EPS-SG MWI Level 1B Product Format Specification

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Document Change Record

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V1	15 December 2014	N/A	Initial version
V1A	06 March 2015	N/A	Updated version after internal review
V1B	31 August 2015	N/A	Updated version based on MWI L1B PGS and GPFS updates
V1C	9 November 2015	EUM-EPSSG-DCR-139	Update of the Applicable and Reference Documents List. Updated product format based on SAG advice (meetings #2 and #3) and internal review.
V2A	17 November 2016	EPSG_DCR_522	Added navigation_data group in order to rationalise data size without redundant information (e.g. geolocation provided per horn, added explanatory Table 1). Updated geolocation parameters considering processing updates. Updated size accordingly and taking into account latest industry manufacturer's input. Added appendix C (BUFR description). Removed XML dump in the document. Removed XML schema, now available in [GPFS]. Updated XML description file (NcML).
V2B	20 September 2017	N/A	Section 4.2.3.1.3: updated Manoeuvre Information according to GPFS update. Section 2: Introduced n_data_groups dimension to take into account input from Instrument Manufacturer Updated Appendix A, updated data size estimation Added Appendix D on reconstruction of geolocation information from tie-points Appendix B: Updated XML according with changes Updated global attributes in XML file description
V2C	16 February 2018	EPSG_DCR_889	Section 4.2.3.3.1: added the value "MWI_L1B" for the processor_name attribute. Removed "PROCESSOR_FULL_NAME" from the source attribute. Various sections: The minimum value for time variables referred to the 2020-01-01 epoch (sensing_start/end_time, gap_start/end_time, manoeuvre_start/end_time, etc.) are allowed to

Issue / Revision	*Date*	*DCN. No*	*Changed Pages / Paragraphs*
			be negative. Value set as maximum value with negative sign. Section 4.2.4.1.3: Added reference to Appendix D, updated undersampling value. Section 4.2.4.1.3: added parameters delta latitude and delta longitude to represent parallax shift due to orography w.r.t. geodetic coordinates on the ellipsoid. Updated appendix A (product size). Section 4.2.1: updated product size. Section 4.2.5.1: harmonized attributes with XML description. Updated XML file. Section 4.2.5.1: updated overall_quality_flag Section 5 updated. Sections 4.2.3.1.1, 4.2.3.2.1, 4.2.3.2.2, 4.2.4.1.1, 4.2.4.2.1, 4.2.4.3.1, 4.2.4.4.1, 4.2.4.4.2, 4.2.4.5.1, 4.2.4.5.2: TBD instead of TBC. Various sections: put n_scan (scan index) as first index of all variables for consistency with PGS. Table 34: Removed second row due to data size consolidation. Update of the TBD/TBC Table.
V3	25 March 2020	EPSG_DCR_1615	Update of signature Table. Added reference to L1B ATBD and L0PFS in the list of reference documents. Minor changes to reflect GPFS updates in Section 3.4.2 and Section 3.4.3. Tables associated to Attributes and dimensioning that are not used have been removed (TBD closed) in multiple sections. Added Attributes to Group:navigation_data (Section 3.4.4), updated Group Dimensions. Updated subsampling description of Group: navigation data (Section 3.4.4.1.3, TBD to TBC). Updated scale factors and offsets of variables of Group: navigation data (Section 3.4.4.1.3). Changed latitude and longitude from SHORT to INT. Added latitude and longitude of sub satellite point. Added sun elevation and azimuth angles in the instrument reference frame. Added roll, pitch, yaw angles. Removed moon flag as information is retained in the moon angle and threshold is given as attribute. Removed RFI angle.

Issue / Revision	*Date*	*DCN. No*	*Changed Pages / Paragraphs*
			Group measurement data (Section 3.4.4.2): radiance is provided according to channel main centre-frequency groups instead of a single matrixes to account for different scale factors with frequency. Band correction coefficients and centre_wavenumber for radiance to brightness temperature conversion added. Group calibration data (Section 3.4.4.3): added Group Attributes; updated group Dimensions, Sidelobe contribution variables moved from measurement data to calibration data. Warm and cold calibration counts variables added. Linear calibration coefficients added. Updated PRTs/THMs temperature in output according to instrument development. Group quality_information (Section 3.4.4.4): mwi_temperature_flag added. Output flags calibration-flag, navigation-status_flag, scan_quality flag mwi_data_quality flag detailed with corresponding bit meaning and settings. Group processing_flags (Section 3.4.4.5: mwi_processing_flags defined). Group quality: minor changes to reflect GPFS updates. Appendix A updated for estimating size of MWI L1B product. Appendix B updated XML according with changes. Appendix D: equation for sample reconstruction updated in D1, reconstruction of Time of Earth samples added in D2. Added Appendix E for radiance to brightness temperature computation. Update of the TBC/TBD Table.
V3A	29 June 2020	EPSG_DCR_1788	Minor typo corrections to align status/satellite variables to GPFS v3D Minor adjustment of the max value and scale factor of variable land_fraction Modify the attribute source in the /status/processing group Adjustment of the scale factor and offset for the radiances in data/measurement_data/ group. Minor adjustment of the scale factor for the calibration coefficients. Modify the variables non_linearity_parameter_v and non_linearity_parameter_h in nonlinear _second_order_calibration_parameter_v and nonlinear_second_order_calibration_parameter_

Issue / Revision	*Date*	*DCN. No*	*Changed Pages / Paragraphs*
			h Add the new variables nonlinear_third_order_calibration_parameter_v and nonlinear_third_order_calibration_parameter_h Added note to dimension gap_items, conditioned to overall quality flag, to align to GPFS v3D. Minor refinement of equation for time of Earth samples reconstruction in Appendix D.2 Minor update of the associated xml file

Table of Contents

1 Introduction 8
1.1 Purpose and Scope 8
1.2 Relation to other documents 8
1.3 Applicable Documents 9
1.4 Reference Documents 9
1.5 Acronyms 9
1.6 Conventions and Terminology 10
1.6.1 Meaning of Table Headings 11
1.7 Document structure 12

2 Overview of the instrument: MWI 13

3 EPS-SG MWI Level 1B Products Overview 16
3.1 Product List 16
3.2 Naming Convention 16
3.3 Overall Structure of EPS-SG MWI L1B product 17
3.4 MWI Level 1B Spectral Radiance 18
3.4.1 Product Summary Sheet 18
3.4.2 Group Name: root 18
3.4.2.1 Attributes (global) 18
3.4.2.2 Dimensions (global) 19
3.4.2.3 Variables (global) 19
3.4.3 Group Name: status 19
3.4.3.1 Group Name: satellite 19
3.4.3.2 Group Name: instrument 28
3.4.3.3 Group Name: processing 31
3.4.4 Group Name: data 32
3.4.4.1 Group Name: navigation_data 33
3.4.4.2 Group Name: measurement_data 42
3.4.4.3 Group Name: calibration_data 46
3.4.4.4 Group Name: quality_information 59
3.4.4.5 Group Name: processing_flags 65
3.4.5 Group Name: quality 66
3.4.5.1 quality: Attributes 66
3.4.5.2 quality: Dimensions 66
3.4.5.3 quality: Variables 67

***4* Product Format Version Control 68**

Appendix A Size of EPS-SG MWI Level 1B products 69

Appendix B XML Description of EPS-SG MWI L1B Products Format 73

Appendix C Description of EPS-SG MWI L1B Product BUFR Format 73

Appendix D TIME AND GEOLOCATION INFORMATION RECONSTRUCTION 79

Appendix E brightness temperature computation FROM MWI SPECTRAL RADIANCES 83

1 INTRODUCTION

1.1 Purpose and Scope

This document describes the Format Specification for EPS-SG Microwave Imager (MWI) Level 1B (L1B) products generated centrally by the EPS-SG Ground Segment at the EUMETSAT Headquarters. It specifies the detailed format of the MWI L1B 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 MWI Level 1B Product Format Specification [MWI-L1B-PFS] is a System document in the System Specification Tree. It is called up in [SRD], [OGSRD], MWI Level 1B Product Generation Specification [MWI-L1B-PGS] and EPS-SG System and Ground Segment documents including ICDs/IRDs wishing to convey information about the MWI Level 1B products format and content. The EPS-SG Image Navigation and Registration Specifications [INR-SPEC], provide information on the geolocation procedures applied to MWI.

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
[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
[OGSRD]	EPS-SG Overall Ground Segment Requirements Document	EUM/LEO-EPSSG/REQ/13/725156
[MWI-L1B-PGS]	EPS-SG MWI Level 1B Product Generation Specification	EUM/LEO-EPSSG/SPE/14/746864
[MWI-L1B-ADS]	EPS-SG MWI Level 1B Auxiliary Data Specification	EUM/LEO-EPSSG/SPE/14/771725
[MWI-L1B-ATBD]	EPS-SG Microwave Imager (MWI) Level1B Product Algorithm Theoretical Basis Document (ATBD)	EUM/LEO-EPSSG/SPE/13/711560
[INR-SPEC]	EPS-SG Image Navigation and Registration Specifications	EUM/LEO-EPSSG/SPE/15/814371
[L0PFS]	EPS-SG L0 Product Format Specification	EUM/LEO-EPSSG/SPE/13/703928
[INTERP]	Fundamentals of Inertial Navigation, Satellite-based Positioning and their integration. Chapter 2.	Noureldin, A., Karamat T.B., Georgy , J., (2013) Springer, New York, ISBN: 978-3-642-30465-1

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
APC	Antenna Pattern Correction
ATBD	Algorithm Theoretical Basis Document
CDPU	Control Data Processing Unit

Acronym	Definition
EPS-SG	EUMETSAT Polar System – Second Generation
GPFS	Generic Product Format Specification
GS	Ground Segment
GTS	Global Telecommunication System
ICI	Ice Cloud Imager
ICU	Instrument Control Unit
MR	Main Reflector
MWI	Microwave Imager
MWS	Microwave Sounder
netCDF	Network Common Data Form
ND	Noise Diode
NRT	Near Real Time
OBCT	On Board Calibration Target
PRT	Platinum Resistance Thermistor
QC	Quality Control
RFI	Radio Frequency Interference
SVR	Space View Reflector
TBC	To Be Confirmed
TBD	To Be Defined
TBW	To Be Written
THM	Thermistor
TOD	True of Date
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

Element Name	Description
Filename	The name of the product (following naming convention described in **[GPFS]**).
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/netcdf/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 than 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: MWI	A description of the main features and characteristics of the MWI is provided in this section, along with its acquisition modes generating data to be processed in the Ground Segment.
3	EPS-SG MWI Level 1B Products Overview	A high-level overview on the MWI Level 1B Products structure is presented in this section. The Product Tree and the Product Naming convention are also specified here.
4	EPS-SG MWI Level 1B Product Detailed Format	The format of each MWI Level 1B Product (detailed description of the NetCDF Data Files of each product) is described in this section.
5	Product Format Version Control	This section is aimed to describe the product format version control number for each product described in this document.
APP A	Size of EPS-SG MWI Level 1B products	In this section the size of each MWI Level 1B Products is provided.
APP B	XML Description of EPS-SG MWI L1B Products Format	The .xml schemas for the MWI Level 1B Products are provided in this section.
APP C	Description of EPS-SG MWI L1B Product BUFR Format	The description of MWI L1B BUFR data format for dissemination over the GTS.
APP D	Geolocation Information from tie points	Description of the method to derive geolocation information from tie-points.
APP E	Radiance to brightness temperature conversion	Description of the method to compute brightness temperature from the radiance information.

2 OVERVIEW OF THE INSTRUMENT: MWI

A description of the main features and characteristics of the MWI is provided in the MWI L1B Product Generation Specification Document [MWI-L1B-PGS]. The [MWI-L1B-PGS] document also describes in detail the acquisition modes generating data to be processed in the Ground Segment. It is useful however to resume here the assignment of the MWI channels with respect to the data groups used here. This assignment is presented in Table 1.

This grouping is needed since the electric boresight of channels MWI-1 and MWI-2 is different, although both use the same horn, and it is also different when considering the horizontal and vertical polarization channels. This requires four dedicated data groups for these channels. The other channels are assigned to data groups associated to the relative horns.

Data group	Channel Number	Channel	Channel Category
1	1	MWI-1 V	channels with double V&H polarization (8)
	2	MWI-1 H	
2	3	MWI-2 V	
	4	MWI-2 H	
3	5	MWI-3 V	
	6	MWI-3 H	
4	7	MWI-4 V	
	8	MWI-4 H	
	9	MWI-5 V	
	10	MWI-5 H	
	11	MWI-6 V	
	12	MWI-6 H	
	13	MWI-7 V	
	14	MWI-7 H	
5	15	MWI-8 V	
	16	MWI-8 H	
6	17	MWI-9 V	channels above 89 GHz with single polarisation (10)
	18	MWI-10 V	
	19	MWI-11 V	
	20	MWI-12 V	
7	21	MWI-13 V	
8	22	MWI-14 V	
	23	MWI-15 V	
	24	MWI-16 V	
	25	MWI-17 V	
	26	MWI-18 V	

Table 1: MWI channels assignment with respect to instrument data groups.

MWI channel index vs MWI channel identification vs Receivers type (front-end + back-end) for 26 MWI channels, 17 different receivers, 7 feedhorns, and 23 receivers temperature sensors in flags in the quality_information Group.

Channel index, *h*	Channel ID	Feedhorn	Receiver sensor ID FE + BE	Receiver temperature sensor index, *l*
1	MWI-1V	*KBF*	RX18V (RX18Vnd)	*1 (2)*
2	MWI-1H		RX18H (RX18Hnd)	*3 (4)*
3	MWI-2V		RX23V (RX23Vnd)	*5 (6)*
4	MWI-2H		RX23H (RX23Hnd)	*7 (8)*
5	MWI-3V	*FEED31*	RX31V (RX31Hnd)	*9 (10)*
6	MWI-3H		RX31H (RX31Hnd)	*11 (12)*
7	MWI-4V	*FEED54*	DC54V + BE54V	*13 + 15*
8	MWI-4H		DC54H + BE54H	*14 + 16*
9	MWI-5V		DC54V + BE54V	*13 + 15*
10	MWI-5H		DC54H + BE54H	*14 + 16*
11	MWI-6V		DC54V + BE54V	*13 + 15*
12	MWI-6H		DC54H + BE54H	*14 + 16*
13	MWI-7V		DC54V + BE54V	*13 + 15*
14	MWI-7H		DC54H + BE54H	*14 + 16*
15	MWI-8V	*FEED89*	RX89V	*17*
16	MWI-8H		RX89H	*18*
17	MWI-9V	*FEED118*	DC118 + BE118165	*19 + 21*
18	MWI-10V		DC118 + BE118165	*19 + 21*
19	MWI-11V		DC118 + BE118165	*19 + 21*
20	MWI-12V		DC118 + BE118165	*19 + 21*
21	MWI-13V	*FEED166*	DC166 + BE118165	*20 + 21*
22	MWI-14V	*FEED183*	DC183 + BE183	*22 + 23*
23	MWI-15V		DC183 + BE183	*22 + 23*
24	MWI-16V		DC183 + BE183	*22 + 23*
25	MWI-17V		DC183 + BE183	*22 + 23*
26	MWI-18V		DC183 + BE183	*22 + 23*

Table 2: MWI channels assignment with respect to receiver temperatures.

3 EPS-SG MWI LEVEL 1B PRODUCTS OVERVIEW

The MWI Level 1B Spectral Radiance product is generated centrally by the EPS-SG Ground Segment at the EUMETSAT Headquarters.

3.1 Product List

Product ID	Product Description	Usage	Mission type
MWI-1B-RAD	MWI Level 1B Spectral Radiance	User	Global/Regional

Table 3: EPS-SG MWI Level 1B Product List

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 MWI L1B radiance 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 "_" and explained in [GPFS].

EPS-SG MWI Level 1B Product Detailed Format

3.3 Overall Structure of EPS-SG MWI 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]. The EPS-SG MWI L1B Product 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*. No additional NetCDF-4 groups or sub-groups are foreseen for L1 products.

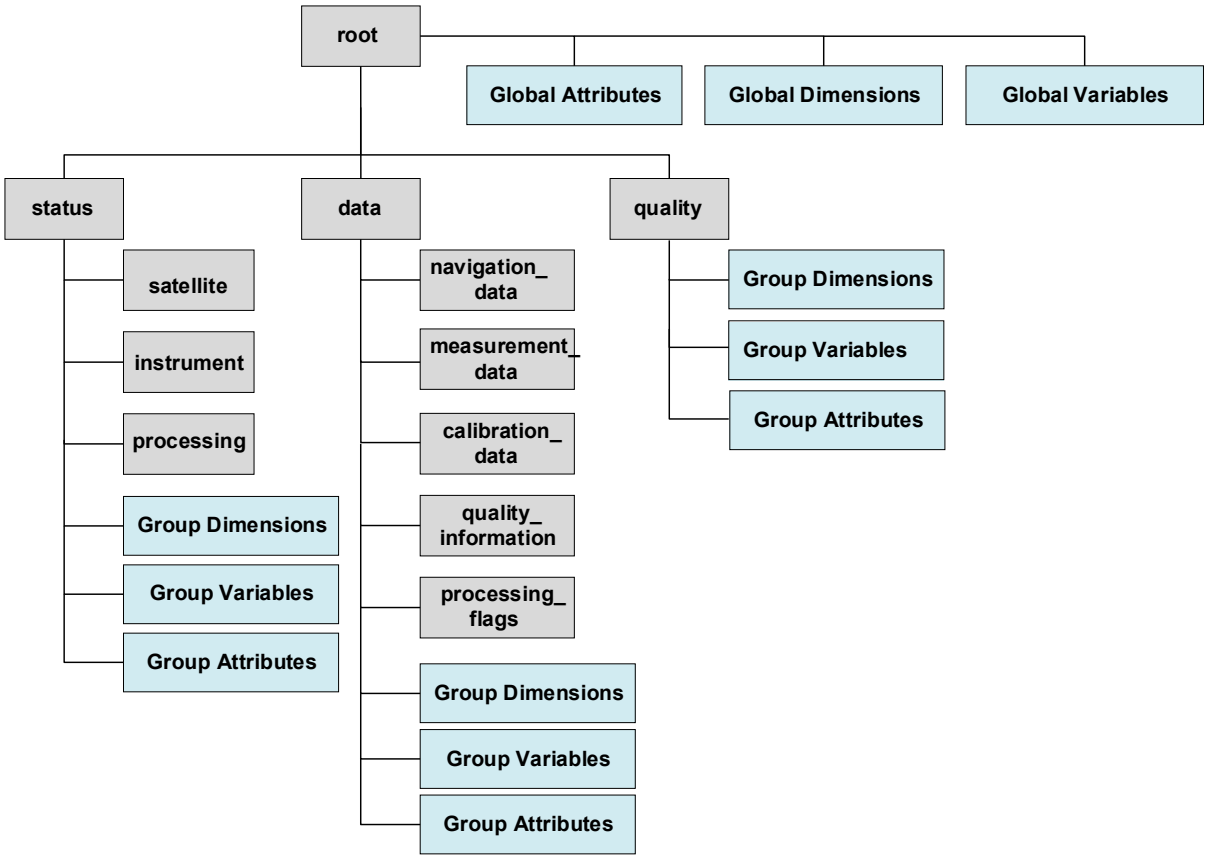

Figure 1: Overall Structure of the EPS-SG MWI L1B Product

In the following sections, the composition of the MWI L1B Spectral Radiance product is specified further.

3.4 MWI Level 1B Spectral Radiance

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

3.4.1 Product Summary Sheet

The table below provides a summary for the MWI L1B Spectral Radiance product. The L1B filename is defined according to the conventions described in the [GPFS] and presented in Section 3.2 specifically for MWI.

Filename	**W_XX-EUMETSAT-Darmstadt,SAT,SGB[1-3]-MWI-1B-RAD_C_EUMT_YYYYMMDDhhmmss___YYYYMMDDhhmmss_YYYYMMDDhhmmss_O_N____.nc**
Product ID	MWI-1B-RAD
Product Description	TOA spectral radiances observed by the MWI instrument
Format	netCDF-4
Size (MBytes/orbit)	1101.00 (see Appendix A)
Duration	To be defined in Phase C

Table 4: MWI radiance product summary sheet

3.4.2 Group Name: root

3.4.2.1 Attributes (global)

Table 5 describes the global attributes for the MWI L1B Spectral Radiance product in accordance with [GPFS].

Attribute Name	Type	Meaning and/or value
Conventions	NC_STRING	e.g.“CF-1.6”
metadata_conventions	NC_STRING	e.g. “Unidata Dataset Discovery v1.0”
product_name	NC_STRING	Product name as set out in Section 3.2
title	NC_STRING	MWI L1B spectral radiance
summary	NC_STRING	Product summary
doi	NC_STRING	Digital Object Identifier
keywords	NC_STRING	”MWI, Level 1B, EPS-SG, polar meteorological satellite, Metop-SG”
history	NC_STRING	(“original generated product” | “aggregated product” | “sub-setted product”)
institution	NC_STRING	“EUMETSAT”
spacecraft	NC_STRING	Metop-SG B satellites: “SGB”[1-3]
instrument	NC_STRING	”MWI”
product_level	NC_STRING	Product processing level “1B” Note: Calibrated and geolocated science data

Attribute Name	Type	Meaning and/or value
type	NC_STRING	Character string providing an indication of the type of product: type: RAD — Meaning: radiance
mission_type	NC_STRING	(“Global” | “Regional” | “Local”)
disposition_mode	NC_STRING	Identification of the type of processing (“Test” | “Commissioning” | “Operational” | “Validation”) Test = Test data Commissioning = Produced during commissioning Operational = expected quality as per requirements based on fully performed validation Validation = During validation of a new processor version during routine operations
sensing_start_time_utc	NC_STRING	UTC time of start of sensing data formatted in CF date and time format with ms precision
sensing_end_time_utc	NC_STRING	UTC time of end of sensing data formatted in CF date and time format with ms precision
environment	NC_STRING	(“Operational” | “Validation” | “Development”| ” Integration & Verification” |”Engineering”)
references	NC_STRING	“www.eumetsat.int”
orbit_start	NC_UINT	Absolute orbit number at sensing_start_time_utc
orbit_end	NC_UINT	Absolute orbit number at sensing_end_time_utc

Table 5: Global Attributes for the MWI L1B product

3.4.2.2 Dimensions (global)

No common global dimensions are currently envisaged.

3.4.2.3 Variables (global)

No common global variables are currently envisaged.

3.4.3 Group Name: status

This section describes the status Group for the MWI Spectral Radiance product.

3.4.3.1 Group Name: satellite

3.4.3.1.1 satellite: Attributes

No satellite Group Attributes are currently envisaged.

3.4.3.1.2 satellite: Dimensions

Table 6 describes the satellite Group Dimensions for the MWI L1B radiance product.

Dimension name=	Comment	Dimension length=
manoeuvre_items	Number of manoeuvres occurring between product start and end	”” 0 ≤ N

Table 6: satellite: Group Dimensions for MWI L1B product.

3.4.3.1.3 satellite: Variables

Table 7 describes the satellite Group Variables for the MWI L1B Spectral Radiance product with their specific attributes. The Cartesian Orbit State Vector fields contain the Cartesian Orbit State Vector in the Earth-Fixed ([EARTH+FIXED]) reference frame as defined in the EPS-SG Mission Conventions Document [MCSD].

Variables Name	Description	Type	Unit	Range or Value	Dimension
Orbit Parameters					
epoch_time_utc	Epoch time in UTC of the orbital elements	NC_DOUBLE	seconds since 2020-01-01 00:00:00.000	Valid_min to Valid_max	1
long_name	Description of variable	NC_STRING		Epoch time in UTC of the orbital elements	
units	Physical units	NC_STRING		seconds since 2020-01-01 00:00:00.000	
Valid_min	Valid minimum value	NC_DOUBLE		-1.e9	
Valid_max	Valid maximum value	NC_DOUBLE		1.e9	
_FillValue	fill value	NC_DOUBLE		-9.e9	
semi_major_axis	Semi major axis of the orbit at epoch time [TOD]	NC_DOUBLE	m	Valid_min to Valid_max	1
long_name	Description of variable	NC_STRING		Semi major axis of the orbit at	

				epoch time [TOD]	
units	Physical units	NC_STRING		m	
Valid_min	Valid minimum value	NC_DOUBLE		7.19e6	
Valid_max	Valid maximum value	NC_DOUBLE		7.20e6	
_FillValue	fill value	NC_DOUBLE		-9.e6	
eccentricity	Eccentricity of the orbit at epoch time [TOD]	NC_DOUBLE		Valid_min to Valid_max	1
long_name	Description of variable	NC_STRING		Eccentricity of the orbit at epoch time [TOD]	
units	Physical units	NC_STRING			
Valid_min	Valid minimum value	NC_DOUBLE		0.1160e-2	
Valid_max	Valid maximum value	NC_DOUBLE		0.1170e-2	
_FillValue	fill value	NC_DOUBLE		-9.e2	
inclination	Inclination of the orbit at epoch time [TOD]	NC_DOUBLE	degrees	Valid_min to Valid_max	1
long_name	Description of variable	NC_STRING		Inclination of the orbit at epoch time [TOD]	
units	Physical units	NC_STRING		degrees	
Valid_min	Valid minimum value	NC_DOUBLE		98.65	
Valid_max	Valid maximum value	NC_DOUBLE		98.75	
_FillValue	fill value	NC_DOUBLE		-99.	
perigee_argument	Argument of perigee of the orbit at epoch time [TOD]	NC_DOUBLE	degrees	Valid_min to Valid_max	1
long_name	Description of variable	NC_STRING		Argument of perigee of the orbit at epoch time [TOD]	
units	Physical units	NC_STRING		degrees	
Valid_min	Valid minimum value	NC_DOUBLE		0.	
Valid_max	Valid maximum value	NC_DOUBLE		360.	
_FillValue	fill value	NC_DOUBLE		-999.	

right_ascension	Right ascension of the orbit at epoch time [TOD]	NC_DOUBLE	degrees	Valid_min to Valid_max	1
long_name	Description of variable	NC_STRING		Right ascension of the orbit at epoch time [TOD]	
units	Physical units	NC_STRING		degrees	
Valid_min	Valid minimum value	NC_DOUBLE		0.	
Valid_max	Valid maximum value	NC_DOUBLE		360.	
_FillValue	fill value	NC_DOUBLE		-999.	
mean_anomaly	Mean anomaly of the orbit at epoch time [TOD]	NC_DOUBLE	degrees	Valid_min to Valid_max	1
long_name	Description of variable	NC_STRING		Mean anomaly of the orbit at epoch time [TOD]	
units	Physical units	NC_STRING		degrees	
Valid_min	Valid minimum value	NC_DOUBLE		0.	
Valid_max	Valid maximum value	NC_DOUBLE		360.	
_FillValue	fill value	NC_DOUBLE		-999.	
earth_sun_distance_ratio	Ratio of current Earth-Sun distance to Mean Earth-Sun distance	NC_DOUBLE		Valid_min to Valid_max	1
long_name	Description of variable	NC_STRING		Ratio of current Earth-Sun distance to Mean Earth-Sun distance	
units	Physical units	NC_STRING			
Valid_min	Valid minimum value	NC_DOUBLE		0.983	
Valid_max	Valid maximum value	NC_DOUBLE		1.017	
_FillValue	fill value	NC_DOUBLE		-999.	
Location Summary					
subsat_latitude_start	Latitude of sub-satellite point at start of the product	NC_DOUBLE	degrees_north	Valid_min to Valid_max	1

long_name	Description of variable	NC_STRING		Latitude of sub-satellite point at start of the product	
units	Physical units	NC_STRING		degrees_north	
Valid_min	Valid minimum value	NC_DOUBLE		-90.	
Valid_max	Valid maximum value	NC_DOUBLE		90.	
_FillValue	fill value	NC_DOUBLE		-99.	
subsat_longitude_start	Longitude of sub-satellite point at start of the product	NC_DOUBLE	degrees_east	Valid_min to Valid_max	1
long_name	Description of variable	NC_STRING		Longitude of sub-satellite point at start of the product	
units	Physical units	NC_STRING		degrees_east	
Valid_min	Valid minimum value	NC_DOUBLE		0.	
Valid_max	Valid maximum value	NC_DOUBLE		360.	
_FillValue	fill value	NC_DOUBLE		-999.	
subsat_latitude_end	Latitude of sub-satellite point at end of the product	NC_DOUBLE	degrees_north	Valid_min to Valid_max	1
long_name	Description of variable	NC_STRING		Latitude of sub-satellite point at end of the product	
units	Physical units	NC_STRING		degrees_north	
Valid_min	Valid minimum value	NC_DOUBLE		-90.	
Valid_max	Valid maximum value	NC_DOUBLE		90.	
_FillValue	fill value	NC_DOUBLE		-99.	
subsat_longitude_end	Longitude of sub-satellite point at end of the product	NC_DOUBLE	degrees_east	Valid_min to Valid_max	1
long_name	Description of variable	NC_STRING		Longitude of sub-satellite point at end of the product	
units	Physical units	NC_STRING		degrees_east	
Valid_min	Valid minimum value	NC_DOUBLE		0.	
Valid_max	Valid maximum value	NC_DOUBLE		360.	
_FillValue	fill value	NC_DOUBLE		-999.	
State Vector and Attitude parameters					

state_vector_time_utc	Time of the state vector and attitude items	NC_DOUBLE	seconds since 2020-01-01 00:00:0 0.000	Valid_min to Valid_max	1
long_name	Description of variable	NC_STRING		Time of the orbit state vector and attitude items	
units	Physical units	NC_STRING		seconds since 2020-01-01 00:00:00.000	
Valid_min	Valid minimum value	NC_DOUBLE		-1.e9	
Valid_max	Valid maximum value	NC_DOUBLE		1.e9	
_FillValue	fill value	NC_DOUBLE		-9.e9	
x_position	X position of the orbital state vector [EARTH+FIXED)	NC_DOUBLE	m	Valid_min to Valid_max	1
long_name	Description of variable	NC_STRING		X position of the orbital state vector [EARTH+FIXED)	
units	Physical units	NC_STRING		m	
Valid_min	Valid minimum value	NC_DOUBLE		-7.2e6	
Valid_max	Valid maximum value	NC_DOUBLE		7.2e6	
_FillValue	fill value	NC_DOUBLE		-9.e6	
y_position	Y position of the orbital state vector [EARTH+FIXED)	NC_DOUBLE	m	Valid_min to Valid_max	1
long_name	Description of variable	NC_STRING		Y position of the orbital state vector [EARTH+FIXED)	
units	Physical units	NC_STRING		m	
Valid_min	Valid minimum value	NC_DOUBLE		-7.2e6	
Valid_max	Valid maximum value	NC_DOUBLE		7.2e6	
_FillValue	fill value	NC_DOUBLE		-9.e6	
z_position	Z position of the orbital state vector [EARTH+FIXED)	NC_DOUBLE	m	Valid_min to Valid_max	1
long_name	Description of variable	NC_STRING		Z position of the orbital state vector [EARTH+FIXED)	
units	Physical units	NC_STRING		m	
Valid_min	Valid minimum value	NC_DOUBLE		-7.2e6	

Valid_max	Valid maximum value	NC_DOUBLE		7.2e6	
_FillValue	fill value	NC_DOUBLE		-9.e6	
x_velocity	X velocity of the orbital state vector [EARTH+FIXED)	NC_DOUBLE	m/s	Valid_min to Valid_max	1
long_name	Description of variable	NC_STRING		X velocity of the orbital state vector [EARTH+FIXED)	
units	Physical units	NC_STRING		m/s	
Valid_min	Valid minimum value	NC_DOUBLE		-8.e3	
Valid_max	Valid maximum value	NC_DOUBLE		8.e3	
_FillValue	fill value	NC_DOUBLE		-9.e3	
y_velocity	Y velocity of the orbital state vector [EARTH+FIXED)	NC_DOUBLE	m/s	Valid_min to Valid_max	1
long_name	Description of variable	NC_STRING		Y velocity of the orbital state vector [EARTH+FIXED)	
units	Physical units	NC_STRING		$m \cdot s^{-1}$	
Valid_min	Valid minimum value	NC_DOUBLE		-8.e3	
Valid_max	Valid maximum value	NC_DOUBLE		8.e3	
_FillValue	fill value	NC_DOUBLE		-9.e3	
z_velocity	Z velocity of the orbital state vector [EARTH+FIXED)	NC_DOUBLE	m/s	Valid_min to Valid_max	1
long_name	Description of variable	NC_STRING		Z velocity of the orbital state vector [EARTH+FIXED)	
units	Physical units	NC_STRING		m/s	
Valid_min	Valid minimum value	NC_DOUBLE		-8.e3	
Valid_max	Valid maximum value	NC_DOUBLE		8.e3	
_FillValue	fill value	NC_DOUBLE		-9.e3	
yaw_error	Yaw attitude error Note: Only applicable to L1/L2 products.	NC_DOUBLE	degrees	Valid_min to Valid_max	1
long_name	Description of variable	NC_STRING		Yaw attitude error.	
units	Physical units	NC_STRING		degrees	
Valid_min	Valid minimum value	NC_DOUBLE		0.	
Valid_max	Valid maximum value	NC_DOUBLE		360.	
_FillValue	fill value	NC_DOUBLE		-999.	

roll_error	Roll attitude error Note: Only applicable to L1/L2 products.	NC_DOUBLE	degrees	Valid_min to Valid_max	1
long_name	Description of variable	NC_STRING		Roll attitude error	
units	Physical units	NC_STRING		degrees	
Valid_min	Valid minimum value	NC_DOUBLE		0.	
Valid_max	Valid maximum value	NC_DOUBLE		360.	
_FillValue	fill value	NC_DOUBLE		-999.	
pitch_error	Pitch attitude error Note: Only applicable to L1/L2 products.	NC_DOUBLE	degrees	Valid_min to Valid_max	1
long_name	Description of variable	NC_STRING		Pitch attitude error	
units	Physical units	NC_STRING		degrees	
Valid_min	Valid minimum value	NC_DOUBLE		0.	
Valid_max	Valid maximum value	NC_DOUBLE		360.	
_FillValue	fill value	NC_DOUBLE		-999.	
Leap Second Information					
leap_second_time_utc	UTC time of occurrence of a leap second in this product (if leap second occurred in the product time window); it represents the time after the leap second occurrence (i.e. midnight of day after the leap second; no leap second results in 0)"	NC_DOUBLE	seconds since 2020-01-01 00:00:00.000	Valid_min to Valid_max	1
long_name	Description of variable	NC_STRING		UTC time of occurrence of a leap second in this product (if leap second occurred in the product time window); it represents the time after the leap second	

				occurrence (i.e. midnight of day after the leap second; no leap second results in 0)"	
units	Physical units	NC_STRING		seconds since 2020-01-01 00:00:00	
Valid_min	Valid minimum value	NC_DOUBLE		-1.e9	
Valid_max	Valid maximum value	NC_DOUBLE		1.e9	
_FillValue	fill value	NC_DOUBLE		-9.e9.	
leap_second_value	Value of leap second in product (1, 0, or −1) 1 = increment; -1 = decrement	NC_SHORT	s	-1 to 1	1
long_name	Description of variable	NC_STRING		Value of leap second in product (1, 0, or −1)	
units	Physical units	NC_STRING		s	
Valid_min	Valid minimum value	NC_SHORT		-1	
Valid_max	Valid maximum value	NC_SHORT		1	
_FillValue	fill value	NC_SHORT		-999	
Manoeuvre Information					
manoeuvre_occurrence	Occurrence of manoeuvres between start and end times of the product (1 or 2) 1 = in-plane manoeuvre occurred 2 = out-of-plane manoeuvre occurred	NC_BYTE		1 or 2	manoeuvre_items
long_name	Description of variable	NC_STRING		Occurrence of manoeuvres between start and end times of the product (1 or 2)	
Valid_min	Valid minimum value	NC_BYTE		1	

Valid_max	Valid maximum value	NC_BYTE		2	
_FillValue	fill value	NC_BYTE		-9	
manoeuvre_start_time_utc	UTC time of start of manoeuvre	NC_DOUBLE	seconds since 2020-01-01 00:00:0 0.000	Valid_min to Valid_max	manoeuvre_items
long_name	Description of variable	NC_STRING		UTC time of start of manoeuvre	
units	Physical units	NC_STRING		seconds since 2020-01-01 00:00:00.000	
Valid_min	Valid minimum value	NC_DOUBLE		-1.e9	
Valid_max	Valid maximum value	NC_DOUBLE		1.e9	
_FillValue	fill value	NC_DOUBLE		-9.e9	
manoeuvre_end_time_utc	UTC time of end of manoeuvre	NC_DOUBLE	seconds since 2020-01-01 00:00:0 0.000	Valid_min to Valid_max	manoeuvre_items
long_name	Description of variable	NC_STRING		UTC time of end of manoeuvre	
units	Physical units	NC_STRING		seconds since 2020-01-01 00:00:00.000	
Valid_min	Valid minimum value	NC_DOUBLE		-1.e9	
Valid_max	Valid maximum value	NC_DOUBLE		1.e9	
_FillValue	fill value	NC_DOUBLE		-9.e9	

Table 7: satellite: Variables for MWI L1B product.

3.4.3.2 Group Name: instrument

3.4.3.2.1 instrument: Attributes

No instrument Group Attributes are foreseen for the MWI L1B Spectral Radiance product.

3.4.3.2.2 Instrument: Dimensions

This section describes the instrument Group Dimensions. Table 8 describes the Instrument group Dimensions for the MWI 1B Spectral Radiance product.

Dimension name=	Comment	Dimension length=
mode_items	Number of modes the instrument assumed during product duration	„„ 1 ≤ N

Table 8: instrument status: Dimensions for MWI L1B product.

3.4.3.2.3 instrument: Variables

Table 9 describes the instrument group variables for the MWI L1B radiance product with their specific attributes. Colours are used to differentiate variable and attributes: variables in light blue and attributes in white with name right-aligned.

Variables Name	Description	Type	Unit	Range or Value	Dimension
mode_start_time_utc	UTC time of start of mode	NC_DOUBLE	"seconds since 2020-01-01 00:00:00.000"	Valid_min to Valid_max	mode_items
long_name	Description of variable	NC_STRING		Start time of the mode	
units	Physical units	NC_STRING		"seconds since 2020-01-01 00:00:00.000"	
Valid_min	Valid minimum value	NC_DOUBLE		-1.e9	
Valid_max	Valid maximum value	NC_DOUBLE		1.e9	
_FillValue	Fill value	NC_DOUBLE		-9.e9	
mode_end_time_utc	UTC time of end of mode	NC_DOUBLE	"seconds since 2020-01-01 00:00:00.000"	Valid_min to Valid_max	mode_items
long_name	Description of variable	NC_STRING		End time of the mode	
units	Physical units	NC_STRING		"seconds since 2020-01-01 00:00:00.000"	
Valid_min	Valid minimum value	NC_DOUBLE		-1.e9	
Valid_max	Valid maximum value	NC_DOUBLE		1.e9	
_FillValue	Fill value	NC_DOUBLE		-9.e9	

Variables Name	Description	Type	Unit	Range or Value	Dimension
instrument_mode	Name of the instrument mode assumed	NC_STRING		Valid modes are provided in [L0PFS]	mode_items
long_name	Description of variable	NC_STRING		Name of the instrument mode assumed.	
_FillValue	Fill value	NC_STRING		"UNDEFINED MODE"	

Table 9: instrument: Variables for MWI L1B product.

3.4.3.3 Group Name: processing

3.4.3.3.1 processing: Attributes

This section describes the processing status Group Attributes for the MWI L1B Spectral Radiance product.

Attribute Name	Description	Type	Range or value
processor_name	"Name of the product processor"	NC_STRING	MWI_L1B
processor_version	"Version number of the processor"	NC_STRING	"v[*n*]"
processing_mode	("NRT" | "Reprocessing") Processing mode in which the product was generated	NC_STRING	"NRT" or "Reprocessing"
format_version	Product format version control number.	NC_STRING	Refer to Table 32.
pgs_reference_and_version	"Reference and version of the PGS"	NC_STRING	" EUM/LEO-EPSSG/SPE/14/746864 v[n]"
pfs_reference_and_version	"Reference and version of the PFS"	NC_STRING	"EUM/LEO-EPSSG/SPE/14/767115 v[*n*] "
atbd_reference_and_version	"Reference and version of the ATBD"	NC_STRING	"EUM/LEO-EPSSG/SPE/13/711560 v[n]"
source	An array of strings of the form specified in as follows: (AUXILIARY_DATA_NAME)* (INPUT_PRODUCT_NAME)* where the asterisks indicate zero or more instances	NC_STRING	Input Data – MWI L0 File, NAVATT L0 File, Input Auxiliary Data – MWI_1B_AUX_CNF_ MWI_1B_AUX_CCDB MWI_1B_AUX_DEM_ MWI_1B_AUX_LSM_ MWI_1B_AUX_APCM _____AUX_IBA_ _____AUX_POFD

Table 10: processing: Attributes for MWI L1B radiance product

3.4.3.3.2 processing: Dimensions

No common processing group dimensions are currently envisaged for the MWI L1B Spectral Radiance product.

3.4.3.3.3 processing: Variables

Table 11 describes the processing group variables for the MWI L1B radiance product with their specific attributes.

Variable name=	Type	Meaning	Attribute name="units" value=
Creation Time Information shape=1			
creation_time_utc	NC_DOUBLE	"UTC time of the start of the product creation"	"seconds since 2020-01-01 00:00:00.000"

Table 11: Processing: Variables for MWI L1B radiance product

3.4.4 Group Name: data

The data Group Dimensions for the MWI L1B Spectral Radiance product are listed in Table 12.

Dimension Name	Description	Range or Value
n_scan	Number of scans in the product	[0-9999] (according to granule size selected)
n_channels	Number of channels of the MWI instrument	18
n_channels_all	Number of channels of the MWI instrument including V and H polarization	26
n_channels_vh	Number of channels with double V&H polarization	8
n_samples	Number of samples for all channels	1394 [TBC]
n_cold_samples	Number of cold samples per scan	352 [TBC]
n_warm_samples	Number of warm samples per scan	339 [TBC]

Table 12: Data: Dimensions for MWI L1B product.

3.4.4.1 Group Name: navigation_data

3.4.4.1.1 navigation_data: Attributes

This section describes the measurement_data Group Attributes for the MWI Spectral Radiance Product. Common group attributes are given Table 13.

Attribute	Description	Type	Range or Value
sun_glint_angle_threshold	Threshold for the sun, for which the data are flagged with sun glint.	NC_STRING	"2.0 2.0 2.0 2.0 2.0"
moon_angle_threshold	Threshold for the difference between the Moon angle and the antenna space view position, for which the data are flagged for moon intrusion in the cold space view.	NC_STRING	"2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0"
undersampling_step_along_scan	spatially sub-sampled factor along scan for several geolocation variables (longitude, latitude, solar zenith, solar azimuth, observation zenith and observation azimuth)	NC_SHORT	10 [TBC]
undersampling_step_last_samples	spatially sub-sampled factor between last two samples of scan for several geolocation variables (longitude, latitude, solar zenith, solar azimuth, observation zenith and observation azimuth)	NC_SHORT	3 [TBC]

Table 13: navigation_data: Attributes for MWI L1B product.

3.4.4.1.2 navigation_data: Dimensions

The navigation_data Group Dimensions for the MWI L1B Spectral Radiance product are presented in Table 14.

Dimension Name	Description	Range or Value
n_sun_glint_datagroups	Number of MWI data groups with sun glint angle calculation 1=MWI-1, V and H 2=MWI-2, V and H 3= MWI-3, V and H 4=MWI-4 to MWI-7, V and H 5=MWI-8, V and H	5
n_data_groups	Number of data groups	8
n_subs	Number of samples at undersampled locations, along scan	141 [TBC]

Table 14: navigation_data: Dimensions for MWI L1B radiance product

3.4.4.1.3 navigation_data: Variables

The navigation_data Group Variables for the MWI L1B Spectral Radiance product are described in Table 15 with their specific attributes. Colours are used to differentiate variable and attributes: variables in light blue and attributes in white with name right-aligned in *italics*.

Latitude, longitude, OZA, azimuth, solar zenith and azimuth angles are undersampled using the factors specified in the undersampling_step_along_scan and undersampling_step_last_samples attributes in Table 13. This is a strategy aiming at reducing the final size of the product reconstructing the geolocation information Appendix D.

Variables Name	Description	Type	Range or Value	Dimension
time_start_scan _utc	UTC time of start of Earth view scan	NC_DOUBLE	valid_min to valid max	n_scan
long_name	Description of variable	NC_STRING	"UTC time of start of Earth view scan"	
units	Physical units	NC_STRING	"seconds since 2020-01-01 00:00:00.000"	
valid_min	minimum time	NC_DOUBLE	-1.e9	
valid_max	maximum time	NC_DOUBLE	1.e9	
_FillValue	missing time value	NC_DOUBLE	-9.e9	
latitude	Geodetic latitude	NC_INT	valid_min to valid max	n_scan, n_subs, n_data_groups
long_name	Description of variable	NC_STRING	"geodetic latitude at subsampled location"	
units	Physical units	NC_STRING	"degrees_north"	
scale_factor	Scale factor applied	NC_FLOAT	1.e-4	
add_offset	Offset applied	NC_FLOAT	0.0	
valid_min	Valid minimum value	NC_INT	-900000	
valid_max	Valid maximum value	NC_INT	900000	
_FillValue	Fill value	NC_INT	-2^{31}	
longitude	Geodetic longitude	NC_INT	valid_min to valid max	n_scan, n_subs, n_data_groups
long_name	Description of variable	NC_STRING	"geodetic longitude at subsampled location"	
units	Physical units	NC_STRING	"degrees_east"	
scale_factor	Scale factor applied	NC_FLOAT	1.e-4	
add_offset	Offset applied	NC_FLOAT	0.0	
valid_min	Valid minimum value	NC_INT	-1800000	

Variables Name	Description	Type	Range or Value	Dimension
valid_max	Valid maximum value	NC_INT	1800000	
_FillValue	Fill value	NC_INT	-2^{31}	
mwi_oza	MWI Observation Zenith Angle at subsampled location (incidence angle)	NC_SHORT	valid_min to valid max	n_scan, n_subs, n_data_groups
long_name	Description of variable	NC_STRING	"MWI Observation Zenith Angle at subsampled location"	
units	units used	NC_STRING	"degrees"	
scale_factor	Scale factor applied	NC_FLOAT	1.e-2	
add_offset	Offset applied	NC_FLOAT	0.0	
valid_min	Valid minimum value	NC_SHORT	0	
valid_max	Valid maximum value	NC_SHORT	9000	
_FillValue	fill value	NC_SHORT	-32768	
mwi_azimuth	MWI azimuth angle at subsampled location	NC_USHORT	valid_min to valid max	n_scan, n_subs, n_data_groups
long_name	Description of variable	NC_STRING	"MWI observation azimuth angle at subsampled location"	
units	Physical units	NC_STRING	"degrees"	
scale_factor	Scale factor applied	NC_FLOAT	1.e-2	
add_offset	Offset applied	NC_FLOAT	0.0	
valid_min	Valid minimum value	NC_USHORT	0	
valid_max	Valid maximum value	NC_USHORT	36000	
_FillValue	fill value	NC_USHORT	65535	
land_fraction	Land Fraction	NC_UBYTE	valid_min to valid max	n_scan, n_samples, n_data_groups
long_name	Description of variable	NC_STRING	"Fraction of footprint covered by land"	
scale_factor	Scale factor applied	NC_FLOAT	0.01	
add_offset	Offset applied	NC_FLOAT	0.0	
valid_min	Valid minimum value	NC_UBYTE	0	
valid_max	Valid maximum value	NC_UBYTE	100	
_FillValue	Fill value	NC_UBYTE	255	
mwi_terrain_elevation	Average terrain elevation	NC_SHORT	valid_min to valid_max	n_scan, n_samples, n_data_groups

Variables Name	Description	Type	Range or Value	Dimension
long_name	Description of variable	NC_STRING	"Average terrain elevation above reference ellipsoid"	
units	Physical units	NC_STRING	"metres"	
scale_factor	Scale factor applied	NC_SHORT	1	
add_offset	Offset applied	NC_SHORT	0	
valid_min	Valid minimum value	NC_SHORT	-500	
valid_max	Valid maximum value	NC_SHORT	10000	
_FillValue	Fill value	NC_SHORT	-32768	
delta_latitude	Parallax latitude shift	NC_BYTE	valid_min to valid max	n_scan, n_samples, n_data_groups
long_name	Description of variable	NC_STRING	" Distance between latitude obtained using DEM and latitude on ellipsoid"	
units	units used	NC_STRING	"metres"	
scale_factor	Scale factor applied	NC_SHORT	100	
add_offset	Offset applied	NC_SHORT	0	
valid_min	Valid minimum value	NC_BYTE	-127	
valid_max	Valid maximum value	NC_BYTE	127	
_FillValue	Fill value	NC_BYTE	-128	
delta_longitude	Parallax longitude shift	NC_BYTE	valid_min to valid max	n_scan, n_samples, n_data_groups
long_name	Description of variable	NC_STRING	"Distance between longitude obtained using DEM and longitude on ellipsoid"	
units	units used	NC_STRING	"m"	
scale_factor	Scale factor applied	NC_SHORT	100	
add_offset	Offset applied	NC_SHORT	0	
valid_min	Valid minimum value	NC_BYTE	-127	
valid_max	Valid maximum value	NC_BYTE	127	
_FillValue	Fill value	NC_BYTE	-128	
sun_glint_angle	Sun glint angle for data groups of MWI-1 to MWI-8	NC_USHORT	valid_min to valid max	n_scan, n_samples, n_sun_glint_datagroups
long_name	Description of variable	NC_STRING	"Sun glint angle for datagroups of channels MWI-1 to MWI-8"	
units	Physical units	NC_STRING	"degrees"	

Variables Name	Description	Type	Range or Value	Dimension
scale_factor	Scale factor applied	NC_FLOAT	1.e-2	
add_offset	Offset applied	NC_FLOAT	0.0	
valid_min	Valid minimum value	NC_USHORT	0	
valid_max	Valid maximum value	NC_USHORT	18000	
_FillValue	Fill value	NC_USHORT	65535	
rfi_flag	MWI-1 RFI flag	NC_UBYTE	valid_min to valid max	n_scan, n_samples
long_name	Description of variable	NC_STRING	"MWI-1 RFI flag"	
valid_min	Valid minimum value	NC_UBYTE	0	
valid_max	Valid maximum value	NC_UBYTE	254	
_FillValue	Fill value	NC_UBYTE	255	
orbit_angle	Angular position in the orbit, starting at zero when the satellite crosses the solar Ecliptic plane northbound.	NC_INT	valid_min to valid max	n_scan
long_name	Description of variable	NC_STRING	"Angular position in the orbit, starting at zero when the satellite crosses the solar Ecliptic plane northbound"	
units	Physical units	NC_STRING	"degrees"	
scale_factor	Scale factor applied	NC_FLOAT	1.e-4	
Valid_min	Valid minimum value	NC_FLOAT	0	
Valid_max	Valid maximum value	NC_INT	3600000	
_FillValue	Fill value	NC_INT	-2^{31}	
spacecraft_altitude	Spacecraft altitude above reference ellipsoid	NC_SHORT	valid_min to valid max	n_scan
long_name	Description of variable	NC_STRING	"Spacecraft altitude above reference ellipsoid"	
units	Physical units	NC_STRING	"km"	
scale_factor	Scale factor applied	NC_FLOAT	1.e-1	
add_offset	Offset applied	NC_FLOAT	0.0	
valid_min	Valid minimum value	NC_SHORT	4000	
Valid_max	Valid maximum value	NC_SHORT	20000	
_FillValue	Fill value	NC_SHORT	-32768	
latitude_ssp	Latitude of sub-satellite point	NC_INT	valid_min to valid max	n_scan

Variables Name	Description	Type	Range or Value	Dimension
long_name	Description of the variable	NC_STRING	"geodetic latitude of sub-satellite point at scan start"	
units	Physical units	NC_STRING	"degrees_north"	
scale_factor	Scale factor applied	NC_FLOAT	1.e-4	
add_offset	Offset applied	NC_FLOAT	0.0	
valid_min	Valid minimum value	NC_INT	-900000	
valid_max	Valid maximum value	NC_INT	900000	
_FillValue	Fill value	NC_INT	-2^{31}	
longitude_ssp	Longitude of sub-satellite point	NC_INT	valid_min to valid max	n_scan
long_name	Description of the variable	NC_STRING	"geodetic longitude of sub-satellite point at scan start"	
units	Physical units	NC_STRING	"degrees_east"	
scale_factor	Scale factor applied	NC_FLOAT	1.e-4	
add_offset	Offset applied	NC_FLOAT	0.0	
valid_min	Valid minimum value	NC_INT	-1800000	
valid_max	Valid maximum value	NC_INT	1800000	
_FillValue	Fill value	NC_INT	-2^{31}	
mwi_roll_angle	Roll angle between nominal yaw steering and instrument reference frame	NC_SHORT	valid_min to valid max	n_scan
long_name	Description of variable	NC_STRING	"Roll angle between nominal yaw steering and instrument reference frame"	
units	Physical units	NC_STRING	degrees	
scale_factor	Scale factor applied	NC_FLOAT	1.e-3	
add_offset	Offset applied	NC_FLOAT	0.0	
valid_min	Valid minimum value	NC_SHORT	$-2^{15}+1$	
valid_max	Valid maximum value	NC_SHORT	$2^{15}-1$	
_Fillvalue	Fill value	NC_SHORT	-2^{15}	
mwi_pitch_angle	Pitch angle between nominal yaw steering and instrument reference frame	NC_SHORT	valid_min to valid max	n_scan

Variables Name	Description	Type	Range or Value	Dimension
long_name	Description of variable	NC_STRING	"Pitch angle between nominal yaw steering and instrument reference frame"	
units	Physical units	NC_STRING	degrees	
scale_factor	Scale factor applied	NC_FLOAT	1.e-3	
add_offset	Offset applied	NC_FLOAT	0.0	
valid_min	Valid minimum value	NC_SHORT	$-2^{15}+1$	
valid_max	Valid maximum value	NC_SHORT	$2^{15}-1$	
_Fillvalue	Fill value	NC_SHORT	-2^{15}	
mwi_yaw_angle	Yaw angle between nominal yaw steering and instrument reference frame	NC_SHORT	valid_min to valid max	n_scan
long_name	Description of variable	NC_STRING	"Yaw angle between nominal yaw steering and instrument reference frame"	
units	Physical units	NC_STRING	"degrees"	
scale_factor	Scale factor applied	NC_FLOAT	1.e-3	
add_offset	Offset applied	NC_FLOAT	0.0	
valid_min	Valid minimum value	NC_SHORT	$-2^{15}+1$	
valid_max	Valid maximum value	NC_SHORT	$2^{15}-1$	
_Fillvalue	Fill value	NC_SHORT	-2^{15}	
sun_elevation_angle	Sun elevation in the instrument reference frame	NC_SHORT	valid_min to valid max	n_scan
long_name	Description of variable	NC_STRING	"Sun elevation angle in the instrument reference frame"	
units	Physical units	NC_STRING	"degrees"	
scale_factor	Scale factor applied	NC_FLOAT	1.e-2	
add_offset	Offset applied	NC_FLOAT	0.0	
valid_min	Valid minimum value	NC_SHORT	-9000	
valid_max	Valid maximum value	NC_SHORT	9000	
_Fillvalue	Fill value	NC_SHORT	-32768	
sun_azimuth_angle	Sun azimuth in the instrument reference frame	NC_USHORT	valid_min to valid max	n_scan

Variables Name	Description	Type	Range or Value	Dimension
long_name	Description of variable	NC_STRING	"Sun azimuth angle in the instrument reference frame"	
units	Physical units	NC_STRING	"degrees"	
scale_factor	Scale factor applied	NC_FLOAT	1.e-2	
add_offset	Offset applied	NC_FLOAT	0.0	
valid_min	Valid minimum value	NC_USHORT	0	
valid_max	Valid maximum value	NC_USHORT	36000	
_Fillvalue	Fill value	NC_USHORT	65535	
mwi_solar_zenith_angle	MWI Solar zenith angle	NC_USHORT	See valid_min and valid_max	n_scan, n_subs, n_data_groups
long_name	Description of variable	NC_STRING	"Solar zenith angle at MWI subsampled locations"	
units	Physical units	NC_STRING	"degrees"	
scale_factor	Scale factor applied	NC_FLOAT	1.e-2	
add_offset	Offset applied	NC_FLOAT	0.0	
valid_min	Valid minimum value	NC_USHORT	0	
valid_max	Valid maximum value	NC_USHORT	18000	
_FillValue	Fill value	NC_USHORT	65535	
mwi_solar_azimuth_angle	MWI Solar azimuth angle	NC_USHORT	valid_min to valid max	n_scan, n_subs, n_data_groups
long_name	Description of variable	NC_STRING	"Solar azimuth angle MWI at subsampled locations"	
units	Physical units	NC_STRING	"degrees"	
scale_factor	Scale factor applied	NC_FLOAT	1.e-2	
add_offset	Offset applied	NC_FLOAT	0.0	
valid_min	Valid minimum value	NC_USHORT	0	
valid_max	Valid maximum value	NC_USHORT	36000	
_FillValue	fill value	NC_USHORT	65535	
moon_angle	Angle between the unit vector centred on the Moon and directed to the satellite and the unit vector pointing in the boresight direction of the Space View Reflector	NC_USHORT	valid_min to valid max	n_scan, n_cold_samples, n_data_groups

Variables Name	Description	Type	Range or Value	Dimension
long_name	Description of variable	NC_STRING	“Angle between Moon and individual space views”	
units	Physical units	NC_STRING	“degrees”	
scale_factor	Scale factor applied	NC_FLOAT	1.e-2	
add_offset	Offset applied	NC_FLOAT	0.0	
valid_min	Valid minimum value	NC_USHORT	0	
valid_max	Valid maximum value	NC_USHORT	18000	
_Fill_value	Fill value	NC_USHORT	65535	

Table 15: navigation_data: Variables for MWI L1B product

3.4.4.2 Group Name: measurement_data

3.4.4.2.1 measurement_data: Attributes

No measurement_data Group Attributes for the MWI L1B Spectral Radiance product are currently envisaged.

3.4.4.2.2 measurement_data: Dimensions

The measurement_data Group Dimensions for the MWI L1B radiance are presented in Table 16.

Dimension Name	Description	Range or Value
nedt_values	NEDT index for cold and warm target 1=warm target 2=cold target	2
n_18	number of channels at 18.7 GHz (including V and H)	2
n_23	number of channels at 23.8 GHz (including V and H)	2
n_31	number of channels at 31.4 GHz (including V and H)	2
n_50	number of channels at 50-53 GHz (including V and H)	4
n_89	number of channels at 89 GHz (including V and H)	2
n_118	number of channels at 118.75 GHz	4
n_165	number of channels at 165.5 GHz	1
n_183	number of channels at 183.31 GHz	5

Table 16: measurement_data: Dimensions for MWI L1B radiance product

3.4.4.2.3 measurement_data: Variables

The measurement_data Group Variables for the MWI L1B radiance product are described in Table 17 with their specific attributes. Colours are used to differentiate variable and attributes: variables in light blue and attributes in white with name right-aligned in *italics*.

Variables Name	Description	Type	Range or Value	Dimension
mwi_radiance_18_vh	MWI spectral radiances at channels MWI-1 V and MWI-1 H	NC_USHORT	valid_min to valid max	n_scan, n_samples, n_18
long_name	Description of variable	NC_STRING	"MWI spectral radiances at channels MWI-1 V and H"	
units	Physical units	NC_STRING	"mW·m-2·sr-1·(cm-1)-1"	
scale_factor	Scale factor applied	NC_DOUBLE	1.57e-08	
add_offset	Offset applied	NC_DOUBLE	9.52e-05	
valid_min	Valid minimum value	NC_USHORT	0	
valid_max	Valid maximum value	NC_USHORT	65534	
_FillValue	Fill value	NC_USHORT	65535	
mwi_radiance_23_vh	MWI spectral radiances at channels MWI-2 V and MWI-2 H	NC_USHORT	valid_min to valid max	n_scan, n_samples, n_23
long_name	Description of variable	NC_STRING	"MWI spectral radiances at channels MWI-2 V and H"	
units	Physical units	NC_STRING	"mW·m-2·sr-1·(cm-1)-1"	
scale_factor	Scale factor applied	NC_DOUBLE	2.55e-08	
add_offset	Offset applied	NC_DOUBLE	1.54e-04	
valid_min	Valid minimum value	NC_USHORT	0	
valid_max	Valid maximum value	NC_USHORT	65534	
_FillValue	Fill value	NC_USHORT	65535	
mwi_radiance_31_vh	MWI spectral radiances at channels MWI-3 V and MWI-3 H	NC_USHORT	valid_min to valid max	n_scan, n_samples, n_31
long_name	Description of variable	NC_STRING	"MWI spectral radiances at channels MWI-3 V and H "	
units	Physical units	NC_STRING	"mW·m-2·sr-1·(cm-1)-1"	
scale_factor	Scale factor applied	NC_DOUBLE	4.43e-08	
add_offset	Offset applied	NC_DOUBLE	2.66e-04	
valid_min	Valid minimum value	NC_USHORT	0	
valid_max	Valid maximum value	NC_USHORT	65534	
_FillValue	Fill value	NC_USHORT	65535	

Variables Name	Description	Type	Range or Value	Dimension
mwi_radiance_50_53_v	MWI spectral radiances at channels MWI-4 V to MWI-7 V	NC_USHORT	valid_min to valid max	n_scan, n_samples, n_50
long_name	Description of variable	NC_STRING	"MWI spectral radiances in V pol at channels MWI-4 to MWI-7 "	
units	Physical units	NC_STRING	"mW·m-2·sr-1·(cm-1)-1"	
scale_factor	Scale factor applied	NC_DOUBLE	1.24e-07	
add_offset	Offset applied	NC_DOUBLE	7.33e-04	
valid_min	Valid minimum value	NC_USHORT	0	
valid_max	Valid maximum value	NC_USHORT	65534	
_FillValue	Fill value	NC_USHORT	65535	
mwi_radiance_50_53_h	MWI spectral radiances at channels MWI-4 H to MWI-7 H	NC_USHORT	valid_min to valid max	n_scan, n_samples, n_50
long_name	Description of variable	NC_STRING	"MWI spectral radiances in H pol at channels MWI-4 to MWI 7"	
units	Physical units	NC_STRING	"mW·m-2·sr-1·(cm-1)-1"	
scale_factor	Scale factor applied	NC_DOUBLE	1.24e-07	
add_offset	Offset applied	NC_DOUBLE	7.33e-04	
valid_min	Valid minimum value	NC_USHORT	0	
valid_max	Valid maximum value	NC_USHORT	65534	
_FillValue	Fill value	NC_USHORT	65535	
mwi_radiance_89_vh	MWI spectral radiances at channels MWI-8 V and MWI-8 H	NC_USHORT	valid_min to valid max	n_scan, n_samples, n_89
long_name	Description of variable	NC_STRING	"MWI spectral radiances at channel MWI-8 V and H "	
units	Physical units	NC_STRING	"mW·m-2·sr-1·(cm-1)-1"	
scale_factor	Scale factor applied	NC_DOUBLE	3.56e-07	
add_offset	Offset applied	NC_DOUBLE	0.002	
valid_min	Valid minimum value	NC_USHORT	0	
valid_max	Valid maximum value	NC_USHORT	65534	
_FillValue	Fill value	NC_USHORT	65535	

Variables Name	Description	Type	Range or Value	Dimension
mwi_radiance_118_v	MWI spectral radiances in V polarisation at channels MWI 9 to MWI 12	NC_USHORT	valid_min to valid max	n_scan, n_samples, n_118
long_name	Description of variable	NC_STRING	"MWI spectral radiances in V pol at channels MWI-9 to MWI-12"	
units	Physical units	NC_STRING	"mW·m-2·sr-1·(cm-1)-1"	
scale_factor	Scale factor applied	NC_DOUBLE	6.34e-07	
add_offset	Offset applied	NC_DOUBLE	0.0035	
valid_min	Valid minimum value	NC_USHORT	0	
valid_max	Valid maximum value	NC_USHORT	65534	
_FillValue	Fill value	NC_USHORT	65535	
mwi_radiance 165_v	MWI spectral radiances in V polarisation at channel MWI 13	NC_USHORT	valid_min to valid max	n_scan, n_samples, n_165
long_name	Description of variable	NC_STRING	"MWI spectral radiances in V pol at channel MWI-13"	
units	Physical units	NC_STRING	"mW·m-2·sr-1·(cm-1)-1"	
scale_factor	Scale factor applied	NC_DOUBLE	1.23e-06	
add_offset	Offset applied	NC_DOUBLE	0.0066	
valid_min	Valid minimum value	NC_USHORT	0	
valid_max	Valid maximum value	NC_USHORT	65534	
_FillValue	Fill value	NC_USHORT	65535	
mwi_radiance 183_v	MWI spectral radiances in V polarisation at channels MWI 14 to MWI 18	NC_USHORT	valid_min to valid max	n_scan, n_samples, n_183
long_name	Description of variable	NC_STRING	"MWI spectral radiances in V pol at channels MWI-14 to MWI-18"	
units	Physical units	NC_STRING	"mW·m-2·sr-1·(cm-1)-1"	
scale_factor	Scale factor applied	NC_DOUBLE	1.51e-06	
add_offset	Offset applied	NC_DOUBLE	0.008	
valid_min	Valid minimum value	NC_USHORT	1	
valid_max	Valid maximum value	NC_USHORT	65534	
_FillValue	Fill value	NC_USHORT	65535	

Variables Name	Description	Type	Range or Value	Dimension
mwi_nedt	NEΔT for all channels	NC_SHORT	valid_min to valid max	n_scan, n_channels_all, nedt_values
long_name	Description of variable	NC_STRING	"MWI radiometric sensitivity based on OBCT and cold view measurements"	
units	NEΔT units	NC_STRING	"K"	
scale_factor	Scale factor applied	NC_FLOAT	1.e-3	
add_offset	Offset applied	NC_FLOAT	0.0	
valid_min	Valid minimum value	NC_SHORT	0	
valid_max	Valid maximum value	NC_SHORT	30000	
_FillValue	Fill value	NC_SHORT	-32768	
bt_conversion_a	Brightness temperature conversion coefficient A	NC_DOUBLE		n_channels
long_name	Description of variable	NC_STRING	"Brightness temperature conversion coefficient A"	
units	Physical units	NC_STRING	""	
bt_conversion_b	Brightness temperature conversion coefficient B	NC_DOUBLE		n_channels
long_name	Description of variable	NC_STRING	"Brightness temperature conversion coefficient B"	
units	Physical units	NC_STRING	"K"	
centre_wavenumber	MWI channels centre frequency wavenumber	NC_DOUBLE		n_channels
long_name	Description of variable	NC_STRING	"MWI channels centre frequency wavenumber"	
units	Physical units	NC_STRING	"cm-1"	

Table 17: measurement_data: Variables for MWI L1B product.

3.4.4.3 Group Name: calibration_data

3.4.4.3.1 calibration_data: Attributes

This section describes the calibration_data Group Attributes for the MWI L1B radiance. Common group attributes are provided in Table 18.

Attribute name	Description	Type	Range or Value
antenna_correction_version	Version of the antenna pattern correction	NC_STRING	v[1 – 1000]

Table 18: calibration_data: Attributes for MWI L1B radiance product

3.4.4.3.2 calibration_data: Dimensions

The calibration_data Group Dimensions for the MWI L1B radiance product is presented in Table 19.

Dimension Name	Description	Range or Value
n_prts_obct	number of PRTs in the OBCT	5 [TBC]
n_samples_prts_obct	number of samples of each PRT in the OBCT	9 [TBC]
n_thms_svr	number of thermistors in the SVR	3 [TBC]
n_samples_thms_svr	number of samples of each thermistor in the SVR	9 [TBC]
n_thms_mr	number of thermistors in the MR	12 [TBC]
n_thms_race	number of thermistors in racetrack	12 [TBC]
n_thms_receivers	number of thermistors of receivers	23 [TBC]
n_diodes	number of noise diodes	6
n_18	number of channels at 18.7 GHz (including V and H)	2
n_23	number of channels at 23.8 GHz (including V and H)	2
n_31	number of channels at 31.4 GHz (including V and H)	2
n_50	number of channels at 50-53 GHz	4
n_89	number of channels at 89 GHz (including V and H)	2
n_118	number of channels at 118.75 GHz	4
n_165	number of channels at 165.5 GHz	1
n_183	number of channels at 183.31 GHz	5

Table 19: calibration_data: Dimensions for MWI L1B radiance product

3.4.4.3.3 calibration_data: Variables

The calibration_data Group Variables for the MWI L1B radiance product with their specific attributes are described in Table 20. Colours are used to differentiate variable and attributes: variables in light blue and attributes in white with name right-aligned in *italics*.

Variables Name	Description	Type	Range or Value	Dimension
mwi_sidelobe_18_vh	Antenna sidelobe correction for channels MWI-1 V and MWI-1 H	NC_UBYTE	valid_min to valid max	n_scan, n_samples, n_18
long_name	Description of variable	NC_STRING	"Sidelobe antenna temperature correction for channels MWI-1 V and H"	
units	Physical units	NC_STRING	"K"	
scale_factor	Scale factor applied	NC_FLOAT	0.02	
add_offset	Offset applied	NC_FLOAT	0.0	
valid_min	Valid minimum value	NC_UBYTE	0	
valid_max	Valid maximum value	NC_UBYTE	254	
_FillValue	Fill value	NC_UBYTE	255	
mwi_sidelobe_23_vh	Antenna sidelobe correction for channels MWI-2 V and MWI-2 H	NC_UBYTE	valid_min to valid max	n_scan, n_samples, n_23
long_name	Description of variable	NC_STRING	"Sidelobe antenna temperature correction for channels MWI-2 V and H"	
units	Physical units	NC_STRING	"K"	
scale_factor	Scale factor applied	NC_FLOAT	0.02	
add_offset	Offset applied	NC_FLOAT	0.0	
valid_min	Valid minimum value	NC_UBYTE	0	
valid_max	Valid maximum value	NC_UBYTE	254	
_FillValue	Fill value	NC_UBYTE	255	
mwi_sidelobe_31_vh	Antenna sidelobe correction for channels MWI-3 V and MWI-3 H	NC_UBYTE	valid_min to valid max	n_scan, n_samples, n_31
long_name	Description of variable	NC_STRING	"Sidelobe antenna temperature correction for channels MWI-3 V and H "	
units	Physical units	NC_STRING	"K"	
scale_factor	Scale factor applied	NC_FLOAT	0.02	
add_offset	Offset applied	NC_FLOAT	0.0	
valid_min	Valid minimum value	NC_UBYTE	0	

Variables Name	Description	Type	Range or Value	Dimension
valid_max	Valid maximum value	NC_UBYTE	254	
_FillValue	Fill value	NC_UBYTE	255	
mwi_sidelobe_50_53_v	Antenna sidelobe correction for channels MWI-4 V to MWI-7 V	NC_UBYTE	valid_min to valid max	n_scan, n_samples, n_50
long_name	Description of variable	NC_STRING	"Sidelobe antenna temperature correction for channels MWI-4 to MWI-7 in V pol"	
units	Physical units	NC_STRING	"K"	
scale_factor	Scale factor applied	NC_FLOAT	0.02	
add_offset	Offset applied	NC_FLOAT	0.0	
valid_min	Valid minimum value	NC_UBYTE	0	
valid_max	Valid maximum value	NC_UBYTE	254	
_FillValue	Fill value	NC_UBYTE	255	
mwi_sidelobe_50_53_h	Antenna sidelobe correction for channels MWI-4 H to MWI-7 H	NC_UBYTE	valid_min to valid max	n_scan, n_samples, n_50
long_name	Description of variable	NC_STRING	"Sidelobe antenna temperature correction for channels MWI-4 to MWI 7 in H pol"	
units	Physical units	NC_STRING	"K"	
scale_factor	Scale factor applied	NC_FLOAT	0.02	
add_offset	Offset applied	NC_FLOAT	0.0	
valid_min	Valid minimum value	NC_UBYTE	0	
valid_max	Valid maximum value	NC_UBYTE	254	
_FillValue	Fill value	NC_UBYTE	255	
mwi_sidelobe_89_vh	Antenna sidelobe correction for channels MWI-8 V and MWI-8 H	NC_UBYTE	valid_min to valid max	n_scan, n_samples, n_89
long_name	Description of variable	NC_STRING	"Sidelobe antenna temperature correction for channels MWI-8 V and H "	
units	Physical units	NC_STRING	"K"	
scale_factor	Scale factor applied	NC_FLOAT	0.02	
add_offset	Offset applied	NC_FLOAT	0.0	
valid_min	Valid minimum value	NC_UBYTE	0	
valid_max	Valid maximum value	NC_UBYTE	254	
_FillValue	Fill value	NC_UBYTE	255	

Variables Name	Description	Type	Range or Value	Dimension
mwi_sidelobe_118_v	Antenna sidelobe correction for channels MWI-9 to MWI-12 in V polarization	NC_UBYTE	valid_min to valid max	n_scan, n_samples, n_118
long_name	Description of variable	NC_STRING	"Sidelobe antenna temperature correction for channels MWI-9 to MWI-12 in V pol"	
units	Physical units	NC_STRING	"K"	
scale_factor	Scale factor applied	NC_FLOAT	0.02	
add_offset	Offset applied	NC_FLOAT	0.0	
valid_min	Valid minimum value	NC_UBYTE	0	
valid_max	Valid maximum value	NC_UBYTE	254	
_FillValue	Fill value	NC_UBYTE	255	
mwi_sidelobe 165_v	Antenna sidelobe correction for channel MWI-13 in V polarisation	NC_UBYTE	valid_min to valid max	n_scan, n_samples, n_165
long_name	Description of variable	NC_STRING	"Sidelobe antenna temperature correction for channel MWI-13 in V pol"	
units	Physical units	NC_STRING	"K"	
scale_factor	Scale factor applied	NC_FLOAT	0.02	
add_offset	Offset applied	NC_FLOAT	0.0	
valid_min	Valid minimum value	NC_UBYTE	0	
valid_max	Valid maximum value	NC_UBYTE	254	
_FillValue	Fill value	NC_UBYTE	255	
mwi_sidelobe_183_v	Antenna sidelobe correction for channels MWI-14 to MWI-18 in V polarisation	NC_UBYTE	valid_min to valid max	n_scan, n_samples, n_183
long_name	Description of variable	NC_STRING	"Sidelobe antenna temperature correction for channels MWI-14 to MWI-18 in V pol"	
units	Physical units	NC_STRING	"K"	
scale_factor	Scale factor applied	NC_FLOAT	0.02	
add_offset	Offset applied	NC_FLOAT	0.0	
valid_min	Valid minimum value	NC_UBYTE	0	
valid_max	Valid maximum value	NC_UBYTE	254	

Variables Name	Description	Type	Range or Value	Dimension
_FillValue	Fill value	NC_UBYTE	255	
warm_calibration_counts_v	MWI OBCT view calibration counts of V pol channels	NC_USHORT	valid_min to valid max	n_scan, n_warm_samples, n_channels
long_name	Description of variable	NC_STRING	"MWI OBCT view calibration counts of V pol channels"	
units	Physical units	NC_STRING	"-"	
valid_min	Valid minimum value	NC_USHORT	0	
valid_max	Valid maximum value	NC_USHORT	65534	
_FillValue	Fill value	NC_USHORT	65535	
warm_calibration_counts_h	MWI OBCT view calibration counts of H pol channels	NC_USHORT	valid_min to valid max	n_scan, n_warm_samples, n_channels_vh
long_name	Description of variable	NC_STRING	"MWI OBCT view calibration counts of H pol channels"	
units	Physical units	NC_STRING	"-"	
valid_min	Valid minimum value	NC_USHORT	0	
valid_max	Valid maximum value	NC_USHORT	65534	
_FillValue	Fill value	NC_USHORT	65535	
cold_calibration_counts_v	MWI cold space view calibration counts of V pol channels	NC_USHORT	valid_min to valid max	n_scan, n_cold_samples, n_channels
long_name	Description of variable	NC_STRING	"MWI cold space view calibration counts of V pol channels"	
units	Physical units	NC_STRING	"-"	
valid_min	Valid minimum value	NC_USHORT	0	
valid_max	Valid maximum value	NC_USHORT	65534	
_FillValue	Fill value	NC_USHORT	65535	
cold_calibration_counts_h	MWI cold space view calibration counts of H pol channels	NC_USHORT	valid_min to valid max	n_scan, n_cold_samples,n_channels_vh
long_name	Description of variable	NC_STRING	"MWI cold space view calibration counts of H pol channels"	
units	Physical units	NC_STRING	"-"	
valid_min	Valid minimum value	NC_USHORT	0	
valid_max	Valid maximum value	NC_USHORT	65534	

Variables Name	Description	Type	Range or Value	Dimension
_FillValue	Fill value	NC_USHORT	65535	
warm_counts_v_average_over_scans	Averaged over scans OBCT view counts of V pol channels used for calibration	NC_UINT	valid_min to valid max	n_scan, n_channels
long_name	Description of variable	NC_STRING	"Averaged over scans OBCT view counts of channels in V pol of current scan line "	
units	Physical units	NC_STRING	"-"	
scale_factor	Scale factor applied	NC_FLOAT	1.e-5	
add_offset	Offset applied	NC_FLOAT	0.0	
valid_min	Valid minimum value	NC_UINT	0	
valid_max	Valid maximum value	NC_UINT	2^{32} - 2	
_FillValue	Fill value	NC_UINT	2^{32} - 1	
warm_counts_h_average_over_scans	Averaged over scans OBCT view counts of H pol channels used for calibration	NC_UINT	valid_min to valid max	n_scan, n_channels_vh
long_name	Description of variable	NC_STRING	"Averaged over scans OBCT view counts of channels in H pol of current scan line "	
units	Physical units	NC_STRING	"-"	
scale_factor	Scale factor applied	NC_FLOAT	1.e-5	
add_offset	Offset applied	NC_FLOAT	0.0	
valid_min	Valid minimum value	NC_UINT	0	
valid_max	Valid maximum value	NC_UINT	2^{32} - 2	
_FillValue	Fill value	NC_UINT	2^{32} - 1	
cold_counts_v_average_over_scans	Averaged over scans cold space view counts of V pol channels used for calibration	NC_UINT	valid_min to valid max	n_scan, n_channels
long_name	Description of variable	NC_STRING	"Averaged over scans cold space view counts of channels in V pol of current scan line "	
units	Physical units	NC_STRING	"-"	
scale_factor	Scale factor applied	NC_FLOAT	1.e-5	
add_offset	Offset applied	NC_FLOAT	0.0	
valid_min	Valid minimum value	NC_UINT	0	
valid_max	Valid maximum value	NC_UINT	2^{32} - 2	
_FillValue	Fill value	NC_UINT	2^{32} - 1	

Variables Name	Description	Type	Range or Value	Dimension
cold_counts_h_average_over_scans	Averaged over scans cold space view counts of H pol channels used for calibration	NC_UINT	valid_min to valid max	n_scan, n_channels_vh
long_name	Description of variable	NC_STRING	"Averaged over scans cold space view counts of channels in H pol of current scan line "	
units	Physical units	NC_STRING	"-"	
scale_factor	Scale factor applied	NC_FLOAT	1.e-5	
add_offset	Offset applied	NC_FLOAT	0.0	
valid_min	Valid minimum value	NC_UINT	0	
valid_max	Valid maximum value	NC_UINT	2^{32} - 2	
_FillValue	Fill value	NC_UINT	2^{32} - 1	
inverse_nonlinear_calibration_gain_v	inverse calibration gain V	NC_INT	valid_min to valid max	n_scan, n_channels
long_name	Description of variable	NC_STRING	"inverse nonlinear calibration gain of channels in V pol expressed in mWm^-2sr^-1(cm^-1)^-1counts^-1"	
units	Physical units	NC_STRING	"mW·m-2·sr-1·(cm-1)-1·"	
scale_factor	Scale factor applied	NC_DOUBLE	1.e-13	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_INT	$-2^{31}+1$	
valid_max	Valid maximum value	NC_INT	$2^{31}-1$	
_FillValue	Fill value	NC_INT	-2^{31}	
inverse_nonlinear_calibration_gain_h	inverse calibration gain H	NC_INT	valid_min to valid max	n_scan, n_channels_vh
long_name	Description of variable	NC_STRING	"inverse nonlinear calibration gain of channels in H pol expressed in mWm^-2sr^-1(cm^-1)^-1counts^-1"	
units	Physical units	NC_STRING	"mW·m-2·sr-1·(cm-1)-1·"	
scale_factor	Scale factor applied	NC_DOUBLE	1.e-13	
add_offset	Offset applied	NC_DOUBLE	0.0	

Variables Name	Description	Type	Range or Value	Dimension
valid_min	Valid minimum value	NC_INT	$-2^{31}+1$	
valid_max	Valid maximum value	NC_INT	$2^{31}-1$	
_FillValue	Fill value	NC_INT	-2^{31}	
inverse_linear_calibration_gain_v	inverse linear calibration gain V	NC_INT	valid_min to valid max	n_scan, n_channels
long_name	Description of variable	NC_STRING	"inverse linear calibration gain of channels in V pol expressed in mWm^-2sr^-1(cm^-1)^-1counts^-1"	
units	Physical units	NC_STRING	"mW·m-2·sr-1·(cm-1)-1·"	
scale_factor	Scale factor applied	NC_DOUBLE	1.e-13	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_INT	$-2^{31}+1$	
valid_max	Valid maximum value	NC_INT	$2^{31}-1$	
_FillValue	Fill value	NC_INT	-2^{31}	
inverse_linear_calibration_gain_h	inverse linear calibration gain H	NC_INT	valid_min to valid max	n_scan, n_channels_vh
long_name	Description of variable	NC_STRING	"inverse linear linear calibration gain of channels in H pol expressed in mWm^-2sr^-1(cm^-1)^-1counts^-1"	
units	Physical units	NC_STRING	"mW·m-2·sr-1·(cm-1)-1·"	
scale_factor	Scale factor applied	NC_DOUBLE	1.e-13	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_INT	$-2^{31}+1$	
valid_max	Valid maximum value	NC_INT	$2^{31}-1$	
_FillValue	Fill value	NC_INT	-2^{31}	
calibration_offset_nonlinear_v	Calibration offset parameter for V channels	NC_INT	valid_min to valid max	n_scan, n_channels
long_name	Description of variable	NC_STRING	"Non linear calibration offset of channels in V pol"	
units	Physical units	NC_STRING	"mW·m-2·sr-1·(cm-1)-1"	
scale_factor	Scale factor applied	NC_DOUBLE	1.e-10	

Variables Name	Description	Type	Range or Value	Dimension
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_INT	$-2^{31}+1$	
valid_max	Valid maximum value	NC_INT	$2^{31}-1$	
_FillValue	Fill value	NC_INT	-2^{31}	
calibration_offset_nonlinear_h	Calibration offset parameter for H channels	NC_INT	valid_min to valid max	n_scan, n_channels_vh
long_name	Description of variable	NC_STRING	"Non linear calibration offset of channels in H pol"	
units	Physical units	NC_STRING	"mW·m-2·sr-1·(cm-1)-1"	
scale_factor	Scale factor applied	NC_DOUBLE	1.e-10	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_INT	$-2^{31}+1$	
valid_max	Valid maximum value	NC_INT	$2^{31}-1$	
_FillValue	Fill value	NC_INT	-2^{31}	
calibration_offset_linear_v	Linear calibration offset parameter for V channels	NC_INT	valid_min to valid max	n_scan, n_channels
long_name	Description of variable	NC_STRING	"Linear calibration offset of channels in V pol"	
units	Physical units	NC_STRING	"mW·m-2·sr-1·(cm-1)-1"	
scale_factor	Scale factor applied	NC_DOUBLE	1.e-10	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_INT	$-2^{31}+1$	
valid_max	Valid maximum value	NC_INT	$2^{31}-1$	
_FillValue	Fill value	NC_INT	-2^{31}	
calibration_offset_linear_h	Linear calibration offset parameter for H channels	NC_INT	See valid_min and valid_max	n_scan, n_channels_vh
long_name	Description of variable	NC_STRING	"Linear calibration offset of channels in H pol"	
units	Physical units	NC_STRING	"mW·m-2·sr-1·(cm-1)-1"	
scale_factor	Scale factor applied	NC_DOUBLE	1.e-10	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_INT	$-2^{31}+1$	
valid_max	Valid maximum value	NC_INT	$2^{31}-1$	
_FillValue	Fill value	NC_INT	-2^{31}	

Variables Name	Description	Type	Range or Value	Dimension
nonlinear_second_order_calibration_parameter_v	Nonlinear second-order calibration parameter for V channels	NC_INT	valid_min to valid max	n_scan, n_channels
long_name	Description of variable	NC_STRING	"Nonlinear second-order calibration parameter of channels in V pol expressed in $mW \cdot m^{-2} \cdot sr^{-1} \cdot (cm^{-1})^{-1} \cdot counts^{-2}$"	
units	Physical units	NC_STRING	"$mW \cdot m^{-2} \cdot sr^{-1} \cdot (cm^{-1)-1}$"	
scale_factor	Scale factor applied	NC_DOUBLE	1.e-19	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_INT	$-2^{31}+1$	
valid_max	Valid maximum value	NC_INT	$2^{31}-1$	
_FillValue	Fill value	NC_INT	-2^{31}	
nonlinear_second_order_calibration_parameter_h	Nonlinear second-order calibration parameter for H channels	NC_INT	valid_min to valid max	n_scan, n_channels_vh
long_name	Description of variable	NC_STRING	"Nonlinear second-order calibration parameter of channels in H pol expressed in $mW \cdot m^{-2} \cdot sr^{-1} \cdot (cm^{-1})^{-1} \cdot counts^{-2}$"	
units	Physical units	NC_STRING	"mW·m-2·sr-1·(cm-1)-1·"	
scale_factor	Scale factor applied	NC_DOUBLE	1.e-19	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_INT	$-2^{31}+1$	
valid_max	Valid maximum value	NC_INT	$2^{31}-1$	
_FillValue	Fill value	NC_INT	-2^{31}	
nonlinear_third_order_calibration_parameter_v	Nonlinear third-order calibration parameter for V channels	NC_INT	valid_min to valid max	n_scan, n_channels

Variables Name	Description	Type	Range or Value	Dimension
long_name	Description of variable	NC_STRING	"Nonlinear third-order calibration parameter of channels in V pol expressed in $mW \cdot m^{-2} \cdot sr^{-1} \cdot (cm^{-1})^{-1} \cdot counts^{-2}$"	
units	Physical units	NC_STRING	"$mW \cdot m^{-2} \cdot sr^{-1} \cdot (cm^{-1)-1}$"	
scale_factor	Scale factor applied	NC_DOUBLE	1.e-25	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_INT	$-2^{31}+1$	
valid_max	Valid maximum value	NC_INT	$2^{31}-1$	
_FillValue	Fill value	NC_INT	-2^{31}	
nonlinear_third_order_calibration_parameter_h	Nonlinear third-order calibration parameter for H channels	NC_INT	valid_min to valid max	n_scan, n_channels_vh
long_name	Description of variable	NC_STRING	"Nonlinear third-order calibration parameter of channels in H pol expressed in $mW \cdot m^{-2} \cdot sr^{-1} \cdot (cm^{-1})^{-1} \cdot counts^{-2}$"	
units	Physical units	NC_STRING	"mW·m-2·sr-1·(cm-1)-1·"	
scale_factor	Scale factor applied	NC_DOUBLE	1.e-25	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_INT	$-2^{31}+1$	
valid_max	Valid maximum value	NC_INT	$2^{31}-1$	
_FillValue	Fill value	NC_INT	-2^{31}	
noise_diode_flag	Noise diodes flag	NC_UBYTE	valid_min to valid max	n_scan
long_name	Description of variable	NC_STRING	"noise diode flag: 0=off, 1=on"	
valid_min	Valid minimum value	NC_UBYTE	0	
valid_max	Valid maximum value	NC_UBYTE	1	
non_linearity_parameter_noise_diodes	Non-linearity parameter for channels MWI-1, -2 and -3 using noise diodes	NC_INT	See valid_min and valid_max	n_scan, n_diodes

Variables Name	Description	Type	Range or Value	Dimension
long_name	Description of variable	NC_STRING	"non-linearity parameter with noise diodes expressed in mW·m-2·sr-1·(cm-1)-1·counts-2"	
units	Physical units	NC_STRING	"mW·m-2·sr-1·(cm-1)-1·"	
scale_factor	Scale factor applied	NC_DOUBLE	1.e-19	
add_offset	Offset applied	NC_DOUBLE	0.0	
valid_min	Valid minimum value	NC_INT	$-2^{31}+1$	
valid_max	Valid maximum value	NC_INT	$2^{31}-1$	
_FillValue	Fill value	NC_INT	-2^{31}	
obct_temperature	OBCT temperature readings from PRTs	NC_SHORT	valid_min to valid max	n_scan, n_samples_prts_obct, n_prts_obct
long_name	Description of variable	NC_STRING	"OBCT temperature readings from PRTs"	
units	Physical units	NC_STRING	"K"	
scale_factor	Scale factor applied	NC_FLOAT	1.e-2	
add_offset	Offset applied	NC_FLOAT	190.0	
valid_min	Valid minimum value	NC_SHORT	0	
valid_max	Valid maximum value	NC_SHORT	16500	
_FillValue	Fill value	NC_SHORT	-9999	
svr_temperature	SVR temperature readings from THMs	NC_SHORT	valid_min to valid max	n_scan, n_samples_thms_svr, n_thms_svr
long_name	Description of variable	NC_STRING	"SVR temperature readings from THMs"	
units	Physical units	NC_STRING	"K"	
scale_factor	Scale factor applied	NC_FLOAT	1.e-2	
add_offset	Offset applied	NC_FLOAT	190.0	
valid_min	Valid minimum value	NC_SHORT	0	
valid_max	Valid maximum value	NC_SHORT	16500	
_Fill_value	Fill value	NC_SHORT	-9999	
mr_temperature	MR temperature readings from THMs	NC_SHORT	valid_min to valid max	n_scan, n_thms_mr
long_name	Description of variable	NC_STRING	"MR temperature readings from THMs"	
units	Physical units	NC_STRING	"K"	

Variables Name	Description	Type	Range or Value	Dimension
scale_factor	Scale factor applied	NC_FLOAT	1.e-2	
add_offset	Offset applied	NC_FLOAT	190.0	
valid_min	Valid minimum value	NC_SHORT	0	
valid_max	Valid maximum value	NC_SHORT	16500	
_FillValue	Fill value	NC_SHORT	-9999	
nd _temperature	Noise diodes temperature	NC_SHORT	valid_min to valid max	n_scan, n_diodes
long_name	Description of variable	NC_STRING	"Noise diodes temperature"	
units	Physical units	NC_STRING	"K"	
scale_factor	Scale factor applied	NC_FLOAT	1.e-2	
add_offset	Offset applied	NC_FLOAT	0.0	
valid_min	Valid minimum value	NC_SHORT	0	
valid_max	Valid maximum value	NC_SHORT	32000	
_FillValue	Fill value	NC_SHORT	-9999	
racetrack_temperature	Racetrack temperature readings from thermistors	NC_SHORT	valid_min to valid max	n_scan, n_thms_race
long_name	Description of variable	NC_STRING	"Racetrack temperature readings from thermistors"	
units	Physical units	NC_STRING	"K"	
scale_factor	Scale factor applied	NC_FLOAT	1.e-2	
add_offset	Offset applied	NC_FLOAT	190.0	
valid_min	Valid minimum value	NC_SHORT	0	
valid_max	Valid maximum value	NC_SHORT	16500	
_FillValue	Fill value	NC_SHORT	-9999	
receivers_temperature	Receivers temperature readings from thermistors	NC_SHORT	valid_min to valid max	n_scan, n_thms_receivers
long_name	Description of variable	NC_STRING	"Receivers temperature readings from thermistors"	
units	Physical units	NC_STRING	"K"	
scale_factor	Scale factor applied	NC_FLOAT	1.e-2	
add_offset	Offset applied	NC_FLOAT	190.0	
valid_min	Valid minimum value	NC_SHORT	0	
valid_max	Valid maximum value	NC_SHORT	16500	
_FillValue	Fill value	NC_SHORT	-9999	

Table 20: calibration_data: Variables for MWI L1B radiance product

3.4.4.4 Group Name: quality_information

3.4.4.4.1 quality_information: Attributes

No quality_information Group Attributes for the MWI L1B Spectral Radiance product are currently envisaged.

3.4.4.4.2 quality_information: Dimensions

No quality_information Group Dimensions for the MWI L1B Spectral Radiance product are currently envisaged.

3.4.4.4.3 quality_information: Variables

The quality_information Group Variables for the MWI L1B radiance product are listed in Table 21 with their specific attributes.

Variables Name	Description	Type	Range or Value	Dimension
mwi_temperatures_flag	Temperatures quality flag See Table 22	NC_UBYTE		n_scan
long_name	Description of variable	NC_STRING	"Flag to summarise the PRTs and THMs temperature status in the scan. Value = 0 if overall quality is good. Individual bits are set to 1 to indicate specific degraded cases."	
calibration_flag	Calibration quality flag See Table 23	NC_USHORT		n_scan, n_channels_all
long_name	Description of variable	NC_STRING	"Flag to summarise calibration quality for each channel and scan. Value = 0 if overall calibration quality is good. Individual bits are set to 1 to indicate specific degraded conditions."	
scan_quality_flag	Scan quality flag See Table 24	NC_UBYTE		n_scan

Variables Name	Description	Type	Range or Value	Dimension
long_name	Description of variable	NC_STRING	"Flag to summarize scan quality. Value = 0 if overall scan quality is good. Individual bits are set to 1 to indicate specific degraded conditions."	
mwi_data_quality_flag	MWI radiance data quality flag See Table 25	NC_UBYTE		n_scan, n_channels_all
long_name	Description of variable	NC_STRING	"Flag to summarise MWI radiance data quality for each channel and scan. Value = 0 if data quality is good. Individual bits are set to 1 to indicate specific degraded conditions."	
navigation_status_flag	navigation quality control flag See Table 26	NC_USHORT		n_scan
long_name	Description of variable	NC_STRING	"Flag to summarise navigation quality for each scan. Value = 0 if navigation quality is good. Individual bits are set to 1 to indicate specific degraded conditions."	

Table 21: quality_information: Variables for MWI L1B radiance product

Table 22 details the individual bit settings of the calibration_flag variable of the quality_information Group Variables for the MWI L1B Spectral Radiance product.

mwi_temperatures_flag	
Bit	**Meaning**
0	PRTs or THMs temperatures are missing or with anomalous readings
1	PRT temperatures of OBCT used in the radiometric calibrations is missing or with anomalous readings
2	THMs temperatures of SVR used in the radiometric calibrations are missing or with anomalous readings

3	THMs temperatures of Main Reflector are missing or with anomalous readings
4	THMs temperatures of the Racetrack are missing or with anomalous readings
5	THMs temperatures of the Receivers are missing or with anomalous readings
6-7	Can be set

Table 22: Values of mwi_temperatures_flag of the quality_information Group Variables.

Table 23 details the individual bit settings of the calibration_flag variable of the quality_information Group Variables for the MWI L1B Spectral Radiance product.

calibration_flag	
Bit	**Meaning**
0	Radiometric calibration failed or is degraded
1	OBCT view counts averaged value over scans is missing
2	cold space view counts averaged value over scans is missing
3	OBCT view counts averaged value over scans is degraded due to missing or anomalous counts values
4	cold space view counts averaged value over scans is degraded due to missing or anomalous counts values
5	OBCT view radiance averaged value over scans is missing
6	cold space view radiance averaged value over scans is missing
7	OBCT view radiance averaged value over scans is degraded due to missing or anomalous values
8	cold space view radiance averaged value over scans is degraded due to missing or anomalous values
9	PRTs or THMs temperatures of current scan are missing or with anomalous readings
10	Moon intrusion in cold space degraded calibration (less than N_{valid_c} samples are not affected by moon for the considered channel and scan)
11	Back-up calibration with noise diodes performed (meaningful only for MWI-1 to MWI-3 with both polarizations)
12-15	can be set

Table 23: Values of calibration_flag of the quality_information Group Variables.

Table 24 details the individual bit settings of the scan_quality_flag variable of the quality_information Group Variables for the MWI L1B Spectral Radiance product.

scan_quality_flag	
Bit	**Meaning**
0	scan is degraded in raw data record
1	Time sequence error

2	Current scan is acquired after a gap
3	Scan is in period of initialization of calibration and of data averages over scans.
4	Moon intrusion angle in space view below threshold for at least one channel
5	Moon correction is applied but is degraded for at least one channel
6	Sun glint angle below threshold for at least one channel
7	RFI contamination in the Earth view (only for MWI-1V and MWI-1H)

Table 24: Values of scan_quality_flag of the quality_information Group Variables.

Table ***25*** details the individual bit settings of the mwi_data_quality_flag variable of the quality_information Group Variables for the MWI L1B Spectral Radiance product.

mwi_data_quality_flag	
Bit	**Meaning**
0	MWI spectral radiance data of channel is missing or degraded
1	Earth view counts of channel within scan are missing or out of bounds
2	Radiometric calibration failed or is degraded
3	Geolocation of channel is erroneous or degraded
4	NEΔT of this data granule is above threshold
5	MR emissivity and spillover correction failed or degraded
6	Sidelobe correction failed or degraded
7	Channel is defective

Table 25: Values of mwi_data_quality_flag of the quality_information Group Variables.

Table ***26*** details the individual bit settings of the navigation_status_flag variable of the quality_information Group Variables for the MWI L1B Spectral Radiance product.

navigation_status_flag	
Bit	**Meaning**
0	geolocation of channel is erroneous or degraded
1	Time sequence error
2	Missing or corrupted NAVATT file lead to the use of predicted orbit files
3	NAVATT Attitude data is degraded
4	Time correlation error (Missing IERS Bulletin)
5	Invalid ephemeris or attitude data
6	Satellite manoeuvre occurs in current scan
7	Non-nominal attitude with yaw, pitch, roll error above threshold Delta_YPR (nominally these angles are 0.0 deg for YSM)
8	Sampling time not within prescribed limits
9	Scan velocity not within prescribed limits
10	Bad pointing (sensor LOS does not intersect ellipsoid or not compliant with observation azimuth/elevation limits)
11	Invalid solar azimuth/zenith angles computed
12	DEM geolocation not performed (with use_DEM_flag = 1)
13	Error in Land fraction computation
14	Predicted Orbit File not available
15	can be set

Table 26: Values of navigation_status_flag of the quality_information Group Variables.

3.4.4.5 Group Name: processing_flags

3.4.4.5.1 processing_flags: Attributes

No processing_flags Group Attributes for the MWI Spectral Radiance product are currently envisaged.

3.4.4.5.2 processing_flags: Dimensions

No processing_flags Group Dimensions for the MWI Spectral Radiance product are currently envisaged.

3.4.4.5.3 processing_flags: Variables

This section describes the processing_flags Group Variables for the MWI radiance with their specific attributes as given in Table 27.

Variables Name	Description	Type	Unit	Range or Value	Dimension
mwi_processing_flags	MWI processing flags indication the processing choices performed.	USHORT			1
long_name	Description of variable	NC_STRING		"MWI processing flags indicating the processing choices performed."	

Table 27: processing_flags: Variables for MWI L1B product.

Table 28 details the individual bit settings of the mwi_processing_flag variable of the quality_information Group Variables for the MWI L1B Spectral Radiance product.

mwi_processing_flags	
Bit	**Meaning**
0	Moon contamination correction on cold space view counts not applied
1	Calibration with noise diodes not applied for channels MWI-1 to MWI-3
2	MR spillover correction relative to emission by instrument platform not applied
3	SVR spillover correction relative to emission by instrument platform not applied
4	SVR sidelobe correction not applied
5	Full cross-polarization correction including small angles correction
6	RFI correction in the Earth view not applied
7	Dynamic sidelobe correction not applied for MWI-1
8	Dynamic sidelobe correction not applied for MWI-2
9	Dynamic sidelobe correction not applied for MWI-3
10	Dynamic sidelobe correction not applied for MWI-4
11	Dynamic sidelobe correction not applied for MWI-8
12-15	Can be set

Table 28: Values of mwi_processing_flags of the quality_information Group Variables.

3.4.5 Group Name: quality

3.4.5.1 quality: Attributes

Table 29 describes the quality Group Attributes for the MWI L1B radiance.

Attribute name=	Data Type	Meaning and/ or value
overall_quality_flag	NC_USHORT	"0" if overall quality is OK Individual bits of the flag are set to indicate degraded conditions, the first four bits are set in case of: 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 5: degraded manoeuvre Bits 6 to 15: can be set

Table 29: quality: Attributes for MWI L1B radiance product.

3.4.5.2 quality: Dimensions

This section describes the quality Group Dimensions for the MWI radiance.

Dimension name=	Comment	Dimension length=
gap_items	Number of gaps identified during product duration. Note: it will not appear in the Product if overall_quality_flag bit 1 equals 0.	„„ 1 ≤ N

Table 30: Quality: Dimensions for MWI L1B radiance product.

3.4.5.3 quality: Variables

This section describes the quality Group Variables for the MWI L1B radiance product with their specific attributes as given in Table 31.

Variable name=	Data Type type=	Attribute name="long_name" value=	Attribute name="units" value=
Product Duration shape=1			
duration_of_product	NC_DOUBLE	"Entire duration of the product"	"s"
duration_of_data_present	NC_DOUBLE	"Amount of data present in the product"	"s"
duration_of_data_missing	NC_DOUBLE	"Amount of data missing in the product"	"s"
duration_of_data_degraded	NC_DOUBLE	"Amount of data degraded in product"	"s"
Gaps Information shape=gap_items			
gap_start_time_utc	NC_DOUBLE	"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.	seconds since 2020-01-01 00:00:00.000
gap_end_time_utc	NC_DOUBLE	"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.	seconds since 2020-01-01 00:00:00.000

Table 31: Variables for MWI L1B radiance product

4 PRODUCT FORMAT VERSION CONTROL

Table 32 provides the *Product Format Version Control Numbers* of the MWI L1B Product defined within this document, as described in the [GPFS]. The Product Format Version Control Number is updated according the guidelines described in the [GPFS].

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)
MWI L1B radiance	*0.0*	*1B*	*1G*
MWI-1B-RAD	*1.0*	*1C*	*1H*
MWI-1B-RAD	*2.0*	*2A*	*2A*
MWI-1B-RAD	*2.3*	*2C*	*3B*
MWI-1B-RAD	*3.0*	*3*	*3D*
MWI-1B-RAD	*3.0*	*3A*	*3D*

Table 32: Record Format Version Numbers

APPENDIX A SIZE OF EPS-SG MWI LEVEL 1B PRODUCTS

This appendix provides an estimated size (in Mbytes/orbit, 1 Mbytes=10^6 bytes) of the EPS-SG MWI Level 1B product, given in Table 33. The estimation was made considering only the information available so far.

The number of Earth samples per scan is 1394 [TBC], the number of cold sky view samples per scan is 352 [TBC] and the number of OBCT views per scan is 339 [TBC]. The number of the various PRTs of the instrument are provided in Table 19.
The assumed size of the considered parameters (in bytes) is presented in Table 34.

The geolocation information (navigation_data group) is grouped by data groups, avoiding duplication of redundant information. See Table 1 for channels assignment to each data group.

A sub-sampling factor of 10 [TBC] is applied to the latitude and longitude information in Table 34. The assumption is that the geolocation information can be re-computed using the interpolation technique presented in Appendix D. . The same sub-sampling is applied to solar zenith, solar azimuth, MWI observation zenith and observation azimuth angles. The initial number of samples assumed (without interpolation) for the geolocation information is 10*1394=13940 samples [TBC]. The number of samples assumed for the geolocation subsampled information is 10*141=1410 samples [TBC]. Processing flags and (overall) Quality flags attached to the product (last sections of Table 34) are not considered in the computation, as well as the common parameters.

Mean duration D of one orbit was assumed to be (in minutes):

D=R·Day_minutes/N_orbits

With R: Repeat cycle (29 days); Day_minutes: Number of minutes per day (1440 minutes), N_orbits: number of orbits in a repeat cycle (412).

Thus D=101.36 minutes/orbit.

With a scan every 1.33 s (scanning at 45 RPM) this implies 4573 scans per orbit. This value is considered in the size estimation.

Product ID	Product Description	Size (MB/Orbit)
MWI L1B product	MWI L1B product (using geolocation information interpolation)	1101.00

Table 33: Size of the MWI Level 1B Product

Applicability	Parameter	samples per scan	bytes
Navigation			
MWI-1 to MWI-18	UTC time of start of Earth view for each scan pattern	1	8
MWI-1 to MWI-18 (data_groups)	Geodetic latitude	1128	4
MWI-1 to MWI-18 (data_groups)	Geodetic longitude	1128	4
MWI-1 to MWI-18 (data_groups)	OZA	1128	2
MWI-1 to MWI-18 (data_groups)	Azimuth	1128	2
MWI-1 to MWI-18 (data_groups)	Land Fraction	11152	1
MWI-1 to MWI-18 (data_groups)	delta latitude	11152	1
MWI-1 to MWI-18 (data_groups)	delta longitude	11152	1
MWI-1 to MWI-18 (data_groups)	Average terrain elevation	11152	2
MWI-1 to MWI-8 (data_groups)	Sun glint angle	6970	2
MWI-1	RFI glint flag	1394	1
For each scan	orbit angle	1	4
For each scan	latitude sub satellite point	1	4
For each scan	longitude sub satellite point	1	4
For each scan	spacecraft altitude	1	2
For each scan	roll	1	2
For each scan	pitch	1	2
For each scan	yaw	1	2
For each scan	Sun elevation	1	2
For each scan	Sun azimuth	1	2
MWI-1 to MWI-18 (data_groups)	MWI Sun zenith angle	1410	2
MWI-1 to MWI-18 (data_groups)	MWI Sun azimuth angle	1410	2
MWI-1 to MWI-18 (data_groups)	Moon angle for each scan	2816	2
Measurement data			
MWI-1 to MWI-18	Radiances	36244	2
MWI-1 to MWI-18	NEΔT (HOT LOAD+COLD LOAD)	52	2
Calibration			

MWI-1 to MWI-18	Sidelobe antenna temperature corrections	36244	1
MWI-1 to MWI-18	Warm calibration counts	8814	2
MWI-1 to MWI-18	Cold calibration counts	9152	2
MWI-1 to MWI-18	Average warm counts	26	4
MWI-1 to MWI-18	Average cold counts	26	4
MWI-1 to MWI-18	inverse linear calibration gain	26	4
MWI-1 to MWI-18	linear calibration offset	26	4
MWI-1 to MWI-18	inverse nonlinear calibration gain	26	4
MWI-1 to MWI-18	nonlinear calibration offset	26	4
MWI-1 to MWI-18	nonlinear_second_order_calibration_parameter	26	4
MWI-1 to MWI-18	nonlinear_third_order_calibration_parameter	26	4
MWI-1 to MWI-3	non-linearity with noise diodes	6	4
MWI-1 to MWI-3	Noise diode flag	1	1
MWI-1 to MWI-3	Noise diode temperature	6	2
For each scan	OBCT Temperature	45	2
For each scan	SVR Temperature	27	2
For each scan	MR temperature	12	2
For each scan	Racetrack Temperature	12	2
For each scan	Receivers temperatures	23	2
Quality information			
MWI-1 to MWI-18	calibration_flag	26	2
For each scan	mwi_temperature_flag	1	1
For each scan	scan_quality_flag	1	1
MWI-1 to MWI-18	mwi_data_quality_flag	26	1
For each scan	navigation_status_flag	1	2
Processing flags			
For the whole product	mwi_processing_flags	1	2
Quality			
For the whole product	overall_quality_flag	1	1
For the whole product	duration_of_product	1	4
For the whole product	time_of_data_present	1	4
For the whole product	time_of_data_missing	1	4
For the whole product	time_of_data_degraded	1	4

Table 34: Assumed size of the MWI Level 1B Product variables

APPENDIX B XML DESCRIPTION OF EPS-SG MWI L1B PRODUCTS FORMAT

The XML description of the NetCDF-4 EPS-SG MWI L1B product is attached in the file EPS-SG-MWI-L1B-RAD_30_02.xml:

EPS-SG-MWI-L1B-RAD_30_02.xml

APPENDIX C DESCRIPTION OF EPS-SG MWI L1B PRODUCT BUFR FORMAT

The description of the EPS-SG MWI L1B BUFR product is provided in Table 35. The size is estimated to be as follows:

MWI-1B-RAD = 1.2 GB/orbit

Table 35: Description of the BUFR format for MWI-1B-RAD products.

References	Element	Variable(s) from NetCDF
Navigation data		
0 01 033	Identification of originating/generating centre	254
0 01 034	Identification of originating/generating sub-centre	0
0 01 007	Satellite identifier	/spacecraft
0 02 048	Satellite instruments	/instrument
0 05 040	Orbit number	/orbit_start
2 01 133	*Change data width*	
0 05 041	Scan line number	n_scans index
2 01 000	*Change data width*	
301011	Year, month, day	Computed as in in EUM/LEO-EPSSG/SPE/14/767115 D.2
301012	Hour, minute	Computed as in in EUM/LEO-EPSSG/SPE/14/767115 D.2
207003	*Increase scale, reference value and data width*	
004006	Second	Computed as in in EUM/LEO-EPSSG/SPE/14/767115 D.2
207000	*Increase scale, reference value and data width*	
2 02 126	*Change scale*	
0 07 001	Height of station	/data/navigation_data/spacecraft_altitude

2 02 000	*Change scale*	
0 07 XXX	Solar zenith angle in instrument reference frame	/data/navigation_data/sun_zenith_angle
0 05 XXX	Solar azimuth in instrument reference frame	/data/navigation_data/sun_azimuth_angle
0 07 XXX	Orbit angle	/data/navigation_data/orbit_angle
Quality information		
0 33 XXX	MWI temperatures flag	/data/quality_information/mwi_temperatures_flag
0 33 XXX	MWI scan quality flag	/data/quality_information/scan_quality_flag
0 33 XXX	MWI navigation status flag	/data/quality_information/navigation_status_flag
Per-horn variables		
1 07 008	Repeat 7 descriptors 8 times	
0 05 001	Latitude (high accuracy)	/data/navigation_data/latitude
0 06 001	Longitude (high accuracy)	/data/navigation_data/longitude
0 07 024	Satellite zenith angle	/data/navigation_data/mwi_oza
0 07 025	Solar zenith angle	/data/navigation_data/mwi_solar_zenith_angle
0 05 022	Solar azimuth	/data/navigation_data/mwi_solar_azimuth_angle
0 05 021	Bearing or azimuth	/data/navigation_data/mwi_azimuth
0 07 XXX	Angle between moon and space view	/data/navigation_data/moon_angle
Spectral radiances in horn		
1 15 002	*Repeat next 15 descriptors 2 times (Channel group 1)*	
0 05 042	Channel number	Channel number of observation
2 02 131	*Change scale*	
0 02 153	Satellite channel centre frequency	/data/measurement_data/centre_wavenumber
0 02 154	Satellite channel band width	Band width of channel
2 02 000	*Change scale*	
0 33 XXX	MWI calibration flag	/data/quality_information/calibration_flag
0 33 XXX	MWI data quality flag	/data/quality_information/mwi_data_quality_flag
0 02 104	Antenna polarization	Polarisation of channel
2 02 135	*Change width (11 + 7 = 18)*	
2 02 139	*Change scale (0 + 11 = 11)*	
0 14 045	Channel radiance (0 to 0.00262142 +/- 0.00000001 mW m–2 sr–1 cm)	Spectral radiances from /data/measurement_data variables
2 02 000	*Change scale (reset to 0)*	
2 01 000	*Change width (reset to 11)*	

0 12 158	Noise-equivalent delta temperature while viewing cold target	/data/calibration/measurement_data/mwi_nedt
0 12 159	Noise-equivalent delta temperature while viewing warm target	/data/calibration/measurement_data/mwi_nedt
1 15 002	*Repeat next 15 descriptors 2 times (Channel group 2)*	
0 05 042	Channel number	Channel number of observation
2 02 131	*Change scale*	
0 02 153	Satellite channel centre frequency	/data/measurement_data/centre_wavenumber
0 02 154	Satellite channel band width	Band width of channel
2 02 000	*Change scale*	
0 33 XXX	MWI calibration flag	/data/quality_information/calibration_flag
0 33 XXX	MWI data quality flag	/data/quality_information/mwi_data_quality_flag
0 02 104	Antenna polarization	Polarisation of channel
2 01 135	*Change width (11 + 7 = 18)*	
2 02 139	*Change scale (0 + 11 = 11)*	
0 14 045	Channel radiance (0 to 0.00262142 +/- 0.00000001 mW m–2 sr–1 cm)	Spectral radiances from /data/measurement_data variables
2 02 000	*Change scale (reset to 0)*	
2 01 000	*Change width (reset to 11)*	
0 12 158	Noise-equivalent delta temperature while viewing cold target	/data/calibration/measurement_data/mwi_nedt
0 12 159	Noise-equivalent delta temperature while viewing warm target	/data/calibration/measurement_data/mwi_nedt
1 15 002	*Repeat next 15 descriptors 2 times (Channel group 3)*	
0 05 042	Channel number	Channel number of observation
2 02 131	*Change scale*	
0 02 153	Satellite channel centre frequency	/data/measurement_data/centre_wavenumber
0 02 154	Satellite channel band width	Band width of channel
2 02 000	*Change scale*	
0 33 XXX	MWI calibration flag	/data/quality_information/calibration_flag
0 33 XXX	MWI data quality flag	/data/quality_information/mwi_data_quality_flag
0 02 104	Antenna polarization	Polarisation of channel
2 01 136	*Change width (11 + 8 = 19)*	
2 02 139	*Change scale (0 + 11 = 11)*	
0 14 045	Channel radiance (0 to 0.00524286 +/- 0.00000001 mW m–2 sr–1 cm)	Spectral radiances from /data/measurement_data variables
2 02 000	*Change scale (reset to 0)*	
2 01 000	*Change width (reset to 11)*	
0 12 158	Noise-equivalent delta temperature while viewing cold target	/data/calibration/measurement_data/mwi_nedt

0 12 159	Noise-equivalent delta temperature while viewing warm target	/data/calibration/measurement_data/mwi_nedt
1 15 008	*Repeat next 15 descriptors 8 times (Channel group 4)*	
0 05 042	Channel number	Channel number of observation
2 02 131	*Change scale*	
0 02 153	Satellite channel centre frequency	/data/measurement_data/centre_wavenumber
0 02 154	Satellite channel band width	Band width of channel
2 02 000	*Change scale*	
0 33 XXX	MWI calibration flag	/data/quality_information/calibration_flag
0 33 XXX	MWI data quality flag	/data/quality_information/mwi_data_quality_flag
0 02 104	Antenna polarization	Polarisation of channel
2 01 131	*Change width (11 + 3 = 14)*	
2 02 138	*Change scale (0 + 10 = 10)*	
0 14 045	Channel radiance (0 to 0.0016382 +/- 0.0000001 mW m–2 sr–1 cm)	Spectral radiances from /data/measurement_data variables
2 02 000	*Change scale (reset to 0)*	
2 01 000	*Change width (reset to 11)*	
0 12 158	Noise-equivalent delta temperature while viewing cold target	/data/calibration/measurement_data/mwi_nedt
0 12 159	Noise-equivalent delta temperature while viewing warm target	/data/calibration/measurement_data/mwi_nedt
1 15 002	*Repeat next 15 descriptors 2 times (Channel group 5)*	
0 05 042	Channel number	Channel number of observation
2 02 131	*Change scale*	
0 02 153	Satellite channel centre frequency	/data/measurement_data/centre_wavenumber
0 02 154	Satellite channel band width	Band width of channel
2 02 000	*Change scale*	
0 33 XXX	MWI calibration flag	/data/quality_information/calibration_flag
0 33 XXX	MWI data quality flag	/data/quality_information/mwi_data_quality_flag
0 02 104	Antenna polarization	Polarisation of channel
2 01 136	*Change width (11 + 8 = 19)*	
2 02 138	*Change scale (0 + 10 = 10)*	
0 14 045	Channel radiance (0 to 0.0524286 +/- 0.0000001 mW m–2 sr–1 cm)	Spectral radiances from /data/measurement_data variables
2 02 000	*Change scale (reset to 0)*	
2 01 000	*Change width (reset to 11)*	
0 12 158	Noise-equivalent delta temperature while viewing cold target	/data/calibration/measurement_data/mwi_nedt
0 12 159	Noise-equivalent delta temperature while viewing warm target	/data/calibration/measurement_data/mwi_nedt

1 15 004	*Repeat next 15 descriptors 4 times (Channel group 6)*	
0 05 042	Channel number	Channel number of observation
2 02 131	*Change scale*	
0 02 153	Satellite channel centre frequency	/data/measurement_data/centre_wavenumber
0 02 154	Satellite channel band width	Band width of channel
2 02 000	*Change scale*	
0 33 XXX	MWI calibration flag	/data/quality_information/calibration_flag
0 33 XXX	MWI data quality flag	/data/quality_information/mwi_data_quality_flag
0 02 104	Antenna polarization	Polarisation of channel
2 01 136	*Change width (11 + 8 = 19)*	
2 02 138	*Change scale (0 + 10 = 10)*	
0 14 045	Channel radiance (0 to 0.0524286 +/- 0.0000001 mW m–2 sr–1 cm)	Spectral radiances from /data/measurement_data variables
2 02 000	*Change scale (reset to 0)*	
2 01 000	*Change width (reset to 11)*	
0 12 158	Noise-equivalent delta temperature while viewing cold target	/data/calibration/measurement_data/mwi_nedt
0 12 159	Noise-equivalent delta temperature while viewing warm target	/data/calibration/measurement_data/mwi_nedt
1 15 001	*Repeat next 15 descriptors 1 time (Channel group 7)*	
0 05 042	Channel number	Channel number of observation
2 02 131	*Change scale*	
0 02 153	Satellite channel centre frequency	/data/measurement_data/centre_wavenumber
0 02 154	Satellite channel band width	Band width of channel
2 02 000	*Change scale*	
0 33 XXX	MWI calibration flag	/data/quality_information/calibration_flag
0 33 XXX	MWI data quality flag	/data/quality_information/mwi_data_quality_flag
0 02 104	Antenna polarization	Polarisation of channel
2 01 134	*Change width (11 + 6 = 17)*	
2 02 137	*Change scale (0 + 9 = 9)*	
0 14 045	Channel radiance (0 to 0.131070 +/- 0.000001 mW m–2 sr–1 cm)	Spectral radiances from /data/measurement_data variables
2 02 000	*Change scale (reset to 0)*	
2 01 000	*Change width (reset to 11)*	
0 12 158	Noise-equivalent delta temperature while viewing cold target	/data/calibration/measurement_data/mwi_nedt
0 12 159	Noise-equivalent delta temperature while viewing warm target	/data/calibration/measurement_data/mwi_nedt
1 15 005	*Repeat next 15 descriptors 5 times (Channel group 8)*	

0 05 042	Channel number	Channel number of observation
2 02 131	*Change scale*	
0 02 153	Satellite channel centre frequency	/data/measurement_data/centre_wavenumber
0 02 154	Satellite channel band width	Band width of channel
2 02 000	*Change scale*	
0 33 XXX	MWI calibration flag	/data/quality_information/calibration_flag
0 33 XXX	MWI data quality flag	/data/quality_information/mwi_data_quality_flag
0 02 104	Antenna polarization	Polarisation of channel
2 01 134	*Change width (11 + 6 = 17)*	
2 02 137	*Change scale (0 + 9 = 9)*	
0 14 045	Channel radiance (0 to 0.131070 +/- 0.000001 mW m–2 sr–1 cm)	Spectral radiances from /data/measurement_data variables
2 02 000	*Change scale (reset to 0)*	
2 01 000	*Change width (reset to 11)*	
0 12 158	Noise-equivalent delta temperature while viewing cold target	/data/calibration/measurement_data/mwi_nedt
0 12 159	Noise-equivalent delta temperature while viewing warm target	/data/calibration/measurement_data/mwi_nedt

APPENDIX D TIME AND GEOLOCATION INFORMATION RECONSTRUCTION

D.1 Geolocation of all samples from tie points

In order to reduce the product size, the geolocation information is assigned to prescribed groups, as discussed in Section 2. Moreover, the geodetic latitude/longitude information, as well as OZA and azimuth and solar zenith and azimuth angles are provided only for selected tie-points over each scan since it is possible to reconstruct this information for the intermediate points. This appendix describes the procedure in detail.

For latitude and longitude the procedure is based on the method described in [INTERP]. The method is based on a simple linear interpolation of tie-points after a transformation from geodetic latitude/longitude coordinates into Cartesian Coordinates in the Earth-Centred Earth-Fixed (ECEF). The advantage of this approach is that interpolating on position vectors introduces errors which do not depend on latitude and do not need special treatment for latitude or longitude discontinuities. The geolocation error resulting from the interpolation is depending on the number of footprint between the tie points, as shown in the table below.

Sub sampling Factor	Maximal position error over one orbit [m]
4	5
5	10
6	15
8	30
12	80

The steps are as follows:

1) Conversion from Geodetic to Cartesian Coordinates in the ECEF Frame

Two neighbouring tie-points are selected in the scan, and their latitude/longitude coordinates, observation zenith angle and azimuth are transformed using the following transformation:

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} N \cdot cos\varphi \cdot cos\lambda \\ N \cdot cos\varphi \cdot sin\,\lambda \\ N \cdot (1 - e^2) \cdot sin\,\varphi \end{bmatrix}$$

Where:

(x y, z) are the ECEF Frame Cartesian coordinates of each point;
λ is the geodetic longitude;
φ is the geodetic latitude;
a is the semi-major ellipsoid axis (equatorial radius, = 6378137.0 m);
b is the semi-minor ellipsoid axis (*b* = 6356752.3142 m);
e is the eccentricity of the ellipsoid defined as:

$$e = \sqrt{\frac{a^2 - b^2}{a^2}}$$

N is the radius of curvature in the prime vertical:

$$N = \frac{a}{\sqrt{1 - e^2 \cdot (sin\,\varphi)^2}}$$

2) Interpolation of tie-points in Cartesian Coordinates in the ECEF Frame.

Given two tie-points, $p_1(t_1) = (\varphi_1, \lambda_1)$ and $p_2(t_2) = (\varphi_2, \lambda_2)$, and being (x_1,y_1,z_1) and (x_2,y_2,z_2) the the cartesian coordinates of the two tie points transformed according step 1, any point in between can be calculated as:

$$\begin{aligned} x &= x_1 + t*(x_2 - x_1)/(t_2 - t_1) \\ y &= y_1 + t*(y_2 - y_1)/(t_2 - t_1) \\ z &= z_1 + t*(z_2 - z_1)/(t_2 - t_1) \end{aligned}$$

where t is the time associated to the selected footprint between the two tie-points, and t_1 and t_2 are the scan time at tie-points. Assuming a constant scan rate the time elapsed within the scan is computed as:

$$t = \Delta T \cdot (i - 1)$$

where ΔT is the integration time associated to each channel and *i* is the scan index, with *i* going from 1 to $N_{samples}$.
Taking into account the parameters in Table 13, any point in between two tie points can be calculated as as follows:

$$\begin{aligned} x(k) &= x_1 + (k/f)*(x_2 - x_1) \\ y(k) &= y_1 + (k/f)*(y_2 - y_1) \\ z(k) &= z_1 + (k/f)*(z_2 - z_1) \end{aligned}$$

where f is equal to undersampling_step_along_scan for all samples except for those between the last two tie points of the scan, for which f is equal to undersampling_step_last_samples. The index k goes from 1 to undersampling_step_along_scan or undersampling_step_last_samples, respectively.

3) Transformation from Cartesian Coordinates in the ECEF Frame to Geodetic Coordinates

Each triplet (x, y, z) in the ECEF Frame cartesian coordinates associated to each footprint is transformed back in geodetic latitude and longitude coordinates using the following closed-form transformation.

Longitude is computed as:

$$\lambda = atan2(y, x)$$

Latitude is:

$$\varphi = atan2(z + e2p \cdot b \cdot (sin\,\theta)^3, p - e^2 \cdot a \cdot (cos\,\theta)^3)$$

Where:

$$\theta = atan2(z \cdot a, p \cdot b)$$

$$e2p = \frac{a^2}{b^2} - 1$$

$$p = \sqrt{x^2 + y^2}$$

The procedure for the reconstruction of MWI observation zenith angle OZA_{MWI} and azimuth AZI_{MWI} (as well as for solar zenith and azimuth angles) is slightly different from that applied above to latitude and longitude. The method is based on a simple linear interpolation of tie-points after a transformation from spherical coordinates (R_N, OZA_{MWI}, AZI_{MWI}) into Cartesian Coordinates (x_A,y_A,z_A). In such cases, it holds:

4) Conversion to Cartesian Coordinates:

$$\begin{bmatrix} x_A \\ y_A \\ z_A \end{bmatrix} = \begin{bmatrix} R_N \cdot sin(OZA_{MWI}(i,:,j)) \cdot cos(AZI_{MWI}(i,:,j)) \\ R_N \cdot sin(OZA_{MWI}(i,:,j)) \cdot sin(AZI_{MWI}(i,:,j)) \\ R_N \cdot cos(OZA_{MWI}(i,:,j)) \end{bmatrix}$$

Where (x_A y_A, z_A) are the Cartesian coordinates of each point and R_N is the earth radius.

5) Interpolation of tie-points in Cartesian Coordinates as described in point 2) of the latitude/longitude reconstruction, to reconstruct any point ($x_{int\_MWI}, y_{int\_MWI}, z_{int\_MWI}$) in between two tie points.

6) Transformation from Cartesian Coordinates to spherical coordinates:

$$\begin{bmatrix} OZA_{\_MWI} \\ AZI_{\_MWI} \end{bmatrix} = \begin{bmatrix} atan(\frac{p_{MWI}}{z_{int\_MWI}}) \\ atan(\frac{y_{int\_MWI}}{x_{int\_MWI}}) \end{bmatrix}$$

Where:

$$p_{MWI} = \sqrt{{x_{int\_MWI}}^2 + {y_{int\_MWI}}^2}$$

D.2 Time of Earth samples reconstruction

In the navigation_data group, the variable time_start_scan_utc is provided for each scan i. It corresponds to the UTC time of the first Earth view sample of MWI-1 provided for each scan. The UTC time corresponding to each sample k (1 to 1394) and channel j (1 to 26) can be computed as follows:

$$time\_sample(i,j,k) = time\_start\_scan\_utc(i) + t_{offset}\,(j) + T_{int} \cdot (k-1) - t_{offset}\,(1)$$

Where T_{int} is the MWI integration time over a single sample of 0.394 ms [TBC].

Channel index association is as follows:

Channel index	MWI channel	t_{offset} (TBC)
1	MWI-1 V	0.0650
2	MWI-1 H	0.0650
3	MWI-2 V	0.0650
4	MWI-2 H	0.0650
5	MWI-3 V	0.0860
6	MWI-3 H	0.0860
7	MWI-4 V	0.0720
8	MWI-4 H	0.0720
9	MWI-5V	0.0720
10	MWI-5 H	0.0720
11	MWI-6 V	0.0790
12	MWI-6 H	0.0790
13	MWI-7 V	0.0790
14	MWI-7 H	0.0790
15	MWI-8 V	0.0860
16	MWI-8 V	0.0860
17	MWI-9	0.0930
18	MWI-10	0.0930
19	MWI-11	0.1000
20	MWI-12	0.1000
21	MWI-13	0.1070
22	MWI-14	0.0930
23	MWI-15	0.0930
24	MWI-16	0.1000
25	MWI-17	0.1000
26	MWI-18	0.1070

Table 36: Channel index for all channels

APPENDIX E BRIGHTNESS TEMPERATURE COMPUTATION FROM MWI SPECTRAL RADIANCES

Earth view radiances R of channel i can be converted to brightness temperature T_B as follows:

$$T_B(v_{ci}, R) = \left[\frac{c_2 v_{ci}}{ln\left(1 + \frac{c_1 {v_c}^3}{B}\right)}\right] \cdot A_i + B_i$$

where R is provided mW·m-2·sr-1·(cm-1)-1

The parameters required for the actual calculation of the brightness temperature are:

	Description	Reference
v_{ci}	Central frequency wave number (µm)	Included in the product
A_i	Band Correction Coefficient (Unitless)	
B_i	Band Correction Coefficient (K)	
c	Speed of Light (m s^{-1})	299792458 m s^{-1}
$c_1 = 2hc^2$	mW/(sr m^2 cm^{-4})	$1.191042 \cdot 10^{-5}$
$c_2 = hc/k$	K cm	1.4387752
k	Boltzmann constant (m^2 kg s^{-2} K^{-1})	1.38065 10^{-23} m^2 kg s^{-2} K^{-1} (JK^{-1})
h	Planck constant (m^2 kg s^{-1})	6.626069 10^{-34} m^2 kg s^{-1} (Js)

Appendix: TBC and TBD Items

The following table presents the TBDs affecting the current version of the document.

ID	Section	Title	Text
~~TBD-1.~~	~~4.2.3.1.1, 4.2.3.2.1, 4.2.3.2.2, 4.2.4.3.1, 4.2.3.3.2,~~	~~Attributes & dimensions # 1~~	~~Some attribute values and dimensions are set as TBD, if need is not confirmed they could be removed. Attributes and dimensioning of some parameters are TBD pending further development of processing and information from instrument manufacturer.~~
~~TBD-2.~~	~~4.2.4.1.1, 4.2.4.2.1,~~	~~Attributes & dimensions # 2~~	~~Some attribute values and dimensions are set as TBD, if need is not confirmed they could be removed. Attributes and dimensioning of some parameters are TBD pending further development of processing and information from instrument manufacturer.~~
~~TBD-3.~~	~~4.2.4.4.1, 4.2.4.4.2, 4.2.4.5.1, 4.2.4.5.2~~	~~Attributes & dimensions # 3~~	~~Some attribute values and dimensions are set as TBD, if need is not confirmed they could be removed. Attributes and dimensioning of some parameters are TBD pending further development of processing and information from instrument manufacturer.~~
~~TBD-4.~~	~~4.2.4.1.2 4.2.4.2.3 4.2.4.4.3~~	~~Attributes & dimensions # 4~~	~~Some attribute values and dimensions are set as TBD, if need is not confirmed they could be removed. Attributes and dimensioning of some parameters are TBD pending further development of processing and information from instrument manufacturer.~~

The following table presents the TBCs affecting the current version of the document.

ID	Section	Title	Text
~~TBC-1.~~		~~Instrument monitoring variables~~	~~It is unclear whether instrument monitoring variables are only diagnostic variables resulting from L0 processing, or are also instrument parameters (e.g. receiver temperature). This kind of information could also be included in the auxiliary files, if not needed by the users.~~
~~TBC-2.~~	~~Multiple sections~~	~~Structure and content~~	~~First consolidation performed, further updates expected.~~
TBC-3.-	Appendix A	Product Size	Data size is based on current estimated number of samples and on assessment of output variables.
TBC-4.	Multiple sections	Attributes and dimensions	Attributes and dimensioning of some parameters are TBC pending further development of processing and information from instrument manufacturer.
~~TBC-5.~~	~~3.4.4.3~~	~~Non-linearity parameters~~	~~Non-linearity parameters in output need to be finalized after discussion/measurements~~
TBC-6.	3.4.4.3	Noise diodes parameters	Output variables of noise diodes need to be consolidated
~~TBC-7.~~	~~3.4.3.2~~	~~Instrument status~~	~~Instrument status (attributes, dimension, variables) will need updating when the instrument details will be available~~

~~TBC-8.~~	~~3.4.4.2~~	~~Grouping of radiance data~~	~~Grouping of radiance measurements data is based on dynamic range assessment in order to minimize memory needs using appropriate data types.~~
~~TBC-9.~~	~~Appendix A~~	~~Undersampling of geolocation information~~	~~Undersampling of geolocation information by a factor 12 is assumed in order to reduce product size.~~
TBC-10.	Multiple sections	Number of samples	The same number of samples per n_scan is assumed for each channel. This is TBC depending on further details on instrument design.
~~TBC-11.~~	~~table 7~~	~~Parameter values~~	~~Some parameter values are still TBC~~
~~TBC-12.~~	~~4.2.4.2.3~~	~~Undersampling factor~~	~~Undersampling factor is TBC.~~
TBC-13.	3.4.5	Quality flag bit meaning	Meaning of quality flags bit settings need to be further consolidated