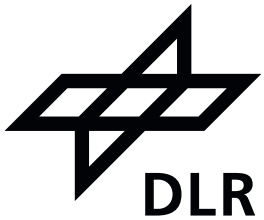
SCIAMACHY Level 1 netCDF Product User Guide

Level 0-1 Processing

Issue 3



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Change Record

Issue	Date	Page	Description of Change
0.9	20.02.2019		completely new
1	7.03.2019	various	Correction of typos
2	3.04.2019	p. 41 ff.	Update of autogenerated tables to Level 1b V9.01
3	4.12.2021	p. 18	Added entry for Moon group
		p. 24	Added entry for Moon group
		p. 26	Adjusted to new Moon group
		p, 28	Added description of Moon scanning observations
		p. 38	Removed state ID 54 from description
		p. 38	Adjusted for new Moon group
		p. 41 ff.	Update of autogenerated tables to Level 1b V.10

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1 Introduction

1.1 Purpose and Scope of the Document

SCIAMACHY (SCanning Imaging Absorption SpectroMeter for Atmospheric CHartographY) was one of the Earth observation research instruments which was part of the payload of the ENVISAT platform of ESA (European Space Agency) which had been launched on March 1st, 2002. The ENVISAT mission ended on April 8th 2012, following the unexpected loss of contact with the satellite.

The main scientific objective of SCIAMACHY was to measure distributions of a number of chemically important atmospheric trace gas species on a global basis. SCIAMACHY had a spectrometer and telescope system designed to observe light transmitted through, reflected by and scattered from the Earth's atmosphere over a spectral range from 212 to 2400 nm. It had an alternating limb and nadir viewing capability, and was able to perform solar and lunar occultation measurements.

Nadir UV/visible measurements provide global column distributions of O_3, NO_2, BrO, SO_2, OClO, HCHO, CHOCHO and H_2O, as well as cloud and aerosol parameters. Nadir infrared measurements are used to generate column distributions of CO and CH_4. Limb observations provide vertical stratospheric profiles of O_3, NO_2 and BrO from the UV/visible wavelength range. By combining limb and nadir measurements tropospheric NO_2 columns are retrieved. Tropospheric columns are also available for BrO.

This document provides the specification of the level 1 product as generated by version 9.00 and 9.01 of the level 0 to 1b processor. For version 9.00 the product format was changed from the ENVISAT binary format to netCDF V4.

The document is not intended to give background on the calibration algorithms, for this the user should consult the ATBD [6].

Following ideas lead to the current SCIAMACHY Level 1 product design:

- The product shall be similar to currently developed or planned EO products in netCDF-4 format, especially to those of the Sentinel missions. The similarity to other EO products should lead to reusable reading software with little or no adaptations to the various products.
- The product shall be netCDF-4-CF compliant.
- The product shall additionally be compliant to following standards:
  - EOP (ESA)
  - EO-FFS (ESA)
  - INSPIRE (EU based on ISO)
- The netCDF-4 product will consist of a hierarchy of groups with top level groups for modes and bands. Geolocation and other associated data will be incorporated in such a group and matched to the measured ground pixels.

In order to achieve similarity to other level-1 products some measures had to be taken:

- The spectra of the earth measurements shall be organised as a four-dimensional array in order to be compatible to the push-broom sensors like Sentinel 5, Sentinel 4 or Sentinel 5 Precursor, although SCIAMACHY has just a one-dimensional scanning sensor with 8192 detector pixels.

  Therefore the across track scans of SCIAMACHY shall be used as the second dimension: for example the scans generated by the 5 second scan mirror movement of SCIAMACHY will define the across track ground-pixels of one scanline.
- Additional dimensions will be added for the sequential observations in flight direction in time or "scanlines" and for a global orbit time.

The main advantages of the new format are:

- ➢ netCDF is a standard, widely used, self-describing format that ensures that the data can be read in the future.
- ➢ All results are easily accessible via a dedicated variable.
- ➢ Geolocation is now available per observation. Previously only geolocations for the shortest integration time were contained in the product and the user was responsible for calculating the coordinates for a given observation on his own.
- ➢ Obsolete parameters were removed from the product.

1.2 Documents

1.2.1 Applicable Documents

None

1.2.2 References

[1] *Earth Observation Ground Segment File Format Standard, , ESA, PE-TN-ESA-GS-0001*. issue2.0. May 2012.

[2] M. Gottwald and E. Krieg. *SCIAMACHY Operations Change Request Catalogue 2003-2012 (PO-TN-DLR-SH-0036)*. Tech. rep. issue 1. DLR-IMF, Apr. 2016. URL: https://atmos.eoc.dlr.de/projects/scops/mission_documents/sciamachy_ocr_catalogue_2003_2012_i1.pdf.

[3] Manfred Gottwald and Heinrich Bovensmann, eds. *SCIAMACHY - Exploring the Changing Earth's Atmosphere*. Manuscript Version available under https://atmos.eoc.dlr.de/projects/scops/sciamachy_book/sciamachy_book_springer_editors_version.html. Springer, 2011.

[4] *ISO 8601 Data elements and interchange formats – Information interchange – Representation of dates and time*. Sept. 2006.

[5] Matthijs Krijger. *FDR4ATMOS: SCIAMACHY Lunar Irradiance Calculation & Validation (ESS-FDR-TN-001-Rev3)*. Tech. rep. 3. Nov. 2021.

[6] S. Slijkhuis and G. Lichtenberg. *ENVISAT-1 SCIAMACHY Level 0 to 1c Processing, Algorithm Theoretical Basis Document, issue 7A (ENV-ATB-DLR-SCIA-0041)*. Tech. rep. DLR, Mar. 2019. URL: http://atmos.caf.dlr.de/cgi-bin/h.cgi?page=projdocs.

[7] SCIAMACHY Operations Support Team. *SCIAMACHY Operations Concept I. Mission Scenarios (PO-TN-DLR-SH-0001/1)*. Tech. rep. issue 3. DLR-IMF, Oct. 2001.

[8] SCIAMACHY Operations Support Team. *SCIAMACHY Operations Concept II. Timelines: Generation, Planning & Execution Rules and Reference Timelines (PO-TN-DLR-SH-0001/2)*. Tech. rep. issue 3. DLR-IMF, Oct. 2001.

[9] SOST Team. *SCIAMACHY Operations Concept III. Instrument States and Onboard Tables (PFM), PO-TN-DLR-SH-0001/3*. Tech. rep. 3. DLR, IUP, Sept. 2002.

1.3 Abbreviations and Documents

ADS	Annotation Data Set
ANX	Ascending Node Crossing
APSM	Aperture Stop Mechanism
ASM	Azimuth Scanner Module
DLR	Deutsches Zentrum für Luft- und Raumfahrt e.V. (German Aerospace Centre)
DNX	Descending Node Crossing

DOAS	Differential Optical Absorption Spectroscopy
ENVISAT	Environmental Satellite
EO	Earth Observation
EOP	Earth Observation Product
ESA	European Space Agency
ESM	Elevation Scanner Module
GADS	Global Annotation Dataset
GDF	Generalised Distribution Function
ICU	Instrument Control Unit
ISO	International Standards Organisation
IFoV	Instantaneous Field of View
MDS	Measurement Data Set
MO&C	Moon Occultation & Calibration
NDF	Neutral density Filter
NDFM	Neutral density Filter Mechanism
netCDF	network Common Data Format
NH	Northern Hemisphere
OCR	Operation Change Request
PMD	Polarisation Measurement Device
S/W	Software
SCD	Slant Column Density
SCIAMACHY	Scanning Imaging Absorption Spectrometer for Atmospheric Chartography
SF	Sun Follower
SH	Southern Hemisphere
SLS	Spectral Line Source
SMR	Sun Mean Reference
SO&C	Solar Occultation & Calibration
SZA	Solar Zenith Angle
T/L	Time Line
TCFoV	Total Clear Field of View
TOA	Top of Atmosphere
WLS	White Light Source

1.4 Document Overview

Section 2 gives background about the observation modes of SCIAMACHY and the organisation of the observations on the instrument side. Section 3 explains the overall structure of the format and gives additional explanations for specific entries. Sections 4 to 21 contain information for all netCDF entries in tabular form. The tables are directly extracted from a Level 1 netCDF file generated by the operational processor. This ensures that the variable names and attributes in this document exactly match those in the operational products. Thus, in cases where we show values for attributes or variables, these are those from the file chosen for the generation of the tables. They are only shown for illustration purposes and may be different for other products.

The global file attributes are listed in section 4. The following sections contain the data entries for the product. In section 5 we have one table for each group of metdata (EOP, ESA and ISO). The metadata are separated into many sublevels. For each sublevel we add a "./" to the name of the group in the first column of the table. Rows where a new group starts are coloured in light cyan. For example "./gmd:contact" is a subgroup of the ISO metadata group. Below that another subgroup "././gmd:contactInfo" exists and so on.

For the other data a less compact (and easier to navigate) document structure was chosen, since here we do not have as many levels as for the metadata. The description of the variables and the group attributes are structured along the groups in the netCDF file like this:

- *Top Group:* Section
  - *Subgroup:* Subsection
    - *Subgroup of Subgroup:* Subsubsection

and so on. The section names are simply the group names. Every group has one table for the group attributes (if any) and one table for the variables (if any). The tables for the group attributes contain the attribute's name and the value. We give no description because the names are self-explanatory and the value (like "used wavelength range") are more useful for the reader. The tables for the variables contain

1. Name of the variable
2. The description
3. The unit
4. The data type
5. The number of dimensions, if the data are organised in arrays

and are all taken directly from an operational product.

With this information the user can quickly extract data of interest by using standard S/W and the names of the variables.

In this document we use the following convention: Internal document links are marked in dark green can be clicked to navigate through the document. External links are marked in red and can be clicked to access the corresponding URL with your standard internet browser.

1.5 Quick Look-up

In this section we summarise information for those users who are only interested in a quick look up of essential data. Details of the file structure can be found in the following sections.

Each Level 1 file contains the (available) data of one orbit. The observational data are organised along observation configuration (limb, nadir, occultation etc.) and then along spectral bands. Additional information such as instrument configuration or calibration data have their own group. The following table gives links of the relevant sections in the document (these are click-able in the electronic pdf version) where the tables with variables names, descriptions and units can be found. Additional information about the file structure can be found in Section 3.

Table 1: *Top groups of the product and where to find them.*

Group Name	Description	Section
MODE_MOON	Contains moon scanning observations above atmosphere	6
MODE_NADIR	Contains all nadir observations	7
MODE_LIMB	Contains all Limb observations	8
MODE_OCCULTATION	Contains all solar occultation observations	9
MODE_SUNDIFFUSER	Contains all sun measurements with the diffuser	10
MODE_SUBSOLAR	Contains all subsolar observations	11
MODE_SLS	Contains all SLS observations	13
MODE_WLS	Contains all WLS observations	14
MODE_MONITORING	Contains all other observations	12
CALIBRATION	Contains all data needed for calibration	15
INSTRUMENT	Operations and instrument information	16
INSTRUMENT/OCR	Information about OCRs relevant for the orbit	16.14
LEVEL0	Level 0 header data	17
PROCESSOR	Level 1 processor configuration	18
STATES	Information about states done in the orbit	19
STATES_GEOLOCATION	Edge Coordinates of the state swath	20
STATE_QUALITY	Statewise quality flags	21
METADATA	Header information	5

The following table gives an overview about the approximate[1] wavelengths of the different bands

Table 2: *Approximate wavelength start and end of the bands. In nadir mode 56 bands are defined, in all other modes we have 40 bands.*

BAND	Nadir (Wavelength [nm])	Other (Wavelength [nm])
1	212.58 - 213.19	212.58 - 213.19
2	213.34 - 239.93	213.34 - 239.93
3	240.06 - 281.92	240.06 - 281.92
4	282.03 - 303.55	282.03 - 313.93
5	303.66 - 313.93	314.04 - 333.82
6	333.93 - 334.39	333.93 - 334.39
7	411.74 - 412.17	411.74 - 412.17
8	391.86 - 403.96	404.07 - 411.63
9	320.16 - 391.75	320.16 - 403.96
10	309.45 - 320.05	309.45 - 320.05
11	300.60 - 301.07	301.19 - 309.33
12	383.51 - 385.78	300.60 - 301.07
13	391.82 - 404.03	383.51 - 385.78
14	404.28 - 423.67	386.04 - 391.57
15	423.92 - 526.96	391.82 - 605.44
16	527.20 - 544.55	605.68 - 627.17
17	544.78 - 565.04	627.42 - 628.40
18	565.28 - 597.23	595.31 - 596.20
19	597.47 - 605.44	596.43 - 597.32
20	627.42 - 628.40	597.55 - 789.80
21	595.31 - 596.20	790.02 - 811.22
22	597.55 - 605.35	811.44 - 812.31
23	605.58 - 612.44	773.19 - 774.40
24	612.66 - 725.97	774.70 - 775.91

Continued on next page

[1] The exact value might be slightly different after wavelength calibration

Continued from previous page

BAND	Nadir (Wavelength [nm])	Other (Wavelength [nm])
25	726.18 - 753.75	776.21 - 1056.19
26	753.96 - 775.88	1056.47 - 1061.35
27	776.09 - 789.80	1061.63 - 1062.78
28	811.44 - 812.31	971.46 - 978.74
29	773.19 - 774.40	979.54 - 990.03
30	776.21 - 789.71	990.83 - 1750.08
31	790.00 - 798.03	1750.91 - 1764.23
32	798.32- 946.63	1765.07 - 1772.59
33	946.90 - 990.36	1934.38 - 1935.43
34	990.64 - 1056.19	1935.55 - 1939.87
35	1061.63 - 1062.78	1939.99 - 2040.18
36	971.46 - 978.742	2040.28 - 2042.70
37	990.83 - 1056.22	2042.79 - 2043.66
38	1057.01 - 1233.24	2259.25 - 2260.47
39	1234.00 - 1253.14	2260.60 - 2384.48
40	1253.90 - 1388.95	2384.59 - 2385.60
41	1389.72 - 1410.35	N/A
42	1411.12 - 1548.51	N/A
43	1549.29 - 1670.70	N/A
44	1671.50 - 1695.83	N/A
45	1696.65 - 1707.25	N/A
46	1708.07 - 1750.08	N/A
47	1765.07 - 1772.59	N/A
48	1934.38 - 1935.43	N/A
49	1939.99 - 1967.78	N/A
50	1967.89 - 1984.04	N/A
51	1984.15- 2029.893	N/A
52	2029.99 - 2040.18	N/A
53	2042.79 - 2043.66	N/A
54	2259.25 - 2260.47	N/A
55	2260.60 - 2384.48	N/A
56	2384.59 - 2385.60	N/A

2 SCIAMACHY Mission Scenarios, Observation Modes and States

Before we describe the data structure for the different observation modes, we quickly summarise how SCIAMACHY observes the Earth. More details are described in [3].

2.1 Mission Scenarios

SCIAMACHY had a sun-synchronous North-South orbit with the DNX on the day side. A standard Earth observation orbit consist of solar observations, interchanging nadir and limb observations of the Earth and dark measurements on the eclipse side. In regular time intervals additional observations of the sun, moon and calibration sources are done which last part of the orbit or a complete orbit. Solar observations are done in the SO&C window over the North pole, subsolar observations are done around the descending node crossing (DNX) and Moon observations are done in the MO&C window (see schematic overview in Figure 1).

For nominal operations, the orbital mission scenario is defined by

- a swath width of ±480 km (±417 km after orbit lowering in 2010) relative to ground track in nadir and limb scans for global coverage within 6 days, taking the alternating limb/nadir measurements into account
- matching limb/nadir measurements in the illuminated part of the orbit
- Sun occultation measurements each orbit
- Moon occultation measurements whenever possible (moonrise on nightside of Earth)
- mesosphere/lower thermosphere measurements in eclipse each orbit, intermittent with calibration and monitoring measurements
- the equivalent of 2 days per month with mesosphere/lower thermosphere measurements in the illuminated part of the orbit
- calibration and monitoring measurements on a daily (every 14th orbit), weekly (every 100th orbit) and monthly basis

The simplest orbital mission scenario is executed whenever the Moon is not visible and no regular calibration and monitoring tasks have to be performed. This scenario occurs about 90% of the time during a month and can be accommodated by 4 timelines[2]. The most complex scenario is defined when implementing monthly calibration and monitoring requirements. This consists of a series of 5 consecutive orbits filled with calibration and monitoring activities.

The nominal operations could be interrupted for special observation requests, the so-called OCRs (Operation Change Request). A description of the OCRs relevant for a product is contained in the Level 1b files themselves. The full documentation can be found in [2].

[2] A timeline defines the sequence of states to be performed

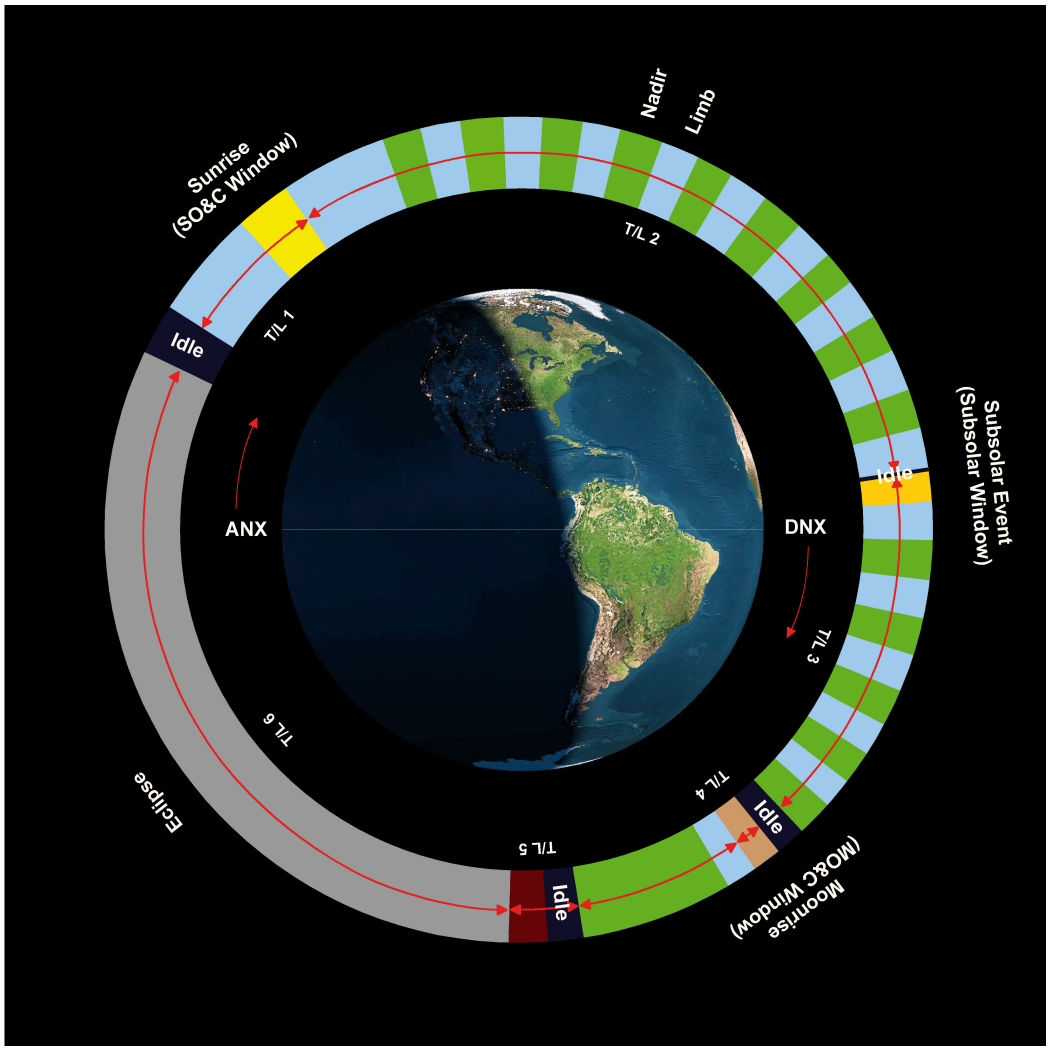

Figure 1: *SCIAMACHY reference orbit with Sun/Moon fixed events along the orbit. The events define orbital segments which are filled with timelines. Details can be found in [3].*

2.2 SCIAMACHY Observation Modes & States

SCIAMACHY's detectors consist of one-dimensional photo diode arrays. East-West coverage during Earth observations is achieved by moving one (nadir) or two (limb) scan mirrors. Figure 2 shows the scanning strategies.

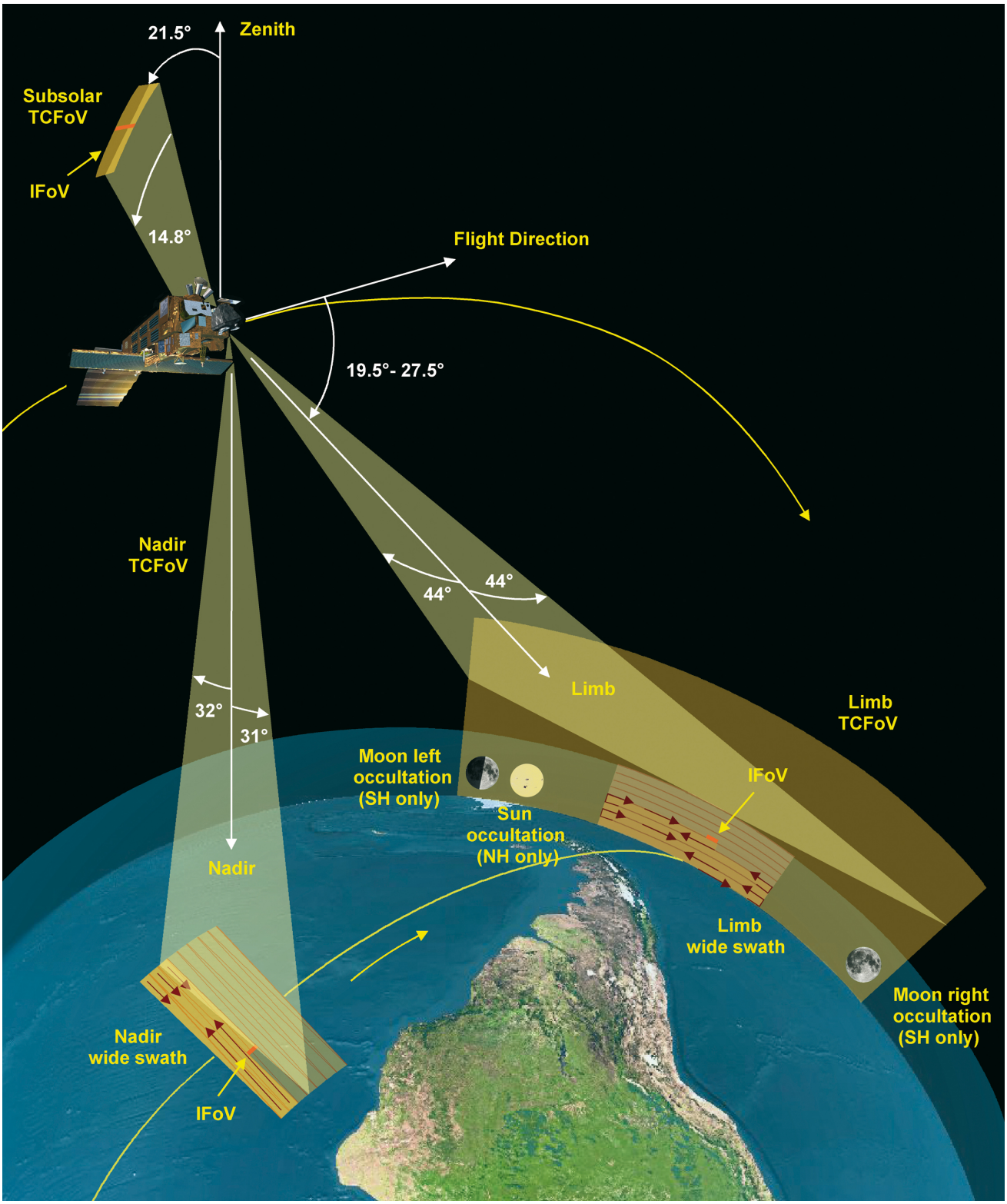

Figure 2: *Sketch of SCIAMACHY's TCFoV and observation geometries. Details can be found in [3].*

The different observation modes are implemented in the instrument on-board logic as *states*: a specific instrument configuration constitutes a state and is defined by

- A spectral band definition (BAND_xx in the netCDF file)
- Exposure time parameters (Co-adding and pixel exposure time; the total exposure time is co-adding $\times$ pixel exposure time). These can be different per band.
- Main position of scan mirror modules (defines also if diffuser or mirror is used)
- Scanning strategy around the main position
- Mechanisms moved in or out the light path (Neutral Density Filter and small aperture)
- WLS and SLS lamp status (on or off)

In total 70 states were defined for SCIAMACHY, but not all were used in routine observations. States could be changed (or exchanged) for a limited time or permanently through an OCR. One example is the Limb Mesosphere/Thermosphere state which was permanently implemented for routine observations in November 2008 through OCR 36.

The following gives a short overview of all defined states at the end of the mission.

Table 3: *Defintion of SCIAMACHY states.*

State ID	State	Measurement Type	Remark
1 - 7	nadir 960/935 km swath	science	all orbital positions
8, 26, 46, 63,	dark current	calibration	pointing at 250 km
9 - 15	nadir 120 km swath	science	all orbital positions
16	NDF monitoring, NDF out	monitoring	
17 - 21	sun ASM diffuser	calibration	Sun above atmosphere
22	sun ASM diffuser atmosphere	monitoring	various azimuth angles
23 - 25, 42 - 45	nadir pointing	science	all orbital positions
27	limb mesosphere	science	scanning 150 - 80 km
28 - 33	limb 960/935 km swath	science	all orbital positions
34 - 37, 40, 41	limb no swath	science	all orbital positions
38	nadir pointing left	monitoring	
39	dark current Hot Mode	calibration	
47	SO&C scanning/pointing	science, calibration	Sun through and above atmosphere
48	NDF monitoring, NDF in	monitoring	
49	SO&C nominal scanning, long duration	science, calibration	Sun through and above atmosphere
50	SO&C fast sweep scanning	calibration	
51	SO&C pointing	science, calibration	Sun through and above atmosphere
52	sun ESM diffuser, NDF out	calibration	Sun above atmosphere
53	sub-solar pointing	calibration	
54	moon nominal scanning	calibration	Moon above atmosphere
55	limb mesosphere-thermosphere	science	scanning 150-60 km
56	moon pointing	science, calibration	Moon through atmosphere
57	moon pointing, long duration	science, calibration	Moon through and above atmosphere
58	sub-solar pointing/nominal scanning	calibration	
59	SLS	calibration	
60	sub-solar fast sweep scanning	calibration	
61	WLS	calibration	
62	sun ESM diffuser, NDF in	calibration	Sun above atmosphere
64	sun extra mirror pointing	calibration	Sun above atmosphere

Continued on next page

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State ID	State	Measurement Type	Remark
65	ADC, scanner maintenance	calibration	
66	sun extra mirror nominal scanning	calibration	Sun above atmosphere
68	sun extra mirror fast sweep scanning	calibration	Sun above atmosphere
69	SLS ESM diffuser	calibration	
70	WLS ESM diffuser	calibration	

The Level 0-1 processor uses the *measurement category* to define *data types*. An instrument observation is assigned a data type, if it has a certain measurement category. The data type can be associated with more than one category: the nadir data type is associated with 5 measurement categories. All measurements belonging to a certain data type share the same treatment (calibrations etc) and are written to the *same* netCDF group. The table below shows the instrument configuration and the netCDF groups for each measurement category.

Table 4: *Measurement categories, instrument configuration and netCDF groups.*

State	Meas. Cat.	netCDF Group (MODE_...)	State ID	NCWM	Aperture	NDFM	WLS	SLS
Nadir	1	NADIR	1-7; 9-15	Closed	Large	Out	Off	Off
Limb	2	LIMB	28-37; 40-41	Closed	Large	Out	Off	Off
Nadir_pointing	3	NADIR	23-25; 42-45	Closed	Large	Out	Off	Off
SO&C_Scanning	4	OCCULTATION	47;49;50	Closed	Small	In	Off	Off
SO&C Pointing	5	OCCULTATION	51	Closed	Small	In	Off	Off
MO&C_Pointing	6	MONITORING	56; 57	Closed	Large	Out	Off	Off
Moon_Scanning	7	MOON	54	Closed	Large	Out	Off	Off
Sun_ESM_Diffusor_Calibration (ND OUT)	8	SUN_DIFFUSER	52	Closed	Large	Out	Off	Off
Sub-solar_Calibration	9	SUB_SOLAR	53;58;60	Open	Small	In	Off	Off
Spectral_Lamp_Calibration	10	SLS	59;69	Closed	Large	Out	Off	On
White_Lamp_Calibration (ND IN)	11	WLS	61	Closed	Large	In	On	Off
Dark_Current_Calibration	12	-	8;26;46;63;67	Closed	Large	Out	Off	Off
Sun Nadir/Elevation_Mirror_Calibration	13	MONITORING	64;66;68	Closed	Small	In	Off	Off
Moon Nadir/Elevation_Mirror_Calibration	14	MONITORING	not used	Closed	Large	Out	Off	Off
ADC_Calibration	15	-	65	Closed	Large	Out	Off	Off
Sun_ESM_Diffusor_Calibration (ND IN)	16	SUN_DIFFUSER	62	Closed	Large	In	Off	Off
Nadir_Eclipse_Pointing	17	-	not used	Closed	Large	Out	Off	Off
Nadir_Eclipse_Scanning	18	-	not used	Closed	Large	Out	Off	Off
White_Lamp_Calibration (ND OUT)	19	MONITORING	70	Closed	Large	Out	On	Off
Dark_Current_Calibration_HM	20	MONITORING	39	Closed	Large	Out	Off	Off
NDF Monitoring (ND OUT)	21	MONITORING	16	Closed	Large	Out	On	Off
NDF Monitoring (ND IN)	22	MONITORING	48	Closed	Large	In	On	Off
Sun_ASM_Diffuser	23	SUN_DIFFUSER	17-21	Closed	Large	Out	Off	Off
Nadir_Pointing_Left	24	NADIR	38	Closed	Large	Out	Off	Off
Sun_ASM_Diffuser_Atmosphere	25	MONITORING	22	Closed	Large	Out	Off	Off
Limb_Mesosphere	26	LIMB	27	Closed	Large	Out	Off	Off
Limb_Mesosphere_Thermosphere	27	LIMB	55	Closed	Large	Out	Off	Off

The individual dark measurements are not written to the Level 1b product (only the averages per state are available in the CALIBRATION group), hence there is no group for the dark measurements. The ADC calibration state is used for the check of instrument electronics and mechanisms and produces no detector data.

3 File Structure and Additional Information

3.1 Product Filename

The product filename will be constructed according to [1] as follows:

<MMM>_<CCCC>_<TTTTTTTTTT>_<instance ID>.nc

with the following elements:

Table 5: *Elements of standard file naming.*

MMM	Mission ID
CCCC	File Class
TTTTTTTTTT	Mission specific file type = <FFFF><DDDDDD>
FFFF	File category
DDDDDD	Product semantic descriptor
instance ID	start time, end time, orbit number, packet version, processor version, processing time

The packet version is a version number which is specific for the combination of processor version, input data (for example calibration data) version and configuration version. All time strings in the file-name and product are formatted in ISO 6801 format [4]. Individual fields are separated by underscores ("_").

For SCIAMACHY Level 1 products and the latest reprocessing, the fixed values are:

Table 6: *SCIAMACHY product fixed values for the latest re-processing with V9.01.*

Mission ID	*ENV* for ENVISAT
File Class	*RPRO* for re-processing
File Type Fields	*SCI* for the SCIAMACHY instrument
	*L1B_* for the processing level
Packet version	01
Processor Version	090100 for version 9.01

Following this scheme, the result would be in our case for orbit 46246:

`ENV_RPRO_SCI_L1B____20110103T134510_20110103T152521_46246_01_090100_20181019T222703.nc`

The packet version is 1 and the processor version is currently 9.01. We encode these versions into "01_090100" as the versions part of the "instance ID".

The file extension shall be ".nc". This is typically used for netCDF files.

3.2 Array Dimensions Compared to Other Instruments

Typical dimensions for the observational data of SCIAMACHY are shown in the following table, which also shows a few other instruments.

Table 7: *Typical dimensions of the observational data.*

Dimension	SCIAMACHY	GOME	GOME-2	S5P
time	1	1	1	1
scanline	~400	~500	~500	~3300
ground_pixel	16 + 4	3 + 1	24 + 8	79/316/456/256
channel	8	4	4	-
band	64	6	6	8
spectral_channel	8192	4096	4096	3072

time corresponds to a time per orbit, for example the midnight time (00.00), the orbit start time or time at ascending node crossing. In Sentinel 4 it will be a time for a complete image of Europe and North-Africa which may be measured several times per day.

scanline corresponds to one complete sensor image of the 2-dimensional sensor e.g. Sentinel 5p. For SCIAMACHY it corresponds to one complete scan consisting of 4 seconds forward and 1 second backward scans for nadir and 1.5 second for limb.

ground_pixel corresponds to the spatial extent (across track) of a 2-dimensional push-broom sensor (e.g. Sentinel 5p) or to the across-track scans of a scanning spectrometer (GOME, GOME-2, SCIAMACHY) generated by scan mirror movement.

channel corresponds to the number of detector sensor-chips in the instrument.

band corresponds to the number of spectral windows which can be configured individually with certain pixel-exposure-times, co-adding factors, start- and end-detector-pixels. For SCIAMACHY we have a maximum of 64 so-called clusters (16 per detector channel) which function as programmable spectral bands.

spectral_channel corresponds to the total number of foto-diodes or transistors of the detectors. Each foto-diode measures light at a certain wavelength.

For SCIAMACHY the observational data such as signal values, stray light etc. are organised along spectral bands, i.e. there is a group for each band. SCIAMACHY is a more complex instrument than the Sentinels: The observations are done in up to 64 spectral bands. Contrary to the Sentinel instruments, the exposure time varies with spectral band *and* orbit phase. Over the poles the exposure time for a given band is typically longer than at lower latitudes in order to maximise the signal-to-noise values. Within a band group the data arrays for the observations and the polarisation always have dimensions that allow to fit in the *smallest integration time* (highest number of observations) for a given orbit. For orbit phases where the integration time is larger than the minimum time the array is filled with a fill value. The netCDF arrays themselves are organised as

$$\text{time} \times \text{scanline} \times \text{ground pixel} \times \text{spectral channel}$$

The *time* dimension is always 1 for SCIAMACHY, it is only kept for compatibility with the other sensors. Details about the scanning strategy and how the arrays are filled can be found in Section 2.2

3.3 Product Structure

The Level 1 product consists of one single file which has the following basic group structure (in this overview only top level groups and not all variables are mentioned):

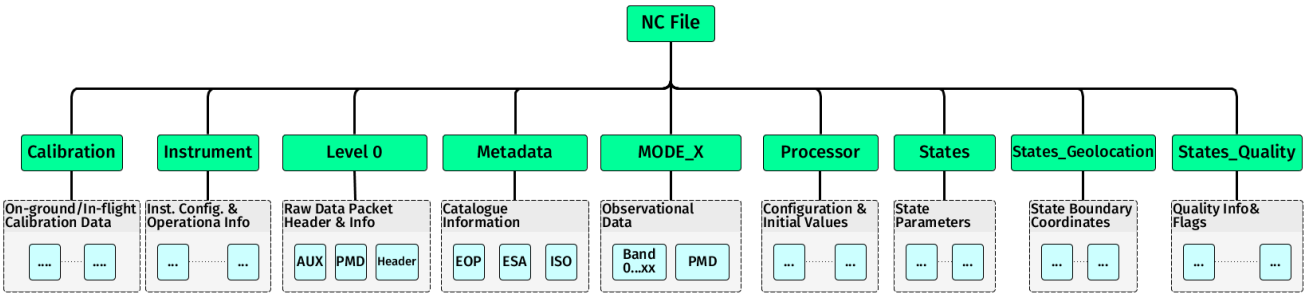

Figure 3: *Top group structure for the Level 1b netCDF file. We do not show all subgroups (ellipsis). For more details see text.*

The following modes (MODE_X in the figure above) are defined:

MODE_MOON	Used for lunar observations above the atmosphere
MODE_NADIR	Used for nadir Earth observations.
MODE_LIMB	Used for limb Earth observations.
MODE_OCCULTATION	Used for solar occultation observations.
MODE_SUBSOLAR	Used for subsolar observations.
MODE_SUN_DIFFUSER	Used for solar observations made with a diffuser.
MODE_WLS	Used for White Light Source measurements.
MODE_SLS	Used for Spectral Line Source measurements
MODE_MONITORING	Used for all other monitoring or calibration measurements except moon obserav-tions above the atmosphere (state ID 54)

In each MODE group we have one subgroup for each spectral band (also named "cluster"). These are named *BAND_N*, where *N* is a zero padded two-digit number between 1 and 56, depending on the mode. Additionally we have also a group *PMD* that contains the PMD measurements for the mode. The cluster group have subgroups for observational data (the uncalibrated radiances), the polarisation values and the coordinates (see Fig. 4).

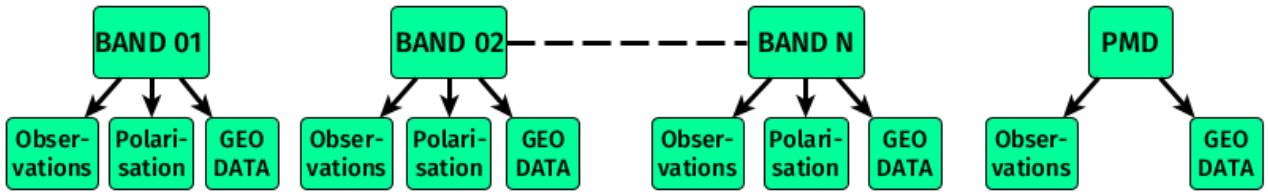

Figure 4: *Structure of the band (or cluster) groups that are contained in the MODE groups. The modes contain between 40 and 64 bands and one PMD group. For more details see text.*

The OBSERVATION group contains values related to the observations and the calibration. The POLARISATION group contains polarisation fractions Q,U with error, the wavelength and the GDF parameters. The GEODATA group contains the viewing geometry and the ground pixel coordinates.

3.4 Lunar Observations Above the Atmosphere

The group for the scanning measurements of the moon can be found in Sec. . SCIAMACHY observed the moon regularly above the atmosphere near the South Pole. The SCIAMACHY slit dimensions are 0.0458ˆ{°} in dispersion direction and 1.883ˆ{°} in cross-dispersion direction, meaning that in dispersion direction the observation covers only part of the Moon while in cross-dispersion direction the whole moon is covered (the moon has an apparent size of ≈ 0.5ˆ{°}). The observation sequence is as follows: In the first phase the centre of the moon is acquired. After a successful acquisition the lunar disk is scanned several times, first going downwards and then doing alternating up and down scans. At the end of each scan the Moon has left the field of view completely (see 5).

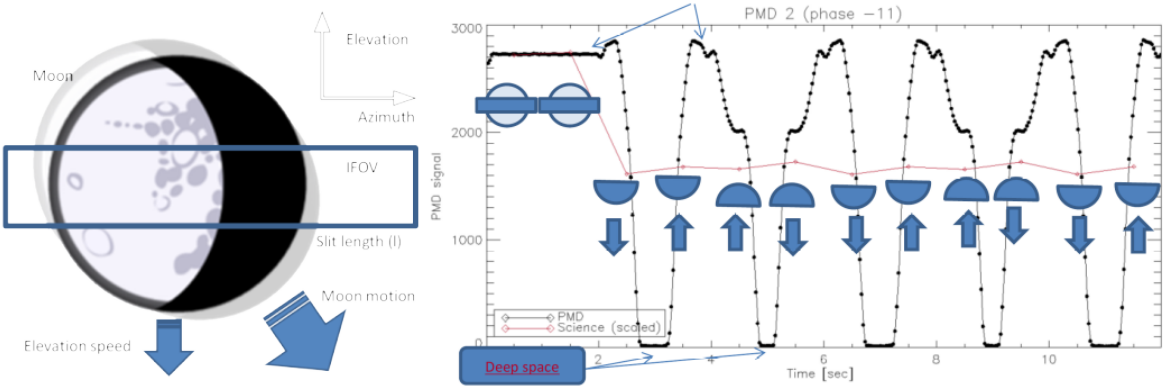

Figure 5: *Left: Schematic of Slit movement Right: Scan pattern for moon observations with state ID 54 with PMD2 signal (black) and science signal(red). Figures from [5]*

The individual scan observations can be found in section 6. We also provide full disk irradiance and reflectance that are calculated from the individual scans. The data can be found in the `CALIBRATION/MEAN_MOON` netCDF group (see section 15.6). The irradiance is stored in the variable `mean_moon_irradiance` and the reflectance is stored in the variable `mean_moon_reflectance`. The calibrated values are already part of the Level 1*b* product, there is no need to run the `scial1c` tool. Details of the calculation can be found in [5] and [6].

3.5 Nadir Observations

The netCDF entries associated with nadir observations are listed in Section 7. In this section we give background information needed to interpret the data correctly.

In the MODE_NADIR group the following states are collected:

- ➢ standard nadir states with East-West scanning used for trace gas retrievals (state IDs 1-7, 9-15)
- ➢ pointing states used for, e.g. degradation monitoring (state IDs 23-25, 38, 42-45)

In nominal Earth observations only the standard states 1-7 are used. The short swath states 9-15 were only intermittently used between 2002 and 2004. The difference to the standard states is the swath width which is only 117km.

In one standard nadir observation (equals to a nadir state, see 2.2) the instrument scans

- ➢ East-West (32° to 31° from the nadir position)[3] forward scan for 4 seconds
- ➢ A fast scan to the East-most position in 1 second ("backscan")
- ➢ East-West (32° to 31°) forward scan for 4 seconds

[3]The scan is not symmetric because of an FoV obstruction on the West side

and so on (see also Figure 6). The duration of one continuous nadir observation (or nadir state) is 65 seconds meaning that we have 13 forward/backscan pairs in one nadir observation.

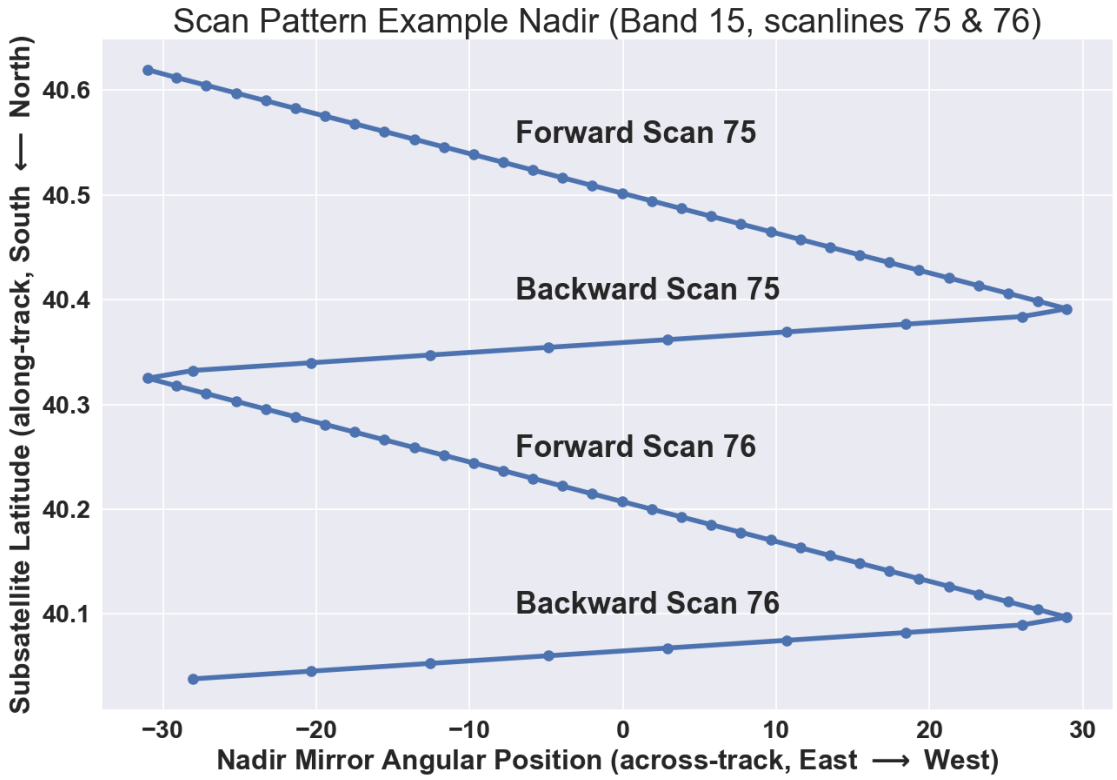

Figure 6: *Example for nadir scan pattern for Band 14. The scanlines 75 and 76 were done with state ID 5 and an integration time of 0.125s. This leads to 40 groundpixels (32 in forward scan direction and 8 in backward scan direction).*

Backscans can be found by inspecting the *backscan_flag* in the product. The flag has the same structure as the observations (time × scanline × ground pixel) without the spectral channel dimension and is set to 1 for backscans. The width (across track) of the swath is 960km before the lowering of the orbit in October 2010 and 935 km after it.

The array dimensions are:

Table 8: *Nadir array dimensions.*

time	Always 1
scanline	Number of forward/backward scan combinations in orbit
ground pixel	(scan duration [5s]) divided by (Minimum integration time in the orbit)
spectral channel	fixed (depending on the spectral band)

The ground pixel dimension in the array represents the across track position of the observation, the scanline the along track position. These a are roughly the East-West and North-South position, if the observation is not at higher latitudes.

The *scanline* dimension has the same size for all spectral bands for a given orbit while the number of ground pixels can vary with the band according to the exposure time. The arrays are filled such that observations of a certain scan are always found at the *same scanline* index for all spectral bands and PMDs.

If a spectral band has at some point in the orbit an exposure time larger than the minimum exposure time in the orbit, the data are filled in at the end of the exposure time:

Table 9: *Example fill pattern for ground pixels in Nadir for a minimum orbit exposure time of 0.5s. Dark coloured cells represent array elements containing the fill value.*

Exp. Time	GP1	GP2	GP3	GP4	GP5	GP6	GP7	GP8	GP9	GP10
0.5s (min)										
1s										
2.5s										
5s										

The main data contained in the OBSERVATION group are:

radiance not calibrated signal data

memoryeffect memory effect signal on the measurement

straylight straylight signal on the measurement

Additionally flags (see below) and some auxiliary data are given.

3.5.1 PMD Data

PMD data are organised in the same way as the nadir data. The original 40Hz measurements are converted to 32 Hz values synchronised with the science measurements[4]. Thus the data arrays in the PMD group have 160 ground pixels. The PMDs are continuously read out and the array has no fill values. The array contains the values for all 6 PMDs measuring Q (value 1 to 6 in the *spectral_channel* dimension and the PMD measuring U in the 7th value.

3.5.2 Coordinates

In the the byte stream ENVISAT format only contained coordinates for the minimum exposure time. In the new format we give the coordinates for all ground pixels, i.e. also for those with larger exposure times:

Table 10: *Nadir geographic coordinates.*

Variables	Variable Meaning
latitude_bounds longitude_bounds	Corner coordinates of each observation
latitude longitude	Centre Coordinate of each observation
latitude_subsatellite longitude_subsatellite	Subsatellite point
earth_radius satellite_altitude	Earth Radius and Altitude
solar angles LoS angles ESM position	Viewing geometry and mirror position

The solar and LoS angles are given for the start, middle and end of the observations. The corner coordinates encompass the whole observation. All other values are given for the centre of the observation.

[4] The science detector electronics minimum clocktime is 0.03125s = 32 Hz

3.5.3 Polarisation Values

The array for the polarisation values provides 12 entries for each ground pixel:

1. The theoretical point in the UV (1 entry)
2. The fractional polarisations derived from the PMDs (6 entries)
3. Polarisation values derived from channel overlaps (5 entries)

In the current algorithm, only the theoretical point and the polarisation fraction for the first 5 PMDs are calculated. PMD F and the channel overlaps turned out to be noisy for a reliable polarisation determination. Thus only the first 6 entries contain useful values; all other values are set to 0. In order to find valid entries[5] the user can check the variable *polarisation_lambda* or the error of Q or U: Valid entries will have a wavelength assigned, other entries will have the wavelength 0 and a negative error.

Additionally we give the parameters for the GDF function (for details see [6]).

3.5.4 Flags

The following radiance flags are defined for Nadir observations:

Table 11: *Flag meanings for radiance_flags*

Flag Meaning	Flag Value
0 = normal	0
1 = saturation	1
2 = red-grass	2
4 = sun-glint	4
8 = rainbow	8

Further explanations:

sunglint The flag alerts the user only to a *possible* sun glint, i.e. the viewing geometry could lead to sun glint. This is also what is stated in the variable description. Checking if sun glint actually occurs is difficult and would be only possible with external information about the scene, e.g. expected signal or polarisation.

saturation The flag indicates detector saturation

red-grass The flag indicates possible red grass (see [6])

rainbow The flag alerts the user about *possible* rainbow conditions, i.e. the viewing geometry may lead to rainbow conditions, which may invalidate the polarisation correction of the data (see [6]).

Additionally a flag indicating, if a ground pixel was measured during a backscan, is given (variable *backscan_flag*)

Table 12: *Backscan Flag.*

Flag Meaning	Flag Value
forward_scan	0
backward_scan	1

The fill value for the backscan is -1.

[5] Just checking for 0 is not enough: Q,U might be 0 for, e.g. unpolarised light.

3.6 Limb Observations

The netCDF entries associated with limb observations are listed in Section 8. In this section we give background information needed to interpret the data correctly.

In a limb observation the instrument uses both mirrors. It looks forward through the atmosphere with the tangent point approximately 3300km ahead of the instrument.

In this group the following states or observations are collected:

- standard limb states (ID 28-33)
- no swath limb states (ID 34-37, 40, 41), here the ASM does no across-track scanning but points into flight direction
- limb mesosphere observations (state ID 27), where the altitudes from 150km down to around 80 km are scanned. No across-track scanning is done.
- limb mesosphere/thermosphere observations (state ID 55) scans downwards from 150km to 60km and then jumps to 350km for a dark measurements. This measurement was introduced into routine operations in November 2008 (orbit 34922, OCR 36) to observe the mesosphere and thermosphere. After a test phase before the routine implementation, the observations were done on 2 days per month, 1 day coinciding with MIPAS upper atmosphere observations (see also [2]).

For the operational retrieval of trace gases only states 28-33 are used, which have the following scan pattern starting below the horizon (see also Figure 7):

1. Starting in the East, the instrument scans westward by 17° for 1.5s. The curvature of the Earth is taken into account during the scan , i.e. the altitude above the Earth ellipsoid stays constant.
2. When the west most position is reached, the elevation is increased by $\approx$ 3km (using the elevation mirror) and the scan direction is reversed.
3. At the eastern most point the elevation mirror is pointed to the next altitude $\approx$ 3km higher and the scan starts in the East and goes to the West.

and so on. The scan pattern is continued for 30 (29 after the orbit lowering) elevation steps, with the final altitude at around 93km. Then the altitude is increased to 250km and a limb dark measurement is obtained. The East-West extension of the scan is 960km matching the nadir swath (935 km after lowering of the orbit in October 2010.)

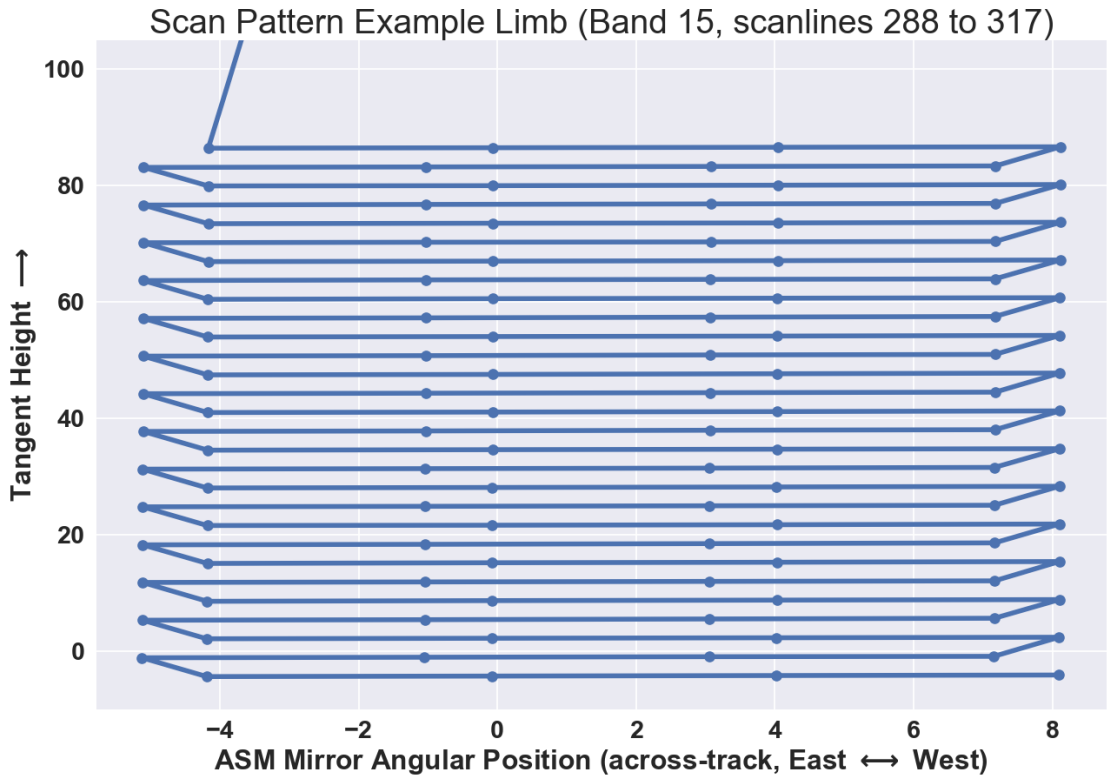

Figure 7: *Example for limb scan pattern for Band 15 for a complete state comprising 29 scans of the atmosphere and one dark scan at 250km at the end (not in the plot range).*

The limb observation are timed such that they observe the same volume of air that is later observed with the nadir observations. This enables the retrieval of tropospheric columns by combining limb and nadir observations. The array dimensions are similar to the nadir ones, except there is no fast backscan.

The array dimensions are:

Table 13: *Limb array dimensions.*

time	Always 1
scanline	Number of scans in orbit
ground pixel	(scan duration [1.5s]) divided by (Minimum integration time in the orbit)
spectral channel	fixed (depending on the spectral band)

The ground pixels are filled in the same way as for the nadir observations, i.e. at the end of the exposure time (see Table 9). The same data as for nadir are saved in the observation group.

3.6.1 PMD Data

PMD data are organised in the same way as the limb data. The original 40Hz measurements are converted to 32 Hz values synchronised with the science measurements[4]. The array contains the values for all 6 PMDs measuring Q (value 1 to 6 in the *spectral_channel* dimension and the PMD measuring U in the 7th value.

3.6.2 Coordinates

In the following table the variables describing the coordinates and viewing geometry for limb are listed:

Table 14: *Meaning of the coordinate and viewing variables for limb data.*

Variables	Variable Meaning
latitude longitude	Coordinates at tangent point for start, middle and end of observation
tangent height	Tangent height for start, middle and end of observation
latitude subsatellite longitude subsatellite	Coordinates of subsatellite at the middle of the observation
earth_radius satellite altitude	Values for the middle of the observation
solar angles LoS angles	Solar angles and viewing geometry for the start, middle and end of the observation
ESM position ASM position	Mirror positions for the middle of the observation.

3.6.3 Polarisation Values

The array for the polarisation values provides 12 entries for each ground pixel:

1. The theoretical point in the UV (1 entry)
2. The fractional polarisations derived from PMDs (6 entries)
3. Polarisation values derived from channel overlap (5 entries)

In the current algorithm, only the theoretical point and the polarisation fraction for the first 5 PMDs are calculated. PMD F and the channel overlaps turned out to be noisy for a reliable polarisation determination. Thus only the first 6 entries contain useful values; all other values are set to 0. In order to find valid entries[5] the user can check the variable *polarisation_lambda* or the errors of Q,U: Valid entries will have a wavelength assigned, other entries will have the wavelength 0 and a negative error.

Additionally we give the parameters for the GDF function (for details see [6]).

3.6.4 Flags

The radiance flags in limb are the same as for nadir:

Table 15: *Flag meanings for radiance_flags*

Flag Meaning	Flag Value
0 = normal	0
1 = saturation	1
2 = red-grass	2
4 = sun-glint	4
8 = rainbow	8

For details see Section 3.5.4.

While the backscan flag is contained in the limb observation group, it is always set to 0[6], because there is no backscan as such in limb observations: Even if the scan direction changes every other scan, all observations are made in the same way (with the same scan velocity).

[6] For groundpixels with data; the fill value for ground pixels without data is -1.

3.7 Solar Occultation Observations

All netCDF entries associated with the occultation observations can be found in Section 9. While nadir and limb observations can be defined by selecting appropriate positions and scan ranges for the ESM and ASM, the states observing Sun (or Moon) require dynamic control of the scanners. Sun- and moonrise are affected by refraction. This leads to elevation rates of the rising solar/lunar disks being different between start and end of the occultation measurement. One rate results from refraction, the other from the platform's orbital motion. Scanner control via the Sun Follower would be able to compensate for this but cloud coverage may prevent the Sun Follower from successfully acquiring the solar or lunar disk. The control loop via the ICU works with a single scan rate only and is unsuitable for tracking the rising Sun/Moon in the early occultation phase. Therefore, the corresponding states implement a dedicated Sun/Moon occultation procedure based on the fact that at an altitude of about 17 km, refracted image and true position overlap well. From then on, the Sun/Moon rises with an almost constant rate. At the beginning of the state the ESM is rotated to point at an elevation corresponding to 17 km and performs continuous vertical scans of 2 sec each with a vertical range of 0.33°. The ASM is rotated to an azimuth angle which ensures that the Sun or Moon is within the field of view of the Sun Follower when their refracted disk appears at the limb (see Figure 8). Because of the scan motion of the ESM, the object is detected when reaching an altitude between the horizon and 17 km. Once the Sun/Moon has arrived at an altitude of 17 km above the horizon, control is switched either to the SF or ICU. In the latter case a constant rate for the ESM is sufficient because from that elevation onwards refraction can be neglected. The ESM tracks the upward motion of the Sun/Moon in pointing or in one of the scanning modes.

The ESM scan strategy for the solar occultation states is varying slightly after the initial acquisition of the sun position (the ASM mirror always follows the sun):

Table 16: *ESM Scan strategies for solar occultation.*

State ID	Scan Strategy
ID 47 (Scanning/Pointing)	ESM scans $\pm 0.33^\circ$ in 2s over the solar disk until the sun is above the atmosphere, then the ESM is pointed towards the centre of the sun and stops scanning (but follows the sun)
ID 49 (Scanning Long Duration)	As state 49, but the ESM continues to scan over the solar disk with the sun above the atmosphere
ID 50 (Scanning Fast Sweep)	The ESM scans over the solar disk in 0.125s with the scan spanning $\pm 2.72^\circ$ (used for calibration)
ID 51 (Pointing)	The ESM points to the centre of the solar disk

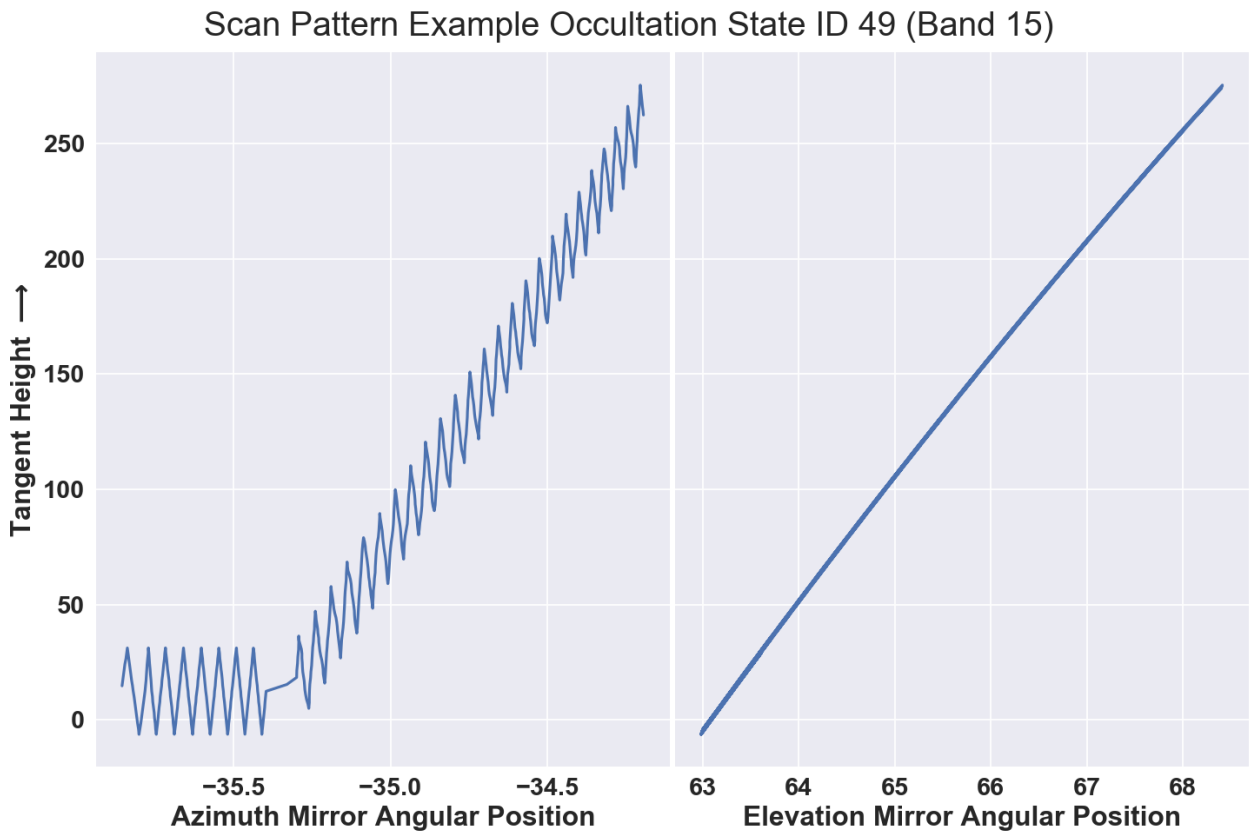

Figure 8: *Example for occultation scan pattern for Band 15 and state ID 49. The ESM is scanning up and down across the solar disk, while at the same time following the centre of the solar disk. The ASM is following the sun after the acquisition phase. The tangent height is the one in around 3290 km distance, i.e. roughly 30km for the ±0.33° scan. The scan is not well visible in the plot of the ESM position, because here the general upwards movement of the mirror and the scan are superimposed.*

The array dimensions of the occultation observations are the same as for nadir and limb observations, i.e. we have also the dimension "ground pixel", although physically speaking, during a solar observation there is no such thing as a ground pixel. This dimension is used to be able to synchronise the detector observations with the PMD observations. As an example we can take state ID 49:

- ➢ The detector exposure time for band 15 is 0.0625s and the size of the ground pixel dimension is 1
- ➢ The PMD values are synchronised to 32Hz, i.e. we have a value every 0.03125s and 2 per detector observation. Thus the ground pixel dimension size is 2.

In this way the user can extract interesting parameters by just using the scanline dimension. The associated values can then be found in the ground pixel dimension.

3.7.1 PMD Data

The entries in the PMD group are equivalent to those in the limb and nadir group (details in 3.5.1).

3.7.2 Coordinates

The coordinate variables and their meaning are the same as for Limb (see Table 14).

3.7.3 Flags

The flags are the same as for limb (Section 3.6.4)

3.8 Sun Diffuser Observations

Variables for the sun diffuser group can be found in Section 10. SCIAMACHY has two diffusers on board, mounted on the ASM and ESM backsides. The sun is observed above the atmosphere one time a day with each diffuser on two consecutive orbits. The measurements are used to construct the Sun Mean Reference (SMR). The diffusers are used to fill the complete slit with solar light (the extension of the sun is only 0.5°, which does not fill the slit of SCIAMACHY when observed via the mirrors.)

The following observations are collected in this group:

1. ESM diffuser observations without NDF (state ID 52, only for monitoring, should not be used for reflectance calculation)
2. ESM diffuser observations with NDF (state ID 62)
3. ASM diffuser observations (state ID 17 -21)

For the ASM diffuser 5 states are needed because of the solar azimuth angle changes over the year. Thus for a given time of the year only one ASM diffuser state is performed. The ASM diffuser was added to the instrument very late in the project and was not radiometrically calibrated. However, the spectra do not suffer from spectral features as the ESM diffuser spectra do. Depending on the application, the user can choose to use the ASM or ESM reference spectrum; both are saved in the calibration group.

3.9 Subsolar Observations

Variables and attributes listings can be found in Section 11. Subsolar observations are calibration measurements using only the elevation mirror. They are done around the DNX, by opening the subsolar mechanism and looking "backwards" to the sun. The following observations can be found in this group (if they were done in the orbit):

- ➢ Subsolar pointing (state ID 53)
- ➢ Subsolar pointing and nominal scanning (state ID 58)
- ➢ Subsolar fast sweep scanning (state ID 60)

The measurements are solely used for instrument monitoring.

3.10 WLS observations

Variables for the WLS measurements can be found in Section 14. The measurements are used for instrument monitoring and are done weekly. Only measurements done using state ID 61 are written to this group.

3.11 SLS observations

Variables for the SLS measurements can be found in Section 13. The measurements are used for the spectral calibration of the instrument and are done weekly and monthly. The following measurements are written to this group:

- ➢ SLS measurements done with the mirrors (used for spectral calibration, state ID 59)
- ➢ SLS measurements done with the diffuser (state 69, these measurements are not used operationally)

3.12 Other measurements (Monitoring)

Variables and attributes in this group are described in Section 12. All measurements done with states that are not written to one of the above groups are written to the MODE_MONITORING group. Therefore, in this group we may have measurements done in very different instrument configurations. In order to find measurements of a certain state one can use the variable *state_index* together with the information given in the states group. The *state_index* gives the index of the variable *STATES/state_id* for all scanlines. In pseudo-code:

```
# find all states for an obsveration in a given BAND:
idx_of_states = nc["MODE_XX/BAND_YY/OBSERVATIONS/state_index"]

# Find Indices of target state, might be more than one
state_ids = nc["STATES/state_id"]
idx_of_target_state = where(state_ids == target_state_id) #gives back indices of target

# use target index to get scanline index
scan_idx_for_target = where(idx_of_states == idx_of_target_state)
                      #gives back indices for scan lines with state

# extract observations
rad = nc["MODE_XX/BAND_YY/OBSERVATIONS/radiance"]
obs_from_state = rad[0,scan_idx_for_target,:,:]
```

This works also for the other MODE_xxx groups. In the monitoring groups the following measurements are collected (see also Tables 4 and 3):

- ➢ Moon pointing measurements (state IDs 56, 57)
- ➢ Solar monitoring measurements done with the extra mirror (state IDs 64, 66, 68)
- ➢ WLS measurements done over the diffuser without the NDF (state ID 70)
- ➢ Hot mode dark measurements (state ID 39)
- ➢ NDF monitoring measurements done with WLS (state IDs 16 and 48)
- ➢ Solar measurements through the atmosphere done with the ASM diffuser (state ID 25)

3.13 Calibration Data

This group contains calibration data and constants that are used in the calibration by the Level 2 processor and by the scial1c user tool. A complete list of variables and attributes can be found in Section 15. The calibration parameters are calculated from on-ground derived parameters, theoretical models and in-flight measurements. For the latter there are two groups of parameters: the consolidated ones that are derived from a complete set of inputs (and possibly more than one orbit) and parameters that are derived from data available directly in the same orbit (e.g. dark current parameters or sun reference spectra).

The parameters that can be always found in this group are

DARK_AVERAGES	The orbit average values of all dark measurements per pixel, individually for each state.
KEYDATA_ERRORS	Available errors of the calibration key data
LEAKAGE_CONSTANT	Dark correction parameters analogue offset, leakage current and mean noise that are independent from the orbit phase.
LEAKAGE_VARIABLE	Dark correction parameters that depend on the orbit phase for channels 6-8
LIMB_UV_LUT	Look-up table needed for the polarisation correction of limb measurements in the UV

MEAN_SUN_REFERENCE Solar reference spectra

PPG-ETALON Pixel-to-pixel gain parameters and etalon correction parameters

POLARISATION_SENSITIVITY_XXX
Polarisation correction values for the different observation modi

RADIANCE_SENSITIVITY_XXX
Radiometric conversion values for the different observation modi

SLIT_FUNCTION Slit function parameters for the large slit

SMALL_AP_SLIT_FUNCTION
Slit function parameters for the small slit used during some solar observations

SPECTRAL_CALIBRATION
Parameters used for the spectral calibration

Calibration parameters derived from the same orbit can be found in the following groups:

NEW_LEAKAGE Dark correction parameters

NEW_SUN_REFERENCE Solar reference spectra

NEW_PPG_ETALON PPG and etalon parameters

NEW_SPECTRAL spectral calibration parameters

Moon reflectance and irradiance is only stored in products from orbits with lunar observations in the `MEAN_MOON` group

Details and background of the calibration can be found in the Level 0-1c ATBD [6]

3.14 Operational Information

The INSTRUMENT group contains all instrument configuration and relevant house-keeping data for the orbit. It was written to the Level 1b product in order to preserve the information after the SCIAMACHY related projects have ended and are mostly of interest for instrument experts.

One exception to this is the OCR subgroup: here information about operation change requests relevant for the product are saved. This information is important for users that look for measurements performed during the OCRs. For other users it is important to know if nominal operations (and instrument state definitions) were temporarily or permanently changed. The variables in this group are:

Table 17: *Variables meanings of group OCR*

Name	Description
ocr_id	The identification of the OCRs (OCR_NN)
ocr_title	Title of the OCRs
ocr_request	Complete text of the original request
upload_filename	Source of the information
start_orbit	First orbit were the OCR was implemented
stop_orbit	Last orbit were the OCR was implemented (if permanently implemented this is the last orbit before loss of contact)

If more than one OCR is pertinent for an orbit, the variables are arrays with each element containing the information for one OCR. All information is saved as string. Details about OCRs can be found in [2].

More information about instrument operations and parameters can be found in [9], [7] and [8].

3.15 Level 0 Parameters

This group contains an excerpt of the header and a copy of some auxiliary data of the Level 0 file used to generate the product. It is written to the Level 1b file for traceability and is usually only of interest to expert users. The variables are described in Section 17.

3.16 Processor Configuration

The processor configuration variables and attributes are listed in Section 18. It contains the static processor initialisation inputs used in the generation of the product to provide traceability.

3.17 State Information

The STATES group contains information about the states done in the orbit. A complete listing of variables and attributes can be found in Section 19.

The variables describe amongst others

- ➢ Integration time parameters like shortest integration time, longest integration time, co-adding and PETs
- ➢ State IDs (this information can be used to extract only measurements of a certain instrument state, see Section 3.12)
- ➢ the orbit phase were the states were performed

3.18 State Geolocation

The STATES_GEOLOCATION group contains

- ➢ the start times of the states
- ➢ the corner coordinates of the footprint covered by the states

The variable description can be found in Section 20

3.19 States Quality

The group STATES_QUALITY contains state wide quality flags.

The variable *overall_quality_flag* is currently set to 1 (**bad**), if the SAA flag is set, i.e. it is identical to the *saa_flag* variable. The reason is that no algorithm was defined that reliably avoids the exclusion of useful data for all possible applications. The user still can use combination of flags provided to construct a reasonable filter for the target application.

For details see the description in Section 21.

4 Global File Attributes

Table 18: *Global Attributes*

Name	Value
Conventions	CF-1.8
filename	EN1_RPRO_SCI_____1P_20110103T134510_20110103T152521_046246_01_100000_20211203T112201.nc
product_type	SCI_____1P
orbit	46246
time_coverage_start	2011-01-03T13:45:10.593Z
time_coverage_end	2011-01-03T15:25:21.461Z
time_reference	2011-01-03T00:00:00.000Z
date_created	2021-12-03T11:22:01Z
history	SCIAMACHY reprocessing 2021
institution	Deutsches Zentrum fuer Luft- und Raumfahrt (DLR)
title	SCIAMACHY Level 1B product
source	satellite observations
platform	ENVISAT
sensor	SCIAMACHY
level	L1B
processor	SCIAMACHY L01 processor
temporal	orbital
version	10.0
reference_document	ENV-IODD-DLR-SCIA-0136
references	https://earth.esa.int/eogateway/instruments/sciamachy www.sciamachy.org https://atmos.eoc.dlr.de
project	FDR4ATMOS
identifier_product_doi	10.5270/EN1-5eab12a
identifier_product_doi_authority	http://dx.doi.org
contact	eohelp@esa.int

5 METADATA

5.1 EOP_METADATA

Table 19: *Metadata attributes for group EOP_METADATA*

Group/Name	Value
EOP_METADATA	
gml:id	EN1_RPRO_SCI_____1P_20110103T134510_20110103T152521_046246_01_100000_20211203T112201.ID
objectType	atm:EarthObservation
./eop:metaDataProperty	
eop:acquisitionType	NOMINAL
eop:identifier	EN1_RPRO_SCI_____1P_20110103T134510_20110103T152521_046246_01_100000_20211203T112201.nc
eop:parentIdentifier	urn:ogc:def:EOP:SCI_____1P
eop:productType	SCI_____1P
eop:status	ARCHIVED
objectType	eop:EarthObservationMetaData
./../eop:archivedIn	
eop:archivingCenter	DLR Oberpfaffenhofen
eop:archivingDate	NA
objectType	eop:ArchivingInformation
./../eop:downlinkedTo	
eop:acquisitionDate	2011-01-03
eop:acquisitionStation	PDHS-K
objectType	eop:DownlinkInformation
./../eop:processing	
eop:processingCenter	DLR Oberpfaffenhofen
eop:processingDate	2021-12-03
eop:processingLevel	L1b
eop:processorName	scial01
eop:processorVersion	10.0
objectType	eop:ProcessingInformation
./om:featureOfInterest	
objectType	eop:FootPrint
eop:id	EN1_RPRO_SCI_____1P_20110103T134510_20110103T152521_046246_01_100000_20211203T112201.nc
./../eop:multiExtentOf	
objectType	gml:MultiSurface
./../../gml:surfaceMembers	
objectType	gml:Polygon

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Group/Name	Value
./../../gml:exterior	
gml:posList	0.8117 123.9991 0.5848 98.9900
objectType	gml:LinearRing
./om:observedProperty	
nilReason	inapplicable
./om:phenomenonTime	
gml:beginPosition	2011-01-03T13:45:10.593Z
gml:endPosition	2011-01-03T15:25:21.461Z
objectType	gml:TimePeriod
./om:procedure	
gml:id	EN1_RPRO_SCI_____1P_20110103T134510_20110103T152521_046246_01_100000_20211203T112201.EOE
objectType	eop:EarthObservationEquipment
./../eop:acquisitionParameters	
eop:orbitNumber	46246
objectType	eop:Acquisition
./../eop:instrument	
eop:shortName	SCIAMACHY
objectType	eop:Instrument
./../eop:platform	
eop:shortName	ENVISAT
objectType	eop:Platform
./../eop:sensor	
eop:sensorType	ATMOSPHERIC
objectType	eop:Sensor
./om:result	
objectType	atm:EarthObservationResult
gml:id	EN1_RPRO_SCI_____1P_20110103T134510_20110103T152521_046246_01_100000_20211203T112201.nc
./../eop:product	
objectType	eop:ProductInformation
./../../eop:fileName	
objectType	ows:ServiceReference
ows:RequestMessage	
xlink:href	http://atmos.eoc.dlr.de/sciamachy/
./om:resultTime	
gml:timePosition	2021-12-03T11:22:01Z
objectType	gml:TimeInstant

5.2 ESA_METADATA

Table 20: *Metadata attributes for group ESA_METADATA*

Group/Name	Value
ESA_METADATA	
objectType	Earth_Explorer_File
./earth_explorer_header	
objectType	Earth_Explorer_Header
./../fixed_header	
File_Class	REP5
File_Description	SCIAMACHY ENVISAT Geo-located atmospheric spectra (Level 1b)
File_Name	EN1_RPRO_SCI_____1P_20110103T134510_20110103T152521_046246_01_100000_20211203T112201.nc
File_Type	SCI_____1P
File_Version	10.0
Mission	ENVISAT
Notes	SCIAMACHY Reprocessing
objectType	Fixed_Header
./../../source	
Creation_Date	UTC=2021-12-03T11:22:01Z
Creator	DLR L01b processor
Creator_Version	10.0
System	DLR Oberpfaffenhofen
objectType	Source
./../../validity_period	
Validity_Start	UTC=2011-01-03T13:45:10.593Z
Validity_Stop	UTC=2011-01-03T15:25:21.461Z
objectType	Validity_Period

5.3 ISO_METADATA

Table 21: *Metadata attributes for group ISO_METADATA*

Group/Name	Value
ISO_METADATA	
gmd:dateStamp	2021-12-03
gmd:fileIdentifier	urn:ogc:def:EOP:ESA:ENV.SCIA_L1B_RAD
gmd:hierarchyLevelName	EO Product Collection

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Group/Name	Value
gmd:metadataStandardName	ISO 19115-2 Geographic Information - Metadata Part 2 Extensions for imagery and gridded data
gmd:metadataStandardVersion	ISO 19115-2:2009(E), SCIAMACHY profile
objectType	gmi:MI_Metadata
./gmd:characterSet	
codeList	http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD_CharacterSetCode
codeListValue	utf8
objectType	gmd:MD_CharacterSetCode
./gmd:contact	
gmd:individualName	DLR
gmd:organisationName	Deutsches Zentrum fuer Luft- und Raumfahrt (DLR)
gmd:positionName	
objectType	gmd:CI_ResponsibleParty
./../gmd:contactInfo	
objectType	gmd:CI_Contact
./../../gmd:address	
gmd:electronicMailAddress	eohelp@esa.int
objectType	gmd:CI_Address
./../gmd:role	
codeList	http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_RoleCode
codeListValue	pointOfContact
objectType	gmd:CI_RoleCode
./gmd:dataQualityInfo	
objectType	gmd:DQ_DataQuality
./../gmd:lineage	
objectType	gmd:LI_Lineage
gmd:statement	L1b radiance dataset produced by DLR/IMF from the SCIAMACHY ENVISAT L0 product
./../../gmd:processStep	
gmd:description	Processing of L0 to L1b data using the DLR l01b processor
objectType	gmi:LE_ProcessStep
./../../../gmd:source	
gmd:description	SCIAMACHY ENVISAT L0 product
objectType	gmi:LE_Source
gmd:title	SCI_NL__0PPLRA20110103_134510_000059703098_00111_46246_6712.N1
./../../../gmi:processedLevel	
gmd:code	L0
objectType	gmd:MD_Identifier

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Group/Name	Value
./././/gmi:output	
gmd:description	SCIAMACHY ENVISAT L1b radiance product
objectType	gmi:LE_Source
././././/gmd:sourceCitation	
gmd:title	EN1_RPRO_SCI_____1P_20110103T134510_20110103T152521_046246_01_100000_20211203T112201.nc
objectType	gmd:CI_Citation
./././././gmd:date	
gmd:date	2021-12-03T11:22:01Z
objectType	gmd:CI_Date
./././././gmd:dateType	
codeList	http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_DateTypeCode
codeListValue	creation
objectType	gmd:CI_DateTypeCode
././././/gmi:processedLevel	
gmd:code	L1b
objectType	gmd:MD_Identifier
././././/gmi:processingInformation	
objectType	gmi:LE_Processing
././././/gmi:documentation#1	
objectType	gmd:CI_Citation
gmd:title	ENVISAT-1 SCIAMACHY Level 0 to 1c Processing ATBD (ENV-ATB-DLR-SCIA-0041)
./././././gmd:date	
gmd:date	2018
objectType	gmd:CI_Date
./././././gmd:dateType	
codeList	http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_DateTypeCode
codeListValue	publication
objectType	gmd:CI_DateTypeCode
././././/gmi:documentation#2	
gmd:title	SCIAMACHY Level 1 netCDF Product User Guide (ENV-IODD-DLR-SCIA-0136)
objectType	gmd:CI_Citation
./././././gmd:date	
gmd:date	2018
objectType	gmd:CI_Date
./././././gmd:dateType	
codeList	http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_DateTypeCode
codeListValue	publication

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Group/Name	Value
objectType	gmd:CI_DateTypeCode
./../../../gmi:identifier	
gmd:code	DLR L01b processor
objectType	gmd:MD_Identifier
./../../../gmi:softwareReference	
gmd:title	SCIAMACHY L01b processor description
objectType	gmd:CI_Citation
./../../../../gmd:date	
gmd:date	2017
objectType	gmd:CI_Date
./../../../../gmd:dateType	
codeList	http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_DateTypeCode
codeListValue	creation
objectType	gmd:CI_DateTypeCode
./../../gmi:report	
gmi:description	L0 processed to L1b data using the DLR L01b processor
gmi:fileType	netCDF
gmi:name	SCIAMACHY ENVISAT L01b processing report
objectType	gmi:LE_ProcessStepReport
./../gmd:report	
objectType	gmd:DQ_DomainConsistency
./../../gmd:result	
gmd:pass	true
gmd:explanation	INSPIRE Data specification for orthoimagery is not yet officially published so conformity has not yet been evaluated
objectType	gmd:DQ_ConformanceResult
./../../gmd:specification	
objectType	gmd:CI_Citation
gmd:title	INSPIRE Data Specification on Orthoimagery - Guidelines, version 3.0rc3
./../../../gmd:date	
gmd:date	2013-02-04
objectType	gmd:CI_Date
./../../../../gmd:dateType	
codeList	http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_DateTypeCode
codeListValue	publication
objectType	gmd:CI_DateTypeCode
./../gmd:scope	
objectType	gmd:DQ_Scope

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Group/Name	Value
./../gmd:level	
codeList	http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD_ScopeCode
codeListValue	dataset
objectType	gmd:MD_ScopeCode
./gmd:hierarchyLevel	
codeList	http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD_ScopeCode
codeListValue	dataset
objectType	gmd:MD_ScopeCode
./gmd:identificationInfo	
gmd:abstract	SCIAMACHY spectrometer on ENVISAT measurements
gmd:credit	ESA
gmd:language	eng
gmd:topicCategory	imageryBaseMapsEarthCover
objectType	gmd:MD_DataIdentification
./../gmd:characterSet	
codeList	http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD_CharacterSetCode
codeListValue	utf8
objectType	gmd:MD_CharacterSetCode
./../gmd:citation	
gmd:title	SCIAMACHY ENVISAT L1b radiance product
objectType	gmd:CI_Citation
./../../gmd:date	
gmd:date	2021-12-03
objectType	gmd:CI_Date
./../../../gmd:dateType	
codeList	http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_DateTypeCode
codeListValue	creation
objectType	gmd:CI_DateTypeCode
./../../gmd:identifier	
gmd:code	urn:ogc:def:EOP:ESA:ENV.SCIA_L1B_RAD_BD
objectType	gmd:MD_Identifier
./../gmd:descriptiveKeywords	
gmd:keyword	orthoimagery
objectType	gmd:MD_Keywords
./../../gmd:thesaurusName	
gmd:title	GEMET - INSPIRE themes, version 1.0

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Group/Name	Value
objectType	gmd:CI_Citation
./../../gmd:date	
gmd:date	2008-06-01
objectType	gmd:CI_Date
./../../../gmd:dateType	
codeList	http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_DateTypeCode
codeListValue	publication
objectType	gmd:CI_DateTypeCode
./../gmd:type	
codeList	http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD_KeywordTypeCode
codeListValue	theme
objectType	gmd:MD_KeywordTypeCode
./../gmd:extent	
objectType	gmd:EX_Extent
./../../gmd:geographicElement	
gmd:eastBoundLongitude	180.0
gmd:northBoundLatitude	90.0
gmd:southBoundLatitude	-90.0
gmd:westBoundLongitude	-180.0
objectType	gmd:EX_GeographicBoundingBox
./../../gmd:temporalElement	
objectType	gmd:EX_TemporalExtent
./../../../gmd:extent	
gml:beginPosition	2011-01-03T13:45:10.593Z
gml:endPosition	2011-01-03T15:25:21.461Z
objectType	gml:TimePeriod
./../gmd:pointOfContact	
gmd:individualName	eoHelp
gmd:organisationName	ESA
gmd:positionName	Order Desk
objectType	gmd:CI_ResponsibleParty
./../../gmd:contactInfo	
objectType	gmd:CI_Contact
./../../../gmd:address	
gmd:electronicMailAddress	eohelp@esa.int
objectType	gmd:CI_Address

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Group/Name	Value
./../gmd:role	
codeList	http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_RoleCode
codeListValue	distributor
objectType	gmd:CI_RoleCode
./../gmd:resourceConstraints	
gmd:useLimitation	no conditions apply
objectType	gmd:MD_LegalConstraints
./../gmd:accessConstraints	
codeList	http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD_RestrictionCode
codeListValue	copyright
objectType	gmd:MD_RestrictionCode
./../gmd:spatialRepresentationType	
codeList	http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD_SpatialRepresentationTypeCode
codeListValue	grid
objectType	gmd:MD_SpatialRepresentationTypeCode
./../gmd:spatialResolution	
gmd:distance	240.0
objectType	gmd:MD_Resolution
uom	km
./gmd:language	
codeList	http://www.loc.gov/standards/iso639-2/
codeListValue	eng
objectType	gmd:LanguageCode
./gmi:acquisitionInformation	
objectType	gmi:MI_AcquisitionInformation
./../gmi:platform	
objectType	gmi:MI_Platform
./../gmi:description	
gco:characterString	ENVISAT
./../gmi:identifier	
gmd:code	ENV
gmd:codeSpace	http://www.esa.int/
objectType	gmd:RS_Identifier
./../gmi:instrument	
objectType	gmi:MI_Instrument
./../../gmi:identifier	

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Group/Name	Value
gmd:code	SCIAMACHY
gmd:codeSpace	http://www.esa.int/
objectType	gmd:RS_Identifier
./../../gmi:type	
codeList	
codeListValue	UV-VIS-NIR-SWIR scanning spectrometer
objectType	gmi:MI_SensorTypeCode

6 MODE_MOON

Table 22: *Attributes for group BAND_xx in moon mode.*

Name	Value
start_stop_pixel	0 4

Table 23: *Variables of group BAND_xx in moon mode.*

Name	Description	Unit	Type	# Dim.
spectral_channel	index in detector array	1	uint16	1
start_pixel	start-index of this band in detector array	1	int16	-
end_pixel	end-index of this band in detector array	1	int16	-
detector	index of this detector array: 0, 1 . . . 7	1	int16	-
start_wavelength	approximate start wavelength of this spectral band	1e-09m	float32	-
end_wavelength	approximate end wavelength of this spectral band	1e-09m	float32	-

6.1 GEODATA

Table 24: *Attributes for group GEODATA in moon mode.*

Name	Value
comment	the dimension angle is 3 for angles at start, middle and end of the ground-pixel

Table 25: *Variables of group GEODATA in moon mode.*

Name	Description	Unit	Type	# Dim.
latitude	the latitude of the sub-satellite track	degrees_north	float32	3
longitude	the longitude of the sub-satellite track	degrees_east	float32	3
esm_position	elevation scan mirror position	degree	float32	3
asm_position	azimuth scan mirror position	degree	float32	3
solar_zenith_angle	at satellite	degree	float32	4
solar_azimuth_angle	at satellite	degree	float32	4
lunar_zenith_angle	at satellite	degree	float32	4
lunar_azimuth_angle	at satellite	degree	float32	4
satellite_moon_distance	normalized distance between satellite and moon	1	float32	3
state_vector_satellite	position and velocity vector	1	float64	4
state_vector_sun	position and velocity vector	1	float64	4
state_vector_moon	position and velocity vector	1	float64	4
selene_sun_longitude	Selene longitude for sun	degrees_east	float64	3
selene_sun_latitude	Selene latitude for sun	degrees_north	float64	3
selene_satellite_longitude	Selene longitude for satellite	degrees_east	float64	3
selene_satellite_latitude	Selene latitude for satellite	degrees_north	float64	3
selene_sun_distance	Distance between moon and sun	km	float64	3
selene_satellite_distance	Distance between moon and satellite	km	float64	3
phase_angle	Angle between sun, moon and satellite	degrees	float64	3
measurement_time	Measurement time obtained from SCIAMACHY Level 1B product. Calculated using time_reference and delta_time	-	string	3

6.2 OBSERVATIONS

Table 26: *Variables of group OBSERVATIONS in moon mode.*

Name	Description	Unit	Type	# Dim.
orbit_phase	orbit-phase is 0 when instrument goes into eclipse and solar elevation is zero	1	float32	2
spectral_index	index in the group of available wavelength grids: see in group /CALIBRATION/SPECTRAL_CALIBRATION/wavelength	1	int16	2
scanline	along track dimension index	1	int32	2
delta_time	time offset in seconds from midnight	s	float64	3
state_index	the index of the state in this product counted from 0	1	uint16	2
integration_time	the integration time of this band, actually the readout-time as maximum(exposure-time, 0.0625s) * coadding-factor	s	float32	2
backscan_flag	according scan-mirror movement: forward scan is scanning from left to right across flight direction, backward scan from right to left	1	int8	3
radiance	the uncalibrated radiance in binary units	1	float32	4
radiance_calibrated	the calibrated radiance in	photons/cm2.nm.s	float32	4
radiance_flags	flags can be combined with an OR-operation	1	int8	3
memoryeffect	memory effect for channels 1 to 5 (UV-VIS), nonlinearity signal for channels 6 to 8 (IR)	1	float32	4
straylight	straylight signal	1	float32	4

6.3 PMD

Table 27: *Variables of group PMD in moon mode.*

Name	Description	Unit	Type	# Dim.
spectral_channel	index in detector array	1	uint16	1
integration_time	the constant integration time of all integrated PMD measurements	s	float32	-

6.3.1 GEODATA

Table 28: *Variables of group GEODATA in moon mode.*

Name	Description	Unit	Type	# Dim.
latitude	the center latitude of each observation	degrees_north	float32	3
longitude	the center longitude of each observation	degrees_east	float32	3
latitude_bounds	the corner coordinate latitudes of each observation	degrees_north	float32	4
longitude_bounds	the corner coordinate longitudes of each observation	degrees_east	float32	4
esm_position	elevation scan mirror position	degree	float32	3
asm_position	azimuth scan mirror position	degree	float32	3
solar_zenith_angle	at satellite	degree	float32	4
solar_azimuth_angle	at satellite	degree	float32	4
lunar_zenith_angle	at satellite	degree	float32	4
lunar_azimuth_angle	at satellite	degree	float32	4
selene_sun_longitude	Selene longitude for sun	degrees_east	float64	3
selene_sun_latitude	Selene latitude for sun	degrees_north	float64	3
selene_satellite_longitude	Selene longitude for satellite	degrees_east	float64	3
selene_satellite_latitude	Selene latitude for satellite	degrees_north	float64	3
selene_sun_distance	Distance between moon and sun	km	float64	3
selene_satellite_distance	Distance between moon and satellite	km	float64	3
phase_angle	Angle between sun, moon and satellite	degrees	float64	3

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Name	Description	Unit	Type	# Dim.
measurement_time	Measurement time obtained from SCIAMACHY Level 1B product. Calculated using time_reference and delta_time	-	string	3

6.3.2 OBSERVATIONS

Table 29: *Variables of group OBSERVATIONS in moon mode.*

Name	Description	Unit	Type	# Dim.
scanline	along track dimension index	1	int32	2
delta_time	time offset in seconds from midnight	s	float64	3
state_index	the index of the state in this product counted from 0	1	uint16	2
backscan_flag	flag if back-scan or not: 0=no back-scan, 1=back-scan	1	int8	3
wavelength	the approximate center wavelength of the PMD spectral range (A, B, D, E, F, 45)	1e-09m	float32	2
radiance	the uncalibrated radiance in binary units	1	float32	4

7 MODE_NADIR

Table 30: *Attributes for group BAND_xx in nadir mode.*

Name	Value
start_stop_pixel	0 4

Table 31: *Variables of group BAND_xx in nadir mode.*

Name	Description	Unit	Type	# Dim.
spectral_channel	index in detector array	1	uint16	1
start_pixel	start-index of this band in detector array	1	int16	-
end_pixel	end-index of this band in detector array	1	int16	-
detector	index of this detector array: 0, 1 . . . 7	1	int16	-
start_wavelength	approximate start wavelength of this spectral band	1e-09m	float32	-
end_wavelength	approximate end wavelength of this spectral band	1e-09m	float32	-

7.1 GEODATA

Table 32: *Attributes for group GEODATA in nadir mode.*

Name	Value
comment	the dimension angle is 3 for angles at start, middle and end of the ground-pixel

Table 33: *Variables of group GEODATA in nadir mode.*

Name	Description	Unit	Type	# Dim.
latitude	the center latitude of each observation	degrees_north	float32	3
longitude	the center longitude of each observation	degrees_east	float32	3
latitude_bounds	the corner coordinate latitudes of each observation	degrees_north	float32	4

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Name	Description	Unit	Type	# Dim.
longitude_bounds	the corner coordinate longitudes of each observation	degrees_east	float32	4
esm_position	elevation scan mirror position	degree	float32	3
solar_zenith_angle	at top of atmosphere	degree	float32	4
solar_azimuth_angle	at top of atmosphere	degree	float32	4
viewing_zenith_angle	at top of atmosphere	degree	float32	4
viewing_azimuth_angle	at top of atmosphere	degree	float32	4
satellite_altitude	satellite altitude	m	float32	3
earth_radius	earth radius	m	float32	3
latitude_subsatellite	the subsatellite latitude of each observation	degrees_north	float32	3
longitude_subsatellite	the subsatellite longitude of each observation	degrees_east	float32	3

7.2 OBSERVATIONS

Table 34: *Variables of group OBSERVATIONS in nadir mode.*

Name	Description	Unit	Type	# Dim.
orbit_phase	orbit-phase is 0 when instrument goes into eclipse and solar elevation is zero	1	float32	2
spectral_index	index in the group of available wavelength grids: see in group /CALIBRATION/SPECTRAL_CALIBRATION/wavelength	1	int16	2
scanline	along track dimension index	1	int32	2
delta_time	time offset in seconds from midnight	s	float64	3
state_index	the index of the state in this product counted from 0	1	uint16	2
integration_time	the integration time of this band, actually the readout-time as maximum(exposure-time, 0.0625s) * coadding-factor	s	float32	2
backscan_flag	according scan-mirror movement: forward scan is scanning from left to right across flight direction, backward scan from right to left	1	int8	3
radiance	the uncalibrated radiance in binary units	1	float32	4
radiance_flags	flags can be combined with an OR-operation	1	int8	3
memoryeffect	memory effect for channels 1 to 5 (UV-VIS), non-linearity signal for channels 6 to 8 (IR)	1	float32	4
straylight	straylight signal	1	float32	4

7.3 POLARISATION

Table 35: *Variables of group POLARISATION in nadir mode.*

Name	Description	Unit	Type	# Dim.
polarisation_lambda	the wavelength of the fractional polarisation Q and U	1e-09m	float32	4
polarisation_Q	the fractional polarisation Q	1	float32	4
polarisation_U	the fractional polarisation U	1	float32	4
polarisation_Q_error	the error on fractional polarisation Q, negative error means Q is invalid	1	float32	4
polarisation_U_error	the error on fractional polarisation U, negative error means U is invalid	1	float32	4
polarisation_GDF	the input values for the GDF function: lambda0 and lambdaSG (steepest gradient) for Q and U	1	float32	4

7.4 PMD

Table 36: *Variables of group PMD in nadir mode.*

Name	Description	Unit	Type	# Dim.
spectral_channel	index in detector array	1	uint16	1
integration_time	the constant integration time of all integrated PMD measurements	s	float32	-

7.4.1 GEODATA

Table 37: *Variables of group GEODATA in nadir mode.*

Name	Description	Unit	Type	# Dim.
latitude	the center latitude of each observation	degrees_north	float32	3
longitude	the center longitude of each observation	degrees_east	float32	3
latitude_bounds	the corner coordinate latitudes of each observation	degrees_north	float32	4
longitude_bounds	the corner coordinate longitudes of each observation	degrees_east	float32	4
esm_position	elevation scan mirror position	degree	float32	3
solar_zenith_angle	at top of atmosphere	degree	float32	4
solar_azimuth_angle	at top of atmosphere	degree	float32	4
viewing_zenith_angle	at top of atmosphere	degree	float32	4
viewing_azimuth_angle	at top of atmosphere	degree	float32	4
satellite_altitude	satellite altitude	m	float32	3
earth_radius	earth radius	m	float32	3
latitude_subsatellite	the subsatellite latitude of each observation	degrees_north	float32	3
longitude_subsatellite	the subsatellite longitude of each observation	degrees_east	float32	3

7.4.2 OBSERVATIONS

Table 38: *Variables of group OBSERVATIONS in nadir mode.*

Name	Description	Unit	Type	# Dim.
scanline	along track dimension index	1	int32	2
delta_time	time offset in seconds from midnight	s	float64	3
state_index	the index of the state in this product counted from 0	1	uint16	2
backscan_flag	flag if back-scan or not: 0=no back-scan, 1=back-scan	1	int8	3
wavelength	the approximate center wavelength of the PMD spectral range (A, B, D, E, F, 45)	1e-09m	float32	2
radiance	the uncalibrated radiance in binary units	1	float32	4

8 MODE_LIMB

Table 39: *Attributes for group BAND_xx in limb mode.*

Name	Value
start_stop_pixel	0 4

Table 40: *Variables of group BAND_xx in limb mode.*

Name	Description	Unit	Type	# Dim.
spectral_channel	index in detector array	1	uint16	1

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Name	Description	Unit	Type	# Dim.
start_pixel	start-index of this band in detector array	1	int16	-
end_pixel	end-index of this band in detector array	1	int16	-
detector	index of this detector array: 0, 1 . . . 7	1	int16	-
start_wavelength	approximate start wavelength of this spectral band	1e-09m	float32	-
end_wavelength	approximate end wavelength of this spectral band	1e-09m	float32	-

8.1 GEODATA

Table 41: *Attributes for group GEODATA in limb mode.*

Name	Value
comment	the dimension angle is 3 for angles at start, middle and end of the ground-pixel

Table 42: *Variables of group GEODATA in limb mode.*

Name	Description	Unit	Type	# Dim.
latitude	the tangent latitude at start, middle and end of integration	degrees_north	float32	4
longitude	the tangent longitude at start, middle and end of integration	degrees_east	float32	4
tangent_height	the tangent height of each limb observation	km	float32	4
esm_position	elevation scan mirror position	degree	float32	3
asm_position	azimuth scan mirror position	degree	float32	3
solar_zenith_angle	at top of atmosphere	degree	float32	4
solar_azimuth_angle	at top of atmosphere	degree	float32	4
viewing_zenith_angle	at top of atmosphere	degree	float32	4
viewing_azimuth_angle	at top of atmosphere	degree	float32	4
satellite_altitude	satellite altitude	m	float32	3
earth_radius	earth radius	m	float32	3
latitude_subsatellite	the subsatellite latitude of each observation	degrees_north	float32	3
longitude_subsatellite	the subsatellite longitude of each observation	degrees_east	float32	3

8.2 OBSERVATIONS

Table 43: *Variables of group OBSERVATIONS in limb mode.*

Name	Description	Unit	Type	# Dim.
orbit_phase	orbit-phase is 0 when instrument goes into eclipse and solar elevation is zero	1	float32	2
spectral_index	index in the group of available wavelength grids: see in group /CALIBRATION/SPECTRAL_CALIBRATION/wavelength	1	int16	2
scanline	along track dimension index	1	int32	2
delta_time	time offset in seconds from midnight	s	float64	3
state_index	the index of the state in this product counted from 0	1	uint16	2
integration_time	the integration time of this band, actually the readout-time as maximum(exposure-time, 0.0625s) * coadding-factor	s	float32	2
backscan_flag	according scan-mirror movement: forward scan is scanning from left to right across flight direction, backward scan from right to left	1	int8	3
radiance	the uncalibrated radiance in binary units	1	float32	4

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Name	Description	Unit	Type	# Dim.
radiance_flags	flags can be combined with an OR-operation	1	int8	3
memoryeffect	memory effect for channels 1 to 5 (UV-VIS), non-linearity signal for channels 6 to 8 (IR)	1	float32	4
straylight	straylight signal	1	float32	4

8.3 POLARISATION

Table 44: *Variables of group POLARISATION in limb mode.*

Name	Description	Unit	Type	# Dim.
polarisation_lambda	the wavelength of the fractional polarisation Q and U	1e-09m	float32	4
polarisation_Q	the fractional polarisation Q	1	float32	4
polarisation_U	the fractional polarisation U	1	float32	4
polarisation_Q_error	the error on fractional polarisation Q, negative error means Q is invalid	1	float32	4
polarisation_U_error	the error on fractional polarisation U, negative error means U is invalid	1	float32	4
polarisation_GDF	the input values for the GDF function: lambda0 and lambdaSG (steepest gradient) for Q and U	1	float32	4

8.4 PMD

Table 45: *Variables of group PMD in limb mode.*

Name	Description	Unit	Type	# Dim.
spectral_channel	index in detector array	1	uint16	1
integration_time	the constant integration time of all integrated PMD measurements	s	float32	-

8.4.1 GEODATA

Table 46: *Variables of group GEODATA in limb mode.*

Name	Description	Unit	Type	# Dim.
latitude	the tangent latitude at start, middle and end of integration	degrees_north	float32	4
longitude	the tangent longitude at start, middle and end of integration	degrees_east	float32	4
tangent_height	the tangent height of each limb observation	km	float32	4
esm_position	elevation scan mirror position	degree	float32	3
asm_position	azimuth scan mirror position	degree	float32	3
solar_zenith_angle	at top of atmosphere	degree	float32	4
solar_azimuth_angle	at top of atmosphere	degree	float32	4
viewing_zenith_angle	at top of atmosphere	degree	float32	4
viewing_azimuth_angle	at top of atmosphere	degree	float32	4
satellite_altitude	satellite altitude	m	float32	3
earth_radius	earth radius	m	float32	3
latitude_subsatellite	the subsatellite latitude of each observation	degrees_north	float32	3
longitude_subsatellite	the subsatellite longitude of each observation	degrees_east	float32	3

8.4.2 OBSERVATIONS

Table 47: *Variables of group OBSERVATIONS in limb mode.*

Name	Description	Unit	Type	# Dim.
scanline	along track dimension index	1	int32	2
delta_time	time offset in seconds from midnight	s	float64	3
state_index	the index of the state in this product counted from 0	1	uint16	2
backscan_flag	flag if back-scan or not: 0=no back-scan, 1=back-scan	1	int8	3
wavelength	the approximate center wavelength of the PMD spectral range (A, B, D, E, F, 45)	1e-09m	float32	2
radiance	the uncalibrated radiance in binary units	1	float32	4

9 MODE_OCCULTATION

Table 48: *Attributes for group BAND_xx in occultation mode.*

Name	Value
start_stop_pixel	0 4

Table 49: *Variables of group BAND_xx in occultation mode.*

Name	Description	Unit	Type	# Dim.
spectral_channel	index in detector array	1	uint16	1
start_pixel	start-index of this band in detector array	1	int16	-
end_pixel	end-index of this band in detector array	1	int16	-
detector	index of this detector array: 0, 1 . . . 7	1	int16	-
start_wavelength	approximate start wavelength of this spectral band	1e-09m	float32	-
end_wavelength	approximate end wavelength of this spectral band	1e-09m	float32	-

9.1 GEODATA

Table 50: *Attributes for group GEODATA in occultation mode.*

Name	Value
comment	the dimension angle is 3 for angles at start, middle and end of the ground-pixel

Table 51: *Variables of group GEODATA in occultation mode.*

Name	Description	Unit	Type	# Dim.
latitude	the tangent latitude at start, middle and end of integration	degrees_north	float32	4
longitude	the tangent longitude at start, middle and end of integration	degrees_east	float32	4
tangent_height	the tangent height of each limb observation	km	float32	4
esm_position	elevation scan mirror position	degree	float32	3
asm_position	azimuth scan mirror position	degree	float32	3
solar_zenith_angle	at top of atmosphere	degree	float32	4
solar_azimuth_angle	at top of atmosphere	degree	float32	4
viewing_zenith_angle	at top of atmosphere	degree	float32	4
viewing_azimuth_angle	at top of atmosphere	degree	float32	4
satellite_altitude	satellite altitude	m	float32	3
earth_radius	earth radius	m	float32	3

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Name	Description	Unit	Type	# Dim.
latitude_subsatellite	the subsatellite latitude of each observation	degrees_north	float32	3
longitude_subsatellite	the subsatellite longitude of each observation	degrees_east	float32	3

9.2 OBSERVATIONS

Table 52: *Variables of group OBSERVATIONS in occultation mode.*

Name	Description	Unit	Type	# Dim.
orbit_phase	orbit-phase is 0 when instrument goes into eclipse and solar elevation is zero	1	float32	2
spectral_index	index in the group of available wavelength grids: see in group /CALIBRATION/SPECTRAL_CALIBRATION/wavelength	1	int16	2
scanline	along track dimension index	1	int32	2
delta_time	time offset in seconds from midnight	s	float64	3
state_index	the index of the state in this product counted from 0	1	uint16	2
integration_time	the integration time of this band, actually the readout-time as maximum(exposure-time, 0.0625s) * coadding-factor	s	float32	2
backscan_flag	according scan-mirror movement: forward scan is scanning from left to right across flight direction, backward scan from right to left	1	int8	3
radiance	the uncalibrated radiance in binary units	1	float32	4
radiance_flags	flags can be combined with an OR-operation	1	int8	3
memoryeffect	memory effect for channels 1 to 5 (UV-VIS), non-linearity signal for channels 6 to 8 (IR)	1	float32	4
straylight	straylight signal	1	float32	4

9.3 PMD

Table 53: *Variables of group PMD in occultation mode.*

Name	Description	Unit	Type	# Dim.
spectral_channel	index in detector array	1	uint16	1
integration_time	the constant integration time of all integrated PMD measurements	s	float32	-

9.3.1 GEODATA

Table 54: *Variables of group GEODATA in occultation mode.*

Name	Description	Unit	Type	# Dim.
latitude	the tangent latitude at start, middle and end of integration	degrees_north	float32	4
longitude	the tangent longitude at start, middle and end of integration	degrees_east	float32	4
tangent_height	the tangent height of each limb observation	km	float32	4
esm_position	elevation scan mirror position	degree	float32	3
asm_position	azimuth scan mirror position	degree	float32	3
solar_zenith_angle	at top of atmosphere	degree	float32	4
solar_azimuth_angle	at top of atmosphere	degree	float32	4
viewing_zenith_angle	at top of atmosphere	degree	float32	4
viewing_azimuth_angle	at top of atmosphere	degree	float32	4
satellite_altitude	satellite altitude	m	float32	3

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Name	Description	Unit	Type	# Dim.
earth_radius	earth radius	m	float32	3
latitude_subsatellite	the subsatellite latitude of each observation	degrees_north	float32	3
longitude_subsatellite	the subsatellite longitude of each observation	degrees_east	float32	3

9.3.2 OBSERVATIONS

Table 55: *Variables of group OBSERVATIONS in occultation mode.*

Name	Description	Unit	Type	# Dim.
scanline	along track dimension index	1	int32	2
delta_time	time offset in seconds from midnight	s	float64	3
state_index	the index of the state in this product counted from 0	1	uint16	2
backscan_flag	flag if back-scan or not: 0=no back-scan, 1=back-scan	1	int8	3
wavelength	the approximate center wavelength of the PMD spectral range (A, B, D, E, F, 45)	1e-09m	float32	2
radiance	the uncalibrated radiance in binary units	1	float32	4

10 MODE_SUN_DIFFUSER

Table 56: *Attributes for group BAND_xx in sun diffuser mode.*

Name	Value
start_stop_pixel	0 4

Table 57: *Variables of group BAND_xx in sun diffuser mode.*

Name	Description	Unit	Type	# Dim.
spectral_channel	index in detector array	1	uint16	1
start_pixel	start-index of this band in detector array	1	int16	-
end_pixel	end-index of this band in detector array	1	int16	-
detector	index of this detector array: 0, 1 . . . 7	1	int16	-
start_wavelength	approximate start wavelength of this spectral band	1e-09m	float32	-
end_wavelength	approximate end wavelength of this spectral band	1e-09m	float32	-

10.1 GEODATA

Table 58: *Attributes for group GEODATA in sun diffuser mode.*

Name	Value
comment	the dimension angle is 3 for angles at start, middle and end of the ground-pixel

Table 59: *Variables of group GEODATA in sun diffuser mode.*

Name	Description	Unit	Type	# Dim.
latitude	the latitude of the sub-satellite track	degrees_north	float32	3
longitude	the longitude of the sub-satellite track	degrees_east	float32	3
esm_position	elevation scan mirror position	degree	float32	3

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Name	Description	Unit	Type	# Dim.
asm_position	azimuth scan mirror position	degree	float32	3
solar_zenith_angle	at satellite	degree	float32	4
solar_azimuth_angle	at satellite	degree	float32	4
viewing_zenith_angle	position of ESM compared to zero position	degree	float32	4
viewing_azimuth_angle	position of ASM compared to zero position	degree	float32	4

10.2 OBSERVATIONS

Table 60: *Variables of group OBSERVATIONS in sun diffuser mode.*

Name	Description	Unit	Type	# Dim.
orbit_phase	orbit-phase is 0 when instrument goes into eclipse and solar elevation is zero	1	float32	2
spectral_index	index in the group of available wavelength grids: see in group /CALIBRATION/SPECTRAL_CALIBRATION/wavelength	1	int16	2
scanline	along track dimension index	1	int32	2
delta_time	time offset in seconds from midnight	s	float64	3
state_index	the index of the state in this product counted from 0	1	uint16	2
integration_time	the integration time of this band, actually the readout-time as maximum(exposure-time, 0.0625s) * coadding-factor	s	float32	2
backscan_flag	according scan-mirror movement: forward scan is scanning from left to right across flight direction, backward scan from right to left	1	int8	3
radiance	the uncalibrated radiance in binary units	1	float32	4
radiance_flags	flags can be combined with an OR-operation	1	int8	3
memoryeffect	memory effect for channels 1 to 5 (UV-VIS), non-linearity signal for channels 6 to 8 (IR)	1	float32	4
straylight	straylight signal	1	float32	4

10.3 PMD

Table 61: *Variables of group PMD in sun diffuser mode.*

Name	Description	Unit	Type	# Dim.
spectral_channel	index in detector array	1	uint16	1
integration_time	the constant integration time of all integrated PMD measurements	s	float32	-

10.3.1 GEODATA

Table 62: *Variables of group GEODATA in sun diffuser mode.*

Name	Description	Unit	Type	# Dim.
latitude	the center latitude of each observation	degrees_north	float32	3
longitude	the center longitude of each observation	degrees_east	float32	3
latitude_bounds	the corner coordinate latitudes of each observation	degrees_north	float32	4
longitude_bounds	the corner coordinate longitudes of each observation	degrees_east	float32	4
esm_position	elevation scan mirror position	degree	float32	3
asm_position	azimuth scan mirror position	degree	float32	3
solar_zenith_angle	at satellite	degree	float32	4

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Name	Description	Unit	Type	# Dim.
solar_azimuth_angle	at satellite	degree	float32	4
viewing_zenith_angle	position of ESM compared to zero position	degree	float32	4
viewing_azimuth_angle	position of ASM compared to zero position	degree	float32	4

10.3.2 OBSERVATIONS

Table 63: *Variables of group OBSERVATIONS in sun diffuser mode.*

Name	Description	Unit	Type	# Dim.
scanline	along track dimension index	1	int32	2
delta_time	time offset in seconds from midnight	s	float64	3
state_index	the index of the state in this product counted from 0	1	uint16	2
backscan_flag	flag if back-scan or not: 0=no back-scan, 1=back-scan	1	int8	3
wavelength	the approximate center wavelength of the PMD spectral range (A, B, D, E, F, 45)	1e-09m	float32	2
radiance	the uncalibrated radiance in binary units	1	float32	4

11 MODE_SUBSOLAR

Table 64: *Attributes for group BAND_xx in subsolar mode.*

Name	Value
start_stop_pixel	0 4

Table 65: *Variables of group BAND_xx in subsolar mode.*

Name	Description	Unit	Type	# Dim.
spectral_channel	index in detector array	1	uint16	1
start_pixel	start-index of this band in detector array	1	int16	-
end_pixel	end-index of this band in detector array	1	int16	-
detector	index of this detector array: 0, 1 . . . 7	1	int16	-
start_wavelength	approximate start wavelength of this spectral band	1e-09m	float32	-
end_wavelength	approximate end wavelength of this spectral band	1e-09m	float32	-

11.1 GEODATA

Table 66: *Attributes for group GEODATA in subsolar mode.*

Name	Value
comment	the dimension angle is 3 for angles at start, middle and end of the ground-pixel

Table 67: *Variables of group GEODATA in subsolar mode.*

Name	Description	Unit	Type	# Dim.
latitude	the latitude of the sub-satellite track	degrees_north	float32	3
longitude	the longitude of the sub-satellite track	degrees_east	float32	3
esm_position	elevation scan mirror position	degree	float32	3

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Name	Description	Unit	Type	# Dim.
asm_position	azimuth scan mirror position	degree	float32	3
solar_zenith_angle	at satellite	degree	float32	4
solar_azimuth_angle	at satellite	degree	float32	4
viewing_zenith_angle	position of ESM compared to zero position	degree	float32	4
viewing_azimuth_angle	position of ASM compared to zero position	degree	float32	4

11.2 OBSERVATIONS

Table 68: *Variables of group OBSERVATIONS in subsolar mode.*

Name	Description	Unit	Type	# Dim.
orbit_phase	orbit-phase is 0 when instrument goes into eclipse and solar elevation is zero	1	float32	2
spectral_index	index in the group of available wavelength grids: see in group /CALIBRATION/SPECTRAL_CALIBRATION/wavelength	1	int16	2
scanline	along track dimension index	1	int32	2
delta_time	time offset in seconds from midnight	s	float64	3
state_index	the index of the state in this product counted from 0	1	uint16	2
integration_time	the integration time of this band, actually the readout-time as maximum(exposure-time, 0.0625s) * coadding-factor	s	float32	2
backscan_flag	according scan-mirror movement: forward scan is scanning from left to right across flight direction, backward scan from right to left	1	int8	3
radiance	the uncalibrated radiance in binary units	1	float32	4
radiance_flags	flags can be combined with an OR-operation	1	int8	3
memoryeffect	memory effect for channels 1 to 5 (UV-VIS), non-linearity signal for channels 6 to 8 (IR)	1	float32	4
straylight	straylight signal	1	float32	4

11.3 PMD

Table 69: *Variables of group PMD in subsolar mode.*

Name	Description	Unit	Type	# Dim.
spectral_channel	index in detector array	1	uint16	1
integration_time	the constant integration time of all integrated PMD measurements	s	float32	-

11.3.1 GEODATA

Table 70: *Variables of group GEODATA in subsolar mode.*

Name	Description	Unit	Type	# Dim.
latitude	the center latitude of each observation	degrees_north	float32	3
longitude	the center longitude of each observation	degrees_east	float32	3
latitude_bounds	the corner coordinate latitudes of each observation	degrees_north	float32	4
longitude_bounds	the corner coordinate longitudes of each observation	degrees_east	float32	4
esm_position	elevation scan mirror position	degree	float32	3
asm_position	azimuth scan mirror position	degree	float32	3
solar_zenith_angle	at satellite	degree	float32	4

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Name	Description	Unit	Type	# Dim.
solar_azimuth_angle	at satellite	degree	float32	4
viewing_zenith_angle	position of ESM compared to zero position	degree	float32	4
viewing_azimuth_angle	position of ASM compared to zero position	degree	float32	4

11.3.2 OBSERVATIONS

Table 71: *Variables of group OBSERVATIONS in subsolar mode.*

Name	Description	Unit	Type	# Dim.
scanline	along track dimension index	1	int32	2
delta_time	time offset in seconds from midnight	s	float64	3
state_index	the index of the state in this product counted from 0	1	uint16	2
backscan_flag	flag if back-scan or not: 0=no back-scan, 1=back-scan	1	int8	3
wavelength	the approximate center wavelength of the PMD spectral range (A, B, D, E, F, 45)	1e-09m	float32	2
radiance	the uncalibrated radiance in binary units	1	float32	4

12 MODE_MONITORING

Table 72: *Attributes for group BAND_xx in monitoring mode.*

Name	Value
start_stop_pixel	0 4

Table 73: *Variables of group BAND_xx in monitoring mode.*

Name	Description	Unit	Type	# Dim.
spectral_channel	index in detector array	1	uint16	1
start_pixel	start-index of this band in detector array	1	int16	-
end_pixel	end-index of this band in detector array	1	int16	-
detector	index of this detector array: 0, 1 . . . 7	1	int16	-
start_wavelength	approximate start wavelength of this spectral band	1e-09m	float32	-
end_wavelength	approximate end wavelength of this spectral band	1e-09m	float32	-

12.1 GEODATA

Table 74: *Attributes for group GEODATA in monitoring mode.*

Name	Value
comment	the dimension angle is 3 for angles at start, middle and end of the ground-pixel

Table 75: *Variables of group GEODATA in monitoring mode.*

Name	Description	Unit	Type	# Dim.
latitude	the latitude of the sub-satellite track	degrees_north	float32	3
longitude	the longitude of the sub-satellite track	degrees_east	float32	3
esm_position	elevation scan mirror position	degree	float32	3

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Name	Description	Unit	Type	# Dim.
asm_position	azimuth scan mirror position	degree	float32	3
solar_zenith_angle	at satellite	degree	float32	4
solar_azimuth_angle	at satellite	degree	float32	4
viewing_zenith_angle	position of ESM compared to zero position	degree	float32	4
viewing_azimuth_angle	position of ASM compared to zero position	degree	float32	4

12.2 OBSERVATIONS

Table 76: *Variables of group OBSERVATIONS in monitoring mode.*

Name	Description	Unit	Type	# Dim.
orbit_phase	orbit-phase is 0 when instrument goes into eclipse and solar elevation is zero	1	float32	2
spectral_index	index in the group of available wavelength grids: see in group /CALIBRATION/SPECTRAL_CALIBRATION/wavelength	1	int16	2
scanline	along track dimension index	1	int32	2
delta_time	time offset in seconds from midnight	s	float64	3
state_index	the index of the state in this product counted from 0	1	uint16	2
integration_time	the integration time of this band, actually the readout-time as maximum(exposure-time, 0.0625s) * coadding-factor	s	float32	2
backscan_flag	according scan-mirror movement: forward scan is scanning from left to right across flight direction, backward scan from right to left	1	int8	3
radiance	the uncalibrated radiance in binary units	1	float32	4
radiance_flags	flags can be combined with an OR-operation	1	int8	3
memoryeffect	memory effect for channels 1 to 5 (UV-VIS), non-linearity signal for channels 6 to 8 (IR)	1	float32	4
straylight	straylight signal	1	float32	4

12.3 PMD

Table 77: *Variables of group PMD in monitoring mode.*

Name	Description	Unit	Type	# Dim.
spectral_channel	index in detector array	1	uint16	1
integration_time	the constant integration time of all integrated PMD measurements	s	float32	-

12.3.1 GEODATA

Table 78: *Variables of group GEODATA in monitoring mode.*

Name	Description	Unit	Type	# Dim.
latitude	the center latitude of each observation	degrees_north	float32	3
longitude	the center longitude of each observation	degrees_east	float32	3
latitude_bounds	the corner coordinate latitudes of each observation	degrees_north	float32	4
longitude_bounds	the corner coordinate longitudes of each observation	degrees_east	float32	4
esm_position	elevation scan mirror position	degree	float32	3
asm_position	azimuth scan mirror position	degree	float32	3
solar_zenith_angle	at satellite	degree	float32	4

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Name	Description	Unit	Type	# Dim.
solar_azimuth_angle	at satellite	degree	float32	4
viewing_zenith_angle	position of ESM compared to zero position	degree	float32	4
viewing_azimuth_angle	position of ASM compared to zero position	degree	float32	4

12.3.2 OBSERVATIONS

Table 79: in monitoring mode./Variables of group OBSERVATIONS/

Name	Description	Unit	Type	# Dim.
scanline	along track dimension index	1	int32	2
delta_time	time offset in seconds from midnight	s	float64	3
state_index	the index of the state in this product counted from 0	1	uint16	2
backscan_flag	flag if back-scan or not: 0=no back-scan, 1=back-scan	1	int8	3
wavelength	the approximate center wavelength of the PMD spectral range (A, B, D, E, F, 45)	1e-09m	float32	2
radiance	the uncalibrated radiance in binary units	1	float32	4

13 MODE_SLS

Table 80: *Attributes for group BAND_xx in SLS mode.*

Name	Value
start_stop_pixel	0 4

Table 81: *Variables of group BAND_xx in SLS mode.*

Name	Description	Unit	Type	# Dim.
spectral_channel	index in detector array	1	uint16	1
start_pixel	start-index of this band in detector array	1	int16	-
end_pixel	end-index of this band in detector array	1	int16	-
detector	index of this detector array: 0, 1 . . . 7	1	int16	-
start_wavelength	approximate start wavelength of this spectral band	1e-09m	float32	-
end_wavelength	approximate end wavelength of this spectral band	1e-09m	float32	-

13.1 GEODATA

Table 82: *Attributes for group GEODATA in SLS mode.*

Name	Value
comment	the dimension angle is 3 for angles at start, middle and end of the ground-pixel

Table 83: *Variables of group GEODATA in SLS mode.*

Name	Description	Unit	Type	# Dim.
latitude	the latitude of the sub-satellite track	degrees_north	float32	3
longitude	the longitude of the sub-satellite track	degrees_east	float32	3
esm_position	elevation scan mirror position	degree	float32	3

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Name	Description	Unit	Type	# Dim.
asm_position	azimuth scan mirror position	degree	float32	3
solar_zenith_angle	at satellite	degree	float32	4
solar_azimuth_angle	at satellite	degree	float32	4
viewing_zenith_angle	position of ESM compared to zero position	degree	float32	4
viewing_azimuth_angle	position of ASM compared to zero position	degree	float32	4

13.2 OBSERVATIONS

Table 84: *Variables of group OBSERVATIONS in SLS mode.*

Name	Description	Unit	Type	# Dim.
orbit_phase	orbit-phase is 0 when instrument goes into eclipse and solar elevation is zero	1	float32	2
spectral_index	index in the group of available wavelength grids: see in group /CALIBRATION/SPECTRAL_CALIBRATION/wavelength	1	int16	2
scanline	along track dimension index	1	int32	2
delta_time	time offset in seconds from midnight	s	float64	3
state_index	the index of the state in this product counted from 0	1	uint16	2
integration_time	the integration time of this band, actually the readout-time as maximum(exposure-time, 0.0625s) * coadding-factor	s	float32	2
backscan_flag	according scan-mirror movement: forward scan is scanning from left to right across flight direction, backward scan from right to left	1	int8	3
radiance	the uncalibrated radiance in binary units	1	float32	4
radiance_flags	flags can be combined with an OR-operation	1	int8	3
memoryeffect	memory effect for channels 1 to 5 (UV-VIS), non-linearity signal for channels 6 to 8 (IR)	1	float32	4

13.3 PMD

Table 85: *Variables of group PMD in SLS mode.*

Name	Description	Unit	Type	# Dim.
spectral_channel	index in detector array	1	uint16	1
integration_time	the constant integration time of all integrated PMD measurements	s	float32	-

13.3.1 GEODATA

Table 86: *Variables of group GEODATA in SLS mode.*

Name	Description	Unit	Type	# Dim.
latitude	the center latitude of each observation	degrees_north	float32	3
longitude	the center longitude of each observation	degrees_east	float32	3
latitude_bounds	the corner coordinate latitudes of each observation	degrees_north	float32	4
longitude_bounds	the corner coordinate longitudes of each observation	degrees_east	float32	4
esm_position	elevation scan mirror position	degree	float32	3
asm_position	azimuth scan mirror position	degree	float32	3
solar_zenith_angle	at satellite	degree	float32	4
solar_azimuth_angle	at satellite	degree	float32	4

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Name	Description	Unit	Type	# Dim.
viewing_zenith_angle	position of ESM compared to zero position	degree	float32	4
viewing_azimuth_angle	position of ASM compared to zero position	degree	float32	4

13.3.2 OBSERVATIONS

Table 87: *Variables of group OBSERVATIONS in SLS mode.*

Name	Description	Unit	Type	# Dim.
scanline	along track dimension index	1	int32	2
delta_time	time offset in seconds from midnight	s	float64	3
state_index	the index of the state in this product counted from 0	1	uint16	2
backscan_flag	flag if back-scan or not: 0=no back-scan, 1=back-scan	1	int8	3
wavelength	the approximate center wavelength of the PMD spectral range (A, B, D, E, F, 45)	1e-09m	float32	2
radiance	the uncalibrated radiance in binary units	1	float32	4

14 MODE_WLS

Table 88: *Attributes for group BAND_xx in WLS mode.*

Name	Value
start_stop_pixel	0 4

Table 89: *Variables of group BAND_xx in WLS mode.*

Name	Description	Unit	Type	# Dim.
spectral_channel	index in detector array	1	uint16	1
start_pixel	start-index of this band in detector array	1	int16	-
end_pixel	end-index of this band in detector array	1	int16	-
detector	index of this detector array: 0, 1 . . . 7	1	int16	-
start_wavelength	approximate start wavelength of this spectral band	1e-09m	float32	-
end_wavelength	approximate end wavelength of this spectral band	1e-09m	float32	-

14.1 GEODATA

Table 90: *Attributes for group GEODATA in WLS mode.*

Name	Value
comment	the dimension angle is 3 for angles at start, middle and end of the ground-pixel

Table 91: *Variables of group GEODATA in WLS mode.*

Name	Description	Unit	Type	# Dim.
latitude	the latitude of the sub-satellite track	degrees_north	float32	3
longitude	the longitude of the sub-satellite track	degrees_east	float32	3
esm_position	elevation scan mirror position	degree	float32	3
asm_position	azimuth scan mirror position	degree	float32	3

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Name	Description	Unit	Type	# Dim.
solar_zenith_angle	at satellite	degree	float32	4
solar_azimuth_angle	at satellite	degree	float32	4
viewing_zenith_angle	position of ESM compared to zero position	degree	float32	4
viewing_azimuth_angle	position of ASM compared to zero position	degree	float32	4

14.2 OBSERVATIONS

Table 92: *Variables of group OBSERVATIONS in WLS mode.*

Name	Description	Unit	Type	# Dim.
orbit_phase	orbit-phase is 0 when instrument goes into eclipse and solar elevation is zero	1	float32	2
spectral_index	index in the group of available wavelength grids: see in group /CALIBRATION/SPECTRAL_CALIBRATION/wavelength	1	int16	2
scanline	along track dimension index	1	int32	2
delta_time	time offset in seconds from midnight	s	float64	3
state_index	the index of the state in this product counted from 0	1	uint16	2
integration_time	the integration time of this band, actually the readout-time as maximum(exposure-time, 0.0625s) * coadding-factor	s	float32	2
backscan_flag	according scan-mirror movement: forward scan is scanning from left to right across flight direction, backward scan from right to left	1	int8	3
radiance	the uncalibrated radiance in binary units	1	float32	4
radiance_flags	flags can be combined with an OR-operation	1	int8	3
memoryeffect	memory effect for channels 1 to 5 (UV-VIS), non-linearity signal for channels 6 to 8 (IR)	1	float32	4

14.3 PMD

Table 93: *Variables of group PMD in WLS mode.*

Name	Description	Unit	Type	# Dim.
spectral_channel	index in detector array	1	uint16	1
integration_time	the constant integration time of all integrated PMD measurements	s	float32	-

14.3.1 GEODATA

Table 94: *Variables of group GEODATA in WLS mode.*

Name	Description	Unit	Type	# Dim.
latitude	the center latitude of each observation	degrees_north	float32	3
longitude	the center longitude of each observation	degrees_east	float32	3
latitude_bounds	the corner coordinate latitudes of each observation	degrees_north	float32	4
longitude_bounds	the corner coordinate longitudes of each observation	degrees_east	float32	4
esm_position	elevation scan mirror position	degree	float32	3
asm_position	azimuth scan mirror position	degree	float32	3
solar_zenith_angle	at satellite	degree	float32	4
solar_azimuth_angle	at satellite	degree	float32	4
viewing_zenith_angle	position of ESM compared to zero position	degree	float32	4

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Name	Description	Unit	Type	# Dim.
viewing_azimuth_angle	position of ASM compared to zero position	degree	float32	4

14.3.2 OBSERVATIONS

Table 95: *Variables of group OBSERVATIONS in WLS mode.*

Name	Description	Unit	Type	# Dim.
scanline	along track dimension index	1	int32	2
delta_time	time offset in seconds from midnight	s	float64	3
state_index	the index of the state in this product counted from 0	1	uint16	2
backscan_flag	flag if back-scan or not: 0=no back-scan, 1=back-scan	1	int8	3
wavelength	the approximate center wavelength of the PMD spectral range (A, B, D, E, F, 45)	1e-09m	float32	2
radiance	the uncalibrated radiance in binary units	1	float32	4

15 CALIBRATION

Table 96: *Variables of group CALIBRATION*

Name	Description	Unit	Type	# Dim.
keydata_filename	on-ground calibration key-data file	-	string	-
mfactor_filename	m-factors are used for degradation correction	-	string	-
initialisation_filename	various static parameters	-	string	-
calibration_initialisation_filename	static parameters for averaging calibration data	-	string	-
orbit_filename	orbit state vector input file	-	string	-
attitude_filename	satellite attitude parameter input file	-	string	-

15.1 DARK_AVERAGES

Table 97: *Variables of group DARK_AVERAGES*

Name	Description	Unit	Type	# Dim.
measurement_time	time of the first measurement used to create the record	-	string	1
average_dark	average of dark measurements per state	1	float32	2
standard_deviation	standard deviation per state	1	float32	2
solar_straylight	solar straylight per state	1	float32	2
solar_straylight_error	solar straylight error per state	1	float32	2
pmd_offset	PMD offset per state	1	float32	2
pmd_offset_error	PMD offset error per state	1	float32	2
pmd_straylight	PMD stray-light per state	1	float32	2
pmd_straylight_error	PMD stray-light error per state	1	float32	2

15.2 KEYDATA_ERRORS

Table 98: *Variables of group KEYDATA_ERRORS*

Name	Description	Unit	Type	# Dim.
mu2_accuracy	accuracy of polarisation sensitivity Mu2	1	float64	1

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Name	Description	Unit	Type	# Dim.
mu3_accuracy	accuracy of polarisation sensitivity Mu3	1	float64	1
mu2dl_accuracy	accuracy of polarisation sensitivity Mu2 Limb/Occultation	1	float64	1
mu3dl_accuracy	accuracy of polarisation sensitivity Mu3 Limb/Occultation	1	float64	1
radsens_optical_bench_error	error of the radiometric sensitivity of the optical bench	1	float64	1
radsens_nadir_error	error of the radiometric sensitivity of the nadir light path	1	float64	1
radsens_limb_error	error of the radiometric sensitivity of the limb light path	1	float64	1
radsens_sun_error	error of the radiometric sensitivity of the sun light path	1	float64	1
bsdf_error	error of the BSDF (bidirectional scattering distribution function)	1	float64	1

15.3 LEAKAGE_CONSTANT

Table 99: *Variables of group LEAKAGE_CONSTANT*

Name	Description	Unit	Type	# Dim.
fixed_pattern_noise	constant part of the leakage signal	1	float64	1
fixed_pattern_noise_error	error of the constant part of the leakage signal	1	float64	1
leakage_current	integration time dependant part of the leakage signal	1	float64	1
leakage_current_error	error of the integration time dependant part of the leakage signal	1	float64	1
pmd_offset	PMD signal offset	1	float64	1
pmd_offset_error	error of the PMD signal offset	1	float64	1
mean_noise	mean noise of the leakage signal	1	float64	1
database_name	database name of the constant leakage record	-	string	1
database_table	database table of the constant leakage record	-	string	1
orbit_number	orbit-number of the constant leakage database record	1	uint16	1
creation_time	creation time of the constant leakage database record	-	string	1
measurement_time	measurement time of the constant leakage database record	-	string	1

15.4 LEAKAGE_VARIABLE

Table 100: *Variables of group LEAKAGE_VARIABLE*

Name	Description	Unit	Type	# Dim.
orbit_phase	orbit-phase starts when instrument goes into eclipse, so solar elevation is zero	1	float32	1
channel_temperature	10 temperatures of OBM, 8 channels and PMD	K	float32	2
leakage_current	variable (orbit-phase-dependant) part of the leakage signal	1	float64	2
leakage_current_error	error of variable (orbit-phase-dependant) part of the leakage signal	1	float64	2
solar_straylight	solar stray-light	1	float64	2
solar_straylight_error	error of solar stray-light	1	float64	2
pmd_straylight	PMD stray-light	1	float64	2
pmd_straylight_error	error of PMD stray-light	1	float64	2
pmd_offset	PMD offset	1	float64	2
pmd_offset_error	error of PMD offset	1	float64	2

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Name	Description	Unit	Type	# Dim.
database_name	database name of the variable leakage database record	-	string	1
database_table	database table of the variable leakage database record	-	string	1
orbit_number	orbit-number of the variable leakage database record	1	uint16	1
creation_time	creation time of the variable leakage database record	-	string	1
measurement_time	measurement time of the variable leakage database record	-	string	1

15.5 LIMB_UV_LUT

Table 101: *Variables of group LIMB_UV_LUT*

Name	Description	Unit	Type	# Dim.
limb_uv_lut_lambda	wavelength vector for the limb UV polarisation LUT	1e-09m	float64	1
limb_uv_lut_solar_zenith	solar zenith vector for the limb UV polarisation LUT	degree	float64	1
limb_uv_lut_albedo	albedo vector for the limb UV polarisation LUT	1	float64	1
limb_uv_lut_azimuth	relative azimuth vector for the limb UV polarisation LUT	degree	float64	1
limb_uv_lut_tangent_height	tangent height vector for the limb UV polarisation LUT	km	float64	1
limb_uv_lut_stokes	index of the Stokes vector (I = 0, Q = 1, U = 2)	1	int8	1
limb_uv_lut	Lookup-table for limb UV polarisation Stokes values	1	float64	6

15.6 MEAN_MOON

Table 102: /Variables of group MEAN_MOON /

Name	Description	Unit	Type	# Dim.
measurement_time	time of the first measurement used to create the record	-	string	-
lambda_mean_moon	wavelength of the mean sun reference spectrum	1e-09m	float64	1
mean_moon_reference	mean moon spectrum divided by instrument response function and integration time	photons/cm2.nm.s	float64	1
mean_moon_precision	precision of the mean moon reference spectrum	1	float64	1
mean_moon_accuracy	accuracy of the mean moon reference spectrum	1	float64	1
mean_moon_irradiance	lunar irradiance as seen by the satellite	photons/cm2.nm.s	float64	1
mean_moon_reflectance	lunar effective disk reflectance	1	float64	1
mean_scanmirror_azimuth	scan mirror azimuth angle of the moon measurement	degree	float32	-
mean_scanmirror_elevation	scan mirror elevation angle of the moon measurement	degree	float32	-
mean_solar_elevation	solar elevation angle at instrument during measurement	degree	float32	-
mean_solar_azimuth	solar azimuth angle at instrument during measurement	degree	float32	-
mean_lunar_zenith	lunar zenith angle at instrument during measurement	degree	float32	-
mean_lunar_azimuth	lunar azimuth angle at instrument during measurement	degree	float32	-
mean_selene_sun_longitude	Selene sun logitude during measurement	degrees_east	float64	-
mean_selene_sun_latitude	Selene sun latitude during measurement	degrees_north	float64	-

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Name	Description	Unit	Type	# Dim.
mean_selene_satellite_longitude	Selene satellite logitude during measurement	degrees_east	float64	-
mean_selene_satellite_latitude	Selene satellite latitude during measurement	degrees_north	float64	-
mean_selene_sun_distance	Selene sun distance during measurement	km	float64	-
mean_selene_satellite_distance	Selene satellite distance during measurement	km	float64	-
mean_phase_angle	Angle between sun, moon and satellite during measurement	degrees	float64	-
moon_low_signal_flag	the flag is 0 for normal spectra, 1 for spectra with average signal too low (binary units less than 1000)	1	int8	-
mean_moon_pmd	mean moon PMD signal	1	float64	1

15.7 MEAN_SUN_REFERENCE

Table 103: *Attributes for group MEAN_SUN_REFERENCE*

Name	Value
comment	dimension database_record and record could be different if a data-base entry could not be read

Table 104: *Variables of group MEAN_SUN_REFERENCE*

Name	Description	Unit	Type	# Dim.
type	D0: ESM-diffuser calibrated, D1: ESM-diffuser calibrated no NDF, D2: ASM-diffuser calibrated, E0: ESM-diffuser uncalibrated, E1: ESM-diffuser uncalibrated no NDF, A0: ASM-diffuser uncalibrated, S0: subsolar calibrated, V0: subsolar uncalibrated	-	string	1
lambda_mean_sun	wavelength of the mean sun reference spectrum	1e-09m	float64	2
mean_sun_reference	mean sun reference spectrum	photons/cm2.nm.s	float64	2
mean_sun_precision	precision of the mean sun reference spectrum	1	float64	2
mean_sun_accuracy	accuracy of the mean sun reference spectrum	1	float64	2
mean_sun_etalon	etalon signal of the mean sun reference spectrum	1	float64	2
mean_sun_azimuth	scan mirror azimuth angle of the solar measurement	degree	float32	1
mean_sun_elevation	scan mirror elevation angle of the solar measurement	degree	float32	1
mean_sun_solar_elevation	solar elevation angle of the solar measurement	degree	float32	1
mean_sun_pmd	mean sun PMD signal	1	float64	2
mean_sun_out_of_band_signal_nd_out	PMD out-of-band signal without ND (neutral density filter)	1	float64	2
mean_sun_out_of_band_signal_nd_in	PMD out-of-band signal with ND (neutral density filter)	1	float64	2
doppler_shift	doppler shift	1	float32	1
database_name	database name of the mean-sun-reference record	-	string	1
database_table	database table of the mean-sun-reference record	-	string	1
orbit_number	the orbit-number of the mean-sun-reference database record	1	uint16	1
creation_time	creation time of the mean-sun-reference database record	-	string	1
measurement_time	measurement time of the mean-sun-reference database record	-	string	1

15.8 POLARISATION_SENSITIVITY_LIMB_OCCULTATION

Table 105: *Variables of group POLARISATION_SENSITIVITY_LIMB_OCCULTATION*

Name	Description	Unit	Type	# Dim.
angle_esm_limb	elevation angles used for polarisation sensitivities (Mueller matrix element Mu2 and Mu3)	degree	float64	1
angle_asm_limb	azimuth angles used for polarisation sensitivities (Mueller matrix element Mu2 and Mu3)	degree	float64	1
polarisation_sensitivity_limb_mu2	pol.sens. (Mueller matrix element Mu2) for several elevation and azimuth angles	1	float64	3
polarisation_sensitivity_limb_mu3	pol.sens. (Mueller matrix element Mu3) for several elevation and azimuth angles	1	float64	3

15.9 POLARISATION_SENSITIVITY_LIMB_OCCULTATION_NDF

Table 106: *Variables of group POLARISATION_SENSITIVITY_LIMB_OCCULTATION_NDF*

Name	Description	Unit	Type	# Dim.
angle_esm_limb_ndf	elevation angles used for polarisation sensitivities (Mueller matrix element Mu2 and Mu3)	degree	float64	1
angle_asm_limb_ndf	azimuth angles used for polarisation sensitivities (Mueller matrix element Mu2 and Mu3)	degree	float64	1
polarisation_sensitivity_limb_mu2_NDF	pol.sens. (Mueller matrix element Mu2) for several elevation and azimuth angles	1	float64	3
polarisation_sensitivity_limb_mu3_NDF	pol.sens. (Mueller matrix element Mu3) for several elevation and azimuth angles	1	float64	3

15.10 POLARISATION_SENSITIVITY_NADIR

Table 107: *Variables of group POLARISATION_SENSITIVITY_NADIR*

Name	Description	Unit	Type	# Dim.
angle_esm_nadir	elevation angles used for polarisation sensitivities (Mueller matrix element Mu2 and Mu3)	degree	float64	1
polarisation_sensitivity_nadir_mu2	pol.sens. (Mueller matrix element Mu2) for several elevation angles	1	float64	2
polarisation_sensitivity_nadir_mu3	pol.sens. (Mueller matrix element Mu3) for several elevation angles	1	float64	2

15.11 PPG_ETALON

Table 108: *Variables of group PPG_ETALON*

Name	Description	Unit	Type	# Dim.
ppg	pixel to pixel gain factor	1	float64	1
etalon	etalon correction	1	float64	1
etalon_residual	etalon residual	1	float64	1
bad_pixel_mask	bad pixel mask derived from WLS lamp signal	1	int8	1
database_name	database name of the PPG-etalon record	-	string	1
database_table	database table of the PPG-etalon record	-	string	1
orbit_number	orbit-number of the PPG-etalon database record	1	uint16	1
creation_time	creation time of the PPG-etalon database record	-	string	1
measurement_time	measurement time of the PPG-etalon database record	-	string	1

15.12 RADIANCE_SENSITIVITY_LIMB_OCCULTATION

Table 109: *Variables of group RADIANCE_SENSITIVITY_LIMB_OCCULTATION*

Name	Description	Unit	Type	# Dim.
angle_esm_limb	elevation angles used for radiometric sensitivities (Mueller matrix element M1)	degree	float64	1
angle_asm_limb	azimuth angles used for radiometric sensitivities (Mueller matrix element M1)	degree	float64	1
radiance_sensitivity_limb	radiometric sensitivity (Mueller matrix element M1) for several elevation and azimuth angles	BU.s.sr.cm2.1e-09m/photons	float64	3

15.13 RADIANCE_SENSITIVITY_LIMB_OCCULTATION_NDF

Table 110: *Variables of group RADIANCE_SENSITIVITY_LIMB_OCCULTATION_NDF*

Name	Description	Unit	Type	# Dim.
angle_esm_limb_ndf	elevation angles used for radiometric sensitivities (Mueller matrix element M1)	degree	float64	1
angle_asm_limb_ndf	azimuth angles used for radiometric sensitivities (Mueller matrix element M1)	degree	float64	1
radiance_sensitivity_limb_ndf	radiometric sensitivity (Mueller matrix element M1) for several elevation and azimuth angles	BU.s.sr.cm2.1e-09m/photons	float64	3

15.14 RADIANCE_SENSITIVITY_NADIR

Table 111: *Variables of group RADIANCE_SENSITIVITY_NADIR*

Name	Description	Unit	Type	# Dim.
angle_esm_nadir	elevation angles used for radiance sensitivities (Mueller matrix element M1)	degree	float64	1
radiance_sensitivity_nadir	rad.sens. (Mueller matrix element M1) for several elevation angles	BU.s.sr.cm2.1e-09m/photons	float64	2

15.15 SLIT_FUNCTION

Table 112: *Variables of group SLIT_FUNCTION*

Name	Description	Unit	Type	# Dim.
slit_function_pixel_position	slit function pixel position	1	int16	1
slit_function_type	1 = gauss, 2 = single hyperbolic, 3 = voigt	1	int8	1
slit_function_fwhm	slit function full-width-half-maximum (FWHM)	1	float64	1
slit_function_fwhm_gaussian	slit function full-width-half-maximum (FWHM) of Gaussian part (only Voigt)	1	float64	1

15.16 SMALL_AP_SLIT_FUNCTION

Table 113: *Variables of group SMALL_AP_SLIT_FUNCTION*

Name	Description	Unit	Type	# Dim.
small_ap_slit_function_pixel_position	small aperture slit function pixel position	1	int16	1
small_ap_slit_function_type	1 = gauss, 2 = single hyperbolic, 3 = voigt	1	int8	1
small_ap_slit_function_fwhm	small aperture slit function full-width-half-maximum (FWHM)	1	float64	1
small_ap_slit_function_fwhm_gaussian	small aperture slit function full-width-half-maximum (FWHM) of Gaussian part (only Voigt)	1	float64	1

15.17 SPECTRAL_CALIBRATION

Table 114: *Variables of group SPECTRAL_CALIBRATION*

Name	Description	Unit	Type	# Dim.
detector_channel	index of the detector channel (0, 1, . . . 7)	1	int16	1
orbit_phase	orbit-phase starts when instrument goes into eclipse, so solar elevation is zero	1	float32	1
num_lines	num lines used for polynomial fit	1	int16	2
calibration_error	Wavelength calibration error per channel	1	float64	2
spectral_coefficients	orbit-phase-dependant spectral coefficients for each channel	1	float64	3
precise_basis_spectrum	basis wavelength grid	1e-09m	float64	1
wavelength	wavelength calculated from spectral_coefficients	1e-09m	float64	2
wavelength_alternative	wavelength derived from sun spectra with inflight fit	1e-09m	float64	1
database_name	database name of the spectral-calibration record	-	string	1
database_table	database table of the spectral-calibration record	-	string	1
orbit_number	orbit-number of the spectral-calibration record	1	uint16	1
creation_time	creation time of the spectral-calibration database record	-	string	1
measurement_time	measurement time of the spectral-calibration database record	-	string	1

15.18 NEW_LEAKAGE

Table 115: *Variables of group NEW_LEAKAGE*

Name	Description	Unit	Type	# Dim.
measurement_time	time of the first measurement used to create the record	-	string	1
orbit_phase	orbit-phase starts when instrument goes into eclipse, so solar elevation is zero	1	float32	1
channel_temperature	10 temperatures of optical bench, 8 channels and PMD	1	float32	2
fixed_pattern_noise	newly calculated orbital fixed pattern noise	1	float64	2
fixed_pattern_noise_error	error of newly calculated orbital fixed pattern noise	1	float64	2
leakage_current	newly calculated leakage current	1	float64	2
leakage_current_error	error of newly calculated leakage current	1	float64	2
mean_noise	mean noise of leakage signal	1	float64	2
pmd_offset	newly calculated PMD offset	1	float64	2
pmd_offset_error	error of newly calculated PMD offset	1	float64	2

15.19 NEW_SUN_REFERENCE

Table 116: *Variables of group NEW_SUN_REFERENCE*

Name	Description	Unit	Type	# Dim.
type	D0: ESM-diffuser calibrated, D1: ESM-diffuser calibrated no NDF, D2: ASM-diffuser calibrated, E0: ESM-diffuser uncalibrated, E1: ESM-diffuser uncalibrated no NDF, A0: ASM-diffuser uncalibrated, S0: subsolar calibrated, V0: subsolar uncalibrated	-	string	1
measurement_time	time of the first measurement used to create the record	-	string	1
ndf_flag	neutral density filter flag	1	int8	1

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Name	Description	Unit	Type	# Dim.
lambda_mean_sun	wavelength of the mean sun reference spectrum	1e-09m	float64	2
mean_sun_reference	mean sun reference spectrum	photons/cm2.nm.s	float64	2
mean_sun_precision	precision of the mean sun reference spectrum	1	float64	2
mean_sun_accuracy	accuracy of the mean sun reference spectrum	1	float64	2
mean_sun_etalon	etalon signal of the mean sun reference spectrum	1	float64	2
mean_sun_azimuth	scan mirror azimuth angle of the solar measurement	degree	float32	1
mean_sun_elevation	scan mirror elevation angle of the solar measurement	degree	float32	1
mean_sun_solar_elevation	solar elevation angle of the solar measurement	degree	float32	1
mean_sun_pmd	mean sun PMD signal	1	float64	2
mean_sun_out_of_band_signal	PMD out-of-band signal without ND (neutral density filter)	1	float64	2
doppler_shift	doppler shift	1	float32	1

15.20 NEW_PPG_ETALON

Table 117: *Variables of group NEW_PPG_ETALON*

Name	Description	Unit	Type	# Dim.
measurement_time	time of the first measurement used to create the record	-	string	1
ppg	pixel to pixel gain factor	1	float32	2
etalon	etalon correction	1	float32	2
etalon_residual	etalon residual	1	float32	2
wls_average	average white light source spectrum	1	float32	2
wls_standard_deviation	white light source standard deviation	1	float32	2
bad_pixel_mask	bad pixel mask derived from WLS lamp signal	1	int8	2

15.21 NEW_SPECTRAL

Table 118: *Variables of group NEW_SPECTRAL*

Name	Description	Unit	Type	# Dim.
measurement_time	time of the first measurement used to create the record	-	string	1
detector_channel	index of the detector channel (0, 1, . . . 7)	1	int16	1
orbit_phase	orbit-phase starts when instrument goes into eclipse, so solar elevation is zero	1	float32	1
num_lines	num lines used for polynomial fit	1	int16	2
calibration_error	wavelength calibration error per channel	1	float64	2
spectral_coefficients	orbit-phase-dependant spectral coefficients for each channel	1	float64	3
average_spectrum	average SLS or solar spectrum which has been used for the determination of spectral calibration parameters	1	float32	2
source_flag	source of spectral calibration parameters	1	int8	2

16 INSTRUMENT

16.1 CLUSTER_DEFINITION_CD

Table 119: *Variables of group CLUSTER_DEFINITION_CD*

Name	Description	Unit	Type	# Dim.
cluster_definition_id	cluster_definition_id	1	uint16	1
cluster_definition_block_id	cluster_definition_block_id	1	uint16	1
cluster_index	cluster_index	1	uint16	2
cluster_identifier	cluster_identifier	1	uint16	2
start_pixel	start_pixel	1	uint16	2
length	length	1	uint16	2
start_orbit	start_orbit	1	uint16	1
stop_orbit	stop_orbit	1	uint16	1
upload_counter	upload_counter	1	uint16	1
upload_filename	upload_filename	-	string	1
remark_2_table_version	remark_2_table_version	-	string	1

16.2 CLUSTER_PER_CHANNEL_CC

Table 120: *Variables of group CLUSTER_PER_CHANNEL_CC*

Name	Description	Unit	Type	# Dim.
table_id	table_id	1	uint16	1
channel_1a	channel_1a	1	uint16	1
channel_1b	channel_1b	1	uint16	1
channel_2b	channel_2b	1	uint16	1
channel_2a	channel_2a	1	uint16	1
channel_3	channel_3	1	uint16	1
channel_4	channel_4	1	uint16	1
channel_5	channel_5	1	uint16	1
channel_6	channel_6	1	uint16	1
channel_7	channel_7	1	uint16	1
channel_8	channel_8	1	uint16	1
start_orbit	start_orbit	1	uint16	1
stop_orbit	stop_orbit	1	uint16	1
upload_counter	upload_counter	1	uint16	1
upload_filename	upload_filename	-	string	1
remark_2_table_version	remark_2_table_version	-	string	1

16.3 COADDING_CONFIGURATION

Table 121: *Variables of group COADDING_CONFIGURATION*

Name	Description	Unit	Type	# Dim.
co_adding_index	co_adding_index	1	uint16	1
co_adding_factor	co_adding_factor	1	uint16	2
start_orbit	start_orbit	1	uint16	1
stop_orbit	stop_orbit	1	uint16	1
upload_counter	upload_counter	1	uint16	1
upload_filename	upload_filename	-	string	1
remark_2_table_version	remark_2_table_version	-	string	1

16.4 DETECTOR_COMMAND_WORDS_DCW

Table 122: *Variables of group DETECTOR_COMMAND_WORDS_DCW*

Name	Description	Unit	Type	# Dim.
dme	dme	1	uint16	1
exposure_time_factor	exposure_time_factor	1	uint16	1
mode	mode	1	uint16	1
section_address	section_address	1	uint16	1
ratio	ratio	1	uint16	1
control	control	1	uint16	1
comp_mode	comp_mode	1	uint16	1
fine_bias	fine_bias	1	uint16	1
short_pet	short_pet	1	uint16	1
start_orbit	start_orbit	1	uint16	1
stop_orbit	stop_orbit	1	uint16	1
upload_counter	upload_counter	1	uint16	1
upload_filename	upload_filename	-	string	1
remark_2_table_version	remark_2_table_version	-	string	1

16.5 DME_ENABLE_LIST_DME

Table 123: *Variables of group DME_ENABLE_LIST_DME*

Name	Description	Unit	Type	# Dim.
dme	dme	1	uint16	1
enable_disable	enable_disable	1	uint16	1
start_orbit	start_orbit	1	uint16	1
stop_orbit	stop_orbit	1	uint16	1
upload_counter	upload_counter	1	uint16	1
upload_filename	upload_filename	-	string	1
remark_2_table_version	remark_2_table_version	-	string	1

16.6 ENVISAT_PLATFORM_STATUS

Table 124: *Variables of group ENVISAT_PLATFORM_STATUS*

Name	Description	Unit	Type	# Dim.
abs_orbit	abs_orbit	1	uint16	1
upload_counter	upload_counter	1	uint16	1
platform_availability	platform_availability	-	string	1
platform_status	platform_status	-	string	1
platform_status_type	platform_status_type	-	string	1
platform_status_description	platform_status_description	-	string	1
platform_status_utc	platform_status_utc	-	string	1
sfcm_first_burn_utc	sfcm_first_burn_utc	-	string	1
sfcm_second_burn_utc	sfcm_second_burn_utc	-	string	1
ocm_first_burn_utc	ocm_first_burn_utc	-	string	1
ocm_second_burn_utc	ocm_second_burn_utc	-	string	1
cam_first_burn_utc	cam_first_burn_utc	-	string	1
cam_second_burn_utc	cam_second_burn_utc	-	string	1
pointing_performance	pointing_performance	-	string	1
ground_segment_status_description	ground_segment_status_description	-	string	1
upload_filename	upload_filename	-	string	1

16.7 ENVISAT_REFERENCE_ORBIT

Table 125: *Variables of group ENVISAT_REFERENCE_ORBIT*

Name	Description	Unit	Type	# Dim.
abs_orbit	abs_orbit	1	uint16	1
orbit_repeat_cycle	orbit_repeat_cycle	1	uint16	1
upload_counter	upload_counter	1	uint16	1
anx_date	anx_date	-	string	1
upload_filename	upload_filename	-	string	1
anx_longitude	anx_longitude	-	float64	1
orbital_period	orbital_period	-	float64	1
delta_t	delta_t	-	float64	1

16.8 ENVISAT_SCIAMACHY_LLI

Table 126: *Variables of group ENVISAT_SCIAMACHY_LLI*

Name	Description	Unit	Type	# Dim.
abs_orbit	abs_orbit	1	uint16	1
apsm	apsm	1	uint16	1
ncwm	ncwm	1	uint16	1
wls	wls	1	uint16	1
sls	sls	1	uint16	1
cryo_heatpipe	cryo_heatpipe	1	uint16	1
upload_counter	upload_counter	1	uint16	1
upload_filename	upload_filename	-	string	1
ndfm	ndfm	-	float64	1
wls_time	wls_time	-	float64	1
sls_time	sls_time	-	float64	1
esmd_time	esmd_time	-	float64	1
asmd_time	asmd_time	-	float64	1

16.9 ENVISAT_SCIAMACHY_STATUS

Table 127: *Variables of group ENVISAT_SCIAMACHY_STATUS*

Name	Description	Unit	Type	# Dim.
abs_orbit	abs_orbit	1	uint16	1
upload_counter	upload_counter	1	uint16	1
instrument_availability	instrument_availability	-	string	1
instrument_status	instrument_status	-	string	1
instrument_status_type	instrument_status_type	-	string	1
instrument_status_description	instrument_status_description	-	string	1
instrument_status_utc	instrument_status_utc	-	string	1
special_measurement	special_measurement	-	string	1
temporary_ocr_id	temporary_ocr_id	-	string	1
permanent_ocr_id	permanent_ocr_id	-	string	1
ocr_implementation	ocr_implementation	-	string	1
final_flight_state_configuration	final_flight_state_configuration	-	string	1
monthly_lunar_window	monthly_lunar_window	-	string	1
monthly_calibration_period	monthly_calibration_period	-	string	1
limb_mesosphere_thermosphere_period	limb_mesosphere_thermosphere_period	-	string	1
upload_filename	upload_filename	-	string	1

16.10 ENVISAT_SCIAMACHY_THERMAL

Table 128: *Variables of group ENVISAT_SCIAMACHY_THERMAL*

Name	Description	Unit	Type	# Dim.
abs_orbit	abs_orbit	1	uint16	1
upload_counter	upload_counter	1	uint16	1
thermal_performance	thermal_performance	-	string	1
atc_adjustment_utc	atc_adjustment_utc	-	string	1
tc_adjustment_utc	tc_adjustment_utc	-	string	1
upload_filename	upload_filename	-	string	1
setpoint_temp_1	setpoint_temp_1	-	float64	1
setpoint_temp_2	setpoint_temp_2	-	float64	1
setpoint_temp_3	setpoint_temp_3	-	float64	1
sensor_gain_factor_1	sensor_gain_factor_1	-	float64	1
sensor_gain_factor_2	sensor_gain_factor_2	-	float64	1
sensor_gain_factor_3	sensor_gain_factor_3	-	float64	1
t_obm	t_obm	-	float64	1
t_limb	t_limb	-	float64	1
t_nadir	t_nadir	-	float64	1
power_atc_limb	power_atc_limb	-	float64	1
power_atc_nadir	power_atc_nadir	-	float64	1
power_atc_rad_a	power_atc_rad_a	-	float64	1
power_dac_1	power_dac_1	-	float64	1
power_dac_2	power_dac_2	-	float64	1
power_dac_3	power_dac_3	-	float64	1
t_detector_1	t_detector_1	K	float64	1
t_detector_2	t_detector_2	K	float64	1
t_detector_3	t_detector_3	K	float64	1
t_detector_4	t_detector_4	K	float64	1
t_detector_5	t_detector_5	K	float64	1
t_detector_6	t_detector_6	K	float64	1
t_detector_7	t_detector_7	K	float64	1
t_detector_8	t_detector_8	K	float64	1
t_pmd	t_pmd	-	float64	1

16.11 ENVISAT_TLM_DESC

Table 129: *Variables of group ENVISAT_TLM_DESC*

Name	Description	Unit	Type	# Dim.
hk_name	hk_name	-	string	1
hk_description	hk_description	-	string	1
id	id	-	string	1
id_desc	id_desc	-	string	1
id_type	id_type	-	string	1
id_unit	id_unit	-	string	1
id_cal	id_cal	-	string	1

16.12 EXPOSURE_STATE_PARAMETER_ES

Table 130: *Variables of group EXPOSURE_STATE_PARAMETER_ES*

Name	Description	Unit	Type	# Dim.
state_id	state_id	1	uint16	1
low	low	1	uint16	2
high	high	1	uint16	2
start_orbit	start_orbit	1	uint16	1

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Name	Description	Unit	Type	# Dim.
stop_orbit	stop_orbit	1	uint16	1
upload_counter	upload_counter	1	uint16	1
upload_filename	upload_filename	-	string	1
remark_2_table_version	remark_2_table_version	-	string	1

16.13 HOT_MODE_HM

Table 131: *Variables of group HOT_MODE_HM*

Name	Description	Unit	Type	# Dim.
state_id	state_id	1	uint16	1
ch6_mode_dec	ch6_mode_dec	1	uint16	1
ch6_short_pet_dec	ch6_short_pet_dec	1	uint16	1
ch7_mode_dec	ch7_mode_dec	1	uint16	1
ch7_short_pet_dec	ch7_short_pet_dec	1	uint16	1
ch8_mode_dec	ch8_mode_dec	1	uint16	1
ch8_short_pet_dec	ch8_short_pet_dec	1	uint16	1
start_orbit	start_orbit	1	uint16	1
stop_orbit	stop_orbit	1	uint16	1
upload_counter	upload_counter	1	uint16	1
upload_filename	upload_filename	-	string	1
remark_2_table_version	remark_2_table_version	-	string	1

16.14 OCR

Table 132: *Variables of group OCR*

Name	Description	Unit	Type	# Dim.
ocr_id	ocr_id	-	string	1
ocr_title	ocr_title	-	string	1
ocr_request	ocr_request	-	string	1
upload_filename	upload_filename	-	string	1
start_orbit	start_orbit	1	uint16	1
stop_orbit	stop_orbit	1	uint16	1

16.15 SCANNER_BASIC_PROFILE_SBP

Table 133: *Variables of group SCANNER_BASIC_PROFILE_SBP*

Name	Description	Unit	Type	# Dim.
basic_scan_profile_id	basic_scan_profile_id	1	int32	1
azimuth_position	azimuth_position	1	int32	1
azimuth_rate	azimuth_rate	1	int32	1
elevation_position	elevation_position	1	int32	1
elevation_rate	elevation_rate	1	int32	1
start_orbit	start_orbit	1	int32	1
stop_orbit	stop_orbit	1	int32	1
upload_counter	upload_counter	1	int32	1
upload_filename	upload_filename	-	string	1
remark_2_table_version	remark_2_table_version	-	string	1

16.16 SCANNER_RELATIVE_PROFILE_SR

Table 134: *Variables of group SCANNER_RELATIVE_PROFILE_SR*

Name	Description	Unit	Type	# Dim.
profile_id	profile_id	1	int32	1
number_of_used_segments	number_of_used_segments	1	int32	1
duration_of_segment	duration_of_segment	1	int32	2
angular_variation	angular_variation	1	int32	2
acceleration_at_start_of_segment	acceleration_at_start_of_segment	1	int32	2
acceleration_at_end_of_segment	acceleration_at_end_of_segment	1	int32	2
number_of_support_points	number_of_support_points	1	int32	2
bcps_synchronisation	bcps_synchronisation	1	int32	2
start_orbit	start_orbit	1	int32	1
stop_orbit	stop_orbit	1	int32	1
upload_counter	upload_counter	1	int32	1
upload_filename	upload_filename	-	string	1
remark_2_table_version	remark_2_table_version	-	string	1

16.17 SCANNER_STATE_PARAMETER_SP

Table 135: *Variables of group SCANNER_STATE_PARAMETER_SP*

Name	Description	Unit	Type	# Dim.
state_id	state_id	1	int32	1
relative_scan_profile_1_factor	relative_scan_profile_1_factor	1	int32	1
relative_scan_profile_2_factor	relative_scan_profile_2_factor	1	int32	1
relative_scan_profile_3_factor	relative_scan_profile_3_factor	1	int32	1
relative_scan_profile_4_factor	relative_scan_profile_4_factor	1	int32	1
relative_scan_profile_5_factor	relative_scan_profile_5_factor	1	int32	1
relative_scan_profile_6_factor	relative_scan_profile_6_factor	1	int32	1
number_of_scan_phases	number_of_scan_phases	1	int32	1
duration_of_phase	duration_of_phase	1	int32	2
phase_type	phase_type	1	int32	2
azimuth_centering_of_relative_scan_profile	azimuth_centering_of_relative_scan_profile	1	int32	2
azimuth_filtering	azimuth_filtering	1	int32	2
az_inverse_rel_scan_profile_for_even_scan	az_inverse_rel_scan_profile_for_even_scan	1	int32	2
azimuth_correction_of_nominal_scan_profile	azimuth_correction_of_nominal_scan_profile	1	int32	2
azimuth_relative_scan_profile_identifier	azimuth_relative_scan_profile_identifier	1	int32	2
hw_constellation	hw_constellation	1	int32	2
azimuth_basic_scan_profile_identifier	azimuth_basic_scan_profile_identifier	1	int32	2
azimuth_number_of_repetition_of_rel_scan	azimuth_number_of_repetition_of_rel_scan	1	int32	2
elevation_centering_of_relative_scan_profile	elevation_centering_of_relative_scan_profile	1	int32	2
elevation_filtering	elevation_filtering	1	int32	2
el_inverse_rel_scan_profile_for_even_scan	el_inverse_rel_scan_profile_for_even_scan	1	int32	2
elevation_correction_of_nominal_scan_profile	elevation_correction_of_nominal_scan_profile	1	int32	2
elevation_relative_scan_profile_identifier	elevation_relative_scan_profile_identifier	1	int32	2
elevation_basic_scan_profile_identifier	elevation_basic_scan_profile_identifier	1	int32	2
elevation_number_of_repetition_of_rel_scan	elevation_number_of_repetition_of_rel_scan	1	int32	2
start_orbit	start_orbit	1	int32	1
stop_orbit	stop_orbit	1	int32	1
upload_counter	upload_counter	1	int32	1
scanner_state_parameter	scanner_state_parameter	-	string	1
common_param	common_param	-	string	1
upload_filename	upload_filename	-	string	1
remark_2_table_version	remark_2_table_version	-	string	1

16.18 STATE_DURATION_SD

Table 136: *Variables of group STATE_DURATION_SD*

Name	Description	Unit	Type	# Dim.
state_id	state_id	1	int32	1
restart_time	restart_time	1	int32	1
sdpu_duration	sdpu_duration	1	int32	1
wait_meas_exe	wait_meas_exe	1	int32	1
state_duration	state_duration	1	int32	1
scanner_reset_wait	scanner_reset_wait	1	int32	1
start_orbit	start_orbit	1	int32	1
stop_orbit	stop_orbit	1	int32	1
upload_counter	upload_counter	1	int32	1
sdpu_measurement_mode	sdpu_measurement_mode	-	string	1
upload_filename	upload_filename	-	string	1
remark_2_table_version	remark_2_table_version	-	string	1

16.19 STATE_ID_DESC

Table 137: *Variables of group STATE_ID_DESC*

Name	Description	Unit	Type	# Dim.
start_orbit	start_orbit	1	uint16	1
stop_orbit	stop_orbit	1	uint16	1
change_orbit	change_orbit	1	uint16	1
upload_counter	upload_counter	1	uint16	1
state_desc	state_desc	-	string	1
state_list	state_list	-	string	1
upload_filename	upload_filename	-	string	1
remark_2_table_version	remark_2_table_version	-	string	1

16.20 STATE_INDEX_SI

Table 138: *Variables of group STATE_INDEX_SI*

Name	Description	Unit	Type	# Dim.
state_id	state_id	1	uint16	1
cluster_definition_index	cluster_definition_index	1	uint16	1
coadding_index_high_rate	coadding_index_high_rate	1	uint16	1
coadding_index_low_rate	coadding_index_low_rate	1	uint16	1
measurement_category_id	measurement_category_id	1	uint16	1
start_orbit	start_orbit	1	uint16	1
stop_orbit	stop_orbit	1	uint16	1
upload_counter	upload_counter	1	uint16	1
upload_filename	upload_filename	-	string	1
remark_2_table_version	remark_2_table_version	-	string	1

16.21 STATE_RTCS_INDEX_RTI

Table 139: *Variables of group STATE_RTCS_INDEX_RTI*

Name	Description	Unit	Type	# Dim.
rtcs_start_index	rtcs_start_index	1	uint16	1
start_orbit	start_orbit	1	uint16	1
stop_orbit	stop_orbit	1	uint16	1

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Name	Description	Unit	Type	# Dim.
upload_counter	upload_counter	1	uint16	1
upload_filename	upload_filename	-	string	1
remark_2_table_version	remark_2_table_version	-	string	1

16.22 TLM_HK1_SH

Table 140: *Variables of group TLM_HK1_SH*

Name	Description	Unit	Type	# Dim.
abs_start_orbit	abs_start_orbit	1	uint16	1
hk_name	hk_name	-	string	1
hk_filename	hk_filename	-	string	1
acq_time	acq_time	-	string	1
id	id	-	string	1
id_value	id_value	-	string	1

16.23 TLM_HK2_SH

Table 141: *Variables of group TLM_HK2_SH*

Name	Description	Unit	Type	# Dim.
abs_start_orbit	abs_start_orbit	1	uint16	1
hk_name	hk_name	-	string	1
hk_filename	hk_filename	-	string	1
acq_time	acq_time	-	string	1
id	id	-	string	1
id_value	id_value	-	string	1

16.24 TLM_HK3_SH

Table 142: *Variables of group TLM_HK3_SH*

Name	Description	Unit	Type	# Dim.
abs_start_orbit	abs_start_orbit	1	uint16	1
hk_name	hk_name	-	string	1
hk_filename	hk_filename	-	string	1
acq_time	acq_time	-	string	1
id	id	-	string	1
id_value	id_value	-	string	1

16.25 TLM_HK4_SH

Table 143: *Variables of group TLM_HK4_SH*

Name	Description	Unit	Type	# Dim.
abs_start_orbit	abs_start_orbit	1	uint16	1
hk_name	hk_name	-	string	1
hk_filename	hk_filename	-	string	1
acq_time	acq_time	-	string	1
id	id	-	string	1
id_value	id_value	-	string	1

16.26 TLM_HK5_SH

Table 144: *Variables of group TLM_HK5_SH*

Name	Description	Unit	Type	# Dim.
abs_start_orbit	abs_start_orbit	1	uint16	1
hk_name	hk_name	-	string	1
hk_filename	hk_filename	-	string	1
acq_time	acq_time	-	string	1
id	id	-	string	1
id_value	id_value	-	string	1

16.27 TLM_HK6_SH

Table 145: *Variables of group TLM_HK6_SH*

Name	Description	Unit	Type	# Dim.
abs_start_orbit	abs_start_orbit	1	uint16	1
hk_name	hk_name	-	string	1
hk_filename	hk_filename	-	string	1
acq_time	acq_time	-	string	1
id	id	-	string	1
id_value	id_value	-	string	1

16.28 TLM_HK7_SH

Table 146: *Variables of group TLM_HK7_SH*

Name	Description	Unit	Type	# Dim.
abs_start_orbit	abs_start_orbit	1	uint16	1
hk_name	hk_name	-	string	1
hk_filename	hk_filename	-	string	1
acq_time	acq_time	-	string	1
id	id	-	string	1
id_value	id_value	-	string	1

16.29 TLM_HK8_SH

Table 147: *Variables of group TLM_HK8_SH*

Name	Description	Unit	Type	# Dim.
abs_start_orbit	abs_start_orbit	1	uint16	1
hk_name	hk_name	-	string	1
hk_filename	hk_filename	-	string	1
acq_time	acq_time	-	string	1
id	id	-	string	1
id_value	id_value	-	string	1

16.30 TLM_HK9_SH

Table 148: *Variables of group TLM_HK9_SH*

Name	Description	Unit	Type	# Dim.
abs_start_orbit	abs_start_orbit	1	uint16	1
hk_name	hk_name	-	string	1
hk_filename	hk_filename	-	string	1
acq_time	acq_time	-	string	1
id	id	-	string	1
id_value	id_value	-	string	1

17 LEVEL0

17.1 AUXILIARY_DATA_PACKETS

Table 149: *Variables of group AUXILIARY_DATA_PACKETS*

Name	Description	Unit	Type	# Dim.
delta_time	time offset in seconds from midnight	s	float64	2
state_index	the index of the state in this product counted from 0	1	int16	1
num_aux_packets	the index of the state in this product counted from 0	1	int16	1
packetID	ID of the level-0 auxiliary packet	1	uint16	2
packet_length	length of the level-0 auxiliary packet	1	uint16	2
sequence_control	sequence-control of the level-0 auxiliary packet	1	uint16	2
icu_time	ICU time of the level-0 auxiliary packet	1	uint32	2
data_length	auxiliary data field length	1	uint16	2
packet_id_overflow	auxiliary data ID and overflow bits	1	uint16	2
redundancy	auxiliary data redundancy	1	uint16	2
state_code	auxiliary data state code	1	uint16	2
pmtc_settings	PMTC settings	1	uint16	3
broadcast_counter	BCPS	1	uint16	4
sync_word	synchronisation word of the auxiliary block	1	uint16	4
bench_temperature	temperature of optical bench	1	uint16	4
azimuth_scanner_control	azimuth scanner control	1	uint16	4
azimuth_zero_error	azimuth zero error	1	uint16	4
elevation_scanner_control	elevation scanner control	1	uint16	4
elevation_zero_error	elevation zero error	1	uint16	4
flags	flags	1	uint16	4
encoder_counter	encoder counter	1	uint16	5

17.2 DATA_PACKET_HEADERS

Table 150: *Variables of group DATA_PACKET_HEADERS*

Name	Description	Unit	Type	# Dim.
delta_time	time offset in seconds from midnight	s	float64	2
state_index	the index of the state in this product counted from 0	1	int16	1
num_data_packets	the number of ISPs (instrument science packets)	1	int16	1
packetID	ID of the level-0 instrument science packet	1	uint16	2
packet_length	length of the level-0 instrument science packet	1	uint16	2
sequence_control	sequence-control of the level-0 instrument science packet	1	uint16	2
icu_time	ICU time of the level-0 instrument science packet	1	uint32	2
broadcast_counter	BCPS	1	uint16	2

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Name	Description	Unit	Type	# Dim.
data_length	instrument science data field length	1	uint16	2
packet_id_overflow	instrument science data ID and overflow bits	1	uint16	2
redundancy	instrument science data redundancy	1	uint16	2
state_code	instrument science data state code	1	uint16	2
num_channels	number of channels in the instrument science data packet	1	uint16	2
state_vector_time	state-vector-time	1	uint32	2
state_vector	Omega, a, alpha, ex, ey, i, omega_v	1	uint32	3
pmtc_settings	PMTC settings	1	uint16	3

17.3 PMD_DATA_PACKETS

Table 151: *Variables of group PMD_DATA_PACKETS*

Name	Description	Unit	Type	# Dim.
delta_time	time offset in seconds from midnight	s	float64	2
state_index	the index of the state in this product counted from 0	1	int16	1
num_pmd_packets	the index of the state in this product counted from 0	1	int16	1
packetID	ID of the level-0 PMD packet	1	uint16	2
packet_length	length of the level-0 PMD packet	1	uint16	2
sequence_control	sequence-control of the level-0 PMD packet	1	uint16	2
icu_time	ICU time of the level-0 PMD packet	1	uint32	2
data_length	PMD data field length	1	uint16	2
packet_id_overflow	PMD data ID and overflow bits	1	uint16	2
redundancy	PMD data redundancy	1	uint16	2
state_code	PMD data state code	1	uint16	2
temperature	PMD detector temperature	1	uint16	2
broadcast_counter	BCPS	1	uint16	3
delta_time_l0	relative to the BCPS	1	uint16	3
sync_word	synchronisation word of the PMD block	1	uint16	3
readout	the actual PMD detector readouts	1	uint16	4

18 PROCESSOR

Table 152: *Variables of group PROCESSOR*

Name	Description	Unit	Type	# Dim.
initialisation_filename	initialisation filename	-	string	-
detector_channel	index of the detector channel (0, 1, . . . 7)	1	int16	1
detector_channel_ir	index of the infrared detector channel (5, 6, 7)	1	int16	1
n_lc_min	minimum number of measured Dark States for updating LC	1	int16	-
ds_n_phases	number of orbit phase regions for leakage parameters	1	int16	-
ds_phase_boundary	array with phase boundaries defining the intervals for the variable LC	1	float32	1
lc_stray_index	start and end index of straylight region w.r.t. ds_phase_boundaries	1	int32	1
lc_harm_order	order of harmonic fit for variable leakage current (LC)	1	int16	-
ds_poly_order	order of polynomial for straylight fit	1	int16	-
do_var_lc_cha	flag to apply/not apply variable part of LC to each channel	1	int8	1

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Name	Description	Unit	Type	# Dim.
do_stray_lc_cha	flag to apply/not apply straylight part of LC to each channel	1	int8	1
do_var_lc_pmd	flag to apply/not apply variable part of LC to each PMD	1	int8	1
do_stray_lc_pmd	flag to apply/not apply variable part of LC to each PMD	1	int8	1
electrons_bu	number of electrons per binary unit for channel j	1	int16	1
ppg_error	relative error on PPG/etalon calibration	1	float32	-
stray_error	relative error on straylight calibration	1	float32	-
sp_n_phases	number of orbit phase regions for spectral parameters	1	int16	-
sp_phase_boundary	array with SZA boundaries defining the intervals for spectral calibration	1	float32	1
startpix_6	start pixel of detector channel 6+	1	int16	-
startpix_8	start pixel of detector channel 8+	1	int16	-
h_toa	height of the top of the atmosphere	m	float32	-
lambda_end_gdf	termination wavelength of GDF with respect to lambda_ss	1e-09m	float32	-
do_pol_point	flag for each of the 12 polarisation points to disregard this point for interpolation (true means disregard)	1	int8	1
sat_level	saturation level per detector array	1	int32	1
pmd_saturation_limit	signal limit above which a PMD readout is regarded as saturated	1	uint16	-
do_use_limbdark	flag to apply limb dark sky correction (0: no, 1: yes)	1	int8	-
do_pixelwise	flag for pixelwise processing per channel (true means pixelwise)	1	int8	1
alpha0_asm	azimuth mirror zero offset	1	float32	-
alpha0_esm	elevation mirror zero offset	1	float32	-
do_fraunhofer	flag to calculate for channel j the spectral calibration parameters from solar lines	1	int8	1
do_etalon	perform Etalon correction for channel j	1	int8	1
do_ib_sd_etn	flag to indicate if diffuser etalon shall be applied for PMD in-band	1	int8	1
do_ib_oc_etn	flag to indicate if aperture etalon shall be applied for PMD in-band (sun occ)	1	int8	1
level_2_smr	sun reference spectrum record number to be used for level 1b to 2 processing	1	int8	1

19 STATES

Table 153: *Variables of group STATES*

Name	Description	Unit	Type	# Dim.
delta_time	time offset in seconds from midnight	s	float64	1
state_index	the index of the state in this product counted from 0	1	int16	1
state_id	the ID for this measurement mode with a certain viewing and integration configuration	1	int8	1
measurement_category	the measurement category (limb, nadir, sun, etc)	1	int8	1
orbit_phase	orbit-phase starts when instrument goes into eclipse, so solar elevation is zero	1	float32	1
state_duration	the duration of the measurement period (state)	s	float32	1
repetitions_shortest_it	number of scans with shortest integration time in this state	1	int16	1
repetitions_longest_it	number of scans with longest integration time in this state	1	int16	1
longest_integration_time	actually the longest readout-time: max(exposure-time,0.0625s)*coaddings	s	float32	1

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Name	Description	Unit	Type	# Dim.
shortest_integration_time	actually the shortest readout-time: max(exposure-time,0.0625s)*coaddings	s	float32	1
number_of_diff_ITs	number of different ITs in this state	1	int16	1
different_integration_time	all different integration times according number_of_diff_ITs (biggest IT first), actually the readout-times: max(exposure-time,0.0625s)*coaddings	s	float32	2
number_of_PMD_integrals	number of PMD integrals in this state	1	int16	1
number_of_clusters	number of clusters in this state	1	int8	1
cluster_id	cluster identifier (1 to 64) of this cluster	1	int8	2
channel_id	channel identifier (1 to 8) of the channel to which this cluster belongs	1	int8	2
start_pixel	start detector pixel in the channel of this cluster	1	int16	2
length	number of detector pixels of this cluster	1	int16	2
exposure_time	the exposure time of this cluster	s	float32	2
coaddings	number of coadded integrations of this cluster	1	int8	2
integration_time	integration time of this cluster (exposure-time * coaddings)	s	float32	2

20 STATES_GEOLOCATION

Table 154: *Variables of group STATES_GEOLOCATION*

Name	Description	Unit	Type	# Dim.
delta_time	time offset in seconds from midnight	s	float64	1
latitude_bounds	the corner coordinate latitudes of the state	degrees_north	float32	2
longitude_bounds	the corner coordinate longitudes of the state	degrees_east	float32	2

21 STATES_QUALITY

Table 155: *Variables of group STATES_QUALITY*

Name	Description	Unit	Type	# Dim.
delta_time	time offset in seconds from midnight	s	float64	1
detector_channel	index of the detector channel (0, 1, ... 7)	1	int16	1
overall_quality_flag	Overall quality of the product, esp. if data were taken in the SAA	1	int8	1
diff_fraunhofer	Mean value of the wavelength differences of Fraunhofer lines compared to the wavelength calibration parameters (per channel)	1e-09m	float32	2
stddev_fraunhofer	Standard deviation of the wavelength differences (per channel)	1	float32	2
leakage_quality	Mean difference of leakage current or offset per channel and PMD (this field is only valid for limb states; channel 1 to 8, general PMD A to F and the 45 deg PMD)	1	float32	2
sun_glint_flag	sun glint region flag	1	int8	1
rainbow_flag	rainbow flag	1	int8	1
saa_flag	south atlantic anomaly (SAA) region flag	1	int8	1
decontamination_flag	flag indicating higher detector temperatures (caused by e.g. decontaminations)	1	int8	2
hot_pixel_counter	Number of hot pixels per channel and PMD (order: 1 to 8 and A to F and 45 deg)	1	int16	2