function	float		ISRF_sampling
	valid_max	float		
	valid_min	float		
	missing_value	float		
gain	Electronic gain	float		gain_dimension
	valid_max	float		
	valid_min	float		
	missing_value	float	-9e9	
abs_cal	Absolute calibration coefficient	float	W m^-2 um^-1 s^-1 / counts	abs_cal_dimension
	valid_max	float	1e9	
	valid_min	float	0	
	missing_value	float	-9e9	

4.2.6   Group Name: Quality

4.2.6.1   Quality: Attributes

Table 23 describes the Quality Group Attributes for the 3MI L1B reflectance factor.

Table 23: Quality: Attributes for 3MI L1B radiance product

Name	Type	Value
overall_quality_flag	unsigned short	!--'0' if overall quality is OK. Individual bits of the flag are set to indicate degraded conditions: Bit 0: Missing input product(s) Bit 1: Data gap(s) Bit 2: Corrupted input product(s) Bit 3: Instrument anomaly Bit 4: missing or degraded auxiliary data(s) Bit 5: degraded due to manoeuvre Bit 6: Processing flag statistics Bit 7: Quality of the vicarious calibration

4.2.6.2

4.2.6.2   Quality: Dimensions

The following dimensions are foreseen for the Quality group of the 3MI L1B radiance product.

Table 24: quality Dimensions

Name	Length
gap_items	!--Number of gaps indentified during product duration. Note: it will not appear in the Product if overall_quality_flag bit 1 equals 0.--

4.2.6.3   Quality: Variables

Table 25 describes the Quality Group Variables for the 3MI L1B radiance with their specific attributes. Colours are used to differentiate variable and attributes: variables in light blue and attributes in white with name right-aligned.

Table 25: Quality: Variables for 3MI L1B reflectance factor product

Name	Description	Type	Units/Values	Dimension
duration_of_product	Entire duration of	double	s	

	product			
	valid_min	double	0	
duration_of_data_present	Amount of data present in product	double	s	
	valid_min	double	0	
duration_of_data_missing	Amount of data missing in product	double	s	
	valid_min	double	0	
duration_of_data_degraded	Amount of data degraded in product	double	s	
	valid_min	double	0	
gap_start_time_utc	'Gap start time in UTC' Note: will not appear in the Product if overall_quality_flag bit 1 equals 0. CF date and time format.	double	seconds since 2020-01-01 00:00:00.000	gap_items
	valid_min	double	-1.0e9	
gap_end_time_utc	'Gap end time in UTC' Note: will not appear in the Product if overall_quality_flag bit 1 equals 0. CF date and time format.	double	seconds since 2020-01-01 00:00:00.000	gap_items
	valid_min	double	-1.0e9	

5 EPS-SG 3MI LEVEL 1B1 PRODUCT DETAILED FORMAT

5.1 Overall Structure of EPS-SG Products

All EPS-SG product types generated by the EPS-SG Ground Segment are NetCDF-4 files complying with the generic structure and data model set out in the [GPFS]. Their high-level structure is presented in Figure 2 and consists of a *Root* group, holding global attributes defined in the [GPFS] and the following sub-groups: *Status, Data* and *Quality*.
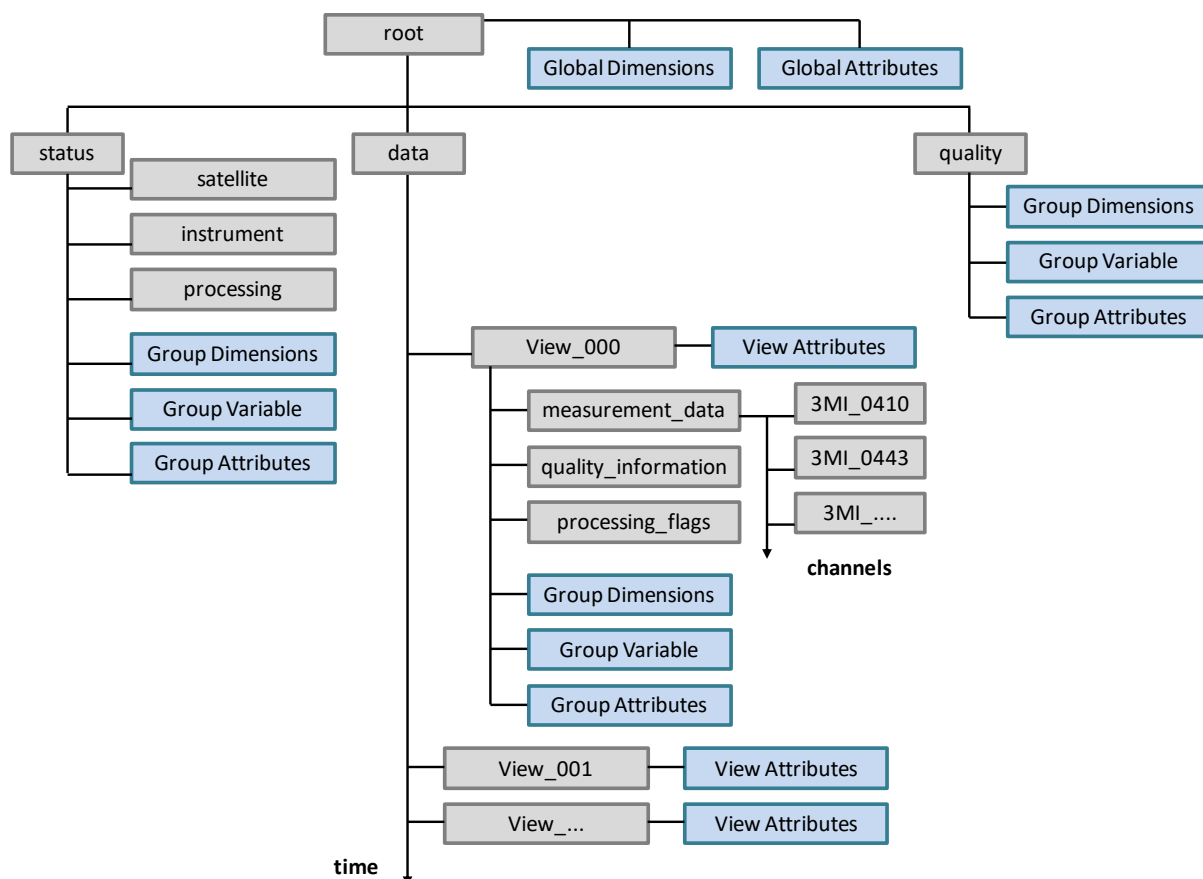

Figure 2: Overall Structure of EPS-SG 3MI L1B1 Product

In the following sections the physical composition is specified for the 3MI Level 1B1 counts product.

5.2 3MI Level 1B1 counts

This section describes the detailed content of the NetCDF file, including groups, attributes, variables and dimensions applicable to the 3MI Level 1B1 counts product.

5.2.1 Product Summary Sheet

The table below provides a summary for the 3MI Level 1B1 counts product. The Level 1B1 filename in Table 26 is defined according to the conventions described in the [GPFS] and presented in Section 3.2 specifically for 3MI.

Table 26: 3MI counts product summary sheet

Filename	**W_xx-eumetsat-darmstadt,SAT,SGA[1-3]-3MI-1B-PRE _C_EUMT_ YYYYMMDDhhmmss ___ YYYYMMDDhhmmss _ YYYYMMDDhhmmss __.nc**
Product ID	3MI-1B-PRE
Product Description	Raw counts for single acquisitions observed by 3MI.
Format	netCDF-4
Size (MBytes/orbit)	27983 (Appendix B) TBC
Duration	To be defined in Phase C

5.2.2 Overall Group Structure

The overall structure of 3MI L1B1 counts is in accordance with [GPFS], as described in Section 4.1.

5.2.3 Group Name: Root

5.2.3.1 Dimensions (global)

No common global dimensions are currently envisaged.

5.2.3.2 Attributes (global)

Table 27 describes the global attributes for the 3MI Level 1B1 counts product in accordance with ones defined in [GPFS] .

Table 27: Global attributes for the 3MI counts product

Name	Type	Value
Conventions	String	!--latest version of 'The Climate and Forecast (CF) Metadata Conventions'. E.g: CF-1.6--
metadata_conventions	String	!--Applicable version of UDDC. E.g: Unidata Dataset Discovery v1.0--
product_name	String	e.g., W_xx-eumetsat-darmstadt,SAT,SGA1-3MI-1B-

		RAD_C_EUMT_20180713130713_G_D_20070912084309_2007091 2084336_T_N____
title	String	3MI L1B1 counts
summary	String	!--A summary as defined in the relevant product format specification.--
doi	String	!--Digital Object Identifier--
keywords	String	!--3MI L1B1 keywords--
history	String	!--original generated product | aggregated product | sub-setted product--
institution	String	EUMETSAT
spacecraft	String	SGA!--[1-3]--
instrument	String	3MI
product_level	String	1B1
type	String	PRE
mission_type	String	!--Global|Regional|Local--
disposition_mode	String	!--"Test" | "Commissioning" | "Operational" | "Validation"--
sensing_start_time_utc	String	!--UTC time of start of sensing data formatted in CF date and time format with ms precision--
sensing_end_time_utc	String	!--UTC time of end of sensing data formatted in CF date and time format with ms precision--
environment	String	!--Operational|Validation|Development|Integration and Verification|Engineering--
references	String	www.eumetsat.int
orbit_start	int	!--Absolute orbit number at sensing_start_time_utc--
orbit_end	int	!--Absolute orbit number at sensing_end_time_utc--

5.2.3.3

5.2.3.3 Variables (global)

No common global variables are currently envisaged.

5.2.4 Group Name: Status

This section describes the Status Group for the 3MI counts product. No dimension, attributes or variables are currently envisage for this group.

5.2.4.1 Group Name: Satellite

5.2.4.1.1 Satellite: Attributes

This section describes satellite Group Attributes for the 3MI counts. No group attributes are currently defined.

5.2.4.1.2 Satellite: Dimensions

Table 28 describes the Satellite Status Group Dimensions for the 3MI L1B1 counts product.

Table 28: Satellite Status: Dimensions for 3MI counts product

Name	Length
manoeuvre_items	!--Number of manoeuvres occurring between product start and end. (0 ≤ N)--

5.2.4.1.3

5.2.4.1.3 Satellite: Variables

Table 29 describes the variables for the 3MI L1B1 counts with their specific attributes.

Table 29: satellite: Variables for 3MI L1B1 counts product

Name	Description	Type	Units/Values	Dimension
epoch_time_utc	Epoch time in UTC of the orbital elements and the orbit state vector	double	seconds since 2020-01-01 00:00:00.000	
	valid_max	double	1.0e9	
	valid_min	double	-1.0e9	
	missing_value	double	-9.0e9	
semi_major_axis	Semi major axis of orbit	double	m	
	valid_max	double	7.20e6	
	valid_min	double	7.19e6	
	missing_value	double	-9.0e6	
eccentricity	Orbit eccentricity	double	None	
	valid_max	double	0.1170e-2	
	valid_min	double	0.1160e-2	
	missing_value	double	-9.0e2	
inclination	Orbit inclination	double	degree	
	valid_max	double	98.75	
	valid_min	double	98.65	
	missing_value	double	-99.0	
perigee_argument	Orbit argument of perigee	double	degree	

	valid_max	double	360.0	
	valid_min	double	0.0	
	missing_value	double	-999.0	
right_ascension	Orbit right ascension	double	degree	
	valid_max	double	360.0	
	valid_min	double	0.0	
	missing_value	double	-999.0	
mean_anomaly	Orbit mean anomaly	double	degree	
	valid_max	double	360.0	
	valid_min	double	0.0	
	missing_value	double	-999.0	
earth_sun_distance_ratio	Earth-Sun distance ratio with respect to average distance	double		
	valid_max	double	1.017	
	valid_min	double	0.983	
	missing_value	double	-9999.0	
subsat_latitude_start	Latitude of sub-satellite point at start of product	double	degree	
	valid_max	double	90.0	
	valid_min	double	-90.0	
	missing_value	double	-99.0	
subsat_longitude_start	Longitude of sub-satellite point at start of product	double	degree	
	valid_max	double	360.0	
	valid_min	double	0.0	
	missing_value	double	-999.0	

subsat_latitude_end	Latitude of sub-satellite point at end of product	double	degree	
	valid_max	double	90.0	
	valid_min	double	-90.0	
	missing_value	double	-99.0	
subsat_longitude_end	Longitude of sub-satellite point at end of product	double	degree	
	valid_max	double	360.0	
	valid_min	double	0.0	
	missing_value	double	-999.0	
state_vector_time_utc	Time in UTC of the orbit state vector and attitude items	double	seconds since 2020-01-01 00:00:00.000	
	valid_max	double	1.0e9	
	valid_min	double	-1.0e9	
	missing_value	double	-9.0e9	
x_position	X-Position of the orbit state vector	double	m	
	valid_max	double	7.2e6	
	valid_min	double	-7.2e6	
	missing_value	double	-9.0e6	
y_position	Y-Position of the orbit state vector	double	m	
	valid_max	double	7.2e6	
	valid_min	double	-7.2e6	
	missing_value	double	-9.0e6	
z_position	Z-Position of the orbit state vector	double	m	
	valid_max	double	7.2e6	
	valid_min	double	-7.2e6	

	missing_value	double	-9.0e6	
x_velocity	X-Velocity of the orbit state vector	double	m/s	
	valid_max	double	8.e3	
	valid_min	double	-8.e3	
	missing_value	double	-9.0e3	
y_velocity	Y-Velocity of the orbit state vector	double	m/s	
	valid_max	double	8.e3	
	valid_min	double	-8.e3	
	missing_value	double	-9.0e3	
z_velocity	Z-Velocity of the orbit state vector	double	m/s	
	valid_max	double	8.e3	
	valid_min	double	-8.e3	
	missing_value	double	-9.0e3	
yaw_error	Yaw attitude error	double	degree	
	valid_max	double	360.0	
	valid_min	double	0.0	
	missing_value	double	-999.0	
roll_error	Roll attitude error	double	degree	
	valid_max	double	360.0	
	valid_min	double	0.0	
	missing_value	double	-999.0	
pitch_error	Pitch attitude error	double	degree	
	valid_max	double	360.0	
	valid_min	double	0.0	

	missing_value	double	-999.0	
leap_second_time_utc	Time at which leap second was introduced	double	seconds since 2020-01-01 00:00:00.000	
	valid_max	double	1.0e9	
	valid_min	double	-1.0e9	
	missing_value	double	-9.0e9	
leap_second_value	number of leap seconds introduced	short	s	
	valid_max	short	1	
	valid_min	short	-1	
	missing_value	short	-999	
manoeuvre_occurrence	Occurrence of manoeuvres between start and end times of the product	byte		manoeuvre_items
	valid_max	byte	2	
	valid_min	byte	1	
	missing_value	byte	-9	
manoeuvre_start_time_utc	UTC time of start of manoeuvre	double	seconds since 2020-01-01 00:00:00.000	manoeuvre_items
	valid_max	double	1.0e9	
	valid_min	double	-1.0e9	
	missing_value	double	-9.0e9	
manoeuvre_end_time_utc	UTC time of end of manoeuvre	double	seconds since 2020-01-01 00:00:00.000	manoeuvre_items
	valid_max	double	1.0e9	
	valid_min	double	-1.0e9	
	missing_value	double	-9.0e9	

5.2.4.2 Group Name: Instrument

5.2.4.2.1 Instrument: Dimensions

Table 30 describes the Instrument Status Group Dimensions for the 3MI L1B1 counts product

Table 30: Instrument Status: Dimensions for 3MI counts product

Name	Length
mode_items	!-- 1 ≤ N --

5.2.4.2.2 Instrument: Variables

Table 31 describes the instrument status group variables for the 3MI L1B1 counts product with their specific attributes.

Table 31: Instrument Status: Variables for 3MI counts product

Name	Description	Type	Units/Values	Dimension
mode_start_time_utc	!--Start time of the mode--	double	seconds since 2020-01-01 00:00:00.000	mode_items
	valid_max	double	1.0e9	
	valid_min	double	-1.0e9	
	missing_value	double	-9.0e9	
mode_end_time_utc	!--End time of the mode--	double	seconds since 2020-01-01 00:00:00.000	mode_items
	valid_max	double	1.0e9	
	valid_min	double	-1.0e9	
	missing_value	double	-9.0e9	
instrument_mode	!--Name of the instrument mode ('OPER' | 'CALIBRATION')--	String		mode_items

5.2.4.3 Group Name: Processing

5.2.4.3.1 Processing: Attributes

Table 32 describes the Processing status group variables for the 3MI L1B1 counts with their specific attributes.

Table 32: Processing: Attributes for 3MI L1B1 counts product

Name	Type	Value
processor_name	String	3MI_L1B
processor_version	String	!--Version number of the processor--
processing_mode	String	!--Processing mode in which the product was generated ("NRT" | "Reprocessing")

format_version	String	!--Product format version control number--
pgs_reference_and_version	String	!--Reference and version of the PGS--
pfs_reference_and_version	String	!--Reference and version of the PFS--
atbd_reference_and_version	String	!--Reference and version of the ATBD--
baseline	String	Climate data record collection version in reprocessed data – optional attribute
source	String	!--As particularised in the relevant product format specification--

5.2.4.3.2

5.2.4.3.2 Processing: Dimensions

This section describes the processing Group Dimensions for the 3MI Level 1B1 counts. No common group dimensions are currently defined.

5.2.4.3.3 Processing: Variables

Table 33 describes the processing group variables for the 3MI Level 1B1 counts product with their specific attributes.

Table 33: processing: Variables for 3MI L1B1 counts product

Name	Description	Type	Units/Values	Dimension
creation_time_utc	UTC time of the product creation	double	seconds since 2020-01-01 00:00:00	

5.2.5   Group Name: Data

5.2.5.1 Data: Dimensions

Table 34 describes the Measurement Data Group Dimensions for the 3MI Level 1B1 counts.

Table 34 Data: Dimensions for 3MI L1B1 counts product

Name	Length
lines_VNIR	509
columns_VNIR	509
lines_SWIR	255
columns_SWIR	499
polarised_channel	3
non_polarised_channel	1

5.2.5.2 Data: Attributes

Table 35 describes the data group attributes for the 3MI L1B1 counts product.

Table 35: Data: Attributes for 3MI L1B1 counts product

Name	Type	Value
views	int	!--???--

5.2.5.3

5.2.5.3 Data: Variables

No variables are currently envisaged for the Data group.

5.2.5.4 View Groups:

The name of the first View group is "View_000". The numeric suffix is incremented by 1 after each full data acquisition sequence, i.e. after four turns of the filter wheel.
Thus, the data group can contain many "View_nnn"-subgroups, which are all identical in structure. Within the view groups, the data is further structured by the channel groups.

Note that the underlying assumption is that a complete View is the smallest amount of data provided as L1B1 product.

Due to the redundancy of the View groups, only the first one is defined in the XML description of the product.

5.2.5.4.1 View: Dimensions
No dimensions are currently envisaged for the View groups.

5.2.5.4.2 View: attributes
No attributes are currently envisaged for the view groups.

5.2.5.4.3 View: Variables
Table 36 View: Variables for 3MI L1B1 counts product describes the View group Variables for the 3MI Level 1B1 counts.

Table 36 View: Variables for 3MI L1B1 counts product

Name	Description	Type	Units/Values	Dimension
orbit_index	Orbit rehearsal counter !--(reset every 29 days)--	short		
	valid_max	short	412	
	valid_min	short	1	
	missing_value	short	32767	
view_index	Number of the view (in one orbit)!--Set to 0 at each phase transition within one orbit (day | night)--	byte		
	valid_max	byte	10	
	valid_min	byte	-128	
	scale_factor	float	1	
	add_offset	float	129	
	missing_value	byte	127	

5.2.5.4.4

5.2.5.4.4 Group Name: Measurement Data

5.2.5.4.4.1 **Channel Groups**

All data acquired by a channel during a single acquisition within a view, together with the geolocation and viewing geometry data required for further processing, are stored in channel groups.

The group names correspond to the channel names, i.e. {3MI_0410, 3MI_0443, 3MI_0490, 3MI_0555, 3MI_0670, 3MI_0763, 3MI_0765, 3MI_0865, 3MI_0910_VNIR, 3MI_0910_SWIR_A, 3MI_1370_A, 3MI_1650_A, 3MI_2130_A, 3MI_1370_B, 3MI_1650_B, 3MI_2130_B}. The subscripts "_A" and "_B" are added to distinguish the two acquisitions per SWIR channel per view.

As these are all identical, only one channel group is listed explicitly in the PFS. The full list can be found in the XML file format description.

5.2.5.4.4.1.1.1 *Channel: Dimensions*

No dimensions are currently envisaged for the channel groups.

5.2.5.4.4.1.1.2 *Channel: Attributes*

Table 37 describes the Channel group Attributes for the 3MI Level 1B1 counts.

Table 37Channel: Attributes for 3MI L1B1 counts product

Name	Type	Value
sequence_number	byte	Sequence number of channel
channel_number	byte	Channel number
centre_wavelength	long	Channel wavelength centre

bandwidth	String	Channel bandwidth

5.2.5.4.4.1.1.3   *Channel: Variables*

The channel Group Variables for the 3MI L1B1 counts product are listed in Table 38 with their specific attributes.

Fields that contain specific values for each channel are left blank. This information is contained in the XML description of the PFS.

The dimensions "lines columns" should be replaced by "lines_VNIR columns_VNIR", respectively by "lines_SWIR columns_SWIR", depending on the detector head.

The dimensions "polarisers" should be replaced by "polarised_channel" or "non_polarised_channel" depending on whether the respective channel is polarised or not.

Table 38 Channel Group: Variables for 3MI L1b1 product

Name	Description	Type	Units/Values	Dimension
C	Total counts	short		polarisers lines columns
	valid_max	short	32766	
	valid_min	short	0	
	scale_factor	float	0.5	
	add_offset	float	0	
	missing_value	short	32767	
Cerr	Radiometric noise	short		polarisers lines columns
	valid_max	short	32766	
	valid_min	short	0	
	scale_factor	float	0.5	
	add_offset	float	0	
	missing_value	short	32767	
t_int	Integration time	short	ms	polarisers
	valid_max	float	1000	
	valid_min	float	0	
	scale_factor	float	0.1	
	add_offset	float	0	
	missing_value	float	32767	
latitude	latitude	int	degrees_north	polarisers lines columns
	valid_max	float	1800000	
	valid_min	float	0	
	scale_factor	float	0.0001	
	add_offset	float	-90	
	missing_value	float	2147483647	
longitude	longitude	int	degrees_east	polarisers lines columns
	valid_max	float	3600000	

	valid_min	float	0	
	scale_factor	float	0.0001	
	add_offset	float	0	
	missing_value	float	2147483647	
delta_lat_N_dem	Orthorectified latitude using Raster Digital Elevation Model (9 arc-seconds)	short	metres_north	polarisers lines columns
	valid_max	short	800	
	valid_min	short	0	
	scale_factor	float	50	
	add_offset	float	-20000	
	missing_value	short	32767	
delta_lon_E_dem	Orthorectified longitude using Raster Digital Elevation Model (9 arc-seconds)	short	metres_east	polarised lines columns
	valid_max	short	800	
	valid_min	short	0	
	scale_factor	float	50	
	add_offset	float	-20000	
	missing_value	short	32767	
SZA	Solar Zenith Angle	short	degrees	polarisers lines columns
	valid_max	float	18000	
	valid_min	float	0	
	scale_factor	float	0.01	
	add_offset	float	-90	
	missing_value	float	32767	
SAA	Solar Azimuth Angle	short	degrees	polarisers lines columns
	valid_max	float	3232	
	valid_min	float	-32768	
	scale_factor	float	0.01	
	add_offset	float	327.68	
	missing_value	float	32767	

OZA	Observational Zenith Angle	short	degrees	polarisers lines columns
	valid_max	float	7000	
	valid_min	float	0	
	scale_factor	float	0.01	
	add_offset	float	0	
	missing_value	float	32767	
OAA	Observational Azimuth Angle	short	degrees	polarisers lines columns
	valid_max	float	3232	
	valid_min	float	-32768	
	scale_factor	float	0.01	
	add_offset	float	327.68	
	missing_value	float	32767	
time_utc	UTC time of the acquisition	double	seconds since 2020-01-01 00:00:00.000	polarisers
	missing_value	double	-9e9	
temp	temperature of the focal plane at time of the acquisition	short	K	polarisers
	valid_max	float	3232	
	valid_min	float	-32768	
	scale_factor	float	0.005	
	add_offset	float	323.84	
	missing_value	float	32767	
x_position	X position of the orbital vector in the orbit frame at ascending node [EARTH+FIXED]	int	km	polarisers
	valid_max	float	2000000	
	valid_min	float	0	
	scale_factor	float	0.01	
	add_offset	float	-10000	
	missing_value	double	2147483647	
y_position	y position of the orbital vector in the orbit frame	int	km	polarisers

	at ascending node [EARTH+FIXED]			
	valid_max	float	2000000	
	valid_min	float	0	
	scale_factor	float	0.01	
	add_offset	float	-10000	
	missing_value	double	2147483647	
z_position	X position of the orbital vector in the orbit frame at ascending node [EARTH+FIXED]	int	km	polarisers
	valid_max	float	2000000	
	valid_min	float	0	
	scale_factor	float	0.01	
	add_offset	float	-10000	
	missing_value	double	2147483647	
x_velocity	X velocity of the orbital vector in the orbit frame at ascending node [EARTH+FIXED]	int	km/s	polarisers
	valid_max	float	2000000	
	valid_min	float	0	
	scale_factor	float	0.00001	
	add_offset	float	-10	
	missing_value	double	2147483647	
y_velocity	Y velocity of the orbital vector in the orbit frame at ascending node [EARTH+FIXED]	int	km/s	polarisers
	valid_max	float	2000000	
	valid_min	float	0	
	scale_factor	float	0.00001	
	add_offset	float	-10	
	missing_value	double	2147483647	
z_velocity	Z velocity of the orbital vector in the orbit frame at ascending node [EARTH+FIXED]	int	km/s	polarisers
	valid_max	float	2000000	

	valid_min	float	0	
	scale_factor	float	0.00001	
	add_offset	float	-10	
	missing_value	double	2147483647	
yaw	Satellite attitude local orbital frame	int	degrees	polarisers
	valid_max	float	6315790	
	valid_min	float	0	
	scale_factor	float	0.000057	
	add_offset	float	0	
	missing_value	double	2147483647	
pitch	Satellite attitude local orbital frame	int	degrees	polarisers
	valid_max	float	3157895	
	valid_min	float	0	
	scale_factor	float	0.000057	
	add_offset	float	-90	
	missing_value	double	2147483647	
roll	Satellite attitude local orbital frame	int	degrees	polarisers
	valid_max	float	3157895	
	valid_min	float	0	
	scale_factor	float	0.000057	
	add_offset	float	-90	
	missing_value	double	2147483647	

5.2.5.4.5 Group Name: Quality_Information

5.2.5.4.5.1 Quality_Information: Attributes

This section describes the quality information Group Attributes for the 3MI counts. Currently, no attributes are foreseen.

5.2.5.4.5.2 Quality_Information: Dimensions

Table 39 describes the quality_information Group Dimensions for the 3MI counts.

Table 39 Quality Information: Dimensions *for 3MI L1B1 product*

Name	Length
geolocation_quality_dimension	1

5.2.5.4.5.3

5.2.5.4.5.3 Quality_Information: Variables

The quality_information Group Variables for the 3MI L1B1 counts product are listed in with their specific attributes.

Each channel will have a geolocation quality control flag. As all are identical, only one geolocation_quality variable is listed explicitly in the PFS. The full list can be found in the XML file format description.

The variable name geolocation_quality should be replaced by geolocation_quality_channel, where "channel" is the correspondent channel name, i.e. {3MI_0410, 3MI_0443, 3MI_0490, 3MI_0555,   3MI_0670,   3MI_0763,   3MI_0765,   3MI_0865,   3MI_0910_VNIR, 3MI_0910_SWIR_A,   3MI_1370_A,   3MI_1650_A,   3MI_2130_A,   3MI_1370_B, 3MI_1650_B, 3MI_2130_B}. The subscripts "_A" and "_B" are added to distinguish the two acquisitions per SWIR channel per view.

Table 40: Quality_Information:

Name	Description	Type	Units/Values	Dimension
geolocation_quality_channel	!-- Geolocation quality flag (0 | 1)--	byte		geolocation_quality_dimension

5.2.5.4.6 Group Name: Processing_Flags

5.2.5.4.6.1 Processing_Flags: Attributes

This section describes the processing_flags Group Attributes for the 3MI counts. No common group attributes are currently defined.

5.2.5.4.6.2 Processing_Flags: Dimensions

This section describes the processing_flags Group Dimensions for the 3MI counts. No common group dimensions are currently defined.

5.2.5.4.6.3 Processing_Flags: Variables

This section describes the processing_flags Group Variables for the 3MI counts with their specific attributes as given in Table 41.

Each channel will have a processing flag. Description of flag contents can be found in Appendix D.

As all processing flags are identical, only one processing _flag variable is listed explicitly in the PFS. The full list can be found in the XML file format description.

The variable name processing flag should be replaced by processing_flag_channel. Where "channel" is the correspondent channel of the flag, i.e. {3MI_0410, 3MI_0443, 3MI_0490, 3MI_0555, 3MI_0670, 3MI_0763, 3MI_0765, 3MI_0865, 3MI_0910_VNIR, 3MI_0910_SWIR, 3MI_1370_A, 3MI_1650_A, 3MI_2130_A, 3MI_1370_B, 3MI_1650_B, 3MI_2130_B}. The subscripts "_A" and "_B" are added to distinguish the two acquisitions per SWIR channel per view.

The dimensions "lines columns" have to be replaced by "lines_VNIR columns_VNIR" or "lines_SWIR columns_SWIR" depending on the channel.

The dimensions "polarisers" should be replaced by "polarised_channel" or "non_polarised_channel" depending on whether the respective channel is polarised or not.

Table 41: Processing_Flags: Variables for 3MI L1B1 counts product

Name	Description	Type	Units/Values	Dimension
processing_flag_channel	3MI 410 nm processing flags	unsigned byte		polarisers lines columns
	valid_max	byte	254	
	valid_min	byte	0	
	missing_value	byte	255	

5.2.6

5.2.6   Group Name: Quality

5.2.6.1   Quality: Attributes

Table 42 describes the Quality Group Attributes for the 3MI L1B1 counts.

Table 42: Quality: Attributes for 3MI L1B1 counts product

Name	Type	Value
overall_quality_flag	unsigned short	!--'0' if overall quality is OK. Individual bits of the flag are set to indicate degraded conditions: Bit 0: Missing input product(s) Bit 1: Data gap(s) Bit 2: Corrupted input product(s) Bit 3: Instrument anomaly Bit 4: missing or degraded auxiliary data) Bit 4: missing or degraded auxiliary data(s) Bit 5: degraded due to manoeuvre

5.2.6.2

5.2.6.2   Quality: Dimensions

The following table describes the dimensions of the 3MI L1B1 product quality group.

Table 43: quality Dimensions

Name	Length
gap_items	!--Number of gaps indentified during product duration. Note: it will not appear in the Product if overall_quality_flag bit 1 equals 0.--

5.2.6.3 Quality: Variables

Table 44 describes the Quality Group Variables for the 3MI L1B1 counts with their specific attributes. Colours are used to differentiate variable and attributes: variables in light blue and attributes in white with name right-aligned.

Table 44: Quality: Variables for 3MI L1B1 counts product

Name	Description	Type	Units/Values	Dimension
duration_of_product	Entire duration of product	double	s	
	valid_min	double	0	
duration_of_data_present	Amount of data present in product	double	s	
	valid_min	double	0	
duration_of_data_missing	Amount of data missing in product	double	s	
	valid_min	double	0	
duration_of_data_degraded	Amount of data degraded in product	double	s	
	valid_min	double	0	
gap_start_time_utc	'Gap start time in UTC' Note: will not appear in the Product if overall_quality_flag bit 1 equals 0. CF date and time format.	double	seconds since 2020-01-01 00:00:00.000	gap_items
	valid_min	double	-1.0e9	
gap_end_time_utc	'Gap end time in UTC' Note: will not appear in the Product if overall_quality_flag bit 1 equals 0. CF date and time format.	double	seconds since 2020-01-01 00:00:00.000	gap_items
	valid_min	double	-1.0e9	

6   PRODUCT FORMAT VERSION CONTROL

This section provides Product Format Version Control Numbers for the 3MI L1B radiance product defined within this document (see Table 45). This version is reflected in the following global attribute present in each EPS-SG mission product centrally generated as described in the [GPFS]:

Table 45: Record Format Version Numbers

Product ID	Product Format Version Control Number (format_version)	Product Format Specification Issue (pfs_ reference_and_version)	Generic Product Format Specification Issue (gpfs_ reference_and_version)
3MI-1B-RAD	0.0	1	1E
3MI-1B-RAD	1.0	1C	1H
3MI-1B-RAD	2.0	2B	2A
3MI-1B-PRE	2.0	2B	2A
3MI-1B-RAD	3.0	3A	3B
3MI-1B-PRE	3.0	3A	3B
3MI-1B-RAD	4.0	3C	3B
3MI-1B-PRE	4.0	3C	3B
3MI-1B-RAD	5.0	3D	3C
3MI-1B-PRE	5.0	3D	3C

APPENDIX A   SIZE OF EPS-SG 3MI LEVEL 1B PRODUCTS

This appendix provides an estimated size of the EPS-SG 3MI Level 1B product.

Table 46: Size of the 3MI Level 1B Product

Product ID	Product Description	Size (MB/Orbit)
3MI-1B-RAD	1. The 3MI L1B for one pixel acquisition is shown in Table 47 2. Number of VNIR pixels = $509 \times 509 = 259081$ 3. Number of SWIR pixels = $499 \times 255 = 127245$ 4. During one acquisition sequence (22 seconds), 9 VNIR channels and (3+3) SWIR channels are measured (910 SWIR not included) 5. This induces a total number of bytes for one acquisition sequence: For the VNIR = $9 \times 259081 \times$ (number of bytes considering the VNIR subsampling in Table 47) = 24979269 bytes For the SWIR = $(3+3) \times 127245 \times$ (number of bytes considering the SWIR subsampling in Table 47) = 1419942546 bytes 6. During the sunlit part (i.e. half a orbit of about 50 min) 139 acquisition sequences can be performed For the VNIR = $139 \times$ 24979269 bytes For the SWIR = $139 \times$ 1419942546 bytes 7. Considering all the complementary information given in table Table 48, this leads to a total of approximately 6584 MB = 6.584 GB	6584

Table 47: Assumed size of the 3MI Level 1B Product variables stemming from the measurement data group per orbit

Parameter	bytes	Subsampling factor VNIR	Subsampling factor SWIR
Latitude	4	64	64
Longitude	4	64	64
delta_lat_N_dem	2	1	1
delta_lon_E_dem	2	1	1
Description	12	259081	127245
Solar Zenith Angle	4	64	64
Solar Azimuth Angle	4	64	64
Observational Zenith Angle	4	64	64
Satellite Azimuth Angle	4	64	64
Total TOA Radiance (I)	2	1	1
Error I (random noise contribution)	1	1	1

Parameter	bytes	Subsampling factor VNIR	Subsampling factor SWIR
TOA Second component of Stokes Vector (Q), only for polarised channels	2	1	1
Error Q (random noise contribution), only for polarised channels	1	1	1
TOA Third component of Stokes Vector (U), only for polarised channels	2	1	1
Error U (random noise contribution), only for polarised channels	1	1	1
Pixel Flags	1	1	1
Integration time	4	259081	127245
Time Stamp	4	259081	127245
Orbit State	9*8	259081	127245

Table 48 lists the sizes of the data contained in the calibration data and the quality groups. Note that this information is appended to each created granule.

Table 48 Assumed size of the 3MI Level 1B Product variables stemming from the calibration data, quality information, Processing Flags and Quality Statistics groups per granule

Parameter	kbytes
Calibration data	
solar_irradiance_wavelength (~4800 samples)	16
solar_irradiance (~4800 samples)	16
Bad_dead_pixel_map_VNIR	253
Bad_dead_pixel_map_SWIR	124
ISRF_wavelength (~200 samples) * 12 channels	10
ISRF (~200 samples) * 12 channels	10
gain * 12 channels	0.1
abs_cal * 12 channels	0.1
transmission * 12 channels	0.3
epsilon * 12 channels	0.3
alpha * 12 channels	0.3
IIA_VNIR * 9 channels	146
IAA_VNIR * 9 channels	146
IIA_SWIR * 3 channels	24
IAA_SWIR * 3 channels	24
Total calibration data per granule	770
Quality Information	
3MI quality flag	2
Geolocation quality flag	1
Processing Flags	

Parameter	kbytes
3MI Processing flag	4
Quality Statistics	
Overall Quality flag	1
Duration of Product	4
Time of Data Present	4
Time of Data Missing	4

APPENDIX B   SIZE OF EPS-SG 3MI LEVEL 1B1 PRODUCTS

This appendix provides an estimated size of the EPS-SG 3MI Level 1B1 product.

Table 49: Size of the 3MI Level 1B1 Product

Product ID	Product Description	Size (GB/Orbit)
3MI-1B-PRE	1. The 3MI L1B1 for one pixel acquisition is shown in Table 50 2. Number of VNIR pixels = $509 \times 509 = 259081$ 3. Number of SWIR pixels = $499 \times 255 = 127245$ 4. During one acquisition sequence (22 seconds), 9 VNIR channels and (4+3) SWIR channels are measured (2nd 910 SWIR not included), with three images per polarised channel, and one per non-polarised channel. 5. This induces a total number of bytes for one acquisition sequence: For the VNIR = $6 \times 259081 \times 3 \times$ (number of bytes considering the VNIR subsampling Table 50) $+3 \times 259081 \times$ (number of bytes considering the VNIR subsampling in) = 157780329 Bytes For the SWIR = $(2*3) \times 127245 \times 3 \times$ (number of bytes considering the SWIR subsampling in Table 50) + $1 \times 127245 \times$ (number of bytes considering the SWIR subsampling in Table 50) = 88961937 Bytes 6. During the sunlit part (i.e. half a orbit of about 50 min) 139 acquisition sequences can be performed For the VNIR = $139 \times$ 157780329 Bytes For the SWIR = $139 \times$ 88961937 Bytes. This leads (considering additional parameters) to a total of approximately 27983 MB = 27.983 GB	27.983

Table 50: Assumed size of the 3MI Level 1B1 Product variables stemming from the measurement data group per orbit

Parameter	bytes	Subsampling factor VNIR	Subsampling factor SWIR
C	4	1	1
Cerr	4	1	1
Combined Flags	1	1	1
T_int	4	259081	127245
Latitude	4	1	1
Longitude	4	1	1
delta_lat_N_dem	2	1	1

delta_lon_E_dem	2	1	1
Solar Zenith Angle	4	1	1
Solar Azimuth Angle	4	1	1
Observational Zenith Angle	4	1	1
Satellite Azimuth Angle	4	1	1
Time Stamp	4	259081	127245
Orbit State	9*8	259081	127245

APPENDIX C   XML DESCRIPTION OF EPS-SG 3MI L1B PRODUCTS FORMAT

The XML description of the NetCDF-4 EPS-SG 3MI L1B product is attached in the file EPS-SG-3MI-L1B_RAD_50_00.xml:

EPS-SG-3MI-L1B_RA
D_50_00.xml

The XML description of the NetCDF-4 EPS-SG 3MI L1B1 product is attached in the file EPS-SG-3MI-L1B1_PRE_50_00.xml:

EPS-SG-3MI-L1B1_P
RE_50_00.xml

APPENDIX D   DESCRIPTION OF FLAG CONTENTS

Table 51 shows the potential values the pixel-wise flags can assume. This contents are TBC (TBC-06).

Table 51: List of pixel flags and their values in the 3MI L1B product. The bad/dead pixel map only contains the flags for bad and dead pixels.

Flag name	condition	value if set (bit value)
Bad/Dead	Bad/Dead pixel according to CCDB bad/dead pixel map	1 (00000001)
Saturation	L0 counts above threshold count	2 (00000010)
Potential stray light contamination	Set by stray light correction algorithm	4 (00000100)
Not spec constrained	Observational Zenith Angle (OZA) > 60°, and not-corrected for non-polarised channels	8 (00001000)
Stray light correction	Set by Straylight correction function	16 (00010000)
No data	No-data due to "non-covered pixels" during registration in the retrieval for polarised (A232) or non-polarised channels (A233)	32 (00100000)
QIzero	I=0 during Q/I computation for contribution(s) in the retrieval for non-polarised channels (A233)	64 (01000000)

Table 51 shows the potential values the pixel-wise flags can assume. This contents are TBC (TBC-06).

Table 52: List of pixel flags and their values in the 3MI L1B1 product. The bad/dead pixel map only contains the flags for bad and dead pixels.

Flag name	condition	value if set (bit value)
Bad/Dead	Bad/Dead pixel according to CCDB bad/dead pixel map	1 (00000001)
Saturation	L0 counts above threshold count	2 (00000010)
Potential stray light contamination	Set by stray light correction algorithm	4 (00000100)
Not spec constrained	Observational Zenith Angle (OZA) > 60°, and not-corrected for non-polarised channels	8 (00001000)
Stray light correction	Set by Straylight correction function	16 (00010000)

APPENDIX E   LIST OF TBD & TBC

No TBDs are referenced.

The following table presents the TBCs.

ID	Section	Title	Text
~~TBC-01~~	4.2.5.1	~~Subsampling of the geometrical data~~	~~Subsampling of geolocation and angular information is assumed by a factor 8~~
~~TBC-02~~	4.2.5.4.3	~~Additional view group attributes~~	~~Possible attributes to the group might be orbit number, view number on the current orbit, time stamps of first and last data acquisition within the view, number of missing frames.~~
~~TBC-03~~	4.2.5.4.4.4	~~Scaling factors and offsets~~	~~Scaling factors, missing values, minimal and maximal values, and offsets will be defined later.~~
~~TBC-04~~	4.2.5.5.1	~~Dimensionality of solar irradiance spectrum, ISRFs~~	~~Size of solar_irradiance_sampling, ISRF_sampling is not defined yet.~~
~~TBC-05~~	4.2.5.5.3.2	~~ISRF information and Tie point definition~~	~~To confirm if the ISRF information (already in the PFS) and the tie point definition (not included in the PFS) have to be provided as part of the calibration data~~
~~TBC-06~~	4.2.5.4.5.3, 4.2.5.4.5 5; 4.2.5.4.6; 5.2.5.4.5; 5.2.5.4.6; Appendix D	~~Definition of the quality and processing flags~~	~~The quality and processing flags values have to be consolidated.~~
~~TBC-07~~	4.2.6.1 5.2.6.1	~~Overall quality flag~~	~~The size and content of the overall quality flag has to be consolidated~~