Welcome to the GOME-2 Products Guide. As a potential user of GOME-2 products, you will find here information to help you get familiar with the GOME-2 instrument, the data processing, end-product contents and format and potential usage and applications.

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History of changes

Date	Section	Description of change
28/02/2005	full doument	initial version 1.0

GOME 2 Products Guide

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1. Introduction

This document is provides a top-level overview of the GOME-2 instrument and its data processing system, from instrument build to product validation. The document is primarily aimed at those unfamiliar with GOME-2. As such the reader is provided with a high-level description of all the relevant components of the GOME-2 system with references to more detailed information in case this is required.

The GOME-2 instrument and basic operating principles are introduced in See The GOME-2 Instrument. A short description of the instrument hardware is provided in See Instrument Hardware., followed by a summary of the data packet structure and basic instrument operation in See Data Packet Structure and Basic Instrument Operation. An overview of the instrument observation modes is provided in See Observation Modes. and the concept of GOME-2 timelines and timeline tables is introduced in See GOME-2 Timelines & Timeline Tables. In See On-ground Calibration & Characterisation. the on-ground calibration and characterisation requirements and activities are discussed. This is followed by a summary of the planned in-flight calibration and characterisation activities in See In-Flight Characterisation & Calibration.

See GOME-2 Data Processing. provides an overview of the GOME-2 data processing system. The level 0 to 1b processor, part of the Core Ground Segment (CGS) located at EUMETSAT in Darmstadt, is described in See Level 0 to 1b Data Processing. A functional breakdown of the main components of the level 0 to 1b data processor is given, followed by a brief description of the algorithmic functions in See Algorithmic Functions., planned instrument monitoring activities in See Sensor Performance Assessment., and product quality monitoring activities in See Product Quality Evaluation. Additionally, a summary of the expected product accuracies is provided in See Level 1b Product Summary and Estimated Accuracies. and an overview of the level 0, 1a and 1b product formats in See Product Formats & Sizes.

See Level 1b to 2 Data Processing. describes the operational level two products produced under the responsibility of the Ozone Monitoring Satellite Application Facility (O3MSAF). A brief discussion of the O3MSAF consortium is given in See The Ozone Monitoring Satellite Application Facility. followed by a description of the level 2 products to be produced by the O3MSAF in See Operational Level 2 Products from GOME-2. For each of the products the responsible institute, a brief description of the algorithm basis, and short description of the product format are given. Examples of pre-operational products are provided if available. A summary of the range of geophysical level 2 products, and their expected accuracy and precision, both real time and off-line, that will be generated from GOME-2 by the O3MSAF is given in See Expected product accuracies for operational GOME-2 level 2 products produced by the O3M SAF.

In See In-Orbit Monitoring, Verification & Validation. a summary of GOME-2 in-orbit monitoring, verification and validation activities is provided. The overall objectives of in-flight GOME-2 characterisation, calibration and validation activities are listed in See Objectives. GOME-2 in-orbit instrument verification, to be carried out under the responsibility of ESA/SSST, is discussed in See GOME-2 In-Orbit Verification. Long-term instrument monitoring activities are briefly discussed in See Instrument Monitoring. followed by a summary of planned level 1 verification, confidence checking and validation activities in See Level 1 Verification, Confidence Checking and Validation. Atmospheric constituent verification and validation activities, to be carried out centrally at EUMETSAT in support of level 1 validation are discussed in See Atmospheric Constituent Verification and Validation. Level 2 operational product validation services to be provided by the O3MSAF are listed in See Validation of Ozone Monitoring SAF Products. followed by a brief discussion of the role of the EUMETSAT/ESA Research Announcement of Opportunity in product calibration and validation activities in See Scientific Activities Carried out via the EPS/MetOp RAO.

A list of acronyms is provided in See Acronyms. Examples of in-flight calibration parameters and their effect on the spectrum to which they are applied are provided in See Examples of In-Flight Corrections and Calibration.

Acknowledgements

The authors wish to acknowledge the invaluable contributions of the GOME-2 project team at ESTEC, the O3MSAF project team, and colleagues at EUMETSAT without whom a successful GOME-2 flying on MetOp would not be possible.

2. Reference documents

The following documents have been used to compile the information in this guide. Some of them are referenced to within the text, others are provided here for further reading.

2.1 EPS Programme documents

[RD1] EPS End User Requirements Document, EUM.EPS.MIS.REQ.93.001

[RD2] EPS Core Ground Segment Requirements Documents, EPS.CGS.REQ.95327

[RD3] EPS Generic Product Format Specification, EPS.GGS.SPE.96167

[RD4] MetOp GOME-2 Instrument Operation Manual, MO-MA-ESA-GO-0304

[RD5] MetOp GOME-2 In-Flight Calibration and Characterisation Plan, MO-PL-ESA-GO-0188

[RD6] MetOp GOME-2 In-Orbit Verification Plan, MO-PL-ESA-GO-0506

[RD7] GOME-2 Level 1 Product Generation Specification, EPS.SYS.SPE.990011

[RD8] GOME-2 Level 1 Product Format Specification, EPS.MIS.SPE.97232

[RD9] GOME-2 Science Data Packet Definition, MO-DS-LAB-GO-0006

[RD10] GOME-2 Requirements Specification, MO-RS-ESA-GO-0071

[RD11] GOME-2 Calibration Plan, MO-PL-TPD-GO-0004

[RD12] GOME-2 Calibration Error Budget, MO-RS-TPD-GO-0016

[RD13] GOME-2 Calibration: Data analysis procedures, MO-RS-TPD-GO-0027

[RD14] GOME-2 FM3 Calibration: Radiometric Calibration, MO-TR-TPD-GO-0098

[RD15] GOME-2 FM3 Calibration: Instrument Performance Testing, MO-TR-TPD-GO-0094

[RD16] GOME-2 FM3 Calibration: Spectral Stray Light, MO-TR-TPD-GO-0096

[RD17] GOME-2 FM3 Slit Function Test Report MO-TR-TPD-GO-0101

[RD18] GOME2 Calibration: Key Data file structure specification, MO-RS-TPD-GO-0025

[RD19] GOME-2 Instrument Calibration: Key Data status list, MO-LI-TPD-GP-0026

[RD20] GOME-201 Calibration Results Review Board Report, MO-RP-ESA-GP-0360

[RD21] GOME-202 Calibration Results Review Board Report, MO-RP-ESA-GP-0432

[RD22] GOME-202 Calibration Results Review Board Report, MO-RP-ESA-GP-0499

[RD23] EPS/MetOp Research Announcement of Opportunity, EUM/STG/42/03/DOC/06

2.2 SAF documents

[O3M1] Ozone SAF User Requirements Document, SAF/O3/RQ/URD

[O3M2] Ozone SAF Science Plan, SAF/O3/FMI/ALG/PL

[O3M3] Ozone SAF Scientific Prototyping Report, SAF/O3/FMI/ALG/REP

[O3M4] Ozone SAF Output Product Format Document for OOP and ARS, SAF/O3M/KNMI/OPF/003

[O3M5] Ozone SAF Output Product Format for GOME-2 Total Column Densities of Ozone and Minor Trace Gases, SAF/O3M/DLR/OPF/001

[O3M6] Ozone SAF NUV Output Product Format, SAF/O3M/DMI/OPF/002

[O3M7] Ozone SAF Output Product Format Document for OUV, SAF/O3M/FMI/OPF/002

2.3 Papers, reports and other technical documentation

[SCD1] Callies, J., E. Corpaccioli, M. Eisinger, A. Hahne and A. Lefebvre, "GOME-2 - MetOp's Second Generation Sensor for Operational Ozone Monitoring", ESA Bulletin, No. 102, May 2000

[SCD2] GOME-2 Error Assessment Study Final Report, EUM Contract EUM/CO/01/901/DK

[SCD3] GOME-2 Error Assessment Study Phase V Final Report, EUM Contract EUM/CO/01/901/DK

[SCD4] I. Aben, M.R. Dobber, D.M. Stam and P. Stammes, "Error Analysis of Polarisation Measurements by GOME", GOME Geophysical Validation Campaign, Final results Workshop Proceedings, ESA WPP-108, 51-59, May 1996

[SCD5] van Oss, R. and R. van der A, "Retrieval of Ozone Profiles from GOME and SCIAMACHY (GOME O3 Profiling Working Group), Proceedings of the 2004 ERS & ENIVSAT Symposium, 6 - 10 September, Salzburg, Austria, in press, 2004.

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[SCD9] Prospero, J.M, P. Ginoux, O. Torres, S.E. Nicholson and T.E. Gill, "Einvironmental characterization of global sources of atmospheric soil dust identified with the Nimbus 7 Total Ozone Mapping Spectrometer (TOMS) Absorbing Aerosol Index Product, Reviews of Geophysics, Vol. 40, No. 1 2002.

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[SCD11] WMO, "Report of the WMO meeting of experts on UV-B measurements, data quality and standardization of UV-indices", Global Atmosphere Watch Report no. 95, 1994.

[SCD12] Kylling, A., "UVSPEC: A program package for calculation of diffuse and direct UV and visible intesities and fluxes" (available by anonymous ftp to kaja.gi. alaska.edu, cd pub/arve).

[SCD13] Stamnes K, S.C. Tsay, W. Wiscombe and K. Jayaweera, "A numerically stable algorithm for discrete ordinate method radiative transfer in multiple scattering and emitting layered media, Applied Optics, 27, 2502-2509, 1988.

[SCD14] McKinlay, A.F., and B.L. Diffey, "A reference action spectrum for ultraviolet induced erythema in human skin", CIE Journal, No. 6, Vol. 1, 17-22, 1987.

[SCD15] Caldwell, M.M., "Solar ultraviolet radiation and the growth and development of higher plants. Photophysiology: Volume 6", ed. A.C. Giese, Academic Press, New York, 131-177, 1971.

[SCD16] Setlow, R.B., "The Wavelengths in Sunlight Effective in Producing Skin Cancer: A Theoretical Analysis", Proc. Nat. Acad. Sci. USA, 71, 9, 3363-3366, 1974.

[SCD17] De Gruijl, F.R., and J.C. Van der Leun, "Estimate of the wavelength dependency of ultraviolet carcinogenesis in humans and its relevance to the risk assessment of a stratospheric ozone depletion", Health Physics, 67, 4, 319-324, 1994.

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[SCD19] Herman, J.R., and E. Celarier, "Earth surface reflectivity climatology at 340-380 nm from TOMS data", J. Geophys. Res., 102, 28, 003-011 1997.

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[SCD25] Komhyr, W.D., "Operations Handbook - Ozone Observations with a Dobson Spectrophotometer", WMO Global Ozone Research and Monitoring Project, Report No. 6, 1980

[SCD26] Basher, R.E., "Review of the Dobson Spectrophotometer and Its Accuracy", WMO Global Ozone Research and Monitoring Project, Report No. 13, December 1982

[SCD27] Kerr, J.B., C. T. McElroy, D. I. Wardle, R. A. Olafson, and W.F.J. Evans, "The automated Brewer spectrophotometer", p. 611-614, Proc. of the Quadrennial Ozone Symposium, ed. C. S. Zerefos and A. Ghazi, D.Reidel Publ. Co., 1984

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3. GOME-2 Products configuration history

This section will be available when the products become operational

4. GOME-2 Products Overview

4.1. The GOME-2 instrument

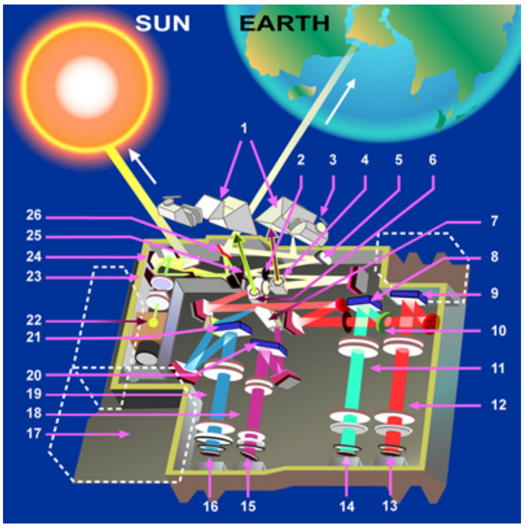
4.1.1. Instrument hardware

GOME-2 is a medium-resolution double UV-VIS spectrometer, fed by a scan mirror which enables across-track scanning in nadir, as well as sideways viewing for polar coverage and instrument characterisation measurements using the moon. The scan mirror directs light into a telescope, designed to match the field of view of the instrument to the dimensions of the entrance slit. This scan mirror can also be directed towards internal calibration sources or towards a diffuser plate for calibration measurements using the sun (See Artists Impression of the GOME-2 Optical Layout (courtesy of ESA).).

GOME-2 comprises four main optical channels which focus the spectrum onto linear silicon photodiode detector arrays of 1024 pixels each, and two Polarisation Measurement Devices (PMDs) containing the same type of arrays for measurement of linearly polarised intensity in two perpendicular directions.

The four main channel detectors are actively cooled in a closed loop configuration to -38°C to maximise sensitivity and minimise noise. In contrast the two PMD detectors are cooled in an open loop configuration to an operating temperature of around 0°.

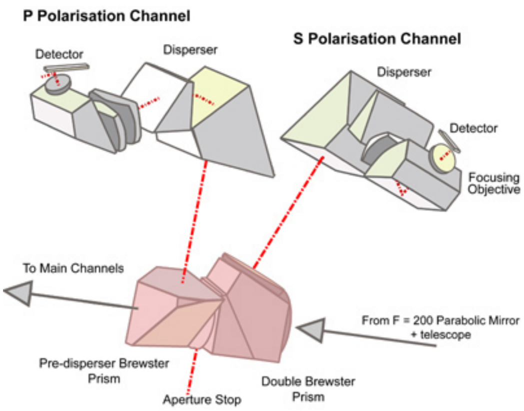
The PMDs are required because GOME-2 is a polarisation sensitive instrument and therefore the intensity calibration must take account of the polarisation state of the incoming light. This is achieved using information from the PMDs.



Artists Impression of the GOME-2 Optical Layout (courtesy of ESA)

1 - Disperser	10 - Beam splitter	19 - Channel # 2
2 - Calibration Slit	11 - Channel # 3	20 - Grating # 1
3 - Detector	12 - Channel # 4	21 - Grating # 2
4 - Double Brewster Prism	13 - 590 -790 nm	22 - Calibration lamp
5 - Telescope mirror	14 - 401 - 600 nm	23 - Calibration Unit
6 - Predisperser Prism	15 - 240 - 315 nm	24 - Sun diffuser
7 - Channel Separator	16 - 311 - 403 nm	25 - Telescope mirrors
8 - Grating # 3	17 - Electronics box	26 - Scan mirror
9 - Grating # 4	18 - Channel # 1	

Light is collimated by an off-axis parabolic mirror, behind the entrance slit, onto the double Brewster and pre-disperser prisms which generate the s- and p- polarised beams. These beams are subsequently dispersed onto detectors contained within the Polarisation Unit (PU).

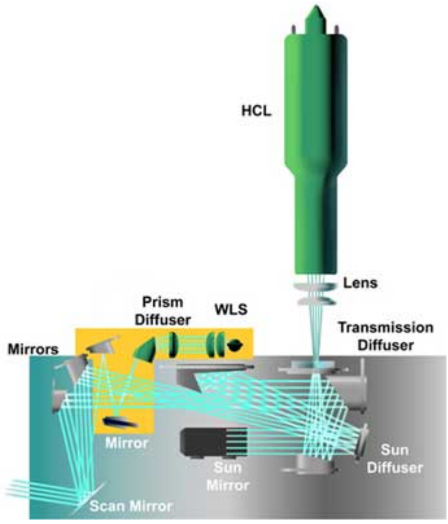


The GOME-2 Polarisation Unit (PU) Detailed Optics (courtesy of ESA)

Light passing through the pre-disperser prism is also directed onto the main spectrometer. A second off-axis parabolic mirror focuses the dispersed beam onto the channel separator prism. This is a quartz prism the first surface of which is partially coated with a transmission coating for channel 1 and a reflective coating for channel 2. The light for channels 3 and 4 passes the prism edge and a dichroic filter separates it into the two channels.

The four main channels provide continuous spectral coverage of the wavelengths between 240 and 790nm with a spectral resolution (FWHM) between 0.25nm and 0.5nm. Compared to the main channels, the PMD measurements are performed at lower spectral resolution, but at higher spatial resolution. The two PMD channels are designed such that maximum similarity in their optical properties is ensured. The wavelength-dependent dispersion of the prisms causes a much higher spectral resolution in the ultraviolet than in the red part of the spectrum.

In order to calculate the transmission of the atmosphere, which contains the relevant information on trace gas concentration, the solar radiation incident on the atmosphere must be known. For this measurement a solar viewing port is located on the flight-direction side of the instrument. When this port is opened, sunlight is directed via a ~40° incidence mirror to a diffuser plate. Light scattered from this plate, or in general, light from other calibration sources such as the Spectral Light Source (SLS or HCL) for wavelength calibration, and the White Light Source (WLS) for etalon (and, optionally, pixel-to-pixel gain) calibration are directed to the scan mirror using auxiliary optics. Diffuser reflectivity can be monitored internally using light from the SLS. All internal calibration sources with their optics are assembled in a subsystem called the `Calibration Unit' (CU). The only exception are light emitting diodes (LEDs) which are located in front of the detectors to monitor the pixel-to-pixel gain. For more information on the GOME-2 instrument see [SCD1] Callies, J., E. Corpaccioli, M. Eisinger, A. Hahne and A. Lefebvre, "GOME-2 - MetOp's Second Generation Sensor for Operational Ozone Monitoring", ESA Bulletin, No. 102, May 2000.



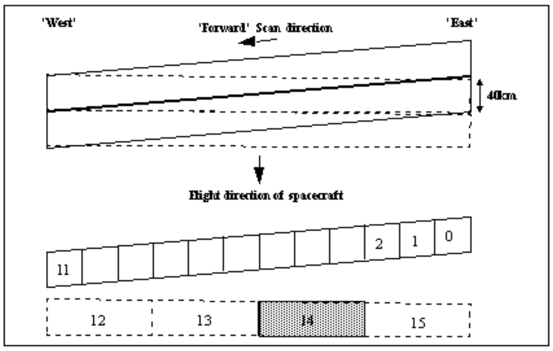
The GOME-2 Calibration Unit (CU) (courtesy of ESA)

4.1.2. Data packet structure and basic instrument operation

Every 375 milliseconds, GOME-2 generates one science data packet. A data packet comprises 9369 2-byte words, leading to an average data rate of 8·2·9369/0.375 bit/s = 400 kbit/s. A detailed description of the science data packet format is provided in See [RD9] GOME-2 Science Data Packet Definition, MO-DS-LAB-GO-0006. Briefly, a GOME-2 data packet consists of three basic parts (apart from header information): instrument housekeeping (HK) data (e.g., temperatures, scan mirror angles, lamp currents and voltages), PMD data, and main channel Focal Plane Assembly (FPA) data. The maximum temporal resolution differs between main channel FPA and PMD data. One data packet contains up to 2 main FPA readouts, corresponding to a 187.5ms temporal resolution, and up to 16 PMD readouts, corresponding to a 23.4ms temporal resolution. A detailed description of the options for PMD readout and data transfer is given in Appendix B of See [RD7] GOME-2 Level 1 Product Generation Specification, EPS.SYS.SPE.990011.

A basic concept in the operation of the GOME-2 instrument is that of the `scan'. A scan is defined as a time interval of 6 seconds, consisting of 16 `subsets' of 375ms each, equivalent to one data packet. The subsets are numbered from 0 to 15. In the earth scanning mode, a scan consists of one scan cycle: 4.5s forward scan (subsets 0 to 11) and 1.5s flyback (subsets 12 to 15). In the static and calibration modes the scan mirror does not move, but the data packet structure is identical to the scanning mode.

In the default measuring mode, the nadir scan, the scan mirror sweeps in 4.5 seconds (12 subsets) from negative to positive viewing angles[1], followed by a flyback of 1.5 seconds (the last 4 subsets) back to negative viewing angles as shown in See The GOME-2 scan pattern in the default measuring mode.



The GOME-2 scan pattern in the default measuring mode.
Solid line: forward scan; dashed line: flyback. Each subset pixel (0-15) corresponds to 375 milliseconds. In one of the four subsets of the flyback (subset 14 is shown as an example) the `unused' parts of the PMD detectors (i.e. Block A see Appendix B of See [RD7] GOME-2 Level 1 Product Generation Specification, EPS.SYS.SPE.990011.) are read out. Note that the figure is not drawn to scale.

The default swath width of the scan is 1920km which enables global coverage of the Earth's surface within 1.5 days (note that other swath widths are also commandable). The scan mirror speed can be adjusted such that, despite the projection effect, the ground is scanned at constant speed. The along-track dimension of the instantaneous field-of-view (IFOV) is ~40km which is matched with the spacecraft velocity, such that each scan closely follows the ground coverage of the previous one. The IFOV across-track dimension is ~4km. For the 1920 km swath, the maximum temporal resolution of 187.5ms for the main channels (23.4ms for the PMD channels) corresponds to a maximum ground pixel resolution (across track x along track) of 80km x 40km (10km x 40km for the PMDs) in the forward scan.

The actual integration time used (and thus the ground pixel size) will depend on the light intensity. The integration time can be separately set for each channel; in channel 1 and 2 it is even possible to subdivide the channel in two parts (called `band 1a', `band 1b' and `band 2a', `band 2b' respectively) having separate integration times. It is anticipated that a default integration time of 187.5ms (yielding two spectrum readouts per data packet) will be used in all channels with two exceptions where longer integration times are needed because of low light intensity: (i) Band 1a has a default integration time of 1.5 seconds (yielding three spectra per scan and one from the fly-back with the possibility of co-adding spectra to improve signal to noise characteristics). (ii) The integration time for all channels will be increased for low solar elevations (high solar zenith angles).

4.1.3. Observation modes

This section gives a classification of the GOME-2 observation modes. The observation modes can be assigned to three categories: earth observation modes, calibration modes, and other modes.

The observation mode is derived in the data processing chain by combining fields from the data packet, such as scan mirror position, subsystem status flags, etc. There is no dedicated field in the data packet indicating the observation mode. Any GOME-2 data packet which does not fit into one of the modes below will be classified as "invalid" by the level 0 to 1 data processor.

Earth observation modes

Earth observation (or "Earthshine") modes are those modes where the earth is in the field of view of GOME-2. They are usually employed on the dayside of the earth (sunlit part of the orbit). The scan mirror can be at a fixed position (static modes), or scanning around a certain position (scanning modes). All internal light sources are switched off and the solar port of the calibration unit is closed.

Nadir scanning

This is the mode in which GOME-2 will be operated most of the time. The scan mirror performs a nadir swath as described above. The swath width is commandable, its default value is 1920km. Scanning can be performed either with constant ground speed, resulting in equally sized ground pixels (this is the default), or with constant angular speed ("GOME-1 mode"), resulting in larger ground pixels for the extreme swath positions as compared to the swath centre.

North polar scanning

The scan mirror performs a swath around the viewing angle +46.696º (default value) in order to cover the North Pole which would be not observable with the normal nadir scanning mode. This mode will typically be used during Northern hemisphere spring.

South polar scanning

The scan mirror performs a swath around the viewing angle -46.172º (default value) in order to cover the South Pole which would be not observable with the normal nadir scanning mode. This mode will typically be used during Southern hemisphere spring.

Other scanning

The scan mirror performs a swath around another off-nadir position.

Nadir static

The scan mirror is pointing towards nadir. This mode will typically be used during the monthly calibration. It is valuable for validation and long-loop sensor performance monitoring purposes.

Other static

The scan mirror is pointing towards an off-nadir position.

4.1.4 Calibration modes

In-orbit instrument calibration and characterisation data are acquired in the various calibration modes. They are usually employed during eclipse with the exception of the solar calibration which is performed at sunrise. Both internal (WLS, SLS, LED) and external (sun, moon) light sources can be employed. The various sources are selected by the scan mirror position.

Dark

The scan mirror points towards the GOME-2 telescope. All internal light sources are switched off and the solar port is closed. Dark signals are typically measured every orbit during eclipse.

Sun (over diffuser)

The scan mirror points towards the diffuser. All internal light sources are switched off and the solar port is open. Solar spectra are typically acquired once per day at the terminator in the Northern hemisphere. The Sun Mean Reference spectrum will be derived from this mode.

White light source (direct)

The scan mirror points towards the WLS output mirror. The WLS is switched on and the solar port is closed. The WLS can be operated at four different currents (360, 380, 400, 420 mA). Etalon (and optionally Pixel-to-Pixel Gain (PPG) calibration) data will be derived from this mode.

Spectral light source (direct)

The scan mirror points towards the SLS output mirror. The SLS is switched on and the solar port is closed. Wavelength calibration coefficients will be derived from this mode.

Spectral light source (over diffuser)

The scan mirror points towards the diffuser. The SLS is switched on and the solar port is closed. Light from the SLS reaches the scan mirror via the diffuser. This mode is employed for in-orbit monitoring of the sun diffuser reflectivity.

LED

The scan mirror points towards the GOME-2 telescope. The LEDs are switched on and the solar port is closed. PPG calibration data will be derived from this mode.

Moon

The scan mirror points towards the moon (typical viewing angles are +70º to +85º). As the spacecraft moves along the orbit, the moon passes the GOME-2 slit within a few minutes. This mode can be employed only if geometrical conditions (lunar azimuth, elevation and pass angle) allow it which will typically occur a few times per year.

Other modes

These modes are either transitory (idle mode) or used in instrument maintenance (dump and test modes). In these modes, data packets are generated, however, they do not contain any useful scientific data.

Idle

This mode is reached during instrument switch-on or switch-off.

Dump

In place of PMD and main channel data, memory contents are downlinked. This mode is used for diagnostic purposes.

Test

In place of PMD and main channel data, a fixed test pattern is downlinked. This mode is used for diagnostic purposes.

4.1.5. GOME-2 timelines & timeline tables

The GOME-2 instrument may be operated using timelines (GTL) and timeline tables (GTT). Timelines are used primarily to reduce the load on the satellite up-link and additionally to provide on-board autonomy. One GTL is pre-loaded as a series of up to thirty three individual instrument commands that are executed without the intervention of the Instrument Control Unit (ICU) or the Payload Module Controller (PMC). GOME-2 can store up to sixteen timelines. Twelve default timelines will be loaded prior to launch and represent a library immediately available for use at the start of instrument operations.

GOME-2 operations and science data acquisition are strongly linked to the viewing geometry and the Solar Zenith Angle (SZA), which determine the expected intensity of light received and the corresponding integration times required. There is in principle no restriction to the duration of a timeline or when it can be activated during an orbit. However in order to simplify the sequencing and generation of timelines all default timelines start with a SZA equal to 90 degrees minus an arbitrary offset of 580 seconds and will have a duration of one orbit. The sequence of commands as well as their duration will remain constant over the year.

A GTT can be loaded, started and stopped by use of a macro command. The GTT allows twenty eight timelines and their execution times to be pre-loaded without the intervention of the ground segment or the PMC. There will be no default GTT stored on board & it is currently not planned to use the GTT capability for instrument operations.

See Example SOlar calibration Timeline (SOT) (courtesy of J. Callies, ESTEC)., based on photometric budget calculations, contains an example Solar calibration timeline (SOT) used once per day (provided by J.Callies, ESTEC). Note that for regular nominal scanning observations, the integration times in band 1a vary between 1.5 and 60 seconds (i.e. comprise up to 10 scans) and that all integration times in bands 1b - 4 are equal. For a full description of instrument operation and the default timelines see the See [RD4] MetOp GOME-2 Instrument Operation Manual, MO-MA-ESA-GO-0304.

Example SOlar calibration Timeline (SOT) (courtesy of J. Callies, ESTEC).

observation mode	time	SZA	band 1A	band 1B	band 2A+B	band 3 + 4
	(s)	(deg)	(s)	(s)	(s)	(s)
	duration		240-283nm	283-312nm	312-400nm	400-790 nm
dark	186		60	1.5	1.5	1.5
dark	120		1.5	0.375	0.375	0.1875
WLS	60		1.5	0.375	0.375	0.1875
dark	120		6	6	1.5	0.375
SLS	120		6	6	1.5	0.375
dark	240		1.5	0.375	0.375	0.375
sun	240		1.5	0.375	0.375	0.375
earth nadir scan	306	85	60	0.375	0.375	0.375
earth nadir scan	2223	70	12	0.1875	0.1875	0.1875
		...				
earth nadir scan	246	70	60	0.375	0.375	0.375
earth nadir scan	366	80	60	1.5	1.5	1.5
dark	306	100	60	1.5	1.5	1.5
dark	900		60	0.375	0.375	0.375
dark	651		12	0.1875	0.1875	0.1875
sum	6084					

4.1.6. On-ground calibration & characterisation

The GOME-2 instrument is built by an industrial team led by Galileo Avionica (I) with support from Laben (I), TNO-TPD (NL), Arcom Space (DK), Innoware (DK) and Finavitec (FIN) where TNO-TPD are responsible for the calibration and characterisation of the instrument. The requirements against which the instrument is built are detailed in See [RD10] GOME-2 Requirements Specification, MO-RS-ESA-GO-0071. Requirements on calibration and characterisation measurements, derived from the expected accuracy of individual calibration parameters and the experimental set-up for on-ground calibration and characterisation activities, are listed below See [RD11] GOME-2 Calibration Plan, MO-PL-TPD-GO-0004. & See [RD12] GOME-2 Calibration Error Budget, MO-RS-TPD-GO-0016.

Requirements on measurements made in thermal vacuum

- measurement of absolute spectral radiance with an accuracy of 2.4% at 250 nm and 1.6% at 655 nm
- measurement of absolute spectral irradiance with an accuracy of 2.3% at 250 nm and 1.5% at 655 nm
- characterisation of the BSDF of the calibration unit to better than 1.2%
- characterisation of all polarisation responses to better than 1.2%
- characterisation of the instrument slit function

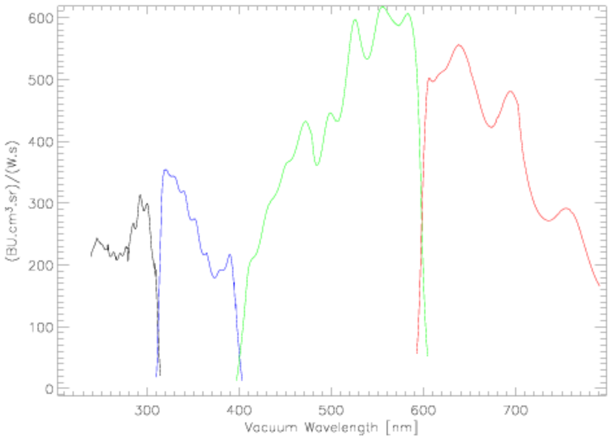
Requirements on measurements made under ambient conditions

- measurement of the scan angle dependence of polarisation and radiometric responses to 1.5% accuracy
- characterisation of the instrument straylight response
- characterisation of the instrument field of view.

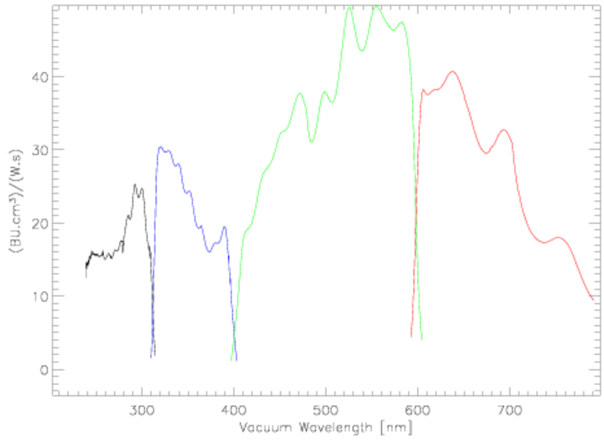
Calibration and characterisation measurements needed in order to meet these requirements are taken during an extensive on-ground campaign. The detailed characterisation measurements are fully described in See [RD11] GOME-2 Calibration Plan, MO-PL-TPD-GO-0004. and See [RD12] GOME-2 Calibration Error Budget, MO-RS-TPD-GO-0016. Characterisation measurements are post-processed to provide Calibration Key Data files which are documented both in terms of content and format in See [RD13] GOME-2 Calibration: Data analysis procedures, MO-RS-TPD-GO-0027., See [RD18] GOME2 Calibration: Key Data file structure specification, MO-RS-TPD-GO-0025. and See [RD19] GOME-2 Instrument Calibration: Key Data status list, MO-LI-TPD-GP-0026. Verification of the Calibration Key Data is addressed during dedicated Calibration Results Reviews for each flight model, See [RD20] GOME-201 Calibration Results Review Board Report, MO-RP-ESA-GP-0360., See [RD21] GOME-202 Calibration Results Review Board Report, MO-RP-ESA-GP-0432. & See [RD22] GOME-202 Calibration Results Review Board Report, MO-RP-ESA-GP-0499. Verification of the on-ground instrument performance against instrument requirements is also carried out at this time. A sub-set of the Calibration Key Data are a required input to the GOME-2 level 0 to 1 processor e.g. the radiance, irradiance and polarisation response of the instrument (see Absolute Radiance Response of GOME-2 FM-203 for the main channel FPAs., See Absolute Irradiance Response of GOME-2 FM-203 for the main channel FPAs. and See Polarisation Response Eta (intensity ratio of s to p polarised light for the exact nadir direction) of GOME-2 FM-203. for examples from the GOME-2 FM-203 Calibration Key data). For a full list of those Key Data used by the GOME-2 level 0 to 1b processing chain see [RD7] GOME-2 Level 1 Product Generation Specification, EPS.SYS.SPE.990011. Other Key Data describe aspects of the on-ground behaviour of the instrument which will also be measured in-orbit using on-board calibration targets e.g. dark signal performance, pixel-to-pixel gain, spectral calibration, and etalon. For these aspects the Calibration Key data form the starting point for instrument monitoring activities which are further discussed in See Product Quality Evaluation.

Additionally, the GOME-2 Error Assessment Study, See [SCD2] GOME-2 Error Assessment Study Final Report, EUM Contract EUM/CO/01/901/DK. & See [SCD2] GOME-2 Error Assessment Study Final Report, EUM Contract EUM/CO/01/901/DK., has shown for the first time that O3 profile retrieval is very sensitive to knowledge of the shape of the slit-function in the wavelength interval of the ozone Huggins bands (320-340nm), which is used for retrieval at low altitudes. It was therefore concluded that, for height-resolved O3 data products from GOME-2 to meet specified User Requirements See [RD1] EPS End User Requirements Document, EUM.EPS.MIS.REQ.93.001. & See [O3M1] Ozone SAF User Requirements Document, SAF/O3/RQ/URD., the slit-function shape must be characterised at sub-pixel resolution pre-flight, as this cannot be determined adequately from information available in-flight. As a result additional slit function characterisation data are being acquired during the on-ground calibration and characterisation campaign See [RD17] GOME-2 FM3 Slit Function Test Report MO-TR-TPD-GO-0101. These data will be further analysed by TNO-TPD and the Rutherford Appleton Laboratory to provide additional Calibration Key data that describes the slit-function shape at sub-pixel resolution, for use in level 1 to 2 processing.

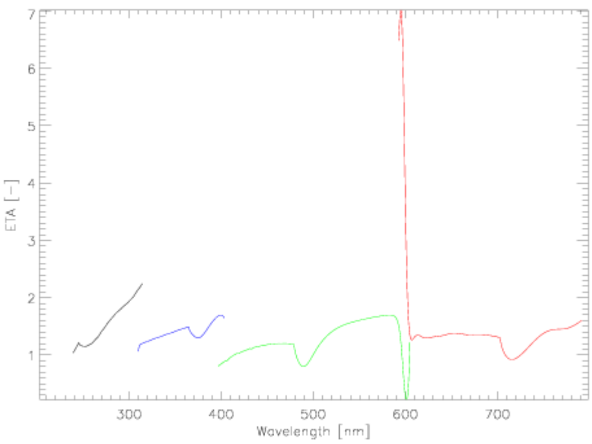
Trace gas absorption spectra measurements are also made with each flight model after completion of the other on-ground calibration and characterisation activities. This is a dedicated activity carried out by the University of Bremen with the support of TNO-TPD. In particular, absorption spectra of O3, NO2 and O2 will be measured in the wavelength region 230-800nm for a range of temperatures. These data will also be made available for use in level 1 to 2 processing.



Absolute Radiance Response of GOME-2 FM-203 for the main channel FPAs



Absolute Irradiance Response of GOME-2 FM-203 for the main channel FPAs



Polarisation Response Eta (intensity ratio of s to p polarised light for the exact nadir direction) of GOME-2 FM-203

4.1.7. In-Flight characterisation & calibration

A range of in-flight characterisation and calibration activities will be carried out routinely during GOME-2 operations. These activities will provide input to level 0 to 1b processing, in addition to the calibration Key data measured on-ground, to ensure the generation of high quality spectrally and radiometrically calibrated radiance and irradiance data and continuous monitoring of instrument performance.

The frequency of on-board calibration activities is scheduled taking into account:

- the expected temporal behaviour of known error sources
- economic usage of life limited items e.g. the calibration lamps & sun diffuser
- the requirement for minimum interference with nominal observations.

Calibration activities interleaved with nominal observations comprise dark signal measurements performed every orbit in eclipse and sun calibration measurements performed once per day at sunrise in the Northern hemisphere. The sun calibration uses one of the twelve on-board stored timelines which includes in addition to the sun measurements itself, both a wavelength calibration and a radiometric calibration. The timeline must be triggered such that the instrument is commanded into SUN observation mode prior to the sun appearing in the instrument field of view. For the remainder of the orbit the timeline consists of nadir scanning observations.

In addition, regular monthly calibration activities are planned. The frequency is determined by the expected change in the mean optical bench temperature, resulting from seasonal variations in the external heat load from the sun, and long-term degradation of thermo-optical surfaces. Although it is primarily the wavelength calibration that is expected to vary, it is logical to perform diffuser characterisation and other calibration and monitoring activities during the monthly calibration activities.

A brief summary of the planned in-flight calibration and characterisation and monitoring activities is given in See Summary of the planned in-flight calibration and characterisation and monitoring activities. Further details may be found in See [RD5] MetOp GOME-2 In-Flight Calibration and Characterisation Plan, MO-PL-ESA-GO-0188.

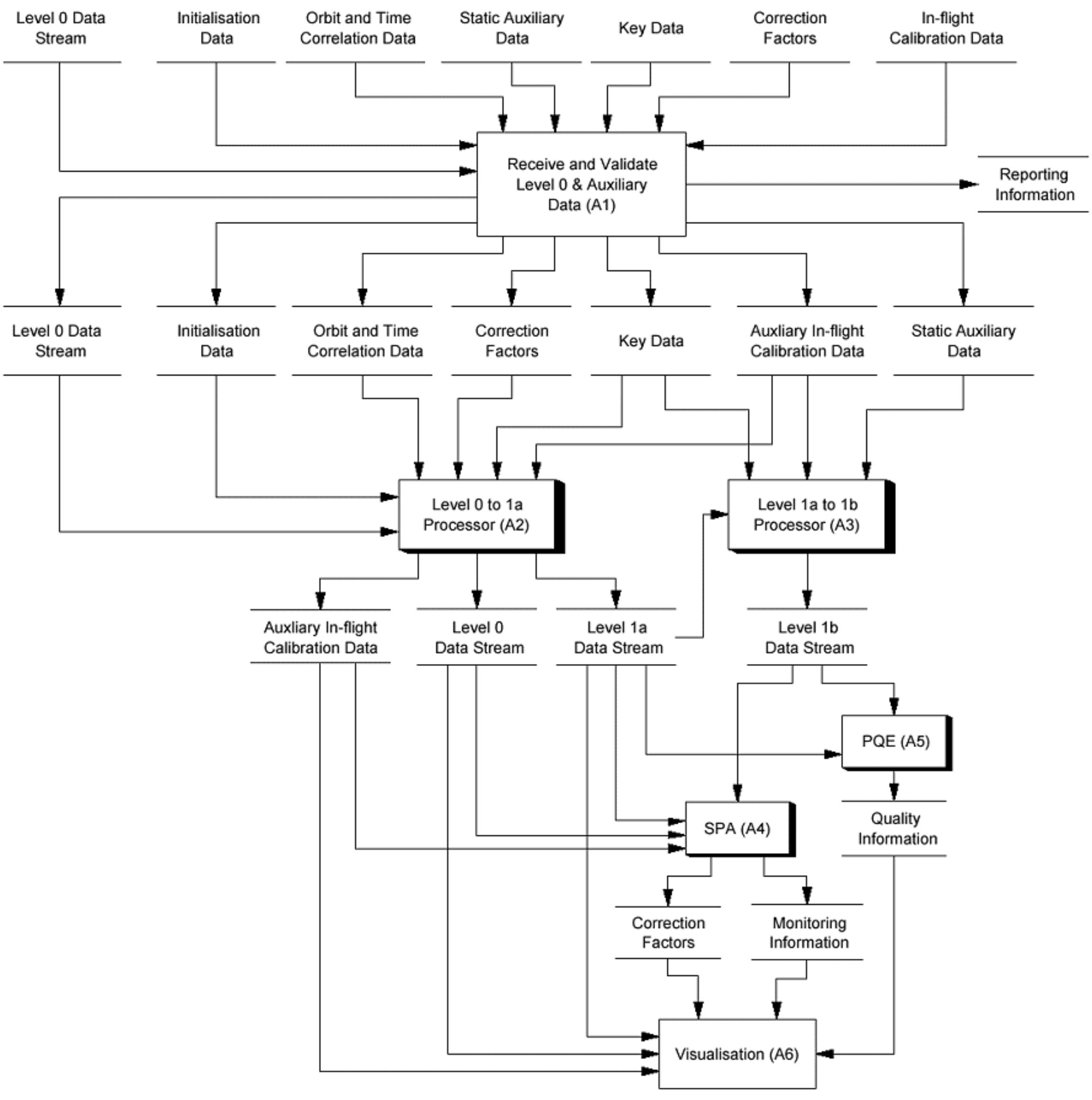
Summary of the planned in-flight calibration and characterisation and monitoring activities

Activity	Mode	Frequency	Duration	Usage
Radiometric Calibration: Dark Signal	Dark	every eclipse	~ 30 mins per orbit	Calculate Dark Signal Correction
Radiometric Calibration: Uniformity of Pixel Response	LED	monthly	~ 10 mins	Calculate Pixel to Pixel Gain Correction
Wavelength Calibration	Spectral Light Source (Direct)	monthly daily before Sun calibration	~ 4 min x 3 per orbit ~ 2 mins	Calculate Spectral Calibration Parameters for Main Channels Calculate Spectral Calibration Parameters for PMD Channels
Radiometric Calibration: Relative	White Light Source (Direct)	daily after Sun calibration	~ 4 mins	Calculate Etalon Correction
Radiometric Calibration: Sun Calibration	Sun over Diffuser	daily at the terminator in the Northern hemisphere	~ 30 seconds - full operational mode lasts ~2 mins	Calculate Solar Mean Reference
Monitoring: Diffuser Monitoring	Spectral Light Source (over Diffuser)	monthly	~ 15 mins during eclipse	Instrument Monitoring: stability of the Sun diffuser
Monitoring: Moon Measurements	Moon	whenever the Moon is in the Field of View and the pass angle between the moon pass and the along slit direction is sufficient typically 3 to 6 times per year	variable during eclipse	Instrument Monitoring: wavelength degradation of the scan mirror reflectivity
Monitoring: Static View Measurements	Nadir Static	after monthly calibration	two full orbits	Instrument Monitoring: potential degradation in the polarisation measuring devices

4.2. GOME-2 data processing

4.2.1. Level 0 to 1b data processing

The central processing facility, located at EUMETSAT headquarters in Darmstadt, is responsible for the processing of all GOME-2 data up to level 1b, and delivers level 0, level 1a and level 1b products to the User community. This level 0 to 1b processing is carried out within the Core Ground Segment (CGS) by the GOME-2 Product Processing Facility (PPF) which converts raw instrument data (level 0 data stream) into time-stamped, geolocated, and fully spectrally and radiometrically calibrated radiances or irradiances (level 1b data stream). Level 0, 1a and level 1b data products, product quality and monitoring information are also generated by the CGS. The first level of functional decomposition of the GOME-2 processor is shown in:



Functional Decomposition of the GOME-2 Processor.

Receive and validate Level 0 and auxiliary data

The receive and validate function, in addition to the generic checks identified in the See [RD2] EPS Core Ground Segment Requirements Documents, EPS.CGS.REQ.95327., performs the instrument-specific acceptance and checking of the input data. Its purpose is to accept the 1evel 0 data and to perform all checks required for validation of the input data before passing them to the algorithmic functions. This functionality correlates level 0 data with auxiliary data and also produces reporting statistics.

Level 0 to 1a processing

The level 0 to 1a processing comprises both the determination of geolocation information on a fixed time grid, and the determination of applicable calibration parameters. From measurements of the various calibration sources encountered during each run of the processor, new calibration constants are calculated and written into an in-flight calibration data storage location. They are also retained in memory for use in processing those data acquired after the satellite comes out of the dark side of the orbit and before the next dump. Calibration parameter usage will be updated at the terminator. Calibration parameters are stored for the lifetime of the mission. The calibration constant determination comprises:

- dark current correction
- pixel-to-pixel gain correction
- determination of spectral calibration parameters
- etalon correction
- determination of straylight correction factors for the sun and polarisation measurements
- determination of the solar mean reference spectrum, and atmospheric polarisation state

The geolocation of the measurements is calculated from the appropriate orbit and attitude information, and time correlation information in the level 0 data stream. Note, any application of calibration parameters in the level 0 to 1a processing should be regarded as interim, to facilitate the generation of new calibration parameters and correction factors. There is no application of calibration parameters to FPA earth observation measurements. A schematic of the level 0 to 1a processing flow is provided in Level 0 to 1b Data Processing. The output of the level 0 to 1a processor is to be formatted into the level 0 and 1a products as described in See Product Formats & Sizes. and specified in See [RD3] EPS Generic Product Format Specification, EPS.GGS.SPE.96167. and See [RD8] GOME-2 Level 1 Product Format Specification, EPS.MIS.SPE.97232.

Level 1a to 1b processing

The level 0 to 1b processing comprises the calculation of geolocation parameters for the actual integration time of each measurement, determination of straylight correction factors for the Earthshine measurements, and the conversion of the raw binary readouts on the level 1a data stream to calibrated radiance and irradiance data. Effective cloud fraction and cloud top pressure are also determined. Furthermore, calibrated measurements from the on-board calibration sources, and the sun and moon are available in the level 1b product. Level 1b data are formatted as described in See Product Formats & Sizes. and specified in See [RD3] EPS Generic Product Format Specification, EPS.GGS.SPE.96167. and See [RD8] GOME-2 Level 1 Product Format Specification, EPS.MIS.SPE.97232.

Sensor performance assessment (SPA)

The Sensor Performance Assessment (SPA) function allows instrument performance to be monitored for the lifetime of the mission. Performance is monitored both from an engineering point of view, using selected housekeeping data, and from a scientific point of view using spectral data, in particular in-flight calibration data, along with their respective time-tags and geolocation. The default sampling interval is one instrument science data packet. Housekeeping data and selected Earthshine data are extracted from the level 1 product files. In-flight calibration data are extracted from the in-flight calibration data storage location. Housekeeping data are converted from binary units to physical units. Spectral data are preprocessed according to the instrument mode. The SPA function handles the extraction and preprocessing of these monitoring parameters. The extracted and preprocessed monitoring parameters are stored in the SPA data storage location and are made available on request for further analysis. Degradation correction factors will be calculated from these data where appropriate, following detailed scientific analysis.

Product quality evaluation

The Product Quality Evaluation (PQE) function provides information about the quality of the generated level 1 data products. A number of checks are performed during Level 0 to 1a Processing and Level 1a to 1b Processing and the results are stored in Product Confidence Data records (PCDs) in the Level 1a and Level 1b data products. PCDs are provided both at the product and scan level. PCDs containing information about the quality of applied calibration parameters is also included. A pre-processing function extracts the PCDs directly after processing of the level 1a and 1b data and updates the PQE storage location with the extracted data. A second function further condenses the extracted data to provide daily, weekly, monthly and yearly Product Quality Summaries and "Quick-Look" information. The data generated by the PQE function are made available for further analysis and visualisation. The highest level of detail, on measurement pixel level, is not covered by automatic PQE functionality.

Auxiliary data required by the GOME-2 PPF

Initialisation data

This data set contains all parameter settings for the PPF, such as threshold values, switches between algorithm options, and instrument parameters not contained in the pre-flight calibration key data.

Orbit data

For Near Real Time processing a predicted orbit state vector is required as input for the geolocation calculations. During reprocessing restituted orbit data are expected to be available.

Time correlation information

This information is required for the conversion of On-Board Time (OBT) to Co-ordinated Universal Time (UTC).

Static auxiliary data

The static auxiliary data comprises the static data sets that are required for use in the level 1a to 1b processor. They are required in particular for the effective cloud fraction and cloud top pressure determination.

Key data

The Calibration Key data comprises the complete set of pre-flight calibration data which is provided by the instrument provider. A sub-set of these data are required as input to the level 0 to 1 processor.

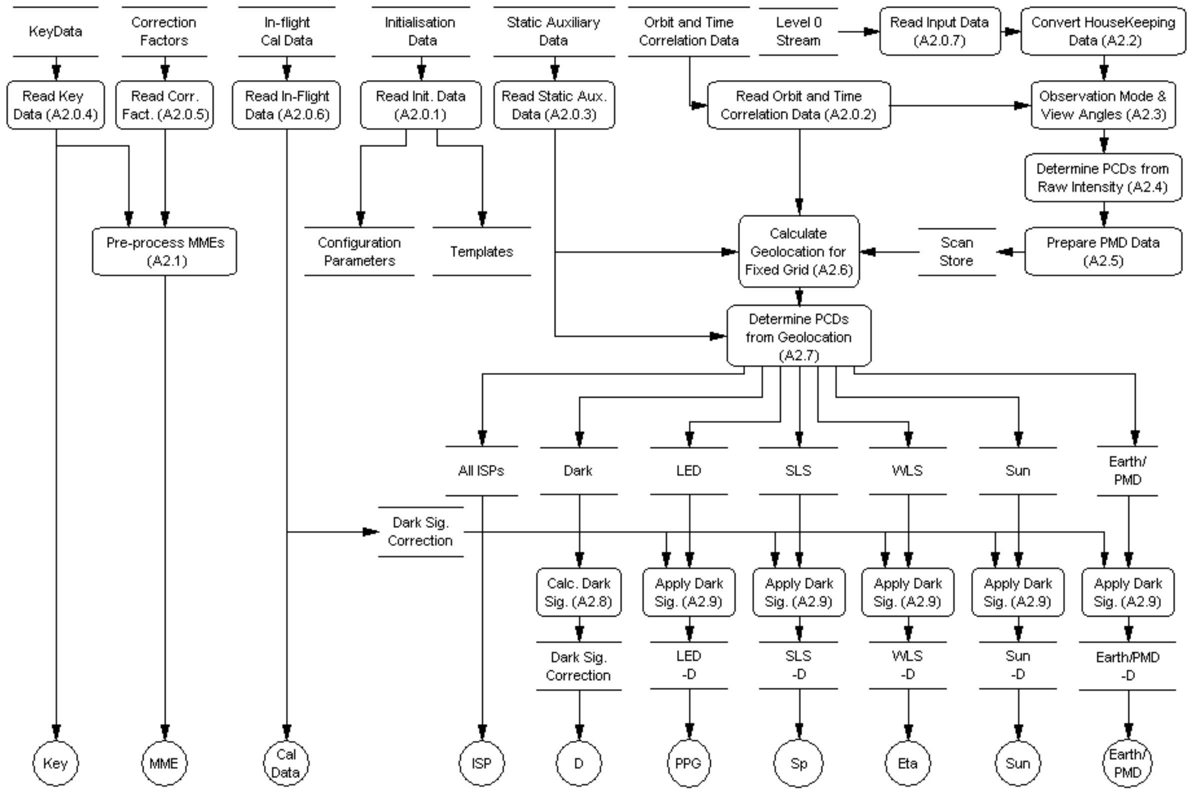
Correction factor data

Instrument characteristics such as radiance and irradiance sensitivity will change during the GOME-2 lifetime due to in-orbit degradation of the instrument. A subset of level 0, 1a and 1b data necessary for the calculation of correction factors will be generated by the SPA function using in-flight measurements and will be made available for the derivation of correction factors. The derived correction factors will subsequently be used in the PPF for level 0 to 1b processing. These data will not be available at the beginning of the in-orbit life of GOME-2.

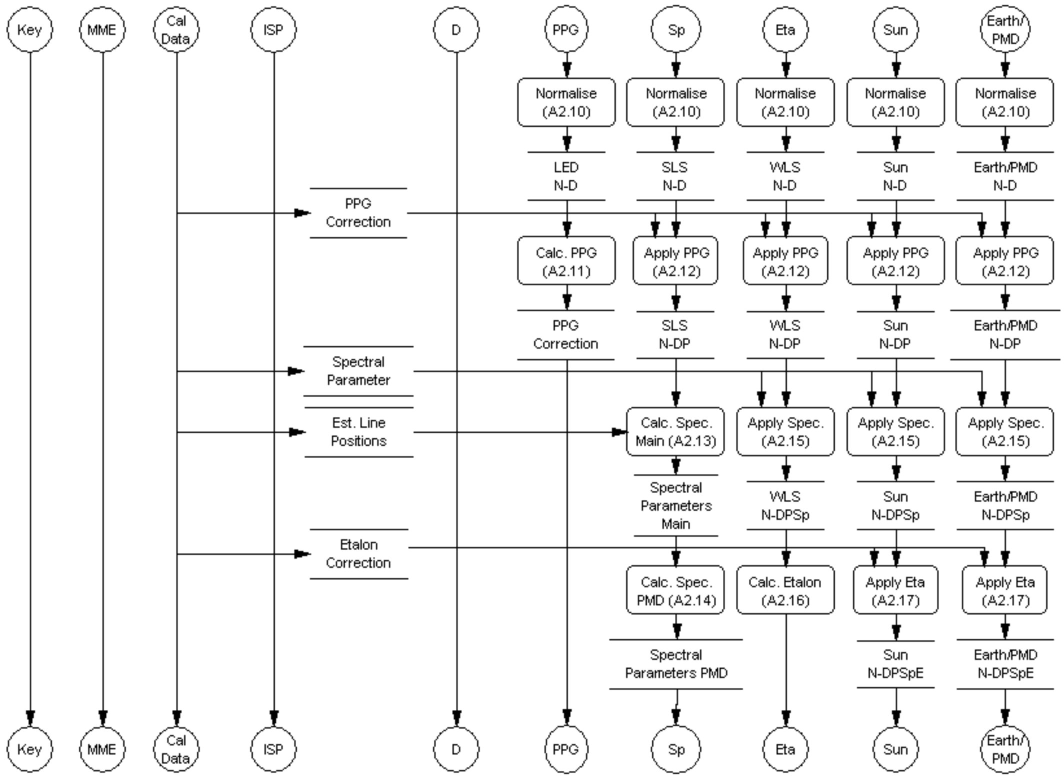
In-flight calibration data

The level 0 to 1a processing includes the determination of in-flight calibration parameters. From measurements of the various calibration sources encountered during each run of the processor, new calibration constants are calculated and written into an in-flight calibration data storage location. They are also retained in memory for use in processing those data acquired after the satellite comes out of the dark side of the orbit and before the next dump. As noted previously calibration parameter usage will be updated at the terminator. Calibration parameters will be stored for the lifetime of the mission.

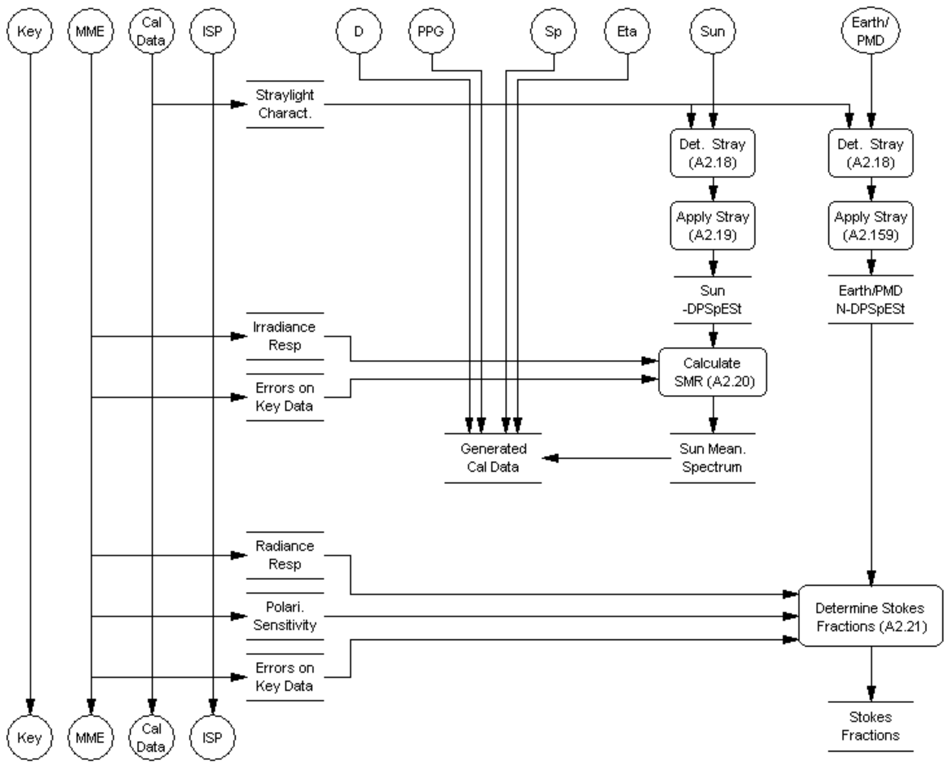
A2 Functional Decomposition: Level 0 to 1a Processor (1).



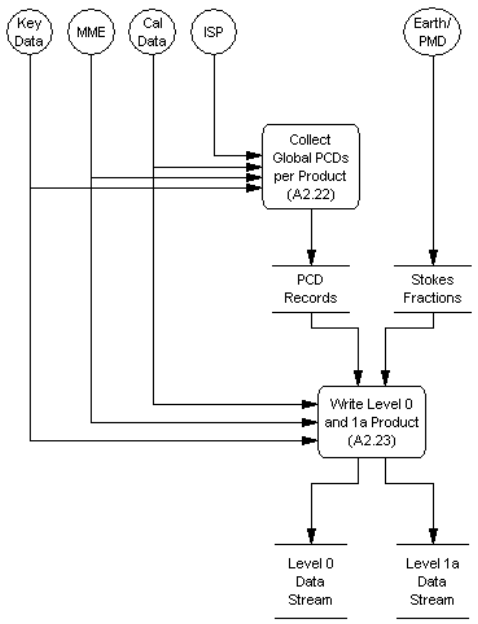
A2 Functional Decomposition: Level 0 to 1a Processor (2).



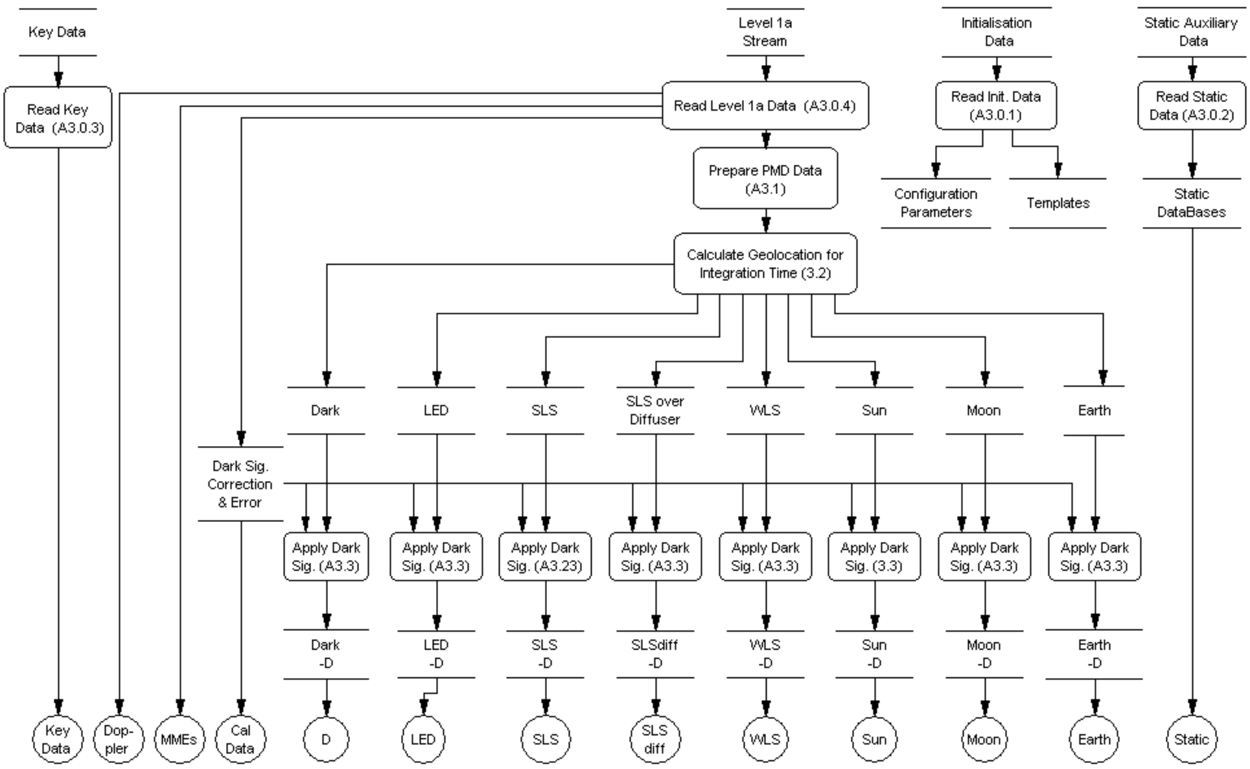
A2 Functional Decomposition: Level 0 to 1a Processor (3).



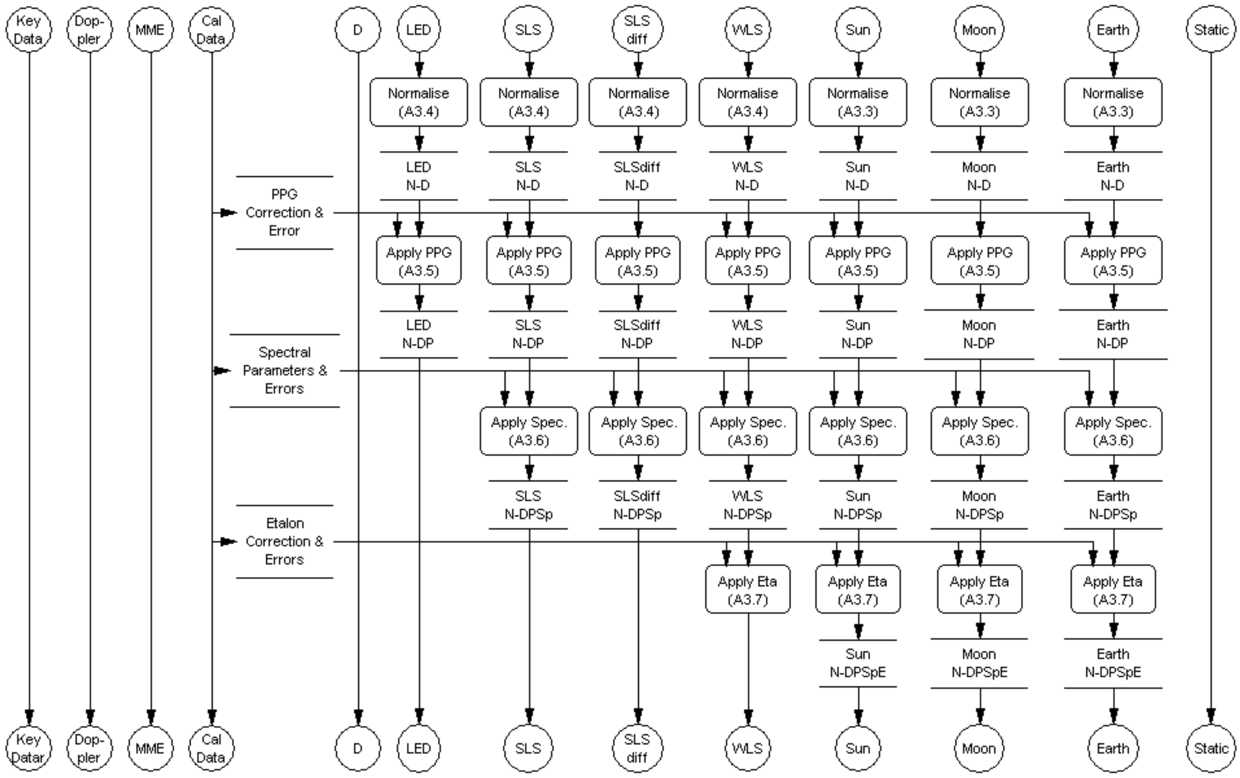
A2 Functional Decomposition: Level 0 to 1a Processor (4).



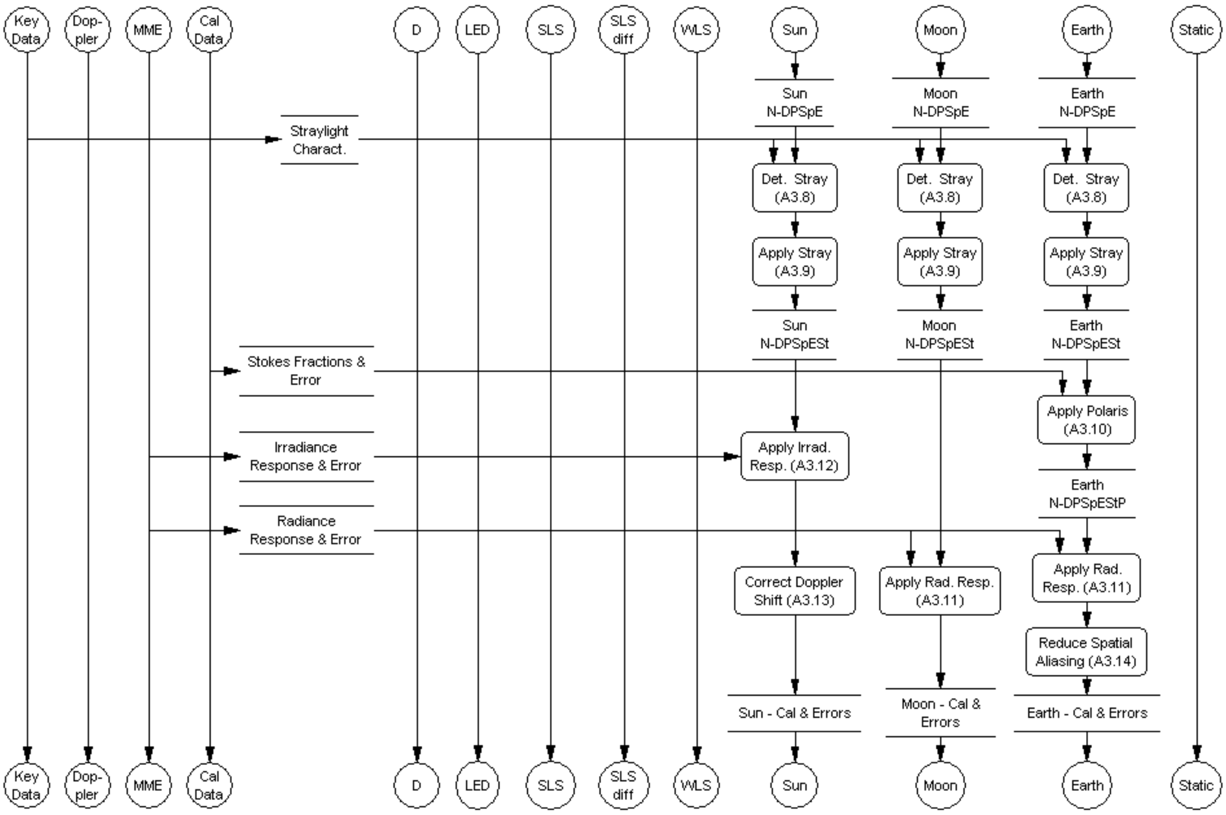
A3 Functional Decomposition: Level 1a to 1b Processor (1)



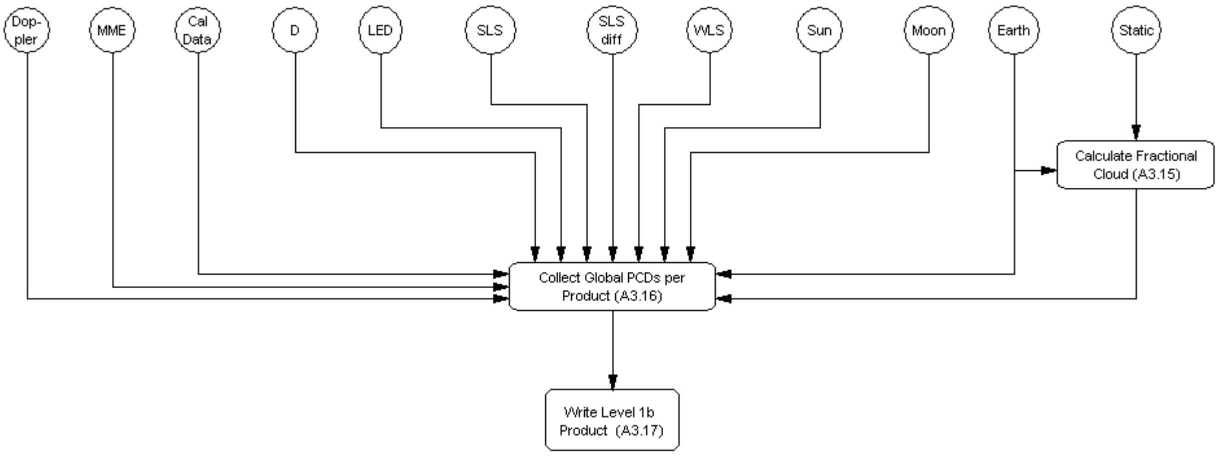
A3 Functional Decomposition: Level 1a to 1b Processor (2)



A3 Functional Decomposition: Level 1a to 1b Processor (3).



A3 Functional Decomposition: Level 1a to 1b Processor (4).



4.2.1.1 Level 1b product summary and estimated accuracies

A summary of the expected relative errors on the GOME-2 level 1b products is given in the table below. The analysed errors on the absolutely calibrated radiance and irradiance spectra, the sun-normalised radiance spectra and the wavelength calibration parameters have been estimated by TPD-TNO (responsible for the instrument calibration and characterisation) on the basis of the accuracy of on-ground calibration and characterisation measurements. The product accuracies listed are generated using a Monte Carlo simulation method See [RD12] GOME-2 Calibration Error Budget, MO-RS-TPD-GO-0016. Using this method errors are generated for each contributing measurement according to a specified distribution function, Gaussian for random errors and Uniform for systematic errors. The parameters of the distribution depend on the measurement in question. The input measurements are perturbed according to these generated errors and a distribution of possible values in the final data product calculated. The 1σ estimated error in the final data product is equal to the standard deviation of this distribution.

Estimates of the absolute error on the absolutely calibrated radiance and irradiance spectra, and the sun-normalised radiance spectra are also provided in the GOME-2 level 1b product See [RD8] GOME-2 Level 1 Product Format Specification, EPS.MIS.SPE.97232. These error estimates are calculated from the root sum square of variances associated with all contributing error sources.

Expected relative errors on the GOME-2 level 1b data products, except cloud parameters which are expressed in absolute values. Note that the wavelength calibration accuracies quoted are applicable to on-ground measurements and may not be representative of in-orbit accuracies.

	Analysed Error	Design Goal	Source
Sun-normalised nadir radiance error (1σ)	2.1% (UV) 1.4% (visible)	1.5% (UV) 1.35% (visible)	See [RD12] GOME-2 Calibration Error Budget, MO-RS-TPD-GO-0016. and See [RD11] GOME-2 Calibration Plan, MO-PL-TPD-GO-0004.
Absolute nadir radiance error (1σ)	1.9% (UV) 1.2% (visible)	1.6% (UV) 1.4% (visible)	
Absolute sun irradiance error (1σ)	1.7% (UV) 1.0% (visible)	1.15% (UV) 0.8% (visible)	
FPA wavelength calibration accuracy	<0.04 pixel	0.04 pixel	
PMD wavelength calibration accuracy	<0.07 pixel	0.07 pixel	
Effective cloud fraction	Global monthly average difference 0.0 in January and 0.1 in July The standard deviation of the differences in absolute values is 0.1 for both months	N/A	See [SCD22] R.B.A, Koelemeijer, P. Stammes, J.W. Hovenier and J.F. de Haan, "Global distributions of effective cloud fraction and cloud top pressure derived from oxygen A-band spectra measured by the Global Ozone Monitoring Instrument: Comparison to ISCCP data, J. Geophys. Res.,Vol. 107 D12, 2002.
Cloud top pressure	Global monthly average difference 27 hPa in July and 36 hPa in January The standard deviation of the difference 110hPa in July and 104hPa in January	N/A	

Estimates of the variances associated with these contributing error sources are obtained as follows.

TPD-TNO provide an estimate of the relative error for:

- the calibration Key data describing the radiometric response of the instrument See [RD14] GOME-2 FM3 Calibration: Radiometric Calibration, MO-TR-TPD-GO-0098.,
- the calibration Key data describing the polarisation response of the instrument, and See [RD15] GOME-2 FM3 Calibration: Instrument Performance Testing, MO-TR-TPD-GO-0094.,
- the calibration Key data describing the BSDF of the diffuser plate See [RD14] GOME-2 FM3 Calibration: Radiometric Calibration, MO-TR-TPD-GO-0098..

These are used in the calculation of the relative error on the Müller Matrix elements in the level 0 to 1 processing See [RD7] GOME-2 Level 1 Product Generation Specification, EPS.SYS.SPE.990011.. Estimates of shot and readout noise are derived from the in-orbit dark signal measurements See [RD7] GOME-2 Level 1 Product Generation Specification, EPS.SYS.SPE.990011., and estimates of the accuracy of the PPG, etalon and straylight corrections are derived from on-ground performance measurements See [RD15] GOME-2 FM3 Calibration: Instrument Performance Testing, MO-TR-TPD-GO-0094. & See [RD16] GOME-2 FM3 Calibration: Spectral Stray Light, MO-TR-TPD-GO-0096.. Estimates of the accuracy of the polarisation correction will be based on the results of the GOME-1 polarisation measurement validation See [SCD4] I. Aben, M.R. Dobber, D.M. Stam and P. Stammes, "Error Analysis of Polarisation Measurements by GOME", GOME Geophysical Validation Campaign, Final results Workshop Proceedings, ESA WPP-108, 51-59, May 1996. and will be refined in-orbit on the basis of in-orbit validation of measured GOME-2 Stokes fractions. See In-Orbit Monitoring, Verification & Validation. for further information.

4.2.2 Level 1b to 2 data processing

4.2.2.1 The Ozone monitoring Satellite Application Facility (Ozone SAF)

The responsibility for extraction of meteorological or geophysical (level 2) products fro

m GOME-2 lies with the Satellite Application Facility on Ozone Monitoring (O3MSAF). The development of the O3MSAF was started in 1997 and is coordinated by the Finnish Meteorological Institute (FMI) in Helsinki. The O3MSAF consortium comprises:

- Finnish Meteorological Institute or Ilmatieteen Laitos (FMI) - host institute, Finland
- Koninklijk Nederlands Meteorologisch Instituut (KNMI), Netherlands
- Deutsches Fernerkundungsdatenzentrum (DLR), Germany
- Deutscher Wetterdienst (DWD), Germany
- Aristotle University of Thessaloniki, Greece
- Hellenic National Meteorological Service (HNMS),Greece
- Danmarks Meteorologiske Institut (DMI), Denmark
- Météo-France, France
- Koninklijk Meteorologisch Instituut van België / Institut Royal Météorologique de Belgique (KMI - IRM), Belgium

As part of the distributed element of the EUMETSAT Applications Ground Segment, the SAF on Ozone Monitoring will provide operational services to end-users, e.g. real time or off line product services, data management and related user services, including co-ordination of and support to relevant research and development. The SAF Visiting Scientist Programme allows involvement of scientific experts external to the SAF Consortium.

4.2.2.2 Operational Level 2 products from GOME-2

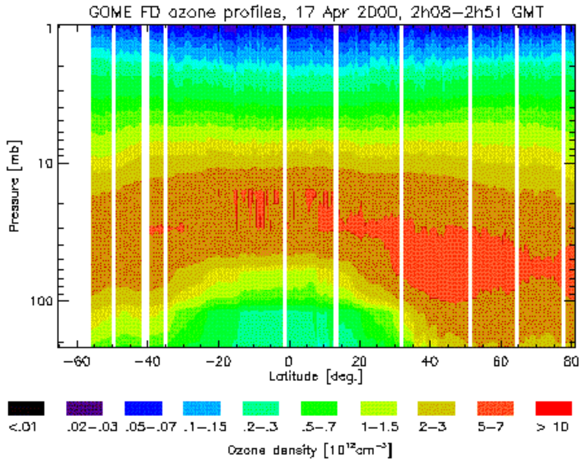
The O3MSAF will produce three classes of level 2 products from GOME-2. These are the Near Real Time (NRT) products, which will be made available and distributed to users within 3 hours of sensing, the Off-line products which will be available no later than 15 days after sensing from the O3MSAF archive, and experimental products whose dissemination and coverage is yet to be decided. Reprocessing the geophysical products for climate applications See [O3M1] Ozone SAF User Requirements Document, SAF/O3/RQ/URD., See [O3M2] Ozone SAF Science Plan, SAF/O3/FMI/ALG/PL. & See [O3M3] Ozone SAF Scientific Prototyping Report, SAF/O3/FMI/ALG/REP. is also anticipated. For a discussion of individual products see below. The O3MSAF will also provide on-line Validation Services on an operational basis. For a summary of the Validation Services to be provided see See Validation of Ozone Monitoring SAF Products.

4.2.2.3 Ozone profile and aerosol products

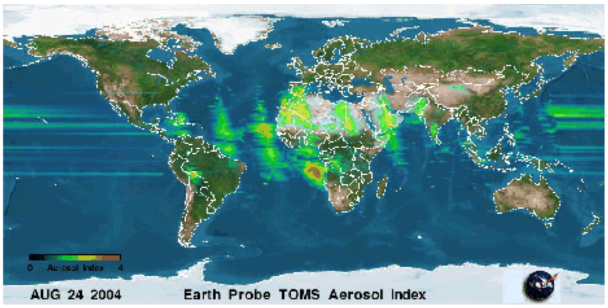
The operational ozone profile and aerosol products from GOME-2 are produced under the responsibility of KNMI. The ozone profile products, both NRT and Off-line, will be made available at a frequency determined by the MetOp orbit repeat cycle. The aerosol products comprising an Absorbing Aerosol Index (AAI) and an Aerosol Optical Depth (AOD) and will be produced daily Off-line. The ozone profile and AAI products will be available at a horizontal resolution equal to the GOME-2 instrument ground pixel size (i.e. 80km across-track x 40km along-track assuming a default integration time of 0.1875s and a swath width of 1920km). The Aerosol Optical Depth product will be available at a horizontal resolution equal to that of the GOME-2 PMD measurements (i.e. 10km across-track x 40km along-track assuming a default integration time of 23.4375ms and a swath width of 1920km).

The ozone profile products are produced using the VERA (VErsatile Retrieval Algorithm) retrieval algorithm. VERA (and its predecessor algorithm Opera) has a strong heritage of operational use for retrievals from GOME-1 on ERS-2, SCIAMACHY on Envisat and OMI on EOS-Aura e.g. See [SCD5] van Oss, R. and R. van der A, "Retrieval of Ozone Profiles from GOME and SCIAMACHY (GOME O3 Profiling Working Group), Proceedings of the 2004 ERS & ENIVSAT Symposium, 6 - 10 September, Salzburg, Austria, in press, 2004.

The VERA retrieval algorithm uses an optimal estimation formalism the details of which are fully described in See [O3M2] Ozone SAF Science Plan, SAF/O3/FMI/ALG/PL. & See [O3M3] Ozone SAF Scientific Prototyping Report, SAF/O3/FMI/ALG/REP. The forward radiative transfer model used is a scalar version of the LIDORT model, See [SCD6] Spurr, R.J.D., T.P. Kurosu, and K.V. Chance, "A linearized discrete ordinate radiative transfer model for atmospheric remote sensing retrieval", J. Quant. Spectrosc. Radiat. Transfer, 68:689-735, 2001. & See [SCD7] Spurr, R.J.D., "Linearized Radiative Transfer Theory: A General Discrete Ordinate Approach to the Calculation of Radiances and Analytic Weighting Functions, with Application to Atmospheric Remote Sensing", Ph.D. Thesis., Technical University of Eindhoven, 2001. For the retrieval of ozone profile information, wavelengths in the range 270 - 330 nm are used. The forward model calculations are carried out on forty atmospheric layers and the ozone profile information is retrieved on the same grid. The ozone profile information will however only be reported as a layer amount for five tropospheric layers and seven stratospheric layers. A vertical resolution of 15km in the troposphere and 7km in the stratosphere (below 2hPa) can be expected. In order to minimise residual errors in the retrieved ozone profile resulting from the use of a scalar forward model, look-up tables depending on a number of parameters including view angle, solar zenith angle, relative azimuth angle, surface albedo, surface pressure, and ozone profile information, will be used to correct the modelled radiances for errors due to the neglect of polarisation. The error remaining after correction is expected to be negligible. Additionally, in order to correct for neglect of the Ring effect in the modelled radiances, a pre-calculated Ring spectrum derived from a high resolution solar reference spectrum is applied. The amplitude of the ring absorption is included as an auxiliary parameter in the state vector and retrieved. This does not however correct for the filling in of ozone absorption lines which will be the subject of further study. An example of the GOME/ERS-2 Fast Delivery Ozone Profile Product is shown in See Example of the GOME/ERS-2 Fast Delivery Ozone Profile Product (courtesy of KNMI).



Example of the GOME/ERS-2 Fast Delivery Ozone Profile Product (courtesy of KNMI).



Map of Absorbing Aerosol Index produced from Earth Probe TOMS Data (courtesy of NASA).

The Aerosol Optical Depth will be retrieved using measurements from the GOME-2 PMDs. The retrieval algorithm will incorporate a linearized vector radiative transfer model and the inversion will be performed using the Levenberg-Marquardt method. The algorithm is currently under development and is the subject of an O3MSAF Visiting Scientist activity. The expected accuracy of the Aerosol Optical Depth product remains to be demonstrated.

In addition to the AOD, an Absorbing Aerosol Index (AAI) will also be produced on an operational basis. The AAI is an index based on the ratio of the back-scattered radiance at 340nm and to that at 380nm. As the ozone absorption is small in this spectral region, and the spectral signature of non-absorbing aerosols is flat, it is assumed that any deviation from the signal associated with pure Rayleigh scattering indicates the presence of absorbing aerosols. An AAI product has been produced on a regular basis from TOMS data for a number of years See [SCD8] Herman, J.R., P.K. Bhartia, O. Torres, C. Hsu, C. Seftor, E. Celarier, "Global distribution of UV-absorbing aerosols from Nimbus 7/TOMS data", J. Geophys. Res., 102, D14, 16, 911-16, 922, 1997. (See Map of Absorbing Aerosol Index produced from Earth Probe TOMS Data (courtesy of NASA).) and its value as a tracer of dust and smoke aerosols, particularly from biomass burning has been clearly demonstrated (e.g. See [SCD9] Prospero, J.M, P. Ginoux, O. Torres, S.E. Nicholson and T.E. Gill, "Einvironmental characterization of global sources of atmospheric soil dust identified with the Nimbus 7 Total Ozone Mapping Spectrometer (TOMS) Absorbing Aerosol Index Product, Reviews of Geophysics, Vol. 40, No. 1 2002.). As the AAI is sensitive to wavelength dependant degradation of the instrument response, it may also be used for diagnostic purposes is assessing the quality of the level 1b data product.

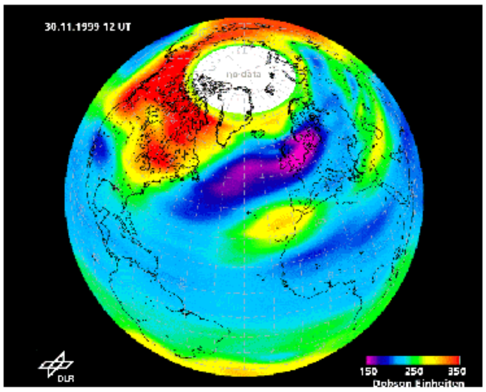
Both the ozone profile and aerosol products will be disseminated to users in HDF5 format. See [O3M4] Ozone SAF Output Product Format Document for OOP and ARS, SAF/O3M/KNMI/OPF/003. for a full description of the product structure.

4.2.2.4 Total column Ozone and trace gases

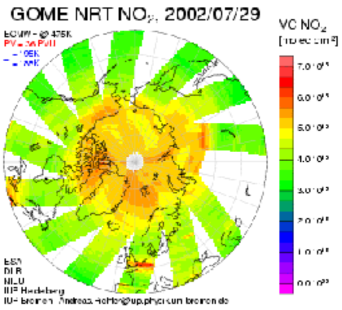
The total column ozone and trace gas products from GOME-2 are produced by DLR. This set of products comprises NRT total column O3 and NO2, off-line total column O3 and NO2 and experimental total column BrO, SO2, and HCHO. These products will also be produced at a frequency determined by the MetOp orbit repeat cycle and will be produced at a horizontal resolution equivalent to the GOME-2 ground-pixel size (i.e. 80km across-track x 40km along-track assuming a default integration time of 0.1875s and a swath width of 1920km). Global coverage of the experimental products is not however assured.

The algorithms used to generate the total column and trace gas products are based on the Differential Optical Absorption Technique (DOAS). The operational GOME/ERS-2 Data Processor V3.0 (GDP V3.0) provides the basis for the further developments and improvements planned for GOME-2 on MetOp. A full description of the GDP V3.0 algorithm and related validation activities may be found in See [SCD10] Lambert, J-C., D. S. Balis, C. Fayt, P. Gerard, J. F. Gleason, J. Granville, G. Hansen, G. Labow, D. Loyola, V. Soebijanta, W. Thomas, J. H. G. van Geffen, R. F. van Oss, M. Van Roozendael, C. Zehner, and C. S. Zerefos, ERS-2 GOME GDP 3.0 Implementation and Delta Validation, ERSE-DTEX-EOAD-TN-02-0006, (also available from http://earth.esa.int/esa_doc/doc_gom.html). Further planned enhancements to the algorithm include an improved treatment of the molecular ring effect, calculation of Air Mass Factor's (for conversion from a slant to a vertical column) at 325.5nm for high SZA's >80 degrees, and application of an I0 corrected ozone reference spectrum. A discussion of these improvements can be found in the See [O3M3] Ozone SAF Scientific Prototyping Report, SAF/O3/FMI/ALG/REP. Under the responsibility of ESA, the updated processor GDP4.0 will be used to reprocess the entire GOME/ERS-2 data set. Continuity between GOME/ERS-2 and GOME-2 on MetOp is therefore assured.

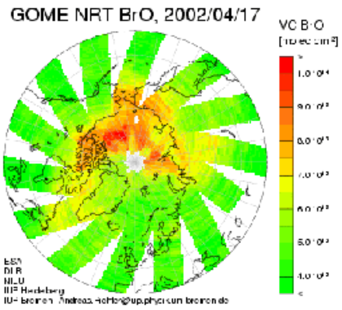
Examples of the total column ozone and trace gas products that have been produced both by DLR and the wider scientific community from GOME/ERS-2 data are shown below (see Example of the GOME/ERS-2 Total Column Ozone field (courtesy of DLR)., See Example of the GOME/ERS-2 Total Column NO2 (courtesy of IFE)., See Example of the GOME/ERS-2 Total Column BrO (courtesy of IFE)., and See Example of the GOME/ERS-2 Total Column SO2 (courtesy of DLR).). It should be noted that GOME/ERS-2 data products are produced at the lower spatial resolution of 320 x 40 km. Both the total column ozone and trace gas products will be disseminated to users in HDF5 format. see [O3M5] Ozone SAF Output Product Format for GOME-2 Total Column Densities of Ozone and Minor Trace Gases, SAF/O3M/DLR/OPF/001. for a full description of the product structure.



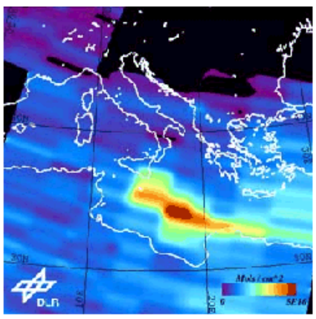
Example of the GOME/ERS-2 Total Column Ozone field (courtesy of DLR)



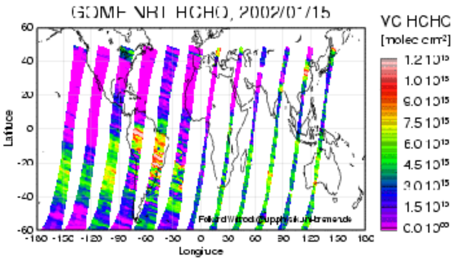
Example of the GOME/ERS-2 Total Column NO2 (courtesy of IFE)



Example of the GOME/ERS-2 Total Column BrO (courtesy of IFE)



Example of the GOME/ERS-2 Total Column SO2 (courtesy of DLR)



Example of the GOME/ERS-2 Total Column HCHO (courtesy of IFE)

4.2.2.5 Near-real time UV products

The Near Real Time UV product produced by DMI provides daily clear-sky UV-fields expressed as a UV index See [SCD11] WMO, "Report of the WMO meeting of experts on UV-B measurements, data quality and standardization of UV-indices", Global Atmosphere Watch Report no. 95, 1994. The product consists of twenty three contour maps, for pre-specified regions, two ascii files containing general information and estimated accuracies for the clear-sky UV fields, and an html file for easy access to the maps and information contained within the product. For a full description of the product contents see [O3M6] Ozone SAF NUV Output Product Format, SAF/O3M/DMI/OPF/002.

The NRT UV product processor employs the widely used UVSPEC radiative transfer model See [SCD12] Kylling, A., "UVSPEC: A program package for calculation of diffuse and direct UV and visible intesities and fluxes" (available by anonymous ftp to kaja.gi.alaska.edu, cd pub/arve). based on the discrete ordinate method (DISORT) See [SCD13] Stamnes K, S.C. Tsay, W. Wiscombe and K. Jayaweera, "A numerically stable algorithm for discrete ordinate method radiative transfer in multiple scattering and emitting layered media, Applied Optics, 27, 2502-2509, 1988. and is based on look-up tables. In the look-up tables pre-calculated UV index values have been tabulated for wide ranges of Solar Zenith Angles (SZAs), ozone amounts, surface albedo and five different ozone profiles. Additionally, tables have been produced for model atmospheres representative of different latitudes and seasons. The UV index values are determined by interpolating in total column ozone amount, SZA and albedo for the most appropriate latitude and season. Corrections for sun-earth distance, altitude and aerosol are also applied. The only dynamic input parameter used in the calculations is total column ozone. Climatological parameters are used for all other input parameters including surface albedo. The total column ozone value used is an assimilated GOME-2 total column ozone field provided as an internal O3MSAF product by KNMI. In the case that the assimilated total column ozone data is not available, monthly average total column ozone data from TOMS will be used and the product flagged accordingly. An alternative approach is to use total column ozone forecast fields provided to the national Meteorological services by ECMWF. For a full description of the algorithm see [O3M2] Ozone SAF Science Plan, SAF/O3/FMI/ALG/PL. and See [O3M3] Ozone SAF Scientific Prototyping Report, SAF/O3/FMI/ALG/REP.

The NRT UV product is produced daily with a maximum delay of 60 minutes after receipt of the assimilated total column ozone, which is not later than 2:45 GMT. The horizontal resolution of the NRT UV index contour maps is 0.25 x 0.25 degrees. Accuracy is expected to be within the required 1 index limit. A prototype NRT UV product is provided by DMI at *http://www.dmi.dk/dmi/index/verden/uv_idag.htm* .

4.2.2.6 Off-line UV fields including clouds and surface albedo

The Off-line UV product, including clouds and surface albedo, is produced by FMI. The product will contain the daily UV dose in J/m2 weighted with four different action spectra: erythema induction (CIE87) See [SCD14] McKinlay, A.F., and B.L. Diffey, "A reference action spectrum for ultraviolet induced erythema in human skin", CIE Journal, No. 6, Vol. 1, 17-22, 1987., generalised plant damage See [SCD15] Caldwell, M.M., "Solar ultraviolet radiation and the growth and development of higher plants. Photophysiology: Volume 6", ed. A.C. Giese, Academic Press, New York, 131-177, 1971., DNA damage See [SCD16] Setlow, R.B., "The Wavelengths in Sunlight Effective in Producing Skin Cancer: A Theoretical Analysis", Proc. Nat. Acad. Sci. USA, 71, 9, 3363-3366, 1974., and skin cancer induction See [SCD17] De Gruijl, F.R., and J.C. Van der Leun, "Estimate of the wavelength dependency of ultraviolet carcinogenesis in humans and its relevance to the risk assessment of a stratospheric ozone depletion", Health Physics, 67, 4, 319-324, 1994. The product is currently planned to be made available Off-line at a frequency determined by the MetOp orbit repeat cycle, with a horizontal resolution equal to the GOME-2 instrument ground pixel size (i.e. 80km across-track x 40km along-track assuming a default integration time of 0.1875s and a swath width of 1920km). Note that a daily gridded product is being considered as an alternative.

The two most critical inputs to the Off-line UV product are the estimated diurnal cloud cover and surface albedo. For the estimation of diurnal cloud cover, two approaches are being considered, the first being the current baseline. In the first approach cloud optical thickness is estimated from the AVHRR Global Area Cover (GAC) data, using an AVHRR pre-processor module which employs pre-calculated look-up tables parameterised in terms of AVHRR channel one radiance, solar zenith angle, satellite zenith angle, relative azimuth angle, terrain pressure, surface albedo and total column ozone. Cloud optical thickness estimated from GOME-2 data will be used as a back-up in the event of AVHRR data being unavailable. The second approach is to use cloud optical thickness from other projects, in particular from the cloud products of the Climate SAF. At present the Climate SAF cloud products are produced on a regional basis and are therefore unsuitable for use by the Off-line UV data processor, however during the operational phase of the Climate SAF global cloud products are planned. At an appropriate time the possibility of using these products as input to the Off-line UV data processor of the O3MSAF will be reconsidered.

In the case of the estimation of surface albedo, if an ECMWF snow analysis field is available, and indicates the presence of snow, an empirical conversion between snow depth and surface albedo, following the method of Arola et al. 2003 See [SDC18] Arola A., J. Kaurola, L. Koskinen, A. Tanskanen, T. Tikkanen, P. Taalas, J.R. Herman, N. Krotkov and V. Fioletov, "A new approach to estimate the albedo for snow-covered surface in satellite-UV method", J. Geophys. Res., 108 (D17), 4531, 2003., is used. Note that further than 250km from an observation station, the current ECMWF snow analysis produces a climatological value only. If no snow is detected or the ECMWF snow field is unavailable, the surface albedo is selected from the Minimum Lambert Equivalent Reflectivity (MLER) climatology compiled from fourteen and a half years of Nimbus-7/TOMS data by Herman and Celarier See [SCD19] Herman, J.R., and E. Celarier, "Earth surface reflectivity climatology at 340-380 nm from TOMS data", J. Geophys. Res., 102, 28, 003-011 1997.

The Off-line UV product is planned to be provided in HDF5 format. For specific details on the structure of the products please see [O3M7] Ozone SAF Output Product Format Document for OUV, SAF/O3M/FMI/OPF/002. Note that for a daily gridded product, GRIB format would be considered.

4.2.2.7 Level 2 product summary and expected accuracies & precision

Expected product accuracies for operational GOME-2 level 2 products produced by the O3M SAF.

Product	Characteristics	Estimates Uncertainties			Source
Total column ozone	Total vertical column amount in Dobson Units NRT and Off-line	SZA	Accuracy (1σ)	Precision (1σ)	
		< 70 deg	-2%... +4%	< 2%	
		< 90 deg	5%... +8%	< 3%	
Trace Gases	Total vertical column amount in mol.cm-2 Off-line	SZA	Accuracy (1σ)	Precision (1σ)	
NO2	operational	< 70 deg	5%...20%	5%...20%	
NO2	operational	< 90 deg	5%...20%	5%...10%	
BrO tropics	operational	N/A	20%...50%	50%...100%	
BrO tropical enhancement	operational	N/A	> 100%	10%...50%	

BrO other	operational	N/A	20%...50%	10%...50%	See [O3M3] Ozone SAF Scientific Prototyping Report, SAF/O3/FMI/ALG/REP.
SO2	experimental	< 65 deg	50%...100%	50%...100%	
SO2	experimental	> 65 deg	> 100%	> 100%	
SO2 volcanic	experimental	< 65 deg	50%...100%	5%...30%	
SO2 volcanic	experimental	> 65 deg	> 100%	> 30%	
HCHO	experimental	N/A	> 100%	>100%	
HCHO biomass burning	experimental	N/A	50%...100%	20%...50%	
OClO ozone hole	experimental	> 75 deg	50%...100%	20...50%	
OClO	experimental	other	> 100%	> 100%	
Ozone Profiles	Eleven layers of ozone mixing ratio (ppm) NRT and Off-line	< 10% in the stratosphere and < 30% in the troposphere for six to eight independent pieces of information.			See [O3M2] Ozone SAF Science Plan, SAF/O3/FMI/ALG/PL.
Aerosol	Absorbing Aerosol Indicator (AAI), Aerosol Optical Depth (AOD) and Aerosol Type (desert dust, smoke and volcanic ash) NRT	AAI no accuracy estimates are given. AOD Accuracy < 20% The AOD will only be computed if AAI > 1			
Clear Sky UV Fields	Surface level spectral UV irradiance NRT Product available as a clear sky UV index	Accuracy 1 UV index			
UV fields with Clouds and Albedo	Spectral UV doses weighted with an appropriate action spectra for clear sky and cloudy conditions Off-line	Accuracy < 20% for a 100 x 100 km grid.			

5. The EPSView tool as an introduction to GOME-2 products

(For this issue of the Gome Product guide, the information provided on EPSView is generic for all EPS instruments. When the User's Guide of this tool is available, the following paragraphs will be replaced by a reference to it, and specific information about the use of EPSView for GOME-2 products inspection will be included in this product guide instead)

EPSView is a flexible, highly portable and easy-to-install visualisation and analysis tool for EPS products generated at EUMETSAT, to be used by EUMETSAT in the inspection, verification and characterisation of EPS System data and products. The tool is provided free-of-charge to the EPS End-Users for familiarisation and handling of EPS data.

It is a portable tool, running in many different platforms, primarily Solaris, HP, AIX, Linux, Windows NT/XP, MAC OS X, IRIX. EPSView has a unique graphical user interface through which the user can easily access all the functionality required.

The following functionality can be provided by EPSView:

- Production of ASCII files with the contents of the input products or a sub-set of them; export of input products contents into GIF, TIFF and JPEG image formats; export of a given data structure or group of structures of the input data for analysis into IDL; access to any data structure and decomposition of the contents down to the bit level;
- Display in ASCII/HEX the contents of any data structure or section within the input products; display colour images and allow for zooming of user-selected image regions; display of latitude and longitude pixel information on the image interactively; visualisation of individual image channels as grey-level images; visualisation of coast-lines and rivers into map-projected displayed images; display of geolocation information of a cursor-selected pixel; display of 2-d plots of user-selected product fields and parameters, either temporal, spectra, scatter plots or vertical profiles; display of vector plots and other more complex plotting, e.g., 3-D plots and contouring.

6. GOME-2 product formats and dissemination

A description of the foreseen dissemination means for EPS products and formats is provided in the following paragraphs, focusing down on GOME-2 products and their formats.

6.1 EPS products available dissemination means

Note that this section about dissemination means of EPS products in general could be removed when that info is available on the EPS web site.

6.1.1 Satellite Direct Broadcast Service

Instrument and ancillary data acquired by the METOP satellites will be broadcast and received by authorised users in real-time via:

- High Resolution Picture Transmission (HRPT) - transmission of data from all METOP instruments in full resolution;

The data will be received by local reception stations. It is the responsibility of the user to procure and install a local reception station. Specification documentation for a EUMETSAT-based HRPT/LRPT Reference User Station. is available for information on the EUMETSAT web page www.eumetsat.int

The output format of the EUMETSAT HRPT/LRPT Reference User Station is Level 0 products in the EPS Native format.

The broadcast data is encrypted. To get authorisation to access it, users need to register with the EUMETSAT User Services and will receive the data decryption information.

Data from the NOAA payload is also broadcast and received by local users via the HRPT mechanism. For details on the NOAA HRPT system, the reader is referred to the NOAA KLM User's Guide [RD41].

6.1.2 EUMETCast

Global EPS products at different levels will be distributed in near real time via EUMETSAT's Data Distribution System (EUMETCast). EUMETCast utilises the services of a satellite operator and telecommunications provider to distribute data files using Digital Video Broadcast (DVB) to a wide audience located within the geographical coverage zone which includes most of Europe and certain areas in Africa.

Within the current EUMETCast configuration, the multicast system is based upon a client/server system with the server side implemented at the EUMETCast uplink site (Usingen, Germany) and the client side installed on the individual EUMETCast reception stations. The telecommunications suppliers provide the DVB multicast distribution mechanism. Data/product files are transferred via a dedicated communications line from EUMETSAT to the uplink facility. These files are encoded and transmitted to a geostationary communications satellite for broadcast to user receiving stations. Each receiving station decodes the signal and recreates the data/products according to a defined directory and file name structure. A single reception station can receive any combination of the provided services.

A typical EUMETCast reception station comprises of a standard PC with DVB card inserted and a satellite off-set antenna fitted with a digital universal V/H LNB. In addition, users require the multicast client software, which can be obtained via the EUMETSAT User Services.

More detailed information on this service can be found in the EUMETSAT web page www.eumetsat.int.

Products distributed on EUMETCast can be formatted in a variety of formats, including EPS native format and the WMO formats (BUFR and GRIB).

6.1.3 GTS/RMDCN

A subset of EPS products will be disseminated additionally in near real time via the Global Telecommunications System (GTS). GTS is the World Meteorological Organisation integrated network of point-to-point circuits, and multi-point circuits which interconnect meteorological telecommunication centres. Its purpose is to enable an efficient exchange of meteorological data and products in a timely an reliable way to meet the needs of World, Regional and National Meteorological Centres. The circuits of the GTS are composed of a combination of terrestrial and satellite telecommunication links. Meteorological Telecommunication Centres are responsible for receiving data and relaying it selectively on GTS circuits. The GTS is organized on a three level basis, namely:

- The Main Telecommunication Network, linking together 3 World meteorological centres and 15 regional telecommunication hubs.
- The Regional Meteorological Telecommunication Networks, consisting of an integrated network of circuits interconnecting meteorological centres in a region, which are complemented by radio broadcasts where necessary. In Europe, the GTS network is supported by the Regional Meteorological Data Communication Network (RMDCN).
- The National Meteorological Telecommunication Networks, which extend the GTS network down to national level.

More detailed information on this service can be found in the WMO web page www.wmo.ch/index-en.html.

Products distributed on the GTS are in official WMO formats, namely BUFR or GRIB.

6.1.4 UMARF

All EPS products and auxiliary data will be archived and available to Users from the EUMETSAT Unified Meteorological Archive and Retrieval Facility (UMARF) upon request.

The UMARF can be accessed through the EUMETSAT web page www.eumetsat.int. Access is through a web interface through which the users are able to browse and order products, manage their user profile, retrieve products, documentation and software libraries, get help, etc.

UMARF features include geographical and time sub-setting and image preview. EPS products archived in the UMARF can be accessed in a variety of formats, including EPS native format and HDF5.

6.2 GOME-2 products dissemination

Table 1 summarises the different dissemination means and formats for all GOME-2 Level 1 products available to users.

Format	Real Time Direct Broadcast	Near Real Time dissemination on EUMETCast (timeliness)	Near Real Time dissemination on GTS (timeliness)	UMARF retrieval (timeliness)
METOP raw data format	GOME-2 HRPT raw data stream and METOP Admin message	--	--	--
EPS native format	--	GOME-2 Level 1A GOME-2 Level 1B	--	GOME-2 Level 1A GOME-2 Level 1B

HDF5	--	--	--	(TBC)
WMO (BUFR)	--	--	--	--

Table 1: Summary of dissemination means and formats for GOME-2 products. Timeliness refers to the elapsed time between sensing and dissemination

Real time broadcast of GOME-2 raw data is not covered in this guide. It is noted though for information that the raw data streams mentioned in the table above indicate what is broadcast by the platform. Depending on the reception system used (i.e., the HRPT/LRPT local reception system), different formats of this raw data stream are produced. This depends on the local reception station provider. For METOP HRPT/LRPT stations, the Reference User Station has been developed to produce EPS Native Level 0 format products.

Although available through the UMARF, GOME-2 Level 0 products are not considered as an end-user product, hence they are not addressed in this guide either.

6.2.1 Near real time dissemination

The GOME-2 Level 1 Products disseminated to users in near real time are:

- GOME-2 Level 1A and Level 1B products, with a timeliness of 2h 15 min from sensing on

The dissemination granularity of the data is (TBC) minutes for Level 1 data.

6.2.2 Archive retrieval

The GOME-2 Level 1 Products available from the UMARF are:

- GOME-2 Level 1a
- GOME-2 Level 1b

The products are archived as full-dump products, but sub-setting capabilities are provided by the UMARF to the user in the retrieval step. The products are available for the users in the UMARF 8 to 9 h after sensing.

6.3 GOME-2 EPS product format

6.3.1 The EPS native formats

6.3.1.1 General overview of the EPS generic product format

All products in EPS native format are structured and defined according to an EPS Generic Product Format. This format is not GOME-2 specific. The general product section breakdown is given, and the following sections will focus on how this generic format is further applied to GOME-2 products.

This description is not aimed at supporting the writing of reader software for the GOME-2 or other EPS products, because readers and product extraction tools are already available. The intention of this and the following sections is to provide enough information to be able to use such available tools and to interpret the retrieved information.

For users interested in writing their own product readers for one or several GOME-2 products in EPS native format, we refer them to the detailed format specifications provided in [RD8] GOME-2 Level 1 Product Format Specification, EPS.MIS.SPE.97232.

The general structure of the products is broken down in sections, which contain one or more records of different classes. Every single record is accompanied by a Generic Record Header (GRH), which contains the metadata necessary to uniquely identify the record type and occurrence within the product. The following general structure is followed by all EPS products, where all the sections occur always in the given order.

Header Section, containing metadata applicable to the entire product. The header section may contain two records, the Main Product Header Record (MPHR) and the Secondary Product Header Record (SPHR). This is the only section that contains ASCII records, the rest of the product is in binary.

Pointer Section, containing pointer information to navigate within the product. It consists of a series of Internal Pointer Records (IPR), which include pointers to records within the Global Auxiliary Data, Variable Auxiliary Data and Body Sections that follow.

Global Auxiliary Data Section, containing information on the auxiliary data that has been used or produced during the process of the product and applies to the whole length of the product. There can be zero or more records in this section, and they can be of two classes: Global External Auxiliary Data Record (GEADR), containing an ASCII pointer to the source of the auxiliary data used, and Global Internal Auxiliary Data Record (GIADR), containing the auxiliary data used itself.

Variable Auxiliary Data Section, containing information on the auxiliary data that has been used or produced during the process of the product and may vary within a product, but with a frequency in any case less than the measurement data itself. There can be zero or more records in this section, and they can be of two classes: Variable External Auxiliary Data Record (VEADR), containing an ASCII pointer to the source of the auxiliary data used, and Variable Internal Auxiliary Data Record (VIADR), containing the auxiliary data used itself.

Body Section, which is usually the main bulk of the product and contains the raw or processed instrument data and associated information. This section contains time-ordered Measurement Data Records (MDR). A particular type of MDR can occur to indicate the location of an unexpected data gap within any product, the Dummy Measurement Data Record (DMDR).

The format of the MPHR, IPRs, GEADR, VEADR and DMDRs is common to all products, while the other records can be of different formats and contents, and identified as of different sub-classes for different products. Every record consists of a series of fields, which can have different data types. See Annex 4 for all possible data types.

It is important to note that GEADR and VEADR records are included in the products to support processing configuration control for EUMETSAT at product level. They point to the name of auxiliary data files used in the processing, but they are not of any interest or use to the end user for the utilisation of the products.

Two types of records deserve special description, because they are key to navigate within the products, namely the GHR and the IPR. Their format and the meaning of their fields are detailed in Annex 5.

Table 7 gives an example of general structure of the Generic Product Format

Section	RECORD CLASS	RECORD SUBCLASS	START TIME	STOP TIME
HEADER SECTION	MAIN PRODUCT HEADER RECORD SECONDARY PRODUCT HEADER RECORD		T1 T1	T6 T6
INTERNAL POINTER SECTION	INTERNAL POINTER RECORD (GEADR Subclass A) INTERNAL POINTER RECORD (GEADR Subclass B) INTERNAL POINTER RECORD (GIADR Subclass A) INTERNAL POINTER RECORD (GIADR Subclass B) INTERNAL POINTER RECORD (GIADR Subclass C) INTERNAL POINTER RECORD (VEADR Subclass A) INTERNAL POINTER RECORD (VEADR Subclass B) INTERNAL POINTER RECORD (VEADR Subclass C)		T1 T1 T1 T1 T1 T1 T1 T1 T1 T1 T1 T1 T1 T1 T1	T6 T6 T6 T6 T6 T6 T6 T6 T6 T6 T6 T6 T6 T6 T6

	INTERNAL POINTER RECORD (VIADR Subclass A) INTERNAL POINTER RECORD (VIADR Subclass B) INTERNAL POINTER RECORD (VIADR Subclass C) INTERNAL POINTER RECORD (MDR Subclass A) INTERNAL POINTER RECORD (MDR Subclass B) INTERNAL POINTER RECORD (MDR DUMMY) INTERNAL POINTER RECORD (MDR Subclass A) INTERNAL POINTER RECORD (MDR Subclass B)		T1	T6
GLOBAL AUXILIARY DATA SECTION	GLOBAL INTERNAL AUXILIARY DATA RECORD GLOBAL INTERNAL AUXILIARY DATA RECORD GLOBAL INTERNAL AUXILIARY DATA RECORD GLOBAL INTERNAL AUXILIARY DATA RECORD GLOBAL INTERNAL AUXILIARY DATA RECORD	SUBCLASS A SUBCLASS B SUBCLASS A SUBCLASS B SUBCLASS C	T1 T1 T1 T1 T1	T6 T6 T6 T6 T6
VARIABLE AUXILIARY DATA SECTION	VARIABLE INTERNAL AUXILIARY DATA RECORD VARIABLE INTERNAL AUXILIARY DATA RECORD VARIABLE INTERNAL AUXILIARY DATA RECORD VARIABLE INTERNAL AUXILIARY DATA RECORD VARIABLE INTERNAL AUXILIARY DATA RECORD VARIABLE INTERNAL AUXILIARY DATA RECORD VARIABLE INTERNAL AUXILIARY DATA RECORD VARIABLE INTERNAL AUXILIARY DATA RECORD VARIABLE INTERNAL AUXILIARY DATA RECORD VARIABLE INTERNAL AUXILIARY DATA RECORD	SUBCLASS A SUBCLASS B SUBCLASS B SUBCLASS C SUBCLASS C SUBCLASS A SUBCLASS A SUBCLASS A SUBCLASS B SUBCLASS C	T1 T1 T3 T1 T5 T1 T2 T4 T1 T1	T6 T3 T6 T5 T6 T2 T4 T6 T6 T6

BODY SECTION	MEASUREMENT DATA RECORD MEASUREMENT DATA RECORD MEASUREMENT DATA RECORD MEASUREMENT DATA RECORD MEASUREMENT DATA RECORD	SUBCLASS A SUBCLASS B DUMMY SUBCLASS A SUBCLASS B	T1 T2 T3 T4 T5	T2 T3 T4 T5 T6

Table 1: Generalised Schematic of the Generic Product Format

6.3.1.2 Granularity of the EPS products

The Full EPS product is produced by processing a dump of data. This is the product size used to archive in the UMARF.

In addition, the Regional EPS product is a full product that has been passed through a geographical filter. This may happen, for example, during the retrieval of the product from the UMARF.

Finally, A Product Dissemination Unit (PDU) is the near real time dissemination of the full product, and it is typically of 3 minutes. A PDU is often referred to as product 'granule'.

The EPS Generic Product Format has been defined to apply to any length of sensing. That means that the same generic format described above applies to a 3-minute duration granule, half an orbit or a full dump of data. The length in time of the product is contained in the MPHR.

6.3.1.3 Product format version control

Every record class and sub-class has an associated record version number contained in its corresponding GHR. In addition, each product has a format version number, which is stored in the MPHR.

6.3.1.4 Product naming convention

File naming convention for EPS products in EPS native format provides a product name that uniquely identifies any product and provides a summary of its contents. The field contents in a product name correspond to those in the MPHR.

<INSTRUMENT_ID>_<PRODUCT_TYPE>_<PROCESSING_LEVEL>_<SPACECRAFT_ID>_
_<SENSING_START>_<SENSING_END>_<PROCESSING_MODE>_<DISPOSITION_MODE>_
<PROCESSING TIME>

Product Name Field / MPHR Field	Description	Size in Characters
INSTRUMENT_ID	Instrument identification	4
PRODUCT_TYPE	Product Type	3
PROCESSING_LEVEL	Processing Level Identification	2
SPACECRAFT_IUD	Spacecraft identification	3
SENSING_START	UTC Time of start of Sensing Data	15
SENSING_END	UTC Time of end of Sensing Data	15
PROCESSING_MODE	Identification of the mode of processing	1
DISPOSITION_MODE	Identification of the type of processing	1
PROCESSING_TIME	UTC time at start of processing for the product	15

Table 8: EPS Product name fields and their correspondence with MPHR fields

For the GOME-2 products, the resulting product file names are as follows:

Product	Product name
GOME-2 Level L1a	GOME_xxx_1A_Mnn_< ...>
GOME-2 Level L1b	GOME_xxx_1B_Mnn_< ...>

Table 9: Generic GOME-2 product names

6.3.2 GOME-2 Level 1a products

GOME-2 level 1a products See [RD7] GOME-2 Level 1 Product Generation Specification, EPS.SYS.SPE.990011. contain reformatted raw instrument data along with all supplementary data needed for further processing, including geolocation and quality flags.

Section	Record class	Record subclasses / Remarks
Header	MPHR	
	SPHR	
Pointer	IPR	(One per target class)
Global Aux Data	GEADR	Time correlation information Orbit parameters Surface elevation Land/sea mask In-flight calibration parameters Configuration parameters Initialisation parameters Calibration key data Correction factors (for long-term effects)
	GIADR	Bands: start pixel and number of pixels Calibration steps applied Müller matrix elements Channels: start/end pixel numbers/wavelengths
Variable Aux Data	VIADR	Dark signals PPG correction Etalon correction Spectral calibration parameters Sun mean reference spectrum
Body	MDR	Earth Calibration Sun Moon Other (Granularity: one scan (6 s))

Typical product size for one full orbit: 250 MB. The level 1a product is smaller than the level 0 product because spectral data from unfinished readouts (hex FFFF) have been removed.

6.3.3 GOME-2 Level 1b products

GOME-2 level 1b products See [RD7] GOME-2 Level 1 Product Generation Specification, EPS.SYS.SPE.990011. contain radiometrically and spectrally calibrated (ir)radiances, along with auxiliary information such as geolocation, quality flags, cloud parameters and polarisation information.

Section	Record class	Record subclasses / Remarks
Header	MPHR	
	SPHR	(same as in level 1a product)
Pointer	IPR	One per target class
Global Aux Data	GEADR	Surface elevation Configuration parameters Initialisation parameters Calibration key data Transmittance database (for Fresco) Surface reflectance database (for Fresco) TOMS UV reflectance database (for Fresco)
	GIADR	Channels: start/end pixel numbers/wavelengths Bands: start pixel and number of pixels, start/end wavelengths Calibration steps applied
Variable Aux Data	VIADR	Sun mean reference spectrum
Body	MDR	Earth Calibration Sun Moon (Granularity: one scan (6 s))

Typical product size for one full orbit: 1.0 GB

6.4 The HDF format

Detailed format descriptions and product naming convention are TBD. Tools to read HDF formats are also TBD, but it is intended that the products can be read using standard HDF libraries. For more information on HDF5 formats in general, see the HDF5 web pages.

6.5 The WMO formats

It is not foreseen to distribute the GOME-2 Level 1 products in WMO (BUFR) format via EUMETCast. The possibility of distributing SAF Level 2 products via EUMETCast is currently discussed..

6.6 Product readers

(To be written when tools are available)

7. GOME-2 products processing algorithms

7.1 Algorithmic functions

This section briefly describes the major algorithmic functions of the GOME-2 level 0 to 1b processor. Only algorithmic functions are described. Those related to data handling are excluded. Functions consisting of a Calculate Correction and an Apply Correction part (as shown in the previous functional decomposition diagrams) will be described together. Module numbers used in the See [RD7] GOME-2 Level 1 Product Generation Specification, EPS.SYS.SPE.990011., where exhaustive information, including variable lists, full algorithm descriptions, and data handling modules can be found, are provided.

Functions will be presented in six groups: initialisation and preprocessing, geolocation, in-flight calibration parameters, scene-dependent corrections, absolute radiometric calibration, and quality flagging. For each function the type of data affected is indicated: radiometric (i.e., "signals"), spectral (i.e., "wavelengths"), housekeeping data, geolocation, quality flags, or other. Several functions affect more than one of these types.

7.1.1 Initialisation and pre-processing

Initialise orbit propagator			**Geolocation**
	Modes	Calibration keydata / MME	PGS reference
Calculate from	N/A	N/A	AG.1

The orbit propagator function is initialised by calling it in its initialisation mode. A Cartesian orbit state vector in earth-fixed coordinates close to Ascending Node Crossing (ANX) is required on input. UTC and mean Kepler elements at ANX are provided as output. This function is executed once at PPF startup.

Preprocess Müller matrix elements			**Radiometric**
	Modes	Calibration keydata / MME	PGS reference
Calculate from	N/A	Radiance response Irradiance response Polarisation sensitivity	A2.1 (AG.2)
Calibration keydata on radiance, irradiance and polarisation response are converted to a representation as Müller matrix elements M. In this formalism, used throughout See [RD7] GOME-2 Level 1 Product Generation Specification, EPS.SYS.SPE.990011., elements M1 represent the radiometric response, M2 the s/p polarisation sensitivity, and M3 the +45°/-45° polarisation sensitivity. Conversion is performed to a wavelength and angular grid defined as initialisation parameters. This function is executed once at PPF startup.			

Receive and validate level 0 data			**Quality**
	Modes	Calibration keydata / MME	PGS reference
Calculate from	All	N/A	A1.1

Basic integrity checks are performed on the incoming level 0 data. The GOME-2 level 0 data flow is checked in three steps, of which the first two are related to the integrity of individual packets, and the last one to the integrity of the sequence of packets. GOME-2 data packets are identified in the data flow via their fixed fields. The length of the data packet is checked. For each packet, the checksum is re-calculated and compared against the checksum contained in the packet. A basic check for duplicate packets and the time order of the packets is performed. In case of problems, error messages are issued. The normal quality flagging mechanism via PCDs can not be used here because corrupted packets have to be excluded from further processing. This function is executed for every scan.

Determine observation mode and viewing angles			**Housekeeping Quality**
	Modes	Calibration keydata / MME	PGS reference
Calculate from	All	N/A	A2.3
Data from different observation modes will be sent to different branches of the processing. This function derives the observation mode for a scan from a combination of housekeeping data and the scanner viewing angles. The viewing angles themselves are calculated from the scan mirror readings in the data packet. Scans which do not match any of the available observation modes are classified as "invalid". Furthermore both the PMD transfer and readout mode are determined, and the UTC times corresponding to the scan mirror positions are calculated. This function is executed for every scan.			

Convert housekeeping data			Housekeeping Quality
	Modes	Calibration keydata / MME	PGS reference
Apply to	All	N/A	AG.3
Selected housekeeping data, e.g., temperatures, lamp currents and voltages, are converted from raw instrument binary units into physical units. The conversion uses a polynomial expansion which is usually linear (2 coefficients). Polynomial coefficients may vary between models and are defined as initialisation parameters. Converted temperatures, voltages, and currents are checked against thresholds defined as initialisation parameters and quality flags are raised as needed. This function is executed for every scan.			

Prepare PMD data			Radiometric
	Modes	Calibration keydata / MME	PGS reference
Apply to	All	N/A	AG.4
For each PMD band, the GOME-2 on-board processor co-adds individual detector readouts (16 bit values) into a band sum, then divides the sum by a scale factor such that it fits again into a 16 bit value. Therefore, PMD signals in binary units have to be reconstructed from the scaled values and scale factors found in the Science Data Packet which is the task of this function. This function is executed for every scan containing PMD data in band transfer mode.			

7.1.2 Geolocation

Calculate geolocation for fixed grid			Geolocation
	Modes	Calibration keydata / MME	PGS reference

Calculate from	All	Instantaneous field of view	A2.6

A number of geolocation parameters are calculated from an orbit state vector, the UTC, and scanner viewing angles. Most geolocation parameters are calculated in granules of the shortest effective integration time for the main channels (187.5 ms, 32 times per scan), independent of the actual integration time in the main channels. The remaining geolocation parameters are calculated once per scan, either because their variation within a scan is small, or because they are not needed on a finer grid by higher-level processing.

Basic geolocation parameters such as the sub-satellite point and solar angles at the satellite are calculated for all measurement modes. In addition, mode-specific geolocation parameters are calculated for earth, sun, and moon modes:

Earth mode: solar and line-of-sight zenith and azimuth angles at a given height, corner and centre coordinates (latitude/longitude) of the ground pixel at ground level, satellite height, and earth radius.

Sun mode: distance between satellite and sun and relative speed of satellite and sun.

Moon mode: Lunar elevation and azimuth angles, sun-moon distance, satellite-moon distance, lunar phase angle, illuminated fraction of lunar disk.

Calculate geolocation for actual integration times			**Geolocation**
	Modes	Calibration keydata / MME	PGS reference
Calculate from	Earth	N/A	A3.2 (AG.19)

Geolocation parameters for the actual integration times in a scan are calculated from the geolocation parameters for the fixed 187.5 ms grid. This is done only for integration times resulting in "simple" ground pixel shapes (below 6s: no change in scanning direction during integration, 6s and higher: only full scans).

The synchronisation between main channel readouts and 187.5 ms ground pixels is taken into account. Geolocations refer to the first detector pixel read in a main channel.

7.1.3 In-flight calibration parameters

A number of calibration parameters can be derived from the dedicated in-flight calibration measurements described in See In-Flight Characterisation & Calibration. These are: dark signal, pixel-to-pixel gain (PPG) correction, spectral calibration parameters, Etalon correction, and the Sun Mean Reference spectrum. The frequency of in-flight calibrations varies between once per orbit (e.g. dark signal) and once per month (e.g. PPG correction). Corrections are generally sufficiently stable to be valid for more than one orbit.

In-flight calibration parameters are not immediately used or stored in a product after they have been calculated. Instead they are stored first in a database. When an Apply Correction step requires in-flight calibration parameters, they are selected from the database according to certain rules. In particular, parameters are only updated close to the Northern Hemisphere terminator. This ensures that in-flight calibration parameters are not changed on the dayside which could lead to artificial steps in higher level processing. Only those in-flight calibration parameters selected to be used are stored within the level 1a product.

If a given in-flight calibration parameter depends on a parameter or parameter combination, this is indicated in the tables below. It is then calculated, stored, and applied separately for each parameter combination. For integer parameters such as integration time and PMD modes this is straightforward. For temperature values, bins are used whose width is defined in the initialisation parameters such that the change of the in-flight calibration parameter within a given bin can be tolerated.

Examples of in-flight calibration parameters (dark signal correction, PPG correction, spectral calibration and etalon correction) and their effect on the spectrum to which they are applied are shown in See Examples of In-Flight Corrections and Calibration.

Dark Signal Correction			**Radiometric Quality**
	Modes	Calibration keydata / MME	PGS reference
Calculate from	Dark	N/A	A2.8
Apply to	All above Dark	N/A	AG.10
Depends on	FPA and PMD: Integration time, detector temperature PMD: PMD readout and transfer modes		

The dark signal for each parameter combination is calculated as average of measurements in dark mode during eclipse. Applying the dark signal correction means subtracting the dark signal from a spectrum. This is the most basic and the first of all corrections applied in level 0 to 1 processing. The dark signal has two components: the integration-time independent offset of typically 1500 BU, and the integration time and detector temperature dependent leakage current of typically 0.7 BU/s at a detector temperature of 235 K. When calculating and applying the dark signal correction, only the total dark signal is considered. There is no need to split the dark signal into its components. This is only done for long-term monitoring purposes, see Sensor Performance Assessment.

Pixel-to-pixel gain (PPG) correction			**Radiometric Quality**
	Modes	Calibration keydata / MME	PGS reference
Calculate from	LED (WLS)	N/A	A2.11
Apply to	All above Dark	N/A	AG.12
Given a uniform illumination over the detector array, dark-signal corrected signals vary slightly between detector pixels, mainly because of small differences in pixel width. To compensate for this effect, the variation in pixel-to-pixel gain is determined from measurements in LED mode which provide a fairly uniform illumination. A PPG correction spectrum is obtained by applying a triangular smoothing to the LED (fall back: WLS) measurements and dividing the measured spectrum by the smoothed spectrum. Applying the PPG correction means dividing a spectrum by the PPG correction spectrum. The PPG correction is of the order of 10^{-4} relative.			

Spectral calibration			**Spectral Quality**
	Modes	Calibration keydata / MME	PGS reference

Calculate from	SLS	FPA: SLS line positions PMD: PMD slit function, SLS Stokes fractions, FPA overlap wavelengths, MME	A2.13 A2.14
Apply to		N/A	AG.13
Depends on	Predisperser prism temperature		

Spectral calibration is the assignment of a wavelength value to each detector pixel. For each GOME-2 channel, a low order polynomial approximation will be used to describe wavelength as a function of detector pixel. Polynomial coefficients are derived from preprocessed spectra of the on-board PtCrNeAr Spectral Light Source (SLS) which provides a number of spectral lines at known wavelengths across the GOME-2 wavelength range.

Different algorithms are used for FPA and PMD channels because their spectral resolution is different. Individual spectral lines can be only be resolved in the FPA channels. Positions of individual lines from a predefined set are determined using a Falk centre-of-gravity algorithm. For the PMD channels an iterative cross-correlation algorithm is used. The expected PMD signal is calculated from the measured FPA signal, taking into account the PMD slit function and ratio of radiometric response between PMD and FPA channels. The expected PMD signal is then spectrally matched with the measured PMD signal using cross-correlation.

The detector pixel onto which light of a given wavelength is impinging depends on instrument temperature. The temperature at the predisperser prism is used as a reference. Typical shifts with temperature are of the order of 0.01 pixel / K for the FPA channels, but depend on detector pixel.

Etalon correction			**Radiometric Quality**
	Modes	Calibration keydata / MME	PGS reference
Calculate from	WLS (Sun)	Reference WLS spectrum	A2.16

Apply to			AG.14
Interference in the thin detector coating layer causes a wave-like pattern on the radiance response (fixed etalon). When deposits settle on the detector coating, the interference pattern is changed (variable etalon). The etalon correction accounts for changes in the variable etalon between on-ground calibration (reference etalon) and the in-orbit situation. It is calculated from preprocessed spectra of the on-board Quartz Tungsten Halogen white light source (WLS). The in-orbit WLS spectrum is ratioed to a reference WLS spectrum representative for the on-ground calibration of the radiance response. Four each channel, a bandpass filter is applied to the ratio. Spectral components within the bandpass (typically 4^{-10} oscillations per channel) are declared to be the Etalon correction. The remainder is called Etalon residual. Applying the Etalon correction means dividing a spectrum by the Etalon correction spectrum. The Etalon correction typically is of the order of 10^{-2} relative.			

Sun mean reference (SMR) spectrum			**Radiometric Spectral Quality**
	Modes	Calibration keydata / MME	PGS reference
Calculate from	Sun	Irradiance response MME	A2.20 (AG.17, AG.18)
Apply to	Earth	N/A	A3.11
A fully calibrated solar spectrum is calculated from preprocessed spectra acquired in sun mode. Spectra within the central part of the sun field-of-view are absolutely radiometrically calibrated taking into account solar elevation and azimuth angles for each spectrum, and then averaged into a sun mean reference (SMR) spectrum. The radiometric calibration is performed for the actually measured spectra, i.e., SMR intensities are not normalised to an earth-sun distance of 1 AU. The SMR spectrum is also spectrally calibrated, correcting the Doppler shift due to the movement of the satellite towards the sun. Applying the SMR spectrum means dividing an earth-radiance spectrum by the SMR spectrum. The SMR irradiance is of the order of 5·1014 photons / (s cm^2 nm) at 550 nm.			

7.1.4 Scene dependent corrections

Polarisation Correction			Radiometric Quality
	Modes	Calibration keydata / MME	PGS reference
Calculate from	Earth	Polarisation MME	A2.21
Apply to	Earth	N/A	A3.10

GOME-2 is a polarisation sensitive instrument: the measured signal depends on the polarisation state of the incoming light which in turn depends on the observed scene, in particular observation geometry and cloudiness. In the Müller matrix formalism, the polarisation state is characterised by Stokes fractions q (for the s/p component) and u (for the +45°/-45° component). For each ground pixel, these Stokes fractions are determined for a number of wavelengths from the observation geometry (single scattering value for the short wavelength end) and ratios of PMD s and PMD p band measurements. In contrast to GOME-1, FPA measurements are not used in this step. Stokes fractions are then interpolated to the wavelengths of the FPA detector pixels, and for each pixel a polarisation correction factor is calculated from Stokes fractions and polarisation MMEs. FPA signals are polarisation corrected by dividing them by the polarisation correction factor.

The polarisation correction typically is of the order of 10^{-2} to 10^{-1} relative, but may be larger for strongly polarised scenes.

Straylight correction			Radiometric
	Modes	Calibration keydata / MME	PGS reference
Calculate from	Earth, Sun	Uniform straylight fraction Ghost straylight intensity and position polynomial coefficients	AG.15
Apply to	Earth, Sun	N/A	AG.16

Spectral straylight is (unwanted) light from other than the nominal wavelength measured by a given detector pixel. We distinguish between uniform straylight from diffuse scatter and ghost straylight from specular reflections. Both types have been characterised during on-ground calibration. It turned out that only intra-channel straylight has to be considered, the most important one being the uniform straylight in channel 1. For each ground pixel the uniform straylight contribution is calculated by weighting the sum of the measured signals in a channel with the corresponding straylight fraction from the calibration keydata. The ghost straylight position and intensity is calculated from the "parent" position and intensity using polynomial coefficients from the keydata. Applying the straylight correction means subtracting the total straylight (sum of uniform and ghost straylight) from the measured signals. The straylight correction typically is smaller than 10^{-3} relative.

Spatial aliasing correction			**Radiometric**
	Modes	Calibration keydata / MME	PGS reference
Calculate from	Earth	N/A	A3.14
Apply to			
Spatial aliasing is caused by the finite readout time of FPA and PMD detector pixel arrays. The detector pixels are read consecutively while the scan mirror is moving and therefore each pixel observes a ground scene that is slightly shifted in space compared to the previous pixel. E.g., with a FPA integration time of 187.5 ms and a detector readout time of 46.875 ms, the shift between the first and last detector pixel amounts to one quarter of the observed scene. This will alias spatial patterns into spectral patterns whose magnitude will depend on scene variability (cloud / no cloud, land / water, etc.). At those main channel boundaries where the last pixel of a channel and the first pixel of the next channel are read at different time, spatial aliasing results in intensity jumps. Spatial aliasing correction makes use of the higher spatial resolution of the PMD channels as compared to the FPA channels. FPA signals are corrected to the time of the readout of the detector pixel at the short wavelength end of the detector. When calculating the correction factor, the relative timing between PMD and FPA readouts is considered. For each FPA channel, only one PMD band is selected, and the correction is interpolated in wavelength between the selected PMD bands to avoid spectral artifacts being introduced by the correction. The spatial aliasing correction typically is of the order of 10^{-1} relative.			

Calculate fractional cloud cover and cloud top pressure			Other Quality
	Modes	Calibration keydata / MME	PGS reference
Calculate from	Earth	N/A	A3.15
An effective cloud fraction and cloud top pressure are retrieved for each GOME-2 ground pixel using the Fast Retrieval Scheme for Clouds from the Oxygen A band (FRESCO) developed by KNMI. The FRESCO retrieval method is based on a comparison of measured and simulated reflectivities in three approximately 1 nm wide spectral windows in and around the oxygen A band (758, 761, 765 nm). Information on cloud fraction is mainly coming from the continuum (high intensity for high cloud cover). Information on cloud top pressure is mainly coming from the oxygen A band itself (high absorption for low cloud). Cloud parameters derived in this function are reported in the products for use in higher level processing. They are not used any further in the level 0 to 1 processor.			

7.1.5 Absolute radiometric calibration

Normalise to integration time of 1 second			Radiometric
	Modes	Calibration keydata / MME	PGS reference
Apply to	All	N/A	AG.11
Preprocessed signals are normalised to an integration time of one second by dividing them by the integration time. For the PMD channels the actual integration time for each block as determined by the readout and transfer modes is used.			

Apply radiance response	Radiometric

	Modes	Calibration keydata / MME	PGS reference
Apply to	Earth	Radiance response MME	A3.11
Absolutely calibrated radiances in physical units [photons / (s cm^2 nm sr)] are calculated from preprocessed signals in instrument units [BU/s]. This is done by dividing the preprocessed signals by the radiance response MME for the actual scanner viewing angle. For calculating absolute radiances from the PMD channels, signals from PMD p and PMD s channels are combined. Radiances are strongly dependent on observation geometry and ground scene. Even for a fixed geometry a variation of one order of magnitude between a cloudy and a cloud-free scene is common. For a solar zenith angle of 60° typical radiance values are between 1013 and 1014 photons / (s cm^2 nm sr).			

Apply irradiance response			**Radiometric**
	Modes	Calibration keydata / MME	PGS reference
Apply to	Sun	Irradiance response MME	AG.17
Absolutely calibrated irradiances in physical units [photons / (s cm^2 nm)] are calculated from preprocessed signals in instrument units [BU/s]. This is done by dividing the preprocessed signals by the irradiance response MME for the actual solar elevation and azimuth angle combination. As stated above for the SMR, the solar irradiance is of the order of 5·1014 photons / (s cm^2 nm) at 550 nm.			

7.1.6 Quality flagging (droduct confidence data generation)

The task of product quality control is shared between the level 0 to 1 processor and the Product Quality Evaluation (PQE) function. The level 0 to 1 processor condenses information relevant for product quality monitoring into Product Confidence Data (PCD). These PCD records are then used by the PQE function to derive quality reports and statistics.

PCDs are provided at three levels:

- PCDs related to in-flight calibration parameters are reported as numbers and flags in the corresponding database entries and VIADRs (see Product Formats).

- PCDs related to individual scans are reported as numbers and flags in the MDRs.
- PCD flags on scan level are counted and their total number is reported on product level in the SPHR. The number of scans per observation mode and the numbers of missing data packets and scans are also reported in the SPHR.

A number of functions create their own PCD records as indicated in the function descriptions above. In addition, there are two dedicated functions performing specific quality checks and generating additional PCD records.

Determine PCDs from raw intensity			**Quality**
	Modes	Calibration keydata / MME	PGS reference
Calculate from	All	N/A	A2.4 (AG.5, AG.6)
Raw signals are checked for the following conditions affecting their quality and flags are raised accordingly: Saturated pixels, i.e., binary readouts above a predefined threshold, typically 50,000 BU. (The threshold should be defined in a conservative way such that it indicates the end of the linear response rather than the real saturation value.) Spectra with saturated pixels should not be used at all in higher level processing because of undefined side effects to non-saturated pixels in the same channel. Hot pixels, i.e., spikes caused by high-energy cosmic particles. This check is applied only to measurement modes having a small signal variation between adjacent pixels, i.e., dark, LED and WLS modes. Spectra with hot pixels could be used in further processing if the hot pixels are excluded. For this purpose a hot pixel mask is generated. Band averaged signal too low. If the band averaged signal is lower than the band averaged offset (around 1500 BU), this points to a problem. E.g., the corresponding FPA might be switched off. For all checks, threshold values are defined as initialisation parameters.			

Determine PCDs from geolocation	**Quality**

	Modes	Calibration keydata / MME	PGS reference
Calculate from	All	N/A	A2.7 (AG.7, AG.8, AG.9)
Geolocation parameters are checked for a number of conditions affecting data quality and flags are raised accordingly: Satellite within South Atlantic Anomaly (SAA) region, defined as a rectangular region in longitude and latitude, Ground pixel possibly affected by sun glint over sea, due to observation geometry, Ground pixel possibly affected by rainbow effect, due to observation geometry, Observation mode and geolocation not consistent (e.g., dark measurements performed on dayside, solar measurements far away from Northern hemisphere terminator, etc.). Threshold angles are defined as initialisation parameters. Sun glint and rainbow flags indicate a geometric possibility only. Actual occurrence and magnitude of the effect depends on cloud cover (sun glint, rainbow) and wind speed at ocean surface (sun glint).			

7.1.6.1 In-flight calibration parameters

A number of calibration parameters can be derived from the dedicated in-flight calibration measurements described in See In-Flight Characterisation & Calibration. These are: dark signal, pixel-to-pixel gain (PPG) correction, spectral calibration parameters, Etalon correction, and the Sun Mean Reference spectrum. The frequency of in-flight calibrations varies between once per orbit (e.g. dark signal) and once per month (e.g. PPG correction). Corrections are generally sufficiently stable to be valid for more than one orbit.

In-flight calibration parameters are not immediately used or stored in a product after they have been calculated. Instead they are stored first in a database. When an Apply Correction step requires in-flight calibration parameters, they are selected from the database according to certain rules. In particular, parameters are only updated close to the Northern Hemisphere terminator. This ensures that in-flight calibration parameters are not changed on the dayside which could lead to artificial steps in higher level processing. Only those in-flight calibration parameters selected to be used are stored within the level 1a product.

If a given in-flight calibration parameter depends on a parameter or parameter combination, this is indicated in the tables below. It is then calculated, stored, and applied separately for each parameter combination. For integer parameters such as integration time and PMD modes this is straightforward. For temperature values, bins are used whose width is defined in the initialisation parameters such that the change of the in-flight calibration parameter within a given bin can be tolerated.

Examples of in-flight calibration parameters (dark signal correction, PPG correction, spectral calibration and etalon correction) and their effect on the spectrum to which they are applied are shown in See Examples of In-Flight Corrections and Calibration.

Dark Signal Correction			**Radiometric Quality**
	Modes	Calibration keydata / MME	PGS reference
Calculate from	Dark	N/A	A2.8
Apply to	All above Dark	N/A	AG.10
Depends on	FPA and PMD: Integration time, detector temperature PMD: PMD readout and transfer modes		
The dark signal for each parameter combination is calculated as average of measurements in dark mode during eclipse. Applying the dark signal correction means subtracting the dark signal from a spectrum. This is the most basic and the first of all corrections applied in level 0 to 1 processing. The dark signal has two components: the integration-time independent offset of typically 1500 BU, and the integration time and detector temperature dependent leakage current of typically 0.7 BU/s at a detector temperature of 235 K. When calculating and applying the dark signal correction, only the total dark signal is considered. There is no need to split the dark signal into its components. This is only done for long-term monitoring purposes, see Sensor Performance Assessment.			

Pixel-to-pixel gain (PPG) correction	**Radiometric Quality**

	Modes	Calibration keydata / MME	PGS reference
Calculate from	LED (WLS)	N/A	A2.11
Apply to	All above Dark	N/A	AG.12
Given a uniform illumination over the detector array, dark-signal corrected signals vary slightly between detector pixels, mainly because of small differences in pixel width. To compensate for this effect, the variation in pixel-to-pixel gain is determined from measurements in LED mode which provide a fairly uniform illumination. A PPG correction spectrum is obtained by applying a triangular smoothing to the LED (fall back: WLS) measurements and dividing the measured spectrum by the smoothed spectrum. Applying the PPG correction means dividing a spectrum by the PPG correction spectrum. The PPG correction is of the order of 10^{-4} relative.			

Spectral calibration			**Spectral Quality**
	Modes	Calibration keydata / MME	PGS reference
Calculate from	SLS	FPA: SLS line positions PMD: PMD slit function, SLS Stokes fractions, FPA overlap wavelengths, MME	A2.13 A2.14
Apply to		N/A	AG.13
Depends on	Predisperser prism temperature		

Spectral calibration is the assignment of a wavelength value to each detector pixel. For each GOME-2 channel, a low order polynomial approximation will be used to describe wavelength as a function of detector pixel. Polynomial coefficients are derived from preprocessed spectra of the on-board PtCrNeAr Spectral Light Source (SLS) which provides a number of spectral lines at known wavelengths across the GOME-2 wavelength range.

Different algorithms are used for FPA and PMD channels because their spectral resolution is different. Individual spectral lines can be only be resolved in the FPA channels. Positions of individual lines from a predefined set are determined using a Falk centre-of-gravity algorithm. For the PMD channels an iterative cross-correlation algorithm is used. The expected PMD signal is calculated from the measured FPA signal, taking into account the PMD slit function and ratio of radiometric response between PMD and FPA channels. The expected PMD signal is then spectrally matched with the measured PMD signal using cross-correlation.

The detector pixel onto which light of a given wavelength is impinging depends on instrument temperature. The temperature at the predisperser prism is used as a reference. Typical shifts with temperature are of the order of 0.01 pixel / K for the FPA channels, but depend on detector pixel.

Etalon correction			**Radiometric Quality**
	Modes	Calibration keydata / MME	PGS reference
Calculate from	WLS (Sun)	Reference WLS spectrum	A2.16
Apply to			AG.14

Interference in the thin detector coating layer causes a wave-like pattern on the radiance response (fixed etalon). When deposits settle on the detector coating, the interference pattern is changed (variable etalon). The etalon correction accounts for changes in the variable etalon between on-ground calibration (reference etalon) and the in-orbit situation. It is calculated from preprocessed spectra of the on-board Quartz Tungsten Halogen white light source (WLS). The in-orbit WLS spectrum is ratioed to a reference WLS spectrum representative for the on-ground calibration of the radiance response. Four each channel, a bandpass filter is applied to the ratio. Spectral components within the bandpass (typically 4^{-10} oscillations per channel) are declared to be the Etalon correction. The remainder is called Etalon residual. Applying the Etalon correction means dividing a spectrum by the Etalon correction spectrum.

The Etalon correction typically is of the order of 10^{-2} relative.

Sun mean reference (SMR) spectrum			**Radiometric Spectral Quality**
	Modes	Calibration keydata / MME	PGS reference
Calculate from	Sun	Irradiance response MME	A2.20 (AG.17, AG.18)
Apply to	Earth	N/A	A3.11

A fully calibrated solar spectrum is calculated from preprocessed spectra acquired in sun mode. Spectra within the central part of the sun field-of-view are absolutely radiometrically calibrated taking into account solar elevation and azimuth angles for each spectrum, and then averaged into a sun mean reference (SMR) spectrum. The radiometric calibration is performed for the actually measured spectra, i.e., SMR intensities are not normalised to an earth-sun distance of 1 AU. The SMR spectrum is also spectrally calibrated, correcting the Doppler shift due to the movement of the satellite towards the sun. Applying the SMR spectrum means dividing an earth-radiance spectrum by the SMR spectrum.

The SMR irradiance is of the order of 5·1014 photons / (s cm^2 nm) at 550 nm.

7.1.6.2. Sensor performance assessment

The Sensor Performance Assessment (SPA) function is used for long-term monitoring of instrument performance. Performance related monitoring parameters are: instrument housekeeping data, spectral data, in particular in-flight calibration parameters, and polarisation data. SPA functionality comprises extraction, preprocessing and analysis of the monitoring parameters. The SPA function consists of two components:

- Monitoring data are extracted from level 1a products, level 1b products, and in-flight calibration datasets. They are preprocessed and written to the SPA database (GOME-2 PGS A4.1).
- Monitoring data for a given timeframe are retrieved from the SPA database and statistically analysed (GOME-2 PGS A4.2).

A typical use of the SPA function would be to extract and preprocess a selected monitoring parameter, e.g. leakage current, and to visually and statistically analyse its time series (trends, oscillations, jumps...).

<table>
<tr><th colspan="3">Extract and pre-process monitoring data</th><th>SPA</th></tr>
<tr><td></td><td>Modes</td><td>Data source</td><td>PGS reference</td></tr>
<tr><td>Calculate from</td><td>All</td><td>1a, 1b, in-flight calibration</td><td>A4.1</td></tr>
<tr><td colspan="4">Monitoring data from the level 1a and 1b data products and the in-flight calibration database is extracted, preprocessed, and written to the SPA database.

Preprocessing reduces the volume of monitoring data which is essential if time series over several years have to be analysed. The following preprocessing steps are applied to the extracted monitoring data:

Housekeeping data are converted to physical units and mean/min/max/stddev values per scan are calculated.

Spectral data are averaged per observation mode and interpolated to a fixed wavelength grid.

Spectra from sun and earth modes are normalised to a solar distance of 1 AU.

Stokes fractions are determined for individual solar measurements (not the SMR).

The spectral reflectivity of the on-board diffuser is determined in predefined wavelength windows from ratios of SLS over diffuser and direct SLS measurements.</td></tr>
</table>

Dark signals are separated into offset and leakage current components.

Perform statistical analysis on time series			**SPA**
	Modes	Data source	PGS reference
Calculate from	All	SPA database	A4.2.1
This function provides basic statistical functions for the higher level functions described below.			

Monitor housekeeping data			**SPA**
	Modes	Data source	PGS reference
Calculate from	All	SPA database	A4.2.3 to A4.2.6
Monitoring of housekeeping data covers thermal, electrical, and mechanical instrument performance. For life-limited items such as on-board lamps, scanner, and shutter usage statistics are derived. The total time per instrument mode is calculated. Selected temperatures are statistically analysed, in particular with respect to orbital and annual periodicities, and trends. SLS and WLS voltages are statistically analysed, per switch on-period and as a long term time series. This includes monitoring of SLS ignition delay and ignition voltage. Scanner positions across the scan are compared to the nominal values, and the timeseries of deviations is monitored.			

Monitor spectral data			**SPA**
	Modes	Data source	PGS reference

Calculate from	All	SPA database	A4.2.7 to A4.2.14
The variation of spectral data over time is analysed in order to monitor detector performance, overall instrument throughput and stability, and sun diffuser reflectivity. Time series of the following parameters can be statistically analysed: Dark signal offsets, leakage current, and dark signal noise. On-board light sources: SLS, WLS, and LED signals. Spectral stability: Wavelength values for selected detector pixels. Etalon spectra and Etalon residuals. Pixel-to-pixel gain. Diffuser reflectivity. Instrument throughput: Ratios of solar spectra with a reference solar spectrum, and ratios of earth spectra for selected scenes (deserts, cloud-free ocean pixels, etc.) with a reference earth spectrum for the same scene.			

Monitor polarisation data			**SPA**
	Modes	Data source	PGS reference
Calculate from	Sun, Earth	SPA database	A4.2.15 to A4.2.16
Selected Stokes fractions are monitored in order to detect changes in the instrument polarisation response and the performance of the PMD channels. Stokes fractions are selected such that they should be zero due to the measurement geometry. Time series of the following parameters can be statistically analysed See [SCD20] Hartmann, H.W., C.P. Tanzi, J.M. Krijger and I. Aben, GOME-2 Polarisation Study - Phase C/D Final Report, RP-GOME2-003SR, SRON, Utrecht, The Netherlands.: Stokes fractions for solar measurements. Stokes fractions for special earth viewing geometries.			

7.1.6.3 Product quality evaluation

The Product Quality Evaluation (PQE) function provides information about the quality of the generated level 1 products. It uses PCD records from the level 1a and 1b data products to derive quality reports, statistics, and quick-look data. The PQE function consists of two components:

- PCDs are extracted from the level 1a and 1b data products and written to the PQE database (PGS A5.1).
- Quality data for a given timeframe are retrieved from the PQE database and condensed to provide daily, weekly, monthly and yearly Product Quality Summaries and Quick Look information.

Extract quality data			**PQE**
	Modes	Data source	PGS reference
Calculate from	All	level 1a and 1b products	A5.1
PCD records are extracted from level 1a and level 1b products and stored in the PQE database.			

Generate daily quick-look data			**PQE**
	Modes	Data source	PGS reference
Calculate from	Earth	PQE database	A5.2.1
The following parameters are calculated (usually from 1 day of data, i.e., 14 orbits) and visualised on a global map: Ozone line ratio from two UV wavelengths (FPA channel 2) as a proxy for ozone column densities. Red-green-blue ("false colour") image from three PMD bands. Normalised Difference Vegetation Index (NDVI) from two wavelengths in FPA channel 4 as a proxy for vegetation. Visual inspection of these maps allows a number of instrument or processing problems to be spotted quickly (e.g., pointing problems, wrong commanding, saturation, errors in geolocation calculations, etc.)			

Generate product quality summaries			PQE
	Modes	Data source	PGS reference
Calculate from	All	PQE database	A5.2.2
PCDs for a specified time interval (day, week, month, year) are condensed as follows: PCDs describing an occurrence number (counters) are summed. PCDs describing mean values are averaged. Flags on non-nominal situations are counted. A report with the condensed information is issued.			

8. GOME-2 products validation and monitoring

8.1. Objectives

The overall objective of the GOME-2 characterisation, calibration and validation activities is to ensure that, after the commissioning phase and thereafter during the mission lifetime, the GOME-2 instrument achieves its expected performance with respect to the GOME-2 requirements specification See [RD10] GOME-2 Requirements Specification, MO-RS-ESA-GO-0071., and that the products satisfy the EPS End User Requirements specified in See [RD1] EPS End User Requirements Document, EUM.EPS.MIS.REQ.93.001. A further objective is that the GOME-2 product accuracy will continuously improve as far as possible to satisfy the evolving state of the art user requirements. The following specific objectives determine the product Cal/Val activities for GOME-2:

- full verification of instrument performance through monitoring of the GOME-2 instrument
- calibration and characterisation of the GOME-2 instrument taking into account long term changes in instrument performance in-flight
- provision of confidence checked and verified GOME-2 level 1 products
- provision of validated GOME-2 level 1b and level 2 products taking account of the feed-back between level 1 and level 2 product validation
- revision of product generation processing algorithms and required data sets, to ensure that the products first meet, and then exceed, user expectations.

It can be expected that correction of GOME-2 in-orbit instrument degradation will periodically require a reprocessing of the complete data set during routine operations to ensure the consistency of the long term data record.

8.2. GOME-2 in-orbit verification

GOME-2 In-Orbit Verification (GOME-2 IOV) will be under the responsibility of the European Space Agency (ESA) and will be carried out in the time period, launch to launch plus 8 weeks. The primary objective of GOME-2 IOV is to verify that the instrument meets its functional and performance requirements. This will be achieved by exercising specific instrument operations, first via manual commanding and then using dedicated test timelines, and by analysis of raw data from both the

S and X bands using dedicated test tools. Demonstration of nominal instrument performance is a prerequisite for successful GOME-2 IOV and Commissioning Phase Hand-over Reviews. In addition GOME-2 IOV activities are expected to provide significant input to the planning of commissioning phase and routine operations. The specific functional and performance tests carried out during IOV are fully detailed in See [RD6] MetOp GOME-2 In-Orbit Verification Plan, MO-PL-ESA-GO-0506.

8.3. Instrument monitoring

Verification of the correct functioning of the GOME-2 instrument requires continuous instrument monitoring activities. These activities will start during the commissioning phase, specifically during in-orbit verification of the instrument function and performance, and continue during the remainder of commissioning phase and during routine operations. Furthermore, instrument characteristics such as radiance and irradiance sensitivity will change during the GOME-2 lifetime due to in-orbit degradation of the instrument. A subset of level 0, 1a and 1b data necessary for instrument performance monitoring and for the calculation of correction factors to account for changes in the sensitivity of the instrument, will be generated by the SPA function of the GOME-2 PPF, see [RD7] GOME-2 Level 1 Product Generation Specification, EPS.SYS.SPE.990011. and See Sensor Performance Assessment. for further details of specific monitoring activities. These monitoring data will be further analysed and degradation correction factors derived where appropriate. The starting point for monitoring activities using internal calibration sources are on-ground reference measurements contained within the set of Calibration Key Data files described in See [RD13] GOME-2 Calibration: Data analysis procedures, MO-RS-TPD-GO-0027. and See [RD18] GOME2 Calibration: Key Data file structure specification, MO-RS-TPD-GO-0025.

8.4. Level 1 verification, confidence checking and validation

It is not possible to fully verify and validate all GOME-2 level 1 products without feedback from the validation of atmospheric constituent retrievals. For further details on the validation of atmospheric constituent retrievals, in support of level 1 validation, see See Atmospheric Constituent Verification and Validation. The spectral solar irradiance data and the cloud parameters may be fully validated, but spectral radiance data can only be partially validated. There are however a number of other parameters in the level 1 product that can be verified or used for confidence checking.

Verification and validation of geolocation information

Basic checks on the scan location, swath width and ground-pixel size are carried out by comparing observed values with those expected based on the scan offset from nadir, the commanded swath width, and integration times specified in the current instrument operating timeline. In addition, the Quick Look False Colour

PMD images generated by the PQE facility of the GOME-2 PPF as described in See [RD7] GOME-2 Level 1 Product Generation Specification, EPS.SYS.SPE.990011., in which coastlines are expected to be visible, will be compared to a validated coastline map to confirm that there are no deviations between the coastline observed in the False Colour PMD image and the coastline map.

Validation of wavelength calibration parameters

Spectral calibration measurements are taken using the Spectral Line Source (SLS) every orbit. In order to verify the spectral calibration parameters generated using the SLS, it is planned to generate an independent estimate of the spectral calibration using the Fraunhofer absorption lines visible in GOME-2 measured spectra. The solar spectrum contains well documented Fraunhofer absorption lines in the spectral range of GOME-2 See [SCD24] Allen, C.W., "Allen's Astrophysical Quantities", 4th edition, Springer Verlag, 2000. By cross-correlating the Fraunhofer lines in a wavelength calibrated high resolution reference solar spectrum, with those in either the GOME-2 SMR, or in calibrated GOME-2 earthshine measurements, an independent estimate of the GOME-2 spectral calibration may be obtained.

Validation of Stokes fractions using a vector RTM

Measured Stokes fractions from GOME-2 can be monitored and also validated with respect to the constraints of an extreme limiting atmosphere as described in See [SCD20] Hartmann, H.W., C.P. Tanzi, J.M. Krijger and I. Aben, GOME-2 Polarisation Study - Phase C/D Final Report, RP-GOME2-003SR, SRON, Utrecht, The Netherlands. An alternative method for validating the polarisation measurements is to use a vector Radiative Transfer Model (RTM), as a reference validation measurement, which fully describes the polarisation state of the incoming radiation measured by GOME-2. The utility of this as a validation method will necessarily depend on the accuracy of the vector RTM and the input parameters for the model calculations, and also the level of validation of the model itself. In practise this method may also be considered as a model validation tool. It is preferable to validate measurements made in nadir static viewing mode for this validation exercise. In addition, the validation activity will be restricted to cloud free scenes.

Validation of cloud parameters

An effective cloud amount and cloud top pressure is retrieved for each GOME-2 ground pixel using the Fast Retrieval Scheme for Clouds from the Oxygen A band (FRESCO), developed by KNMI See [SCD21] R.B.A, Koelemeijer, P. Stammes, J. W. Hovenier and J.F. de Haan, "A fast method for retrieval of cloud parameters using oxygen A-Band measurements from GOME", JGR, Vol 106, 3475-3490, 2001. The FRESCO algorithm has been independently validated for GOME-1 data by comparison to the ISCCP cloud data set See [SCD22] R.B.A, Koelemeijer, P.

Stammes, J.W. Hovenier and J.F. de Haan, "Global distributions of effective cloud fraction and cloud top pressure derived from oxygen A-band spectra measured by the Global Ozone Monitoring Instrument: Comparison to ISCCP data, J. Geophys. Res.,Vol. 107 D12, 2002. The same approach will be followed for validation of FRESCO cloud products from GOME-2. Additionally AVHRR/3, also flying on METOP will produce cloud information at a resolution of approximately 1x1km on the ground. The swath width of AVHRR/3 is ±1447 km which provides complete coverage of the GOME-2 swath with the exception of North and South Polar scanning modes which have default offsets of +46.696º (North Polar) and -46.172º (South Polar) with respect to nadir See [RD8] GOME-2 Level 1 Product Format Specification, EPS.MIS.SPE.97232. This provides a valuable data set with which to validate the FRESCO cloud products produced using GOME-2 data. However, as GOME-2 and AVHRR measure in different spectral regions they will show different sensitivity to clouds. This will complicate the comparison of the two data sets.

Validation of the Sun Mean Reference (SMR) spectrum

The solar irradiance measurements made by GOME-2, typically obtained once per day, are combined into a Sun Mean Reference spectrum which represents an average of a number of solar spectra, subject to quality control criteria, measured during the course of a solar viewing timeline, (see [RD7] GOME-2 Level 1 Product Generation Specification, EPS.SYS.SPE.990011. for more details). The SMR can be validated by comparison to reference solar spectra, obtained from one or more satellite instruments measuring in the same spectral region. Although it is advantageous to obtain coincident measurements in space and time, solar variability when measurements are normalised to an Earth-Sun distance of 1AU, is expected to be no more than a few percent between 210 and 300nm and less than one percent above 300nm See [SCD23] Brasseur, G. and S. Solomon, "Aeronomy of the Middle Atmosphere", 2nd edition, D. Riedel Publishing Company, pp 100, 1986.

Preliminary validation of earthshine radiance spectra and albedo

GOME-2 has a number of Earth scanning observation modes in which measurements of backscattered radiance spectra are made (see Observation Modes.). The validation of Earthshine radiance measurements from GOME-2 is an extremely difficult task due to the inherent variability of the observed atmosphere, clouds, and ground scenes, and the dependence of the measured spectrum on the viewing geometry. These data cannot be completely validated without feedback from level 2 product validation. Further feedback will be provided by NOAA who plan to process GOME-2 level 1b data using the SBUV/2 ozone profile algorithm. Diagnostic information produced will provide useful feedback on the quality of the GOME-2 level 1b data product. A number of possibilities do exist, however, for the preliminary checking and validation of GOME-2 radiance spectra and these are described below.

The UV albedo as measured by GOME is calculated as a ratio of the calibrated radiance spectrum to the SMR spectrum. In the wavelength range 240-290nm surface contributions to the back-scattered radiance are low. The UV albedo is therefore expected to be smooth, both spectrally and temporally, and can be analysed to provide an independent estimate of the accuracy of the noise and dark current corrections. This provides a preliminary confidence check on the pre-flight characterisation of the radiance and irradiance response of the instrument and on the in-flight calibration of the radiance and irradiance spectra themselves.

Furthermore, the ozone absorption peaks in the Hartley band at a wavelength of approximately 255.3nm. It is therefore possible to select wavelengths either side of the peak which have the same absorption and therefore can be expected to measure the same UV albedo. However this is a region of extremely low signal levels and the utility of the method will depend on the quality of measurements at these short wavelengths in-orbit. Spatial and/or temporal averaging in order to improve signal to noise characteristics are likely to be required.

Comparison of GOME-2 backscattered radiance spectra with nadir backscattered radiance spectra measured by other satellite-based sensors can provide a preliminary validation of the GOME-2 level 1b radiance measurements. Ideally these comparisons will be carried out using measurements made in nadir static earth observation mode (see See Observation Modes.) to minimise ground scene variability and additionally differences in viewing geometry. Alternatively, nadir ground pixels in earth scanning mode could be used for the comparison. Differences in Solar Zenith Angle will however remain, even for nadir viewing geometry. Additionally only cloud-free scenes should be selected. The utility of this method may be restricted to the Ultra Violet region where the sensitivity to clouds, and surface albedo is reduced. Good knowledge of aerosol characteristics will still be required. A statistical comparison will be considered.

Due to the intrinsic difficulty in comparing GOME-2 radiance spectra with those measured by other instruments, measured GOME-2 spectra will also be compared to back-scattered spectra simulated using a radiative transfer model. The radiative transfer model requires as input measurements of the atmospheric state (particularly O^3 and NO^2 but also BrO, HCHO and SO^2, and aerosol information) either from independent collocated ground-based or satellite measurements if available, or from model or climatology data. Once again the utility of this method may be restricted to the Ultra Violet region.

8.5. Atmospheric constituent verification and validation

As described in See Level 1b to 2 Data Processing., the operational GOME-2 level 2 data products will be produced by the Ozone Monitoring Satellite Application Facility (O3MSAF), part of the EPS Distributed Ground Segment. The target trace gases for GOME-2 are O^3 profile, total column O^3, NO^2, BrO, HCHO, SO^2 and OClO. Aerosol Absorbing Index (AAI), aerosol optical depth and UV maps (both clear sky and including clouds and albedo) will also be produced. See Expected product accuracies for operational GOME-2 level 2 products produced by the O3M SAF. for further details on expected accuracy and product quality. The O3MSAF is fully responsible for the validation of their own products however it should be noted that there is no commitment for validation of the minor trace gas species. For further information See [O3M1] Ozone SAF User Requirements Document, SAF/O3/RQ/URD., See [O3M2] Ozone SAF Science Plan, SAF/O3/FMI/ALG/PL. and See [O3M3] Ozone SAF Scientific Prototyping Report, SAF/O3/FMI/ALG/REP. O3MSAF level 2 product validation activities are expected to provide relevant feedback for level 1 product validation. In particular diagnostic output from the level 2 retrieval algorithms will contain useful information for analysis of level 1 product quality. Similarly information on instrument performance and level 1 product quality, obtained during the level 1 verification and validation activities, will provide valuable input to the level 2 validation activities.

In addition a restricted processing capability for the retrieval of atmospheric constituents is required centrally at EUMETSAT in support of GOME-2 level 1 product validation. This will comprise at a minimum an ozone profile, a total column ozone, an Aerosol Absorbing Index (AAI), and a minor trace gas retrieval capability, in particular total column NO^2 and BrO. This capability will be used to provide an independent estimate, on the basis of the quality of the retrieved atmospheric constituents, of the quality of the level 1 data products.

Validation of these products will be primarily based on comparison with other independently validated spatially and temporally collocated measurements. Sources of independent validation data sets include ground-based data, satellite-based data, and aircraft- and balloon-based data.

Ground-based measurements:

Ground-based measurements of products relevant to GOME-2 are available from a number of networks of well calibrated and well validated instruments. These networks typically provide a continuous data record of well understood quality. Ground-based measurements will form the basis of an absolute validation of GOME-2 data. Specific collocation possibilities depend on the GOME-2 overpass time for each ground-based station location as compared to the nominal observation time at the ground station. If the available collocated ground-based ozone profile measurements are not sufficient additional measurements, timed to coincide with the GOME-2 overpass time, may be requested as part of a coordinated calibration campaign. Alternatively use of a chemical transport model or data assimilation model may be required to interpret measurements taken at a different time of day or Solar Zenith Angle (SZA). Measurement techniques used in ground-based networks include the following:

- The Dobson spectrophotometer measures the total ozone column amount to an accuracy of 2-3% (station dependent) for solar elevations greater than 15o. It is a double monochromator which measures in the spectral region of the Ozone Huggins bands. The total column ozone is determined using the differential absorption technique applied typically to the wavelength pair 305.5nm-325.4nm and 317.6nm-339.8nm referred to as the AD pair See [SCD25] Komhyr, W.D., "Operations Handbook - Ozone Observations with a Dobson Spectrophotometer", WMO Global Ozone Research and Monitoring Project, Report No. 6, 1980. & See [SCD26] Basher, R.E., "Review of the Dobson Spectrophotometer and Its Accuracy", WMO Global Ozone Research and Monitoring Project, Report No. 13, December 1982.

- The Brewer grating spectrophotometer is similar in principle to the Dobson spectrophotometer however it is fully automated. The total column abundance of ozone is derived from five wavelengths measured in the region 306nm - 320nm See [SCD27] Kerr, J.B., C. T. McElroy, D. I. Wardle, R. A. Olafson, and W.F.J. Evans, "The automated Brewer spectrophotometer", p. 611-614, Proc. of the Quadrennial Ozone Symposium, ed. C. S. Zerefos and A. Ghazi, D.Reidel Publ. Co., 1984.
- Ultra-Violet/Visible zenith sky spectrometer observations performed at twilight allow the determination of column amounts of various trace gases using the Differential Optical Absorption Spectroscopy (DOAS) technique. The gases measured include O^3 with a reported accuracy of 3% and NO^2 with a reported accuracy of 10%. It is also possible to operate UV-visible DOAS spectrophotometers in solar occultation mode to obtain vertical distributions of O^3 and NO^2 from the upper troposphere to the mid stratosphere See [SCD33] Vaughan, G., H.K. Roscoe, L.M. Bartlett, F.M. O'Connor; A. Sarkissian; M. Van Roozendael; J.-C. Lambert, P.C. Simon, K. Karlsen, B.A. Kåastad Høiskar, D.J. Fish, R.L. Jones, R.A. Freshwater, J.-P. Pommereau, F. Goutail, S.B. Andersen, D.G. Drew, P.A. Hughes, D. Moore, J. Mellqvist, E. Hegels, T. Klupfel, F. Erle, K. Pfeilsticker, U. Platt, "An intercomparison of ground-based UV-visible sensors of ozone and NO^2", J. Geophys. Res. Vol. 102, No. D1, p. 1411, 1997. At some latitudes BrO may also be measured.
- Fourier Transform Infrared (FTIR) spectrometers can provide, in addition to other minor trace gases, measurements of total column O^3 with a reported accuracy of 3% and NO^2 with an accuracy of 10% derived from high resolution measurements of the solar spectrum See [SCD34] Bell, W., C. Paton Walsh, P.T. Woods, T.D. Gardiner, M.P. Chipperfield and A.M. Lee, "Ground-based FTIR measurements with high temporal resolution", J. Atmos. Chem., 30, 131-140, 1998. & See [SCD35] Beer, R., "Remote sensing by Fourier Transform Spectrometry", Wiley, New York, USA, 1992.
- Ozonesondes make in situ measurements of the vertical distribution of ozone up to an altitude of 35km 45 km. The principle of operation is based on recording the number of electrons generated in an electro-chemical reaction based on the titration of ozone in a potassium iodide (KI) sensing solution. An exception is the Japanese KC79/96-ozone sensor which uses potassium bromide (KBr) instead of potassium iodide (KI). The sonde is attached to a balloon. Pressure, temperature and humidity information is also measured by an attached radio-sonde. The vertical resolution of the measurements is approximately 100m, with a precision of approximately 2% and an accuracy of 5% See [SCD28] WMO, "Third WMO intercomparison of

the ozonesondes used in the Global Ozone Observing System, Vanscoy, Canada 13-24 May 1991", Global Ozone Research and Monitoring Project Report No. 27, 58 pp., Geneva, 1991., See [SCD29] Brewer, A. and J. Milford, "The Oxford Kew ozonesonde", Proc. Roy. Soc. London, Ser. A, 256, 470, 1960., See [SCD30] Komhyr, W.D., "Development of an ECC-Ozonesonde", NOAA Techn. Rep. ERL 200-APCL 18ARL-149, 1971. & See [SCD31] Kobayashi, J., and Y. Toyama, "On various methods of measuring the vertical distribution of atmospheric ozone (III) - Carbon iodine type chemical ozonesonde", Pap. Met. Geophys., 17, 113-126, 1966.

- To monitor atmospheric ozone with the Differential Absorption Lidar (DIAL) technique, the choice of the laser wavelengths depends on the altitude range of the measurement required See [SCD36] Mégie, G., G. Ancellet, J. Pelon, "Lidar measurements of ozone vertical profiles", Appl. Opt., 24, 3454-3453, 1985. The selected wavelengths differ according to whether the measurement to be made is in the troposphere or in the stratosphere The stratospheric DIAL technique allows measurement of stratospheric ozone in the vertical range 15km to 45km under clear sky conditions. The vertical resolution varies from 0.5km to 8km, increasing with altitude, and with a precision over the entire range of 3% or less and an accuracy varying from 0.5% to 10% depending on vertical resolution See [SCD32] Harris, N., R. Hudson and C. Phillips, "Assessment of Trends in the Vertical Distribution of Ozone", SPARC Report No. 1, WMO Ozone Research and Monitoring Project Report No. 43, 1998. & See [SCD36] Mégie, G., G. Ancellet, J. Pelon, "Lidar measurements of ozone vertical profiles", Appl. Opt., 24, 3454-3453, 1985.
- Microwave radiometers provide profiles of atmospheric trace gas species, particularly ozone, in the 20km to 70km range with no sensitivity to weather conditions or the aerosol loading of the atmosphere. Measurements are available with an accuracy of 10% to 15% and with a vertical resolution of 8km to 12km See [SCD37] Connor, B.J., A. Parrish, J.-J. Tsou, and M.P. McCormick, "Error analysis for the ground-based microwave ozone measurements during STOIC", J. Geophys. Res., 100(D5), 9283-9221, 1995. & See [SCD38] Parrish, A., B.J. Connor, J.J. Tsou, I.S. McDermid, and W.P. Chu, "Ground-based microwave monitoring of stratospheric ozone", J. Geophys. Res., 97(D2), 2541-2546, 1992.

The observing networks which coordinate and collect routine measurements include The World Meteorological Global Atmosphere Watch Program (GAW), The Network for the Detection of Stratospheric Change, and The Climate Monitoring and Diagnostics Laboratory (CMDL).

Satellite measurements:

Satellite-based measurements have the advantage of global coverage which facilitates validation for all seasons and latitudes. Specific collocation possibilities depend on the detailed orbit characteristics of each satellite. In the case that the data are not closely collocated in time, access to additional analysis tools (e.g. Chemical Transport Models, Data Assimilation Systems, Trajectory models etc) will be required for optimal interpretation of the data comparison. Satellite-based measurements do not provide a direct validation reference measurement as they are themselves validated with respect to ground-based measurement systems. However on the assumption that this validation has been successfully carried out they provide an important validation data set, particularly for the examination of seasonal and temporal variability on a global scale. Several satellites, carrying instruments which measure products of relevance to GOME-2 and from which validation data may be available, are expected to be flying concurrently with MetOp. These are SCIAMACHY and MIPAS currently flying on ENVISAT, SBUV/2 flying on the NOAA series of satellites, the Ozone Monitoring Instrument (OMI) to be launched on EOS Aura, currently planned for 2004, and Ozone Mapping and Profiler Suite (OMPS) to be launched on the NPOESS Preparatory Project currently planned for launch in 2006. Furthermore the TOMS series of instruments continues, with EP-TOMS currently in operation. The availability of this data set will however depend on the operational lifetime of the instrument.

Aircraft and balloon measurements:

In addition to the meteorological balloons, referred to above as ozonesondes and classed here as ground-based measurements, larger balloons which require experienced personnel and dedicated launching sites can be used to carry multi-instrument payloads. Intensive balloon campaigns have been used in the past in the context of dedicated campaigns for the validation of satellite based data or in the framework of specific scientific programmes initiated by the European Union e. g. the European Arctic Stratospheric Ozone Experiment (EASOE) and the Second European Stratospheric Arctic and Mid-Latitude Experiment (SESAME). Aircraft are also used to carry multi-instrument payloads which are capable of making detailed measurements of ozone and other trace gases in the upper troposphere and lower stratosphere. They have also been used in the framework of dedicated campaigns. A validation campaign involving coordinated balloon launches and aircraft flights, timed to coincide with satellite overpass times and other dedicated ground-based observations requires the involvement and coordination of many scientists and institutions. It is not proposed to plan such a a campaign solely in support of GOME-2 level 1 validation. However, should such campaign data be available, either from other related scientific campaigns or in support of the validation activities of the O3MSAF it will be used. The requirement of the O3MSAF for a dedicated measurement campaign in support of validation of the operational GOME-2 level products is not yet decided.

Numerical Weather Prediction (NWP) analysis fields:

Numerical Weather Prediction (NWP) systems provide an estimate of the atmospheric state based on an optimal combination of measured data, obtained from many different sources, and model forecast fields. This is typically achieved by the minimisation of an objective cost function with respect to the atmospheric state which comprises both background and observation terms. Under the assumption that the data set to be validated is not assimilated within the data assimilation system, model analysis and forecast fields provide a self-consistent independent reference which takes into account constraints both from the model and from all other assimilated observations. Therefore although analysed model fields produced from a data assimilation system do not provide an absolute validation source, they can be used for monitoring the data to be validated. This allows biases and variability between different measurement types to be easily monitored on a global scale.

Validation method:

Validation of GOME-2 atmospheric constituents can be achieved using any of the independent validation data sources listed above. Collocated data must be selected on the basis of coincidence criteria which will vary depending on the characteristics of the individual data sets. The collocated data will be analysed per instrument and in the case of ground based data per instrument class and/or station. Collocated ozone profile data must be sampled at the same vertical resolution. Typically this will require that the profile with higher vertical resolution is convolved with the averaging kernel of the lower vertical resolution profile. The difference between the collocated data pairs should be calculated and compared to their expected accuracy. The results will be sorted on the basis of:

- Solar Zenith Angle (of the GOME-2 measurements)
- Viewing angle
- Cloud fraction
- Atmospheric aerosol loading
- Total column ozone amount or
- Total column amount of NO^2 or BrO as appropriate
- Latitude and longitude
- Land/sea (in the case of comparison to other satellite data)
- Season

and a statistical analysis carried out. For the purposes of long-term validation and trend assessment, time series of collocated data at selected locations and in the zonal mean will also be analysed. In the event that differences in spatial or temporal collocation are greater than the defined tolerances access to Chemical Transport Models, Data Assimilation Models and Trajectory Models will be needed to aid interpretation.

8.6. Validation of ozone monitoring SAF products

As noted above, validation of O3MSAF products is under the responsibility of the O3MSAF itself. The validation activities planned by the O3MSAF are described in detail See [O3M1] Ozone SAF User Requirements Document, SAF/O3/RQ/URD., See [O3M2] Ozone SAF Science Plan, SAF/O3/FMI/ALG/PL. and See [O3M3] Ozone SAF Scientific Prototyping Report, SAF/O3/FMI/ALG/REP. They comprise:

- validation of the total column ozone using ground-based measurements available through the World Ozone and Ultraviolet radiation Data Centre (WOUDC) (see *http://lap.physics.auth.gr/o3safval* for the prototype validation service to be provided to users).
- validation of ozone profile data using balloon soundings
- validation of ozone profiles using lidar data
- validation of the ozone distribution using data assimilation methods and
- validation of off-line UV fields

Validation results from these activities and also the diagnostic quantities produced in the generation of level 2 products will provide valuable feedback to the level 1 validation activities. Similarly, level 1 verification and validation activities will provide necessary input to the O3MSAF validation activities.

8.7. Scientific activities carried out via the EPS/MetOp RAO

An EPS/MetOp Research Announcement of Opportunity (RAO) to be coordinated by EUMETSAT and ESA is planned. The primary objectives of the Announcement of Opportunity are:

- stimulating relevant research in all domains of Earth Sciences, and structured dialogue and interactions between the selected investigators and the EUMETSAT operational users
- identifying support to calibration and validation activities, complementing and enhancing calibration and validation activities planned by EUMETSAT
- investigation of innovative research algorithm and demonstration of new geophysical products and of their relevance to research.

Further details may be found in See [RD23] EPS/MetOp Research Announcement of Opportunity, EUM/STG/42/03/DOC/06.

It is anticipated that scientific support to GOME-2 calibration and validation activities may be provided via this Research Announcement of opportunity, provided relevant investigations are proposed and selected.

Acronyms and Abbreviations

AAI	Absorbing Aerosol Index
AAPP	ATOVS and AVHRR Pre-processing Package
ADC	Analogue Digital Converter
AMSU	Advanced Microwave Sounding Unit
ANX	Ascending Node Crossing
AOD	Aerosol Optical Depth
ASCAT	Advanced SCATterometer
ASCII	American Standard Code for Information Interchange
ATOVS	Advanced TIROS-N Operational Vertical Sounder
AU	Astronomical Unit
AVHRR	Advanced Very High Resolution Radiometer
BSDF	Bi-directional Scattering Distribution Function
BU	Binary Unit
BUFR	Binary Universal Form for the Representation of meteorological data
CAL	Calibration function of EPS
CDA	Command and Data Acquisition (station)
CGS	Core Ground Segment
CGSRD	Core Ground Segment Requirements Document
CIE	Commission Internationale de L'Eclairage/International Commission on Illumination
CMDL	Climate Monitoring and Diagnostics Laboratory
CU	Calibration Unit of the GOME-2 instrument
DBS	Direct Broadcast Service
DIAL	Differential Absorption Lidar
DISORT	Discrete Ordinate Radiative Transfer model
DLR	Deutsches Zentrum für Luft- und Raumfahrt e.V.
DMDR	Dummy Main Data Record

DMI	Danmarks Meteorologiske Institut
DOAS	Differential Optical Absorption Spectroscopy
DVB	Digital Video Broadcast
DWD	Deutscher Wetterdienst
EASOE	European Arctic Stratospheric Ozone Experiment
ECMWF	European Centre for Medium Range Weather Forecast
ENVISAT	ENVIronmental SATellite
EOS	Earth Observing System
EPS	EUMETSAT Polar System
EPTOMS	Earth Probe TOMS
ERS	European Remote Sensing (satellite)
ESA	European Space Agency
ESTEC	European Space Technology Centre (Noordwijk, NL)
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites (Darmstadt, D)
FIR	Finite Impulse Response
FM	Flight Model.
FMI	Finnish Meteorological Institute or Ilmatieteen Laitos
FPA	Focal Plane Assembly
FRTM	Fast Radiative Transfer Model
FTIR	Fourier Transform InfraRed
FWHM	Full Width at Half Maximum
GAC	Global Area Coverage (data)
GAW	The World Meteorological Global Atmosphere Watch Program
GDP	GOME Data Processor (ERS-2)
GEADR	Global External Auxiliary Data Record
GIADR	Global Internal Auxiliary Data Record
GMF	Geophysical Model Function
GOME	Global Ozone Monitoring Experiment
GRH	Generic Record Header
GRIB	Numerical weather prediction data in grid point form, expressed in binary
GTL	GOME TimeLine
GTS	Global Telecommunication System
GTT	GOME Timeline Table

HCL	Hollow Cathode Lamp
HDF	Hierarchical Data Format
HIRS	High Resolution Infrared Radiation Sounder
HK	Housekeeping
HNMS	Hellenic National Meteorological Service, Greece
HRPT	High Resolution Picture Transmission
IASI	Infrared Atmospheric Sounding Interferometer
ICU	Instrument Control Unit
ID	Identification
IFE	Institut für Fernerkundung der Universität Bremen (D)
IFOV	Instantaneous Field Of View
IIS	Integrated Imaging Subsystem
IPR	Internal Pointer Record
IR	InfraRed
ISCCP	International Satellite Cloud Climatology Project
IT	Integration Time
KMI	Koninklijk Meteorologisch Instituut van België / Institut Royal Météorologique de Belgique
KNMI	Koninklijk Nederlands Meteorologisch Instituut (De Bilt, NL)
LAP	Laboratory of Atmospheric Physics, Aristotle University of Thessaloniki
LED	Light Emitting Diode
LIDORT	Linearised Discrete Ordinate Radiative Transfer Model
LRPT	Low Resolution Picture Transmission
LUT	Look-Up Table
MDR	Main Data Record
METOP	METeorological OPerational (satellite)
MF	Météo-France
MHS	Microwave Humidity Sounder
MIPAS	Michelson Interferometer for Passive Atmospheric Sounding
MLER	Minimum Lambert Equivalent Reflectivity
MLST	Mean Local Solar Time
MME	Müller Matrix Element
MPHR	Main Product Header Record
MPF	Mission Planning Facility

NASA	National Aeronautics and Space Administration
NDSC	Network for the Detection of Stratospheric Change
NDVI	Normalised Difference Vegetation Index
NIR	Near InfraRed
NOAA	National Oceanic and Atmospheric Administration
NPOESS	National Polar-orbiting Operational Environmental Satellite System
NRT	Near Real Time
NWP	Numerical Weather Prediction
NWP SAF	Numerical Weather Prediction Satellite Applications Facility
OBCT	On-Board Clock Time
O3MSAF	Ozone Monitoring Satellite Applications Facility
OMI	Ozone Monitoring Instrument
OMPS	Ozone Mapping and Profiler Suite
OSI SAF	Ocean and Sea Ice Satellite Applications Facility
PCD	Product Confidence Data
PDU	Processing Digital Unit
PFS	Product Format Specification
PG	Power Gain
PGS	Product Generation (function) Specification
PLM	PayLoad Module
PMC	Payload Module Control
PMD	Polarisation Measurement Device
PPF	Product Processing Facility of the EPS CGS
PQE	Product Quality Evaluation
PPG	Pixel-to-Pixel Gain
PRT	Platinum Resistance Thermometer
PU	Polarisation Unit
RAO	Research Announcement of Opportunity
RD	Reference Document
RMDCN	Regional Meteorological Data Communication Network
RMS	Root Mean Square
RTM	Radiative Transfer Model

SAA	Southern Atlantic Anomaly
SAF	Satellite Applications Facility
SAO	Smithsonian Astrophysical Observatory (Cambridge, USA)
SBT	Satellite Binary Time
SBUV	Solar Backscatter Ultra-Violet Experiment
SCIAMACHY	Scanning Imaging Absorption Spectrometer for Atmospheric Cartography
SESAME	Second European Stratospheric Arctic and Mid-latitude Experiment
SLS	Spectral Light Source
SMR	Sun Mean Reference
SOT	SOlar calibration Timeline
SPA	Sensor Performance Assessment
SPHR	Secondary Product Header Record
SST	Sea Surface Temperature
SSST	Single Space Segment Team
SRON	Space Research Organisation of The Netherlands (Utrecht, NL)
SVM	SerVice Module
SZA	Solar Zenith Angle
TBC	To Be Confirmed
TBD	To Be Defined
TIROS	Television and InfraRed Operational Satellites
TOMS	Total Ozone Mapping Spectrometer
TPD	Technisch Physische Dienst (Delft, NL)
UMARF	Unified Meteorological Archive and Retrieval Facility
UTC	Universal Time Clock
UV	Ultra-Violet
VEADR	Variable External Auxiliary Data Record
VERA	VErsatile Retrieval Algorithm
VIADR	Variable Internal Auxiliary Data Record
VIS	Visible
WLS	White Light Source
WMO	World Meteorological Organisation
WOUDC	World Ozone and Ultraviolet Data Centre

Annex 1: Summary of all EPS products

In this annex, we summarise all EPS products generated at EUMETSAT or the SAFs up to Level 2.

The following is a definition of the different product levels, as understood in the EPS context:

Level 0: Raw data after restoration of the chronological data sequence for each instrument, i.e. after demultiplexing of the data by instrument, removal of any data overlap due to the data dump procedure and relevant quality checks. Raw instrument data information (telemetry packets) is maintained during this process.

Level 1a: Instrument data in full resolution with radiometric and geometric (i.e. Earth location) calibration computed and appended but not applied.

Level 1b: Calibrated, earth located and quality controlled product, expressed as radiance or brightness temperature, in the original pixel location, and packaged with needed ancillary, engineering and auxiliary data.

Level 1c: In case of the IASI spectra, level 1b data after application of the apodization function.

Level 2: Earth located values converted to geophysical parameters, at the same spatial and temporal sampling as the level 1b data.

Level 3: Gridded point geophysical products on a multi-pass basis.

It is understood that the average user is interested in products of Level 1b and higher. Details on Level 0 and Level 1a products will thus not be provided in this summary.

Concerning Level 3 ad higher, the SAFs generate a variety of both products and software, based not only on METOP or NOAA data, but on many other satellite data conventional observations. For a complete and updated list of these high level products, it is best to check the EUMETSAT SAF page from www.eumetsat.int or directly the SAF pages, which are linked from there.

NRT and ARC stand in this context for Near Real Time and Archive. When the archive in particular is the EUMETSAT archive, ARC is replace in the table by UMARF.

Note that the following table is not complete all products.

SATELLITE	**PRODUCT NAME**	**LEVEL**	MAIN GEOPHYSICAL /ENG PRAMETER	**PRODUCER**	**COVERAGE**	**DISSEMINATION**	**NRT TIMELINESS**	**ACCURACY**	SWATH WIDTH	H-RESOLUTION	V-RESOLUTION	H-samp	V-samp
METOP	`AVHR_xxx_1B_Mnn`	1b	Radiances	EPS CGS	Global	NRT&UMARF	2h15	1K (µ wave & IR channels) Geolocation: <1km Channel to Channel Misregistration: ≤ 0.1mrad	1447 km (2048 Earth view samples)	Square IFOV: 0.0745 deg, equivalent to 1.08x1.08 km at nadir	N/A	1.08 km across track at nadir, 1.1 km along track	N/A
METOP	`HIRS_xxx_1B_Mnn`	1b	Radiances	EPS CGS	Global	NRT&UMARF	2h15	1K (IR channels) Albedo: 10^{-2} digits not affected by rounding	1080.35 km (56 Earth view samples)	Circular IFOV :0.69 deg, equivalent to 10.0 km at nadir	N/A	10.0 km across track at nadir, 42.15 km along track	N/A
METOP	`AMSA_xxx_1B_Mnn`	1b	Radiances	EPS CGS	Global	NRT&UMARF	2h15	1K	1026 km (30 Earth view samlpes)	Circular IFOV: 3.3 deg, equivalent to 47.63 km at nadir	N/A	47.63 km across track at nadir, 52.69 km along track	N/A
METOP	`MHSx_xxx_1B_Mnn`	1b	Radiances	EPS CGS	Global	NRT&UMARF	2h15	1K	1077.68 km (90 arth view samples)	Circular IFOV: 1.1 deg, equivalent to 15.88 km at nadir	N/A	15.88 km across track at nadir,17.56 km along track	N/A
NOAA	`AVHR_GAC_1B_Nnn`	1b	Radiances	EPS CGS	Global	NRT&UMARF	2h15	1K (µ wave & IR channels) Geolocation: <1km Channel to Channel Misregistration: ≤ 0.1mrad	1447 km (409 Earth view samples)	1.1 (along-track) x 4.4 (across-track) km at nadir (NOAA/GAC resolution)	N/A	3.3 (along-track) x 4.4 (across-track) km at nadir (NOAA/GAC sampling)	N/A
NOAA	`HIRS_xxx_1B_Nnn`	1b	Radiances	EPS CGS	Global	NRT&UMARF	2h15	1K (IR channels) Albedo: 10^{-2} digits not affected by rounding	1080.35 km (56 Earth view samples)	Circular IFOV :0.69 deg, equivalent to 10.0 km at nadir	N/A	10.0 km across trackat nadir, 42.15 km along track	N/A
NOAA	`AMSA_xxx_1B_Nnn`	1b	Radiances	EPS CGS	Global	NRT&UMARF	2h15	1K	1026 km (30 Earth view samlpes)	Circular IFOV: 3.3 deg, equivalent to 47.63 km at nadir	N/A	47.63 km across track at nadir, 52.69 km along track	N/A
NOAA	`MHSx_xxx_1B_Nnn`	1b	Radiances	EPS CGS	Global	NRT&UMARF	2h15	1K	1077.68 km (90 arth view samples)	Circular IFOV: 1.1 deg, equivalent to 15.88 km at nadir	N/A	15.88 km across track at nadir,17.56 km along track	N/A
METOP	`IASI_xxx_1B_Nnn`	1b	Radiances	EPS CGS	Global	NRT&UMARF	2h15						
METOP	`GRAS_xxx_1B_Mnn`	1b	Bending angle	EPS CGS	Global	NRT&UMARF	2h15	1 µ rad or 0.4% (whichever is larger)				<1000km (mean distance between individual soundings over 12h time window)	Surface to 80km
METOP	`GOME_xxx_1B_Mnn`	1b		EPS CGS	Global	NRT&UMARF	2h15	Geolocation: Barycentres of each FOV shall be positioned no worse than 0.06° of the scan mirror TBD (46.435° scan angle)				Instrument Footprint	N/A

METOP	ASCA_SZO_1B_Mnn	1b	ASCAT σ_0 (normalised backscatter) triplets	EPS CGS	Global	NRT&UMARF	2h15	Radiometric accuracy: 0.5 db peak-to-peak Radiometric resolution: 2 - 5 % Geolocation: 4 km	double swath of 550 km with a gap around satellite track of 700 km	50x50 km	N/A	25 km (21 nodes)	N/A
METOP	ASCA_SZR_1B_Mnn	1b	ASCAT σ_0 (normalised backscatter) triplets	EPS CGS	Global	NRT&UMARF	2h15	Radiometric accuracy: 0.5 db peak-to-peak Radiometric resolution: 4 - 11 % Geolocation: 4 km	double swath of 550 km with a gap around satellite track of 700 km	(25-34)x(25-34) km	N/A	12.5 km (41 nodes)	N/A
METOP	ASCA_ FUL _1B_Mnn	1b	ASCAT σ_0 (normalised backscatter) individual values	EPS CGS	Global	UMARF	2h15m	Radiometric accuracy: 0.5 db peak-to-peak Geolocation: 4 km	double swath of 550 km with a gap around satellite track of 700 km	Instrument resolution (approx 20x10 km)	N/A	Instrument sampling (256 values along eachantenna fotprint)	N/A
METOP	IASI_xxx_1C_Mnn	1c	Radiances	EPS CGS	Global	NRT&UMARF	2h15	1K (IR channels)		Instrument FOV	N/A	Instrument FOV	N/A
METOP	ATOV_SND_02_Mnn	2	Atmospheric temperature	EPS CGS	Global	NRT&UMARF	3h	1.7K Troposphere 2K Stratosphere	1080.35 km	N/A	N/A	HIRS/4 instrument horizontal sampling grid: 56 pixels per scan and 42.15 km scan separation	Typically 40 Pressure levels
			Atmospheric water vapour					20%					Typically 15 Pressure levels
			Surface emmissivity					n/a (not a retrieved parameter)					N/A
			Surface Temperature					0.6 K					N/A
			Fractional cloud cover					5-10%					N/A
			Cloud Top Temperature					1-2 K					N/A
			Cloud Top Pressure					50 hPa					N/A
			Tropopause height					50 hPa					N/A
			Cloud Liquid Water Content					0.04 mm					N/A
			Total Column Precipitable Water					5%					N/A
NOAA	ATOV_SND_02_Nnn	2	Atmospheric temperature	EPS CGS	Global	NRT&UMARF	3h	1.7K Troposphere 2K Stratosphere	1080.35 km	N/A	N/A	HIRS/4 instrument horizontal sampling grid: 56 pixels per scan and 42.15 km scan separation	Typically 40 Pressure levels
			Atmospheric water vapour					20%					Typically 15 Pressure levels
			Surface emmissivity					n/a (not a retrieved parameter)					N/A
			Surface Temperature					0.6 K					N/A
			Fractional cloud cover					5-10%					N/A
			Cloud Top Temperature					1-2 K					N/A
			Cloud Top Pressure					50 hPa					N/A
			Tropopause height					50 hPa					N/A
			Cloud Liquid Water Content					0.04 mm					N/A
			Total Column Precipitable Water					5%					N/A
METOP	Reduced ATOVS Level 2 product from METOP (TBD name)	2	Atmospheric temperature	EPS CGS	Global	NRT&UMARF	3h	1.7K Troposphere 2K Stratosphere				Every 4th HIRS/4 FOV and every 2nd HIRS/4 scan line	Pressure levels for atmospheric temperature and water vapour profiles: every 4th level of the full product
			Atmospheric water vapour					20%					
			Surface Temperature					0.6K					N/A
NOAA	Reduced ATOVS Level 2 product from METOP (TBD name)	2	Atmospheric temperature	EPS CGS	Global	NRT&UMARF	3h	1.7K Troposphere 2K Stratosphere				Every 4th HIRS/4 FOV and every 2nd HIRS/4 scan line	Pressure levels for atmospheric temperature and water vapour profiles: every 4th level of the full product
			Atmospheric water vapour					20%					
			Surface Temperature					0.6K					N/A
METOP	IASI_SND_02_Mnn	2	Atmospheric temperature	EPS CGS	Global	NRT&UMARF	3h	1K Troposphere 2K Stratosphere				IASI FOV	40 Pressure levels to 1hPa
			Rel Humidity: 10%					Rel Humidity: 10%				IASI FOV	20 Pressure levels to 10hPa
			Cloud Cover: 10% <10% (climate)					Cloud Cover: 10% <10% (climate)				IASI FOV	N/A
			Cloud Top Temperature: 2K					Cloud Top Temperature: 2K				IASI FOV	N/A
			Cloud Top Height: 300m					Cloud Top Height: 300m				IASI FOV	N/A

			Trace gases					Trace gases: CH4 < 20% N2O < 20 % CO < 10%				250 km	N/A
METOP	Near Surface Wind Vector	2		Ocean & Sea Ice SAF	Global	NRT	3h	2m/s (vector components)				nominal:50km research: 25km	N/A
METOP/ NOAA	Cloud Type (including Fog)	2		Nowcasting SAF	Regional	Software	15 min	N/A				Full AVHRR Resolution	N/A
METOP	Total Ozone from GOME	2		Ozone Monitoring SAF	Global	NRT	3h	< 5%				250 km	N/A
METOP/ NOAA	Total Ozone from HIRS	2		Ozone Monitoring SAF	Global	NRT	3h					HIRS/4 FOV	N/A
METOP	Ozone Profiles	2		Ozone Monitoring SAF	Global	NRT	3h	<15% at pressures < 30 hPa < 50% at pressure > 30 hPa				250 km	7km at pressures < 30hPa < 10 km at pressures >30 hPa
METOP	Aerosol Index	2		Ozone Monitoring SAF	Global	NRT	3h					250 km	
METOP	Trace Gases (note use of IASI not planned)	2		Ozone Monitoring SAF	Global	Offline	3h	< 50% trace gases include ClO, BrO, SO2 and NO2				250 km	N/A
METOP	Ozone Profiles	2		Ozone Monitoring SAF	Global	Offline	3h	<15% at pressures < 30 hPa < 50% at pressure > 30 hPa				250 km	7km at pressures < 30hPa < 10 km at pressures >30 hPa
METOP	Temperature, Humidity and Pressure Profiles	2		GRAS Meteorology SAF	Global	NRT	3h	Temperature: 2 K Troposphere 1K Stratosphere				<1000 km (mean distance between individual soundings over 12h time window)	30 Pressure levels 500 hPa to 10 hPa
								Rel Humidity: 10 % or 0.2 g/kg (whichever is larger)				< 1000 km (mean distance between individual soundings over 12h time window)	20 Pressure levels to 300 hPa
METOP	Temperature, Humidity and Pressure Profiles	2		GRAS Meteorology SAF	Global	Offline	3h	Temperature: 2 K Troposphere 1 K Stratosphere				< 1000 km (mean distance between individual soundings over 12h time window)	30 Pressure levels 500 to 10 hPa
								Rel Humidity: 10 % or 0.2 g/kg (whichever is larger)				< 1000 km (mean distance between individual soundings over 12h time window)	20 Pressure levels to 300 hPa
METOP/ NOAA	Aerosol	2		Land Surface Analysis SAF	Global	NRT	12h	< 50 %				1km	
METOP/ NOAA	Land Surface Temperature	2		Land Surface Analysis SAF	Global	NRT	6h	4K				1km	N/A
METOP/ MSG/ NOAA	Land Surface Temperature	2		Land Surface Analysis SAF	Global	NRT	6h	4K				3km	N/A
METOP/ NOAA	N. Europe Snow Cover	2		Land Surface Analysis SAF	Regional	NRT	1d	5%				1km	N/A
METOP/ MSG/ NOAA	Vegetation Index	2		Land Surface Analysis SAF	Regional	Offline	1d	N/A				1km	N/A

Annex 2: METOP operational orbit

A2.1: METOP orbit basic parameters

The orbit parameters for the operational baseline mean orbit, with respect to the inertial Mean-of-Date System J2000.0 are given below. The orbit propagation is carried out with a geopotential model GEM10B of order 36 and degree 36, with lunisolar perturbations and a medium air drag model MSIS 77.

The repeatability cycle will be of 29 days/412 orbits and the Mean Local Solar Time at ascending node will be 21h 30 min. As the right column in he table shows, this orbit is almost equivalent to a 5 days/71 orbits repeat cycle.

Mean Element		Baseline 29 days/412 revs orbit	Value for a 5 days/71 revs orbit
Semi-Major Axis	a	7,195,605.347 m	7,197,939.000 m
Eccentricity	e	0.001165	0.001165
Inclination	i	98.702198 deg	98.704663 deg
Ascending node	Ω	62.4731 + 0.98564735 * N Where N = number of Julian days from 1 Jan 2000	62.4731 + 0.98564735 * N Where N = number of Julian days from 1 Jan 2000
Argument of Perigee	ω	90.0 deg	90.0 deg
Mean Anomaly	M	270.133359 deg	270.133359 deg

A2.2: METOP attitude law

Here, the yaw steering law will be described

A2.3: METOP orbit and attitude propagation

Here, information about attitude and how to propagate orbit and attitude will be included in due time

Annex 4: Data types used by the generic EPS format

A4.1: Basic data types

Type ID	Type	Size	Range	Comments
Integers				
byte	Signed Byte	1 byte	-128…127	"Two's Complement" coding convention for negative values Range calculated: -2^{n-1} to $+2^{n-1}-1$, where **n** is the length of the integer in bits
u-byte	Unsigned Byte	1 byte	0…255	Range calculated: 0 to $+2^{n}-1$ where **n** is the length of the integer in bits
enumerated	Enumerated Byte	1 byte	256 flag states	May only contain a value from a set of specified integer values, each of which is associated with a named concept, e.g. a set of error codes. When this field type is defined, the possible integer values and associated names are completely specified.
boolean	Boolean Byte	1 byte	False/True	Specific enumerated integer type which takes only 2 possible values: when all bits are zeroed, it denotes 'FALSE', otherwise, if any bit is set (i. e. its value is different from zero), it denotes 'TRUE'.
integer2	Signed 2-byte Integer	2 bytes	-32768…32767	"Two's Complement" coding convention for negative values Range calculated: -2^{n-1} to $+2^{n-1}-1$, where **n** is the length of the integer in bits
u-integer2	Unsigned 2-byte Integer	2 bytes	0…65535	Range calculated: 0 to $+2^{n}-1$ where **n** is the length of the integer in bits
integer4	Signed 4-byte Integer	4 bytes	-2147483648… 2147483647	"Two's Complement" coding convention for negative values Range calculated: -2^{n-1} to $+2^{n-1}-1$, where **n** is the length of the integer in bits
u-integer4	Unsigned 4-byte Integer	4 bytes	0…4294967295	Range calculated: 0 to $+2^{n}-1$ where **n** is the length of the integer in bits
integer8	Signed 8-byte Integer	8 bytes	-9223372036854775808… 9223372036854775807	"Two's Complement" coding convention for negative values Range calculated: -2^{n-1} to $+2^{n-1}-1$, where **n** is the length of the integer in bits
u-integer8	Unsigned 8-byte Integer	8 bytes	0… 18446744073709551615	Range calculated: 0 to $+2^{n}-1$ where **n** is the length of the integer in bits
Bit Strings				

Bit String	bitst(**n**)	1 bit per element	n/a	A bit string is encoded as follows: bn-1…b0 , where bi is the ith bit in the string and n is the length in bits of the bit string, with bn-1 being the most significant bit. The value of n shall always be a multiple of 8 ensuring that a bit string is always a full number of bytes in size.
Character Strings				
Standard Character String	char (**length**)	1 byte per character	n/a	Can only contain upper case letters [A…Z], numbers [0…9] and the underscore character (_). The number of characters in a character string is determined by the **length** parameter e.g. CHAR(8) is an 8 character string.
Enumerated Character String	e-char (**length**)	1 byte per character	n/a	Same properties as standard character string except that it can only contain one of a set of specified string values, and may also include the lower case "x" character (used as whitespace padding).
Extended Character String	x-char (**length**)	1 byte per character	n/a	Same properties as standard character string except that it may also contain space character, the newline character (\n), the equals sign (=) and the plus (+) and minus (-) signs. Only found in ASCII records.
Time formats				
Generalised Time	general time	15 bytes	n/a	This is a char(15) data type with a specific format **YYYYMMDDHHMMSSZ**, Z indicates Zulu or UTC time. If a field has a type of general time, but no time is applicable then the field should be filled with the string for "no applicable time", which is a string of 14 lower case 'x' characters terminated by the ASCII character 'Z', e.g., **xxxxxxxxxxxxxxZ**
Long Generalised Time	long general time	18 bytes	n/a	This is a char(18) data type with a specific format YYYYMMDDHHMMSSmmmZ, Z indicates Zulu or UTC time. If a field has a type of long general time, but no time is applicable then the field should be filled with the string for "no applicable time", which is a string of 17 lower case 'x' characters terminated by the ASCII character 'Z', e.g., **xxxxxxxxxxxxxxxxxZ**

A4.2: Compound data types

Type ID	Type	Size (bytes)	Components

Integers - Variable Scale Factors The EPS product format specification does not allow "real" data types to be present in a product. Instead, real values are encoded into integer format using a fixed scaling factor that is specified in the format specification tables. However, there may be some values that vary too much to be efficiently encoded into an integer value with a fixed scaling factor. If these are single values, they may be encoded into a compound that includes a scaling factor and the integer value as described in this section. If these values are an array of values, they are more easily presented by an array of bytes containing the variable scale factors followed by an array of integer data types			
Variable Scale Factor Byte	V-BYTE	2	byte + byte
Variable Scale Factor Unsigned Byte	VU-BYTE	2	byte + u-byte
Variable Scale Factor Integer-2	V-INTEGER2	3	byte + integer2
Variable Scale Factor Unsigned Integer-2	VU-INTEGER2	3	byte + u-integer2
Variable Scale Factor Integer-4	V-INTEGER4	5	byte + integer4
Variable Scale Factor Unsigned Integer-4	VU-INTEGER4	5	byte + u-integer4
Variable Scale Factor Integer-8	V-INTEGER8	9	byte + integer8
Variable Scale Factor Unsigned Integer-8	VU-INTEGER8	9	byte + u-integer8
Time formats CCSDS Day Segmented (CDS) time represents the day since epoch (1 January 2000 starting with 0). The CDS time is UTC-based and takes into account leap second corrections.			
Short CDS Time	short cds time	6	u-integer2 + u-integer4 (Encodes the day since epoch in the first 2 bytes and the number of milliseconds since the beginning of the day in the day in its last 4 bytes)
Long CDS Time	long cds time	8	u-integer2 + u-integer4 + u-integer2 (Encodes the day since epoch in the first 2 bytes, the number of milliseconds since the beginning of the day in its next 4 bytes, and the number of microseconds since the last millisecond in its last 2 bytes)

Annex 5: Format and contents of the GRH and IPR

A5.1: Generic Record Header

Field	Description	Type	Size (bytes)	Offset (bytes)
RECORD_CLASS	Class of Record	enumerated	1	0
INSTRUMENT_GROUP	Defining group for record subclasses	enumerated	1	1
RECORD_SUBCLASS	Subclass of this record class	enumerated	1	2
RECORD_SUBCLASS_VERSION	Version of this particular format of the record case	enumerated	1	3
RECORD_SIZE	Total size of the record case (including this header)	u-integer4	4	4
RECORD_START_TIME	Start Time for this record - context will depend on record class	short cds time	6	8
RECORD_STOP_TIME	Stop Time for this record - context will depend on record class	short cds time	6	14
			Total	20

A5.1.1 RECORD_CLASS enumerated values

Index	Record Class	Acronym
0	Reserved	
1	Main Product Header Record	MPHR
2	Secondary Product Header Record	SPHR
3	Internal Pointer Record	IPR
4	Global External Auxiliary Data Record	GEADR
5	Global Internal Auxiliary Data Record	GIADR
6	Variable External Auxiliary Data Record	VEADR
7	Variable Internal Auxiliary Data Record	VIADR
8	Measurement Data Record	MDR

A5.1.2 INSTRUMENT_GROUP enumerated values

Index	Defining Group

0	GENERIC (no specific instrument)
1	AMSU-A
2	ASCAT
3	ATOVS instruments (AVHRR/3, HIRS/4, AMSU-A, MHS)
4	AVHRR/3
5	GOME
6	GRAS
7	HIRS/4
8	IASI (except IASI L2 products)
9	MHS
10	SEM
11	ADCS
12	SBUV
13	DUMMY
14	ARCHIVE (Note: Only used in GIADRs. A GIADR with INSTRUMENT_GROUP of archive contains only descriptive information and is not processed).
15	IASI_L2 (used for IASI L2 products only)

A5.1.3 RECORD_SUBCLASS values

This is determined by the Instrument Group and shall vary from instrument to instrument and also, if necessary, from processing level to processing level. The record subclasses are defined in the instrument specific sections of this document.

A5.1.4 RECORD_SUBCLASS_VERSION values

This is the version number of the record subclass. Any update to the format of the record subclass will result in the increment of the subclass version number.

A5.1.5 RECORD_SIZE values

This field contains the total size of the record subclass (including the GRH) in bytes.

A5.1.6 Definitions of RECORD_START_TIME and RECORD_STOP_TIME values

Record Class	Record Start Time	Record Stop Time
Main Product Header Record	RECORD_START_TIME of the first MDR in the product	RECORD_STOP_TIME of the last MDR in the product
Secondary Product Header Record	RECORD_START_TIME of the first MDR in the product	RECORD_STOP_TIME of the last MDR in the product
Internal Pointer Record	RECORD_START_TIME of the first MDR in the product	RECORD_STOP_TIME of the last MDR in the product
Global External Auxiliary Data Record	RECORD_START_TIME of the first MDR in the product	RECORD_STOP_TIME of the last MDR in the product

Global Internal Auxiliary Data Record	RECORD_START_TIME of the first MDR in the product	RECORD_STOP_TIME of the last MDR in the product
Variable External Auxiliary Data Record	The RECORD_START_TIME of the first MDR for which this data applies.	The RECORD_STOP_TIME of the last MDR for which this data was applied.
Variable Internal Auxiliary Data Record	The RECORD_START_TIME of the first MDR for which this data applies.	The RECORD_STOP_TIME of the last MDR for which this data was applied.
Measurement Data Record	Usually the "sensing time" of the first measurement in the record, but see individual PFSs for local definitions	Usually the "sensing time" of the last measurement in the record, but see individual PFSs for local definitions

A5.2: Generic Internal Pointer Record

Field	Description	Type	Size (bytes)	Offset (bytes)
TARGET_RECORD_CLASS	Class of target record as derived from the GRH of the target record	enumerated	1	0
TARGET_INSTRUMENT_GROUP	Defining group for target record subclass as derived from the GRH of the target record	enumerated	1	1
TARGET_RECORD_SUBCLASS	Subclass of target record class as derived from the GRH of the target record	enumerated	1	2
TARGET_RECORD_OFFSET	Offset of target record from start of product	u-integer4	4	3
			Total	7

The meaning of the TARGET_RECORD_CLASS, TARGET_INSTRUMENT_GROUP and TARGET_RECORD_SUBCLASS values correspond to those of the RECORD_CLASS, INSTRUMENT_GROUP and RECORD_SUBCLASS in the GHR above, respectively.

The TARGET_RECORD_OFFSET is given in bytes.

Annex 6. Record description of the GOME-1A products

This GOME 1A description was generated using the GOME PFS Excel document Issue 7 Revision 0 (eps_gomel1_7.0.xls) and pfs2xml version 2.22 (Baseline: PFS April 2004) (MPHR Format Version: 5. 0,)

Contents:

MPHR (name 'mphr', subclass 0, version 2)

class 1

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
Product Details											
PRODUCT_NAME	Complete name of the product			1	1	1	1	string	67	100	20
PARENT_PRODUCT_NAME_1	Name of the parent product from which this product has been produced. For Level 0 products, this field is filled with lower case x's.			1	1	1	1	string	67	100	120
PARENT_PRODUCT_NAME_2	Name of the parent product from which this product has been produced. For Level 0 products or products for which this is not appropriate, this field is filled with lower case x's.			1	1	1	1	string	67	100	220
PARENT_PRODUCT_NAME_3	Name of the parent product from which this product has been produced. For Level 0 products or products for which this is not appropriate, this field is filled with lower case x's.			1	1	1	1	string	67	100	320
PARENT_PRODUCT_NAME_4	Name of the parent product from which this product has been produced. For Level 0 products or products for which this is not appropriate, this field is filled with lower case x's.			1	1	1	1	string	67	100	420

INSTRUMENT_ID	Instrument identification			1	1	1	1	enumerated	4	37	520
INSTRUMENT_MODEL	Instrument Model identification			1	1	1	1	enumerated	3	36	557
PRODUCT_TYPE	Product Type			1	1	1	1	enumerated	3	36	593
PROCESSING_LEVEL	Processing Level Identification			1	1	1	1	enumerated	2	35	629
SPACECRAFT_ID	Spacecraft identification			1	1	1	1	enumerated	3	36	664
SENSING_START	UTC Time of start of sensing data in this object (PDU, ROI or Full Product)			1	1	1	1	time	15	48	700
SENSING_END	UTC Time of end of sensing data in this object (PDU, ROI or Full Product)			1	1	1	1	time	15	48	748
SENSING_START_THEORETICAL	Theoretical UTC Time of start of sensing data in the dump from which this object is derived. This data is the predicted start time at the MPF level.			1	1	1	1	time	15	48	796
SENSING_END_THEORETICAL	Theoretical UTC Time of end of sensing data in the dump from which this object is derived. This data is the predicted end time at the MPF level.			1	1	1	1	time	15	48	844
PROCESSING_CENTRE	Processing Centre Identification			1	1	1	1	enumerated	4	37	892
PROCESSOR_MAJOR_VERSION	Processing chain major version number			1	1	1	1	uinteger	5	38	929
PROCESSOR_MINOR_VERSION	Processing chain minor version number			1	1	1	1	uinteger	5	38	967
FORMAT_MAJOR_VERSION	Dataset Format Major Version number			1	1	1	1	uinteger	5	38	1005
FORMAT_MINOR_VERSION	Dataset Format Minor Version number			1	1	1	1	uinteger	5	38	1043
PROCESSING_TIME_START	UTC time of the processing at start of processing for the product			1	1	1	1	time	15	48	1081
PROCESSING_TIME_END	UTC time of the processing at end of processing for the product			1	1	1	1	time	15	48	1129
PROCESSING_MODE	Identification of the mode of processing			1	1	1	1	enumerated	1	34	1177
DISPOSITION_MODE	Identification of the diposition mode			1	1	1	1	enumerated	1	34	1211
RECEIVING_GROUND_STATION	Acquisition Station Identification			1	1	1	1	enumerated	3	36	1245
RECEIVE_TIME_START	UTC time of the reception at CDA for first Data Item			1	1	1	1	time	15	48	1281
RECEIVE_TIME_END	UTC time of the reception at CDA for last Data Item			1	1	1	1	time	15	48	1329
ORBIT_START	Start Orbit Number, counted incrementally since launch			1	1	1	1	uinteger	5	38	1377
ORBIT_END	Stop Orbit Number			1	1	1	1	uinteger	5	38	1415
ACTUAL_PRODUCT_SIZE	Size of the complete product		bytes	1	1	1	1	uinteger	11	44	1453
ASCENDING NODE ORBIT PARAMETERS											
STATE_VECTOR_TIME	Epoch time (in UTC) of the orbital elements and the orbit state vector. this corresponds to the time of crossing the ascending node for ORBIT_START		UTC	1	1	1	1	longtime	18	51	1497
SEMI_MAJOR_AXIS	Semi major axis of orbit at time of the ascending node crossing.		mm	1	1	1	1	integer	11	44	1548

ECCENTRICITY	Orbit eccentricity at time of the ascending node crossing	10^6		1	1	1	1	integer	11	44	1592
INCLINATION	Orbit inclination at time of the ascending node crossing	10^3	deg	1	1	1	1	integer	11	44	1636
PERIGEE_ARGUMENT	Argument of perigee at time of the ascending node crossing	10^3	deg	1	1	1	1	integer	11	44	1680
RIGHT_ASCENSION	Right ascension at time of the ascending node crossing	10^3	deg	1	1	1	1	integer	11	44	1724
MEAN_ANOMALY	Mean anomaly at time of the ascending node crossing	10^3	deg	1	1	1	1	integer	11	44	1768
X_POSITION	X position of the orbit state vector in the orbit frame at ascending node	10^3	m	1	1	1	1	integer	11	44	1812
Y_POSITION	Y position of the orbit state vector in the orbit frame at ascending node	10^3	m	1	1	1	1	integer	11	44	1856
Z_POSITION	Z position of the orbit state vector in the orbit frame at ascending node	10^3	m	1	1	1	1	integer	11	44	1900
X_VELOCITY	X velocity of the orbit state vector in the orbit frame at ascending node	10^3	m/s	1	1	1	1	integer	11	44	1944
Y_VELOCITY	Y velocity of the orbit state vector in the orbit frame at ascending node	10^3	m/s	1	1	1	1	integer	11	44	1988
Z_VELOCITY	Z velocity of the orbit state vector in the orbit frame at ascending node	10^3	m/s	1	1	1	1	integer	11	44	2032
EARTH_SUN_DISTANCE_RATIO	Earth-Sun distance ratio - ratio of current Eart-Sun distance to Mean Earth-Sun distance			1	1	1	1	integer	11	44	2076
LOCATION_TOLERANCE_RADIAL	Nadir Earth location tolerance radial		m	1	1	1	1	integer	11	44	2120
LOCATION_TOLERANCE_CROSSTRACK	Nadir Earth location tolerance cross-track		m	1	1	1	1	integer	11	44	2164
LOCATION_TOLERANCE_ALONGTRACK	Nadir Earth location tolerance along-track		m	1	1	1	1	integer	11	44	2208
YAW_ERROR	Constant Yaw attitude error	10^3	deg	1	1	1	1	integer	11	44	2252
ROLL_ERROR	Constant Roll attitude error	10^3	deg	1	1	1	1	integer	11	44	2296
PITCH_ERROR	Constant Pitch attitude error	10^3	deg	1	1	1	1	integer	11	44	2340
LOCATION SUMMARY											
SUBSAT_LATITUDE_START	Latitude of sub-satellite point at start of the data set	10^3	Deg	1	1	1	1	integer	11	44	2384
SUBSAT_LONGITUDE_START	Longitude of sub-satellite point at start of the data set	10^3	Deg	1	1	1	1	integer	11	44	2428
SUBSAT_LATITUDE_END	Latitude of sub-satellite point at end of the data set	10^3	Deg	1	1	1	1	integer	11	44	2472
SUBSAT_LONGITUDE_END	Longitude of sub-satellite point at end of the data set	10^3	Deg	1	1	1	1	integer	11	44	2516
Leap Second Information											
LEAP_SECOND	Occurence of Leap second within the product. Field is set to -1, 0 or +1 dependent upon occurrence of leap second and direction.			1	1	1	1	integer	2	35	2560
LEAP_SECOND_UTC	UTC time of occurrence of the Leap Second (If no leap second in the product, value is null)			1	1	1	1	time	15	48	2595
Record counts											
TOTAL_RECORDS	Total count of all records in the product			1	1	1	1	uinteger	6	39	2643

TOTAL_MPHR	Total count of all MPHRs in product (should always be 1!)			1	1	1	1	uinteger	6	39	2682
TOTAL_SPHR	Total count of all SPHRs in product (should be 0 or 1 only)			1	1	1	1	uinteger	6	39	2721
TOTAL_IPR	Total count of all IPRs in the product			1	1	1	1	uinteger	6	39	2760
TOTAL_GEADR	Total count of all GEADRs in the product			1	1	1	1	uinteger	6	39	2799
TOTAL_GIADR	Total count of all GIADRs in the product			1	1	1	1	uinteger	6	39	2838
TOTAL_VEADR	Total count of all VEADRs in the product			1	1	1	1	uinteger	6	39	2877
TOTAL_VIADR	Total count of all VIADRs in the product			1	1	1	1	uinteger	6	39	2916
TOTAL_MDR	Total count of all MDRs in the product			1	1	1	1	uinteger	6	39	2955
Record Based Generic Quality Flags											
COUNT_DEGRADED_INST_MDR	Count of MDRs with degradation due to instrument problems			1	1	1	1	uinteger	6	39	2994
COUNT_DEGRADED_PROC_MDR	Count of MDRs with degradation due to processing problems			1	1	1	1	uinteger	6	39	3033
COUNT_DEGRADED_INST_MDR_BLOCKS	Count of the number of blocks of MDRs degraded due to degraded instrument			1	1	1	1	uinteger	6	39	3072
COUNT_DEGRADED_PROC_MDR_BLOCKS	Count of the number of blocks of MDRs degraded due to degraded processing			1	1	1	1	uinteger	6	39	3111
Time Based Generic Quality Flags											
DURATION_OF_PRODUCT	The duration of the product in milliseconds		ms	1	1	1	1	uinteger	8	41	3150
MILLISECONDS_OF_DATA_PRESENT	The total amount of data present in the product		ms	1	1	1	1	uinteger	8	41	3191
MILLISECONDS_OF_DATA_MISSING	The total amount of data missing from the prodcut		ms	1	1	1	1	uinteger	8	41	3232
Regional Product Information											
SUBSETTED_PRODUCT	Set when product has been subsetted (e.g. geographically subsetted using a region of interest filter). Implies the presence of one or more UMARF GIADRs in GAD section for product retrieved from UMARF.			1	1	1	1	boolean	1	34	3273
											Total: 3307

SPHR (name 'sphr', subclass 1, version 2)

class 2

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
Scans_Summary											
N_SCANS	Number of scans in the product			1	1	1	1	uinteger	5	38	20
N_VALID_WITH_MISS_DP	Number of valid scans with missing data packets			1	1	1	1	uinteger	5	38	58
N_MISS_DP	Number of missing data packets in valid scans			1	1	1	1	uinteger	5	38	96
N_MISSING_SCANS	Number of missing scans			1	1	1	1	uinteger	5	38	134
N_NN_DETECTOR_TEMP_1	Number of scans with non-nominal detector temperature, FPA 1			1	1	1	1	uinteger	5	38	172
N_NN_DETECTOR_TEMP_2	Number of scans with non-nominal detector temperature, FPA 2			1	1	1	1	uinteger	5	38	210
N_NN_DETECTOR_TEMP_3	Number of scans with non-nominal detector temperature, FPA 3			1	1	1	1	uinteger	5	38	248
N_NN_DETECTOR_TEMP_4	Number of scans with non-nominal detector temperature, FPA 4			1	1	1	1	uinteger	5	38	286
N_NN_DETECTOR_TEMP_5	Number of scans with non-nominal detector temperature, PMD p			1	1	1	1	uinteger	5	38	324

N_NN_DETECTOR_TEMP_6	Number of scans with non-nominal detector temperature, PMD s			1	1	1	1	uinteger	5	38	362
N_NN_PDP_TEMP	Number of scans with non-nominal pre-disperser temperature			1	1	1	1	uinteger	5	38	400
N_NN_RAD_TEMP	Number of scans with non-nominal radiator temperature			1	1	1	1	uinteger	5	38	438
N_NN_WLS_U	Number of scans with non-nominal WLS lamp voltage			1	1	1	1	uinteger	5	38	476
N_NN_WLS_I	Number of scans with non-nominal WLS lamp current			1	1	1	1	uinteger	5	38	514
N_NN_SLS_U	Number of scans with non-nominal SLS lamp voltage			1	1	1	1	uinteger	5	38	552
N_NN_SLS_I	Number of scans with non-nominal SLS lamp current			1	1	1	1	uinteger	5	38	590
N_INV_UTC	Number of scans with invalid UTC			1	1	1	1	uinteger	5	38	628
N_NADIR_SCAN	Number of scans in Nadir scanning observation mode			1	1	1	1	uinteger	5	38	666
N_NTH_POLE_SCAN	Number of scans in North pole scanning observation mode			1	1	1	1	uinteger	5	38	704
N_STH_POLE_SCAN	Number of scans in South pole scanning observation mode			1	1	1	1	uinteger	5	38	742
N_OTHER_SCAN	Number of scans in Other scanning observation mode			1	1	1	1	uinteger	5	38	780
N_NADIR_STATIC	Number of scans in Nadir static observation mode			1	1	1	1	uinteger	5	38	818
N_OTHER_STATIC	Number of scans in Other Static observation mode			1	1	1	1	uinteger	5	38	856
N_DARK	Number of scans in Dark observation observation mode			1	1	1	1	uinteger	5	38	894
N_LED	Number of scans in LED observation mode			1	1	1	1	uinteger	5	38	932
N_WLS	Number of scans in WLS observation mode			1	1	1	1	uinteger	5	38	970
N_SLS	Number of scans in SLS observation mode			1	1	1	1	uinteger	5	38	1008
N_SLS_DIFF	Number of scans in SLS over diffuser observation mode			1	1	1	1	uinteger	5	38	1046
N_SUN	Number of scans in Sun observation mode			1	1	1	1	uinteger	5	38	1084
N_MOON	Number of scans in Moon observation mode			1	1	1	1	uinteger	5	38	1122
N_IDLE	Number of scans in Idle observation mode			1	1	1	1	uinteger	5	38	1160
N_TEST	Number of scans in Test observation mode			1	1	1	1	uinteger	5	38	1198
N_DUMP	Number of scans in Dump observation mode			1	1	1	1	uinteger	5	38	1236
N_INVALID	Number of scans assigned Invalid observation mode			1	1	1	1	uinteger	5	38	1274
N_MIN_INTENSITY_1	Number of scans where the minimum mean uncalibrated radiance is below a specified threshold, band FPA 1a			1	1	1	1	uinteger	5	38	1312
N_MIN_INTENSITY_2	Number of scans where the minimum mean uncalibrated radiance is below a specified threshold, band FPA 1b			1	1	1	1	uinteger	5	38	1350
N_MIN_INTENSITY_3	Number of scans where the minimum mean uncalibrated radiance is below a specified threshold, band FPA 2a			1	1	1	1	uinteger	5	38	1388
N_MIN_INTENSITY_4	Number of scans where the minimum mean uncalibrated radiance is below a specified threshold, band FPA 2b			1	1	1	1	uinteger	5	38	1426
N_MIN_INTENSITY_5	Number of scans where the minimum mean uncalibrated radiance is below a specified threshold, band FPA 3			1	1	1	1	uinteger	5	38	1464
N_MIN_INTENSITY_6	Number of scans where the minimum mean uncalibrated radiance is below a specified threshold, band FPA 4			1	1	1	1	uinteger	5	38	1502
N_MIN_INTENSITY_7	Number of scans where the minimum mean uncalibrated radiance is below a specified threshold, band PMD p			1	1	1	1	uinteger	5	38	1540
N_MIN_INTENSITY_8	Number of scans where the minimum mean uncalibrated radiance is below a specified threshold, band PMD s			1	1	1	1	uinteger	5	38	1578
N_SATURATED_1	Number of scans with saturated pixels, band FPA 1a			1	1	1	1	uinteger	5	38	1616

N_SATURATED_2	Number of scans with saturated pixels, band FPA 1b			1	1	1	1	uinteger	5	38	1654
N_SATURATED_3	Number of scans with saturated pixels, band FPA 2a			1	1	1	1	uinteger	5	38	1692
N_SATURATED_4	Number of scans with saturated pixels, band FPA 2b			1	1	1	1	uinteger	5	38	1730
N_SATURATED_5	Number of scans with saturated pixels, band FPA 3			1	1	1	1	uinteger	5	38	1768
N_SATURATED_6	Number of scans with saturated pixels, band FPA 4			1	1	1	1	uinteger	5	38	1806
N_SATURATED_7	Number of scans with saturated pixels, band PMD p			1	1	1	1	uinteger	5	38	1844
N_SATURATED_8	Number of scans with saturated pixels, band PMD s			1	1	1	1	uinteger	5	38	1882
N_HOT_1	Number of scans with hot pixels, band FPA 1a			1	1	1	1	uinteger	5	38	1920
N_HOT_2	Number of scans with hot pixels, band FPA 1b			1	1	1	1	uinteger	5	38	1958
N_HOT_3	Number of scans with hot pixels, band FPA 2a			1	1	1	1	uinteger	5	38	1996
N_HOT_4	Number of scans with hot pixels, band FPA 2b			1	1	1	1	uinteger	5	38	2034
N_HOT_5	Number of scans with hot pixels, band FPA 3			1	1	1	1	uinteger	5	38	2072
N_HOT_6	Number of scans with hot pixels, band FPA 4			1	1	1	1	uinteger	5	38	2110
N_HOT_7	Number of scans with hot pixels, band PMD p			1	1	1	1	uinteger	5	38	2148
N_HOT_8	Number of scans with hot pixels, band PMD s			1	1	1	1	uinteger	5	38	2186
N_SAA	Number of scans in the SAA			1	1	1	1	uinteger	5	38	2224
N_SUNGLINT	Number of scans with sunglint danger			1	1	1	1	uinteger	5	38	2262
N_RAINBOW	Number of scans with rainbow danger			1	1	1	1	uinteger	5	38	2300
N_MODE_GEOLOCATION	Number of scans with possible mismatch between observation mode and geolocation			1	1	1	1	uinteger	5	38	2338
N_MISS_STOKES_1	Number of scans with missing Stokes fractions, PMD band 1			1	1	1	1	uinteger	5	38	2376
N_MISS_STOKES_2	Number of scans with missing Stokes fractions, PMD band 2			1	1	1	1	uinteger	5	38	2414
N_MISS_STOKES_3	Number of scans with missing Stokes fractions, PMD band 3			1	1	1	1	uinteger	5	38	2452
N_MISS_STOKES_4	Number of scans with missing Stokes fractions, PMD band 4			1	1	1	1	uinteger	5	38	2490
N_MISS_STOKES_5	Number of scans with missing Stokes fractions, PMD band 5			1	1	1	1	uinteger	5	38	2528
N_MISS_STOKES_6	Number of scans with missing Stokes fractions, PMD band 6			1	1	1	1	uinteger	5	38	2566
N_MISS_STOKES_7	Number of scans with missing Stokes fractions, PMD band 7			1	1	1	1	uinteger	5	38	2604
N_MISS_STOKES_8	Number of scans with missing Stokes fractions, PMD band 8			1	1	1	1	uinteger	5	38	2642
N_MISS_STOKES_9	Number of scans with missing Stokes fractions, PMD band 9			1	1	1	1	uinteger	5	38	2680
N_MISS_STOKES_10	Number of scans with missing Stokes fractions, PMD band 10			1	1	1	1	uinteger	5	38	2718
N_MISS_STOKES_11	Number of scans with missing Stokes fractions, PMD band 11			1	1	1	1	uinteger	5	38	2756
N_MISS_STOKES_12	Number of scans with missing Stokes fractions, PMD band 12			1	1	1	1	uinteger	5	38	2794
N_MISS_STOKES_13	Number of scans with missing Stokes fractions, PMD band 13			1	1	1	1	uinteger	5	38	2832
N_MISS_STOKES_14	Number of scans with missing Stokes fractions, PMD band 14			1	1	1	1	uinteger	5	38	2870
N_MISS_STOKES_15	Number of scans with missing Stokes fractions, PMD band 15			1	1	1	1	uinteger	5	38	2908
N_BAD_STOKES_1	Number of scans with bad Stokes fractions, PMD band 1			1	1	1	1	uinteger	5	38	2946
N_BAD_STOKES_2	Number of scans with bad Stokes fractions, PMD band 2			1	1	1	1	uinteger	5	38	2984
N_BAD_STOKES_3	Number of scans with bad Stokes fractions, PMD band 3			1	1	1	1	uinteger	5	38	3022
N_BAD_STOKES_4	Number of scans with bad Stokes fractions, PMD band 4			1	1	1	1	uinteger	5	38	3060

N_BAD_STOKES_5	Number of scans with bad Stokes fractions, PMD band 5			1	1	1	1	uinteger	5	38	3098
N_BAD_STOKES_6	Number of scans with bad Stokes fractions, PMD band 6			1	1	1	1	uinteger	5	38	3136
N_BAD_STOKES_7	Number of scans with bad Stokes fractions, PMD band 7			1	1	1	1	uinteger	5	38	3174
N_BAD_STOKES_8	Number of scans with bad Stokes fractions, PMD band 8			1	1	1	1	uinteger	5	38	3212
N_BAD_STOKES_9	Number of scans with bad Stokes fractions, PMD band 9			1	1	1	1	uinteger	5	38	3250
N_BAD_STOKES_10	Number of scans with bad Stokes fractions, PMD band 10			1	1	1	1	uinteger	5	38	3288
N_BAD_STOKES_11	Number of scans with bad Stokes fractions, PMD band 11			1	1	1	1	uinteger	5	38	3326
N_BAD_STOKES_12	Number of scans with bad Stokes fractions, PMD band 12			1	1	1	1	uinteger	5	38	3364
N_BAD_STOKES_13	Number of scans with bad Stokes fractions, PMD band 13			1	1	1	1	uinteger	5	38	3402
N_BAD_STOKES_14	Number of scans with bad Stokes fractions, PMD band 14			1	1	1	1	uinteger	5	38	3440
N_BAD_STOKES_15	Number of scans with bad Stokes fractions, PMD band 15			1	1	1	1	uinteger	5	38	3478
N_CLOUD	Number of scans with fractional cloud above a specified threshold			1	1	1	1	uinteger	5	38	3516
Processing_information											
PROCESSING_INDICATOR	Auxiliary information on processing details. May be filled as needed (no requirements imposed). If not used, this field is filled by lower case x's.			1	1	1	1	string	67	100	3554
											Total: 3654

GEADR (name 'geadr-1a-timecorrelation', subclass 1, version 1)

class 3

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
Identifier	Unique pointer to auxiliary dataset			1	1	1	1	POINTER	100	100	120
											Total: 120

GEADR (name 'geadr-1a-orbit', subclass 2, version 1)

class 3

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
Identifier	Unique pointer to auxiliary dataset			1	1	1	1	POINTER	100	100	120
											Total: 120

GEADR (name 'geadr-elevation', subclass 3, version 1)

class 3

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
Identifier	Unique pointer to auxiliary dataset			1	1	1	1	POINTER	100	100	120
											Total: 120

GEADR (name 'geadr-1a-landseamask', subclass 4, version 1)

class 3

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
Identifier	Unique pointer to auxiliary dataset			1	1	1	1	POINTER	100	100	120
											Total: 120

GEADR (name 'geadr-1a-inflightcal', subclass 5, version 1)

class 3

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
Identifier	Unique pointer to auxiliary dataset			1	1	1	1	POINTER	100	100	120
											Total: 120

GEADR (name 'geadr-configuration', subclass 6, version 1)

class 3

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
Identifier	Unique pointer to auxiliary dataset			1	1	1	1	POINTER	100	100	120
											Total: 120

GEADR (name 'geadr-intialisation', subclass 7, version 1)

class 3

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
Identifier	Unique pointer to auxiliary dataset			1	1	1	1	POINTER	100	100	120
											Total: 120

GEADR (name 'geadr-keydata', subclass 8, version 1)

class 3

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
Identifier	Unique pointer to auxiliary dataset			1	1	1	1	POINTER	100	100	120
											Total: 120

GEADR (name 'geadr-1a-correctionfactor', subclass 12, version 1)

class 3

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
Identifier	Unique pointer to auxiliary dataset			1	1	1	1	POINTER	100	100	120
											Total: 120

GIADR (name 'giadr-1a-bands', subclass 1, version 2)

class 5

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
Band_Separation_Information											
CHANNEL_NUMBER	Channel number			10	1	1	1	enumerated	1	10	20
BAND_NUMBER	Band number			10	1	1	1	enumerated	1	10	30
START_PIXEL	Start pixel of the band in the specified channel			10	1	1	1	uinteger2	2	20	40
NUMBER_OF_PIXELS	Number of pixels in the specified band			10	1	1	1	uinteger2	2	20	60
											Total: 80

GIADR (name 'giadr-1a-steps', subclass 2, version 1)

class 5

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
Applicable_Calibration_Steps_Information											
APPLIED_CAL_STEPS	Calibration steps applied in level 0 to 1a processing for every observation mode - first dimension mode, second dimension calibration steps			20	30	1	1	boolean	1	600	20
											Total: 620

GIADR (name 'giadr-1a-mme', subclass 3, version 2)

class 5

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
MME_Parameters											
MME_N_PSI_F	Number of viewing angles (fine grid), n_psi_f			1	1	1	1	uinteger2	2	2	20
MME_N_E_F	Number of elevation angles (fine grid), n_e_f			1	1	1	1	uinteger2	2	2	22
MME_N_PHI_F	Number of azimuth angles (fine grid), n_phi_f			1	1	1	1	uinteger2	2	2	24
MME_PSI_F	Viewing angles (fine grid)		deg	n_psi_f	1	1	1	vinteger4	5	105	26
MME_E_F	Elevation angles (fine grid)		deg	n_e_f	1	1	1	vinteger4	5	165	131
MME_PHI_F	Azimuth angles (fine grid)		deg	n_phi_f	1	1	1	vinteger4	5	175	296
MME_WL	Wavelength grid for Mueller matrix elements	10^6	nm	4654	1	1	1	uinteger4	4	18616	471
MME_RAD_RESP	Mueller matrix element describing the radiance response of the instrument to unpolarised light		BU.s-1/ (photons/(s.cm^2. sr.nm))	4654	n_psi_f	1	1	vinteger4	5	488670	19087
MME_IRRAD_RESP	Mueller matrix element describing the irradiance response of the instrument to unpolarised light		BU.s-1/ (photons/ (s. cm^2.nm))	4654	n_e_f	n_phi_f	1	vinteger4	5	26876850	507757
MME_POL_SENS	Ratio of MMEs M2 to M1 which describes the polarisation sensitivity of the instrument with respect to the q Stokes component			4654	n_psi_f	1	1	vinteger4	5	488670	27384607
MME_POL_SHIFT	Ratio of MMEs M3 to M1 which describes the polarisation sensitivity of the instrument with respect to the u Stokes component			4654	n_psi_f	1	1	vinteger4	5	488670	27873277
MEE_INT_RAT	Intensity ratio of PMD-s/PMD-p as function of viewing angle			279	n_psi_f	1	1	vinteger4	5	29295	28361947
MME_ERR_RAD_RESP	Error on the Mueller matrix element describing the radiance response of the instrument to unpolarised light			4654	1	1	1	vinteger4	5	23270	28391242
MME_ERR_IRRAD_RESP	Error on the Mueller matrix element describing the irradiance response of the instrument to unpolarised light			4654	1	1	1	vinteger4	5	23270	28414512
MME_ERR_POL_SENS	Error on ratio of MMEs M2 to M1 which describes the polarisation sensitivity of the instrument with respect to the q Stokes component			4654	1	1	1	vinteger4	5	23270	28437782

MME_ERR_POL_SHIFT	Error on ratio of MMEs M3 to M1 which describes the polarisation sensitivity of the instrument with respect to the u Stokes component			4654	1	1	1	vinteger4	5	23270	28461052
MME_SNRR_ERR	Error on the sun-normalised radiance response			4654	1	1	1	vinteger4	5	23270	28484322
											Total: 28507592

GIADR (name 'giadr-channels', subclass 4, version 2)

class 5

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
Band_Separation_Information											
CHANNEL_NUMBER	Channel number			6	1	1	1	enumerated	1	6	20
START_VALID_WAVELENGTHS	Start wavelength of the valid data in the specified channel	10^6	nm	6	1	1	1	integer4	4	24	26
END_VALID_WAVELENGTHS	End wavelength of the valid data in the specified channel	10^6	nm	6	1	1	1	integer4	4	24	50
START_VALID_PIXELS	Approximate start pixel of the valid data in the specified channel			6	1	1	1	uinteger2	2	12	74
END_VALID_PIXELS	Approximate end pixel of the valid data in the specified channel			6	1	1	1	uinteger2	2	12	86
											Total: 98

VIADR (name 'viadr-1a-dark', subclass 1, version 1)

class 7

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
Dark_Signal_Correction_Parameters											
START_UTC_DARK	Start UTC date/time of Dark calibration mode measurements			1	1	1	1	time	6	6	20
END_UTC_DARK	End UTC date/time of Dark calibration mode measurements			1	1	1	1	time	6	6	26
PCD_DARK											
AV_DARK	Dark signal correction averaged per band	10^3	BU	1	1	1	1	integer4	4	4	32
AV_DARK_NOISE	Dark signal correction readout noise averaged per band	10^6	BU	1	1	1	1	integer4	4	4	36
F_AV_DARK	Flag indicating that AV_DARK exceeds a specified threshold			1	1	1	1	boolean	1	1	40
F_AV_DARK_NOISE	Flag indicating that AV_DARK_READ exceeds a specified threshold			1	1	1	1	boolean	1	1	41
F_DARK_MISS	Flag indicating that missing mean dark calibration mode measurements have been filled by interpolation or that complete band is missing			1	1	1	1	enumerated	1	1	42
End: PCD_DARK											
PMD_TRANSFER	PMD transfer mode			1	1	1	1	enumerated	1	1	43
PMD_READOUT	PMD readout mode			1	1	1	1	enumerated	1	1	44
CHANNEL_NUMBER	Channel number			1	1	1	1	enumerated	1	1	45
BAND_NUMBER	Band number			1	1	1	1	enumerated	1	1	46
START_PIXEL	Start pixel of the band in the specified channel			1	1	1	1	uinteger2	2	2	47
NUMBER_OF_PIXELS	Number of pixels in the specified channel			1	1	1	1	uinteger2	2	2	49
INTEGRATION_TIME	Integration time for the band	10^6	s	1	1	1	1	integer4	4	4	51
FPA_TEMP	FPA temperature	10^3	K	1	1	1	1	integer4	4	4	55
DARK_SIGNAL	Dark signal correction	10^3	BU	1024	1	1	1	integer4	4	4096	59
DARK_READOUT_NOISE	Dark signal correction readout noise	10^6	BU	1024	1	1	1	integer4	4	4096	4155
											Total: 8251

VIADR (name 'viadr-1a-ppg', subclass 2, version 1)

class 7

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
Pixel-to-Pixel_Gain_Correction_Parameters											
START_UTC_PPG	Start UTC date/time of LED calibration mode measurements			1	1	1	1	time	6	6	20
END_UTC_PPG	End UTC date/time of LED calibration mode measurements			1	1	1	1	time	6	6	26
PCD_PPG											
PPG_BACK	Switch indicating whether back-up algorithm using WLS for calculation of PPG has been used			1	1	1	1	enumerated	1	1	32
AV_PPG	PPG correction averaged per channel	10^6		6	1	1	1	integer4	4	24	33
STDDEV_PPG	Standard deviation of PPG per channel	10^9		6	1	1	1	integer4	4	24	57
F_AV_PPG	Flag indicating that AV_PPG exceeds a specified threshold			6	1	1	1	boolean	1	6	81
F_STDDEV_PPG	Flag indicating that STDDEV_PPG exceeds a specified threshold			6	1	1	1	boolean	1	6	87
F_PPG_MISS	Flag indicating that missing mean LED calibration mode measurements have been filled by interpolation or that complete channel is missing			6	1	1	1	enumerated	1	6	93
F_PPG_LED	Flag indicating LED status			1	1	1	1	uinteger1	1	1	99
End: PCD_PPG											
PPG	PPG correction	10^6		1024	6	1	1	integer4	4	24576	100
											Total: 24676

VIADR (name 'viadr-1a-etalon', subclass 3, version 1)

class 7

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
Etalon_Correction_Parameters											
START_UTC_WLS	Start UTC date/time of WLS calibration mode measurements			1	1	1	1	time	6	6	20
END_UTC_WLS	End UTC date/time of WLS calibration mode measurements			1	1	1	1	time	6	6	26
PCD_ETALON											
ETALON_BACK	Switch indicating whether back-up algorithm using Sun calibration mode measurements for calculation of Etalon has been used			1	1	1	1	enumerated	1	1	32
ETALON_ALGO	Switch indicating which Etalon correction algorithm has been used			1	1	1	1	enumerated	1	1	33
AV_ETALON	Etalon correction averaged per channel	10^6		6	1	1	1	integer4	4	24	34
STDDEV_ETALON	Standard deviation of Etalon per channel	10^9		6	1	1	1	integer4	4	24	58
AV_RESIDUAL	Mean residual structure at a pixel level	10^6		6	1	1	1	integer4	4	24	82
STDDEV_RESIDUAL	Standard deviation of the residual structure at a pixel level	10^9		6	1	1	1	integer4	4	24	106
F_AV_ETALON	Flag indicating that AV_ETALON exceeds a specified threshold			6	1	1	1	boolean	1	6	130
F_STDDEV_ETALON	Flag indicating that STDDEV_ETALON exceeds a specified threshold			6	1	1	1	boolean	1	6	136
F_AV_RESIDUAL	Flag indicating that AV_RESIDUAL exceeds a specified threshold			6	1	1	1	boolean	1	6	142
F_STDDEV_RESIDUAL	Flag indicating that STDDEV_RESIDUAL exceeds a specified threshold			6	1	1	1	boolean	1	6	148
F_ETALON_MISS	Flag indicating that missing mean WLS calibration mode measurements have been filled by interpolation or that complete channel is missing			6	1	1	1	boolean	1	6	154
End: PCD_ETALON											
LAMBDA_ETALON	Wavelength grid for Etalon correction	10^6	nm	1024	6	1	1	integer4	4	24576	160
ETALON	Etalon correction	10^6		1024	6	1	1	integer4	4	24576	24736
											Total: 49312

VIADR (name 'viadr-1a-spec', subclass 4, version 2)

class 7

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset

RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
Spectral_Calibration_Parameters											
START_UTC_SLS	Start UTC date/time of SLS calibration mode measurements			1	1	1	1	time	6	6	20
END_UTC_SLS	End UTC date/time of SLS calibration mode measurements			1	1	1	1	time	6	6	26
PCD_SPEC											
N_LINES	Number of lines used for spectral calibration per main channel			4	1	1	1	uinteger2	2	8	32
MAX_LINE_DEV	Maximum deviation between fitted and true line position per channel	10^6	nm	4	1	1	1	integer4	4	16	40
AV_LINE_DEV	Average deviation between fitted and true line position per channel	10^6	nm	4	1	1	1	integer4	4	16	56
LINE_DEV	Deviation between fitted and true line positions per channel	10^6	nm	4	30	1	1	integer4	4	480	72
F_N_LINES	Flag indicating that N_LINES is insufficient			4	1	1	1	boolean	1	4	552
F_MAX_LINE_DEV	Flag indicating that MAX_LINE_DEV exceeds a specified threshold			4	1	1	1	boolean	1	4	556
F_SPEC_MISS	Flag indicating that no spectral calibration was generated due to missing mean SLS mode measurements per channel			4	1	1	1	boolean	1	4	560
N_ITERATION	Number of iterations required for PMD spectral calibration, per fitting window and PMD channel			2	20	1	1	uinteger2	2	80	564
F_NO_CONVERGENCE	Flag indicating that PMD spectral calibration has not converged, per PMD channel			2	1	1	1	boolean	1	2	644
F_GOF	Flag indicating that PMD spectral calibration goodness of fit is not acceptable			2	1	1	1	boolean	1	2	646
End: PCD_SPEC											
PDP_TEMP	Pre-disperser prism temperature	10^3	K	1	1	1	1	integer4	4	4	648
POLY_COEFF_FPA	Main FPA spectral calibration polynomial coefficients (8 coefficients + 2 spare per channel maximum), channel 1 first	10^6	nm	4	10	1	1	integer4	4	160	652
POLY_COEFF_PMD	PMD spectral calibration polynomial coefficients (8 coefficients + 2 spare per channel maximum), PMD p first	10^3	nm	2	10	1	1	integer4	4	80	812
											Total: 892

VIADR (name 'viadr-smr', subclass 5, version 1)

class 7

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
Solar_Mean_Reference_Spectrum_Parameters											
START_UTC_SUN	Start UTC date/time of Sun calibration mode measurements			1	1	1	1	time	6	6	20
END_UTC_SUN	End UTC date/time of Sun calibration mode measurements			1	1	1	1	time	6	6	26
PCD_SMR											
N_INTENSITY	Number of Sun calibration mode spectra which pass the intensity check			1	1	1	1	uinteger2	2	2	32
F_N_INTENSITY	Flag indicating that number of sun calibration mode spectra passing the intensity check was too low			1	1	1	1	boolean	1	1	34
F_SMR_MISS	Flag indicating that no SMR was generated due to missing Sun calibration mode measurements, per channel			6	1	1	1	boolean	1	6	35
End: PCD_SMR											
PMD_TRANSFER	PMD transfer mode			1	1	1	1	enumerated	1	1	41
PMD_READOUT	PMD readout mode			1	1	1	1	enumerated	1	1	42
LAMBDA_SMR	Wavelength grid for SMR spectrum (after Doppler correction)	10^6	nm	1024	6	1	1	integer4	4	24576	43
SMR	Solar Mean Reference spectrum		photons/(s.cm^2. nm)	1024	6	1	1	vinteger4	5	30720	24619
E_SMR	Absolute error on Solar Mean Reference spectrum		photons/(s.cm^2. nm)	1024	6	1	1	vinteger4	5	30720	55339

E_REL_SUN	Relative error in the mean of the Nsun spectra having passed the intensity check before correction for the irradiance response of the instrument			1024	6	1	1	vinteger4	5	30720	86059
Total: 116779											

MDR (name 'mdr-1a-earthshine', subclass 1, version 2)

class 8

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
GENERIC_QUALITY_INDICATORS											
DEGRADED_INST_MDR	Quality of MDR has been degraded from nominal due to an instrument degradation. Occurs if any of F_NN_DT, F_NN_PDP, F_NN_RAD, F_NN_WLS_U, F_NN_WLS_I, F_NN_SLS_U, F_NN_SLS_I, F_SAT, F_HOT, F_MIN in PCD_BASIC have been raised			1	1	1	1	boolean	1	1	20
DEGRADED_PROC_MDR	Quality of MDR has been degraded from nominal due to a processing degradation. Occurs if any of F_MISS, F_SAA, F_SUNGLINT, F_RAINBOW, F_OLD_CAL_DATA in PCD_BASIC, or F_INV_STOKES in PCD_EARTH have been raised			1	1	1	1	boolean	1	1	21
Earthshine_measurements_1a											
PCD_BASIC											
F_NN_DT	Flag indicating non-nominal detector temperature, per channel			6	1	1	1	boolean	1	6	22
F_NN_PDP	Flag indicating non-nominal pre-disperser temperature			1	1	1	1	boolean	1	1	28
F_NN_RAD	Flag indicating non-nominal radiator temperature			1	1	1	1	boolean	1	1	29
F_NN_WLS_U	Flag indicating non-nominal WLS voltage			1	1	1	1	boolean	1	1	30
F_NN_WLS_I	Flag indicating non-nominal WLS current			1	1	1	1	boolean	1	1	31
F_NN_SLS_U	Flag indicating non-nominal SLS voltage			1	1	1	1	boolean	1	1	32
F_NN_SLS_I	Flag indicating non-nominal SLS current			1	1	1	1	boolean	1	1	33
F_INV_UTC	Flag indicating invalid UTC			1	1	1	1	boolean	1	1	34
F_MISS	Flag indicating missing data packets			1	1	1	1	boolean	1	1	35
F_SAT	Flag indicating saturated pixels, per band			10	1	1	1	boolean	1	10	36
F_HOT	Flag indicating hot pixels, per band			10	1	1	1	boolean	1	10	46
F_SAA	Flag indicating whether scan is in the SAA			1	1	1	1	boolean	1	1	56
F_SUNGLINT	Flag indicating danger of sun-glint			1	1	1	1	enumerated	1	1	57
F_RAINBOW	Flag indicating danger of rainbow			1	1	1	1	boolean	1	1	58
F_MODE_GEOLOCATION	Flag indicating possible mismatch between observation mode and geolocation			1	1	1	1	boolean	1	1	59
F_MIN	Flag indicating that mean raw signal is below a specified threshold, per band			10	1	1	1	boolean	1	10	60
MEAN_UC	Mean raw signal per band	10^3	BU	10	1	1	1	integer4	4	40	70
F_OLD_CAL_DATA	Flag to indicate that old in-flight auxiliary calibration data is in use			1	1	1	1	enumerated	1	1	110
End: PCD_BASIC											
PCD_EARTH											
F_MISS_STOKES	Flag indicating missing (formerly called 'invalid') Stokes fractions, per PMD band			15	1	1	1	boolean	1	15	111
F_BAD_STOKES	Flag indicating bad Stokes fractions, per PMD band, and main channel readout			15	32	1	1	boolean	1	480	126
SIGMA_SCENE	Scene variability within a 187.5 ms groundpixel	10^6		32	1	1	1	integer4	4	128	606
End: PCD_EARTH											
OBSERVATION_MODE	Observation mode			1	1	1	1	enumerated	1	1	734

PMD_TRANSFER	PMD transfer mode			1	1	1	1	enumerated	1	1	735
PMD_READOUT	PMD readout mode			1	1	1	1	enumerated	1	1	736
SCANNER_ANGLE	Scanner viewing angle with additional element at end of scan	10^6	deg	65	1	1	1	integer4	4	260	737
GEO_BASIC											
UTC_TIME	UTC time associated with every second scanner position (0,2,...,62)			32	1	1	1	time	6	192	997
SUB_SATELLITE_POINT				32	1	1	1	COORD	8	256	1189
LATITUDE	Geodetic latitude (-90 to 90, -90 is the south pole, 90 the north pole, 0 the equator) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	
LONGITUDE	Geocentric longitude (-180 to 180, meridian is 0 and minus is going west) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	
SATELLITE_ALTITUDE	Geodetic altitude of satellite (earth-fixed CS)	10^3	m	32	1	1	1	integer4	4	128	1445
SOLAR_ZENITH_ANGLE	Solar zenith angle (Satellite Relative Actual CS)	10^6	deg	32	1	1	1	integer4	4	128	1573
SOLAR_AZIMUTH_ANGLE	Solar azimuth angle (Satellite Relative Actual CS)	10^6	deg	32	1	1	1	integer4	4	128	1701
End: GEO_BASIC											
GEO_EARTH											
SCAN_CORNER				4	1	1	1	COORD	8	32	1829
LATITUDE	Geodetic latitude (-90 to 90, -90 is the south pole, 90 the north pole, 0 the equator) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	
LONGITUDE	Geocentric longitude (-180 to 180, meridian is 0 and minus is going west) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	
SCAN_CENTRE											
LATITUDE	Geodetic latitude (-90 to 90, -90 is the south pole, 90 the north pole, 0 the equator) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	1861
LONGITUDE	Geocentric longitude (-180 to 180, meridian is 0 and minus is going west) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	1865
End: SCAN_CENTRE											
CORNER				32	4	1	1	COORD	8	1024	1869
LATITUDE	Geodetic latitude (-90 to 90, -90 is the south pole, 90 the north pole, 0 the equator) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	
LONGITUDE	Geocentric longitude (-180 to 180, meridian is 0 and minus is going west) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	
CENTRE				32	1	1	1	COORD	8	256	2893
LATITUDE	Geodetic latitude (-90 to 90, -90 is the south pole, 90 the north pole, 0 the equator) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	
LONGITUDE	Geocentric longitude (-180 to 180, meridian is 0 and minus is going west) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	
SOLAR_ZENITH	Solar zenith angle at height h0 (specified as initialisation parameter), points EFG (topocentric CS)	10^6	deg	32	3	1	1	integer4	4	384	3149
SOLAR_AZIMUTH	Solar azimuth angle at height h0, points EFG (topocentric CS)	10^6	deg	32	3	1	1	integer4	4	384	3533
SAT_ZENITH	Satellite zenith angle at height h0, points EFG (topocentric CS)	10^6	deg	32	3	1	1	integer4	4	384	3917
SAT_AZIMUTH	Satellite azimuth angle at height h0, points EFG (topocentric CS)	10^6	deg	32	3	1	1	integer4	4	384	4301
SCAT_ANGLE	Scattering angle at height h0, point F (topocentric CS)	10^6	deg	32	1	1	1	integer4	4	128	4685
SURFACE_ELEVATION	Land/sea floor elevation (above sea level), point F	10^3	m	32	1	1	1	integer4	4	128	4813
EARTH_RADIUS	Radius of the earth		m	1	1	1	1	integer4	4	4	4941
End: GEO_EARTH											
PDP_TEMP	Temperature of the pre-disperser prism for reference to the corresponding spectral calibration parameters	10^3	K	1	1	1	1	integer4	4	4	4945
FPA_TEMP	FPA temperature, per channel	10^3	K	6	1	1	1	integer4	4	24	4949
RAD_TEMP	Radiator temperature	10^3	K	1	1	1	1	integer4	4	4	4973

INTEGRATION_TIMES	Integration times of the channel bands (1a, 1b, 2a, 2b, 3, 4, 5, 6, shortwave PS and PP)	10^6	s	10	1	1	1	integer4	4	40	4977
POL_SS				32	1	1	1	POLSS	20	640	5017
WL_POL_SS	Wavelength assigned to the single scattering Stokes fractions	10^6	nm	1	1	1	1	integer4	4	4	
P_POL_SS	Degree of polarisation P (single scattering)	10^6		1	1	1	1	integer4	4	4	
CHI_POL_SS	Polarisation angle (single scattering)	10^6	deg	1	1	1	1	integer4	4	4	
Q_POL_SS	Stokes fraction q (theoretical value for single scattering)	10^6		1	1	1	1	integer4	4	4	
U_POL_SS	Stokes fraction u (theoretical value for single scattering)	10^6		1	1	1	1	integer4	4	4	
POL_M				4	32	1	1	POLV	150	19200	5657
Q_POL	Stokes fractions q (15 values from the PMD bands)	10^6		15	1	1	1	integer4	4	60	
Q_POL_ERR	Errors on the Stokes fractions q	10^6		15	1	1	1	uinteger2	2	30	
WL_POL	Wavelengths assigned to the Stokes fractions q	10^6	nm	15	1	1	1	integer4	4	60	
POL_M_P				256	1	1	1	POLV	150	38400	24857
Q_POL	Stokes fractions q (15 values from the PMD bands)	10^6		15	1	1	1	integer4	4	60	
Q_POL_ERR	Errors on the Stokes fractions q	10^6		15	1	1	1	uinteger2	2	30	
WL_POL	Wavelengths assigned to the Stokes fractions q	10^6	nm	15	1	1	1	integer4	4	60	
POL_M_SW	Fractional polarisation value for the short-wave PMD region (currently not used, set to zero)	10^6		1	1	1	1	integer4	4	4	63257
ISP_HEAD				16	1	1	1	ISP_HEAD	978	15648	63261
PRI_HEAD	Packet Primary Header			3	1	1	1	uinteger2	2	6	
SEC_HEAD	Packet secondary header (UTC)			4	1	1	1	uinteger2	2	8	
ANC_DATA	Ancillary data			14	1	1	1	uinteger2	2	28	
HK_375	Housekeeping data at 375 ms			199	1	1	1	uinteger2	2	398	
HK_1_5	Housekeeping data at 1.5 s			268	1	1	1	uinteger2	2	536	
CRC	Packet error control (CRC)			1	1	1	1	uinteger2	2	2	
REC_LENGTH_MDR-1a-Earthshine											
l1	Number of elements per band data record for the 10 bands that follow (l1, l2, ..., l10)			1	1	1	1	uinteger2	2	2	78909
l2	Number of elements per band data record for the 10 bands that follow (l1, l2, ..., l10)			1	1	1	1	uinteger2	2	2	78911
l3	Number of elements per band data record for the 10 bands that follow (l1, l2, ..., l10)			1	1	1	1	uinteger2	2	2	78913
l4	Number of elements per band data record for the 10 bands that follow (l1, l2, ..., l10)			1	1	1	1	uinteger2	2	2	78915
l5	Number of elements per band data record for the 10 bands that follow (l1, l2, ..., l10)			1	1	1	1	uinteger2	2	2	78917
l6	Number of elements per band data record for the 10 bands that follow (l1, l2, ..., l10)			1	1	1	1	uinteger2	2	2	78919
l7	Number of elements per band data record for the 10 bands that follow (l1, l2, ..., l10)			1	1	1	1	uinteger2	2	2	78921
l8	Number of elements per band data record for the 10 bands that follow (l1, l2, ..., l10)			1	1	1	1	uinteger2	2	2	78923
l9	Number of elements per band data record for the 10 bands that follow (l1, l2, ..., l10)			1	1	1	1	uinteger2	2	2	78925
l10	Number of elements per band data record for the 10 bands that follow (l1, l2, ..., l10)			1	1	1	1	uinteger2	2	2	78927
End: REC_LENGTH_MDR-1a-Earthshine											
NUM_RECS_MDR-1a-Earthshine											
b1	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	78929
b2	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	78931
b3	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	78933

b4	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	78935
b5	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	78937
b6	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	78939
b7	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	78941
b8	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	78943
b9	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	78945
b10	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	78947
End: NUM_RECS_MDR-1a-Earthshine											
BAND_1A	Band data record for Band 1a		BU	l1	b1	1	1	uinteger2	2	1762	78949
BAND_1B	Band data record for Band 1b		BU	l2	b2	1	1	uinteger2	2	9152	80711
BAND_2A	Band data record for Band 2a		BU	l3	b3	1	1	uinteger2	2	12288	89863
BAND_2B	Band data record for Band 2b		BU	l4	b4	1	1	uinteger2	2	53248	102151
BAND_3	Band data record for Band 3		BU	l5	b5	1	1	uinteger2	2	65536	155399
BAND_4	Band data record for Band 4		BU	l6	b6	1	1	uinteger2	2	65536	220935
BAND_PP	Band data record for PMD p		BU	l7	b7	1	1	uinteger2	2	9728	286471
BAND_PS	Band data record for PMD s		BU	l8	b8	1	1	uinteger2	2	9728	296199
BAND_SWPP	Band data record for short wavelength range (block B) PMD p		BU	l9	b9	1	1	uinteger2	2	70	305927
BAND_SWPS	Band data record for short wavelength range (block B) PMD s		BU	l10	b10	1	1	uinteger2	2	70	305997
											Total: 306067

MDR (name 'mdr-1a-calibration', subclass 2, version 2)

class 8

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
GENERIC_QUALITY_INDICATORS											
DEGRADED_INST_MDR	Quality of MDR has been degraded from nominal due to an instrument degradation. Occurs if any of F_NN_DT, F_NN_PDP, F_NN_RAD, F_NN_WLS_U, F_NN_WLS_I, F_NN_SLS_U, F_NN_SLS_I, F_SAT, F_HOT, F_MIN in PCD_BASIC have been raised			1	1	1	1	boolean	1	1	20
DEGRADED_PROC_MDR	Quality of MDR has been degraded from nominal due to a processing degradation. Occurs if any of F_MISS, F_SAA, F_SUNGLINT, F_RAINBOW, F_OLD_CAL_DATA in PCD_BASIC have been raised			1	1	1	1	boolean	1	1	21
Calibration_measurements_(except_sun_and_moon)_1a											
PCD_BASIC											
F_NN_DT	Flag indicating non-nominal detector temperature, per channel			6	1	1	1	boolean	1	6	22
F_NN_PDP	Flag indicating non-nominal pre-disperser temperature			1	1	1	1	boolean	1	1	28
F_NN_RAD	Flag indicating non-nominal radiator temperature			1	1	1	1	boolean	1	1	29
F_NN_WLS_U	Flag indicating non-nominal WLS voltage			1	1	1	1	boolean	1	1	30
F_NN_WLS_I	Flag indicating non-nominal WLS current			1	1	1	1	boolean	1	1	31
F_NN_SLS_U	Flag indicating non-nominal SLS voltage			1	1	1	1	boolean	1	1	32
F_NN_SLS_I	Flag indicating non-nominal SLS current			1	1	1	1	boolean	1	1	33
F_INV_UTC	Flag indicating invalid UTC			1	1	1	1	boolean	1	1	34
F_MISS	Flag indicating missing data packets			1	1	1	1	boolean	1	1	35
F_SAT	Flag indicating saturated pixels, per band			10	1	1	1	boolean	1	10	36
F_HOT	Flag indicating hot pixels, per band			10	1	1	1	boolean	1	10	46
F_SAA	Flag indicating whether scan is in the SAA			1	1	1	1	boolean	1	1	56

F_SUNGLINT	Flag indicating danger of sun-glint			1	1	1	1	enumerated	1	1	57
F_RAINBOW	Flag indicating danger of rainbow			1	1	1	1	boolean	1	1	58
F_MODE_GEOLOCATION	Flag indicating possible mismatch between observation mode and geolocation			1	1	1	1	boolean	1	1	59
F_MIN	Flag indicating that mean raw signal is below a specified threshold, per band			10	1	1	1	boolean	1	10	60
MEAN_UC	Mean raw signal per band	10^3	BU	10	1	1	1	integer4	4	40	70
F_OLD_CAL_DATA	Flag to indicate that old in-flight auxiliary calibration data is in use			1	1	1	1	enumerated	1	1	110
End: PCD_BASIC											
OBSERVATION_MODE	Observation mode			1	1	1	1	enumerated	1	1	111
PMD_TRANSFER	PMD transfer mode			1	1	1	1	enumerated	1	1	112
PMD_READOUT	PMD readout mode			1	1	1	1	enumerated	1	1	113
SCANNER_ANGLE	Scanner viewing angle with additional element at end of scan	10^6	deg	65	1	1	1	integer4	4	260	114
GEO_BASIC											
UTC_TIME	UTC time associated with every second scanner position (0,2,...,62)			32	1	1	1	time	6	192	374
SUB_SATELLITE_POINT				32	1	1	1	COORD	8	256	566
LATITUDE	Geodetic latitude (-90 to 90, -90 is the south pole, 90 the north pole, 0 the equator) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	
LONGITUDE	Geocentric longitude (-180 to 180, meridian is 0 and minus is going west) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	
SATELLITE_ALTITUDE	Geodetic altitude of satellite (earth-fixed CS)	10^3	m	32	1	1	1	integer4	4	128	822
SOLAR_ZENITH_ANGLE	Solar zenith angle (Satellite Relative Actual CS)	10^6	deg	32	1	1	1	integer4	4	128	950
SOLAR_AZIMUTH_ANGLE	Solar azimuth angle (Satellite Relative Actual CS)	10^6	deg	32	1	1	1	integer4	4	128	1078
End: GEO_BASIC											
PDP_TEMP	Temperature of the pre-disperser prism for reference to the corresponding spectral calibration parameters	10^3	K	1	1	1	1	integer4	4	4	1206
FPA_TEMP	FPA temperature, per channel	10^3	K	6	1	1	1	integer4	4	24	1210
RAD_TEMP	Radiator temperature	10^3	K	1	1	1	1	integer4	4	4	1234
INTEGRATION_TIMES	Integration times of the channel bands (1a, 1b, 2a, 2b, 3, 4, 5, 6, shortwave PS and PP)	10^6	s	10	1	1	1	integer4	4	40	1238
ISP_HEAD				16	1	1	1	ISP_HEAD	978	15648	1278
PRI_HEAD	Packet Primary Header			3	1	1	1	uinteger2	2	6	
SEC_HEAD	Packet secondary header (UTC)			4	1	1	1	uinteger2	2	8	
ANC_DATA	Ancillary data			14	1	1	1	uinteger2	2	28	
HK_375	Housekeeping data at 375 ms			199	1	1	1	uinteger2	2	398	
HK_1_5	Housekeeping data at 1.5 s			268	1	1	1	uinteger2	2	536	
CRC	Packet error control (CRC)			1	1	1	1	uinteger2	2	2	
REC_LENGTH_MDR-1a-Calibration											
I1	Number of elements per band data record for the 10 bands that follow (I1, I2, ..., I10)			1	1	1	1	uinteger2	2	2	16926
I2	Number of elements per band data record for the 10 bands that follow (I1, I2, ..., I10)			1	1	1	1	uinteger2	2	2	16928
I3	Number of elements per band data record for the 10 bands that follow (I1, I2, ..., I10)			1	1	1	1	uinteger2	2	2	16930
I4	Number of elements per band data record for the 10 bands that follow (I1, I2, ..., I10)			1	1	1	1	uinteger2	2	2	16932
I5	Number of elements per band data record for the 10 bands that follow (I1, I2, ..., I10)			1	1	1	1	uinteger2	2	2	16934
I6	Number of elements per band data record for the 10 bands that follow (I1, I2, ..., I10)			1	1	1	1	uinteger2	2	2	16936
I7	Number of elements per band data record for the 10 bands that follow (I1, I2, ..., I10)			1	1	1	1	uinteger2	2	2	16938

l8	Number of elements per band data record for the 10 bands that follow (l1, l2, ..., l10)			1	1	1	1	uinteger2	2	2	16940
l9	Number of elements per band data record for the 10 bands that follow (l1, l2, ..., l10)			1	1	1	1	uinteger2	2	2	16942
l10	Number of elements per band data record for the 10 bands that follow (l1, l2, ..., l10)			1	1	1	1	uinteger2	2	2	16944
End: REC_LENGTH_MDR-1a-Calibration											
NUM_RECS_MDR-1a-Calibration											
b1	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	16946
b2	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	16948
b3	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	16950
b4	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	16952
b5	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	16954
b6	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	16956
b7	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	16958
b8	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	16960
b9	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	16962
b10	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	16964
End: NUM_RECS_MDR-1a-Calibration											
BAND_1A	Band data record for Band 1a		BU	l1	b1	1	1	uinteger2	2	1762	16966
BAND_1B	Band data record for Band 1b		BU	l2	b2	1	1	uinteger2	2	9152	18728
BAND_2A	Band data record for Band 2a		BU	l3	b3	1	1	uinteger2	2	12288	27880
BAND_2B	Band data record for Band 2b		BU	l4	b4	1	1	uinteger2	2	53248	40168
BAND_3	Band data record for Band 3		BU	l5	b5	1	1	uinteger2	2	65536	93416
BAND_4	Band data record for Band 4		BU	l6	b6	1	1	uinteger2	2	65536	158952
BAND_PP	Band data record for PMD p		BU	l7	b7	1	1	uinteger2	2	9728	224488
BAND_PS	Band data record for PMD s		BU	l8	b8	1	1	uinteger2	2	9728	234216
BAND_SWPP	Band data record for short wavelength range (block B) PMD p		BU	l9	b9	1	1	uinteger2	2	70	243944
BAND_SWPS	Band data record for short wavelength range (block B) PMD s		BU	l10	b10	1	1	uinteger2	2	70	244014
											Total: 244084

MDR (name 'mdr-1a-sun', subclass 3, version 2)

class 8

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
GENERIC_QUALITY_INDICATORS											
DEGRADED_INST_MDR	Quality of MDR has been degraded from nominal due to an instrument degradation. Occurs if any of F_NN_DT, F_NN_PDP, F_NN_RAD, F_NN_WLS_U, F_NN_WLS_I, F_NN_SLS_U, F_NN_SLS_I, F_SAT, F_HOT, F_MIN in PCD_BASIC have been raised			1	1	1	1	boolean	1	1	20
DEGRADED_PROC_MDR	Quality of MDR has been degraded from nominal due to a processing degradation. Occurs if any of F_MISS, F_SAA, F_SUNGLINT, F_RAINBOW, F_OLD_CAL_DATA in PCD_BASIC have been raised			1	1	1	1	boolean	1	1	21
Sun_measurements_1a											
PCD_BASIC											
F_NN_DT	Flag indicating non-nominal detector temperature, per channel			6	1	1	1	boolean	1	6	22
F_NN_PDP	Flag indicating non-nominal pre-disperser temperature			1	1	1	1	boolean	1	1	28

F_NN_RAD	Flag indicating non-nominal radiator temperature			1	1	1	1	boolean	1	1	29
F_NN_WLS_U	Flag indicating non-nominal WLS voltage			1	1	1	1	boolean	1	1	30
F_NN_WLS_I	Flag indicating non-nominal WLS current			1	1	1	1	boolean	1	1	31
F_NN_SLS_U	Flag indicating non-nominal SLS voltage			1	1	1	1	boolean	1	1	32
F_NN_SLS_I	Flag indicating non-nominal SLS current			1	1	1	1	boolean	1	1	33
F_INV_UTC	Flag indicating invalid UTC			1	1	1	1	boolean	1	1	34
F_MISS	Flag indicating missing data packets			1	1	1	1	boolean	1	1	35
F_SAT	Flag indicating saturated pixels, per band			10	1	1	1	boolean	1	10	36
F_HOT	Flag indicating hot pixels, per band			10	1	1	1	boolean	1	10	46
F_SAA	Flag indicating whether scan is in the SAA			1	1	1	1	boolean	1	1	56
F_SUNGLINT	Flag indicating danger of sun-glint			1	1	1	1	enumerated	1	1	57
F_RAINBOW	Flag indicating danger of rainbow			1	1	1	1	boolean	1	1	58
F_MODE_GEOLOCATION	Flag indicating possible mismatch between observation mode and geolocation			1	1	1	1	boolean	1	1	59
F_MIN	Flag indicating that mean raw signal is below a specified threshold, per band			10	1	1	1	boolean	1	10	60
MEAN_UC	Mean raw signal per band	10^3	BU	10	1	1	1	integer4	4	40	70
F_OLD_CAL_DATA	Flag to indicate that old in-flight auxiliary calibration data is in use			1	1	1	1	enumerated	1	1	110
End: PCD_BASIC											
OBSERVATION_MODE	Observation mode			1	1	1	1	enumerated	1	1	111
PMD_TRANSFER	PMD transfer mode			1	1	1	1	enumerated	1	1	112
PMD_READOUT	PMD readout mode			1	1	1	1	enumerated	1	1	113
SCANNER_ANGLE	Scanner viewing angle with additional element at end of scan	10^6	deg	65	1	1	1	integer4	4	260	114
GEO_BASIC											
UTC_TIME	UTC time associated with every second scanner position (0,2,...,62)			32	1	1	1	time	6	192	374
SUB_SATELLITE_POINT				32	1	1	1	COORD	8	256	566
LATITUDE	Geodetic latitude (-90 to 90, -90 is the south pole, 90 the north pole, 0 the equator) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	
LONGITUDE	Geocentric longitude (-180 to 180, meridian is 0 and minus is going west) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	
SATELLITE_ALTITUDE	Geodetic altitude of satellite (earth-fixed CS)	10^3	m	32	1	1	1	integer4	4	128	822
SOLAR_ZENITH_ANGLE	Solar zenith angle (Satellite Relative Actual CS)	10^6	deg	32	1	1	1	integer4	4	128	950
SOLAR_AZIMUTH_ANGLE	Solar azimuth angle (Satellite Relative Actual CS)	10^6	deg	32	1	1	1	integer4	4	128	1078
End: GEO_BASIC											
GEO_SUN											
DISTANCE_SAT_SUN	Satellite-Sun distance	10^-3	m	1	1	1	1	integer4	4	4	1206
VEL_SAT_SUN	Relative speed of satellite and sun (negative if satellite is moving towards the sun)	10^3	m/s	1	1	1	1	integer4	4	4	1210
End: GEO_SUN											
PDP_TEMP	Temperature of the pre-disperser prism for reference to the corresponding spectral calibration parameters	10^3	K	1	1	1	1	integer4	4	4	1214
FPA_TEMP	FPA temperature, per channel	10^3	K	6	1	1	1	integer4	4	24	1218
RAD_TEMP	Radiator temperature	10^3	K	1	1	1	1	integer4	4	4	1242
INTEGRATION_TIMES	Integration times of the channel bands (1a, 1b, 2a, 2b, 3, 4, 5, 6, shortwave PS and PP)	10^6	s	10	1	1	1	integer4	4	40	1246
ISP_HEAD				16	1	1	1	ISP_HEAD	978	15648	1286
PRI_HEAD	Packet Primary Header			3	1	1	1	uinteger2	2	6	
SEC_HEAD	Packet secondary header (UTC)			4	1	1	1	uinteger2	2	8	
ANC_DATA	Ancillary data			14	1	1	1	uinteger2	2	28	
HK_375	Housekeeping data at 375 ms			199	1	1	1	uinteger2	2	398	
HK_1_5	Housekeeping data at 1.5 s			268	1	1	1	uinteger2	2	536	

CRC	Packet error control (CRC)			1	1	1	1	uinteger2	2	2	
REC_LENGTH_MDR-1a-Sun											
l1	Number of elements per band data record for the 10 bands that follow (l1, l2, ..., l10)			1	1	1	1	uinteger2	2	2	16934
l2	Number of elements per band data record for the 10 bands that follow (l1, l2, ..., l10)			1	1	1	1	uinteger2	2	2	16936
l3	Number of elements per band data record for the 10 bands that follow (l1, l2, ..., l10)			1	1	1	1	uinteger2	2	2	16938
l4	Number of elements per band data record for the 10 bands that follow (l1, l2, ..., l10)			1	1	1	1	uinteger2	2	2	16940
l5	Number of elements per band data record for the 10 bands that follow (l1, l2, ..., l10)			1	1	1	1	uinteger2	2	2	16942
l6	Number of elements per band data record for the 10 bands that follow (l1, l2, ..., l10)			1	1	1	1	uinteger2	2	2	16944
l7	Number of elements per band data record for the 10 bands that follow (l1, l2, ..., l10)			1	1	1	1	uinteger2	2	2	16946
l8	Number of elements per band data record for the 10 bands that follow (l1, l2, ..., l10)			1	1	1	1	uinteger2	2	2	16948
l9	Number of elements per band data record for the 10 bands that follow (l1, l2, ..., l10)			1	1	1	1	uinteger2	2	2	16950
l10	Number of elements per band data record for the 10 bands that follow (l1, l2, ..., l10)			1	1	1	1	uinteger2	2	2	16952
End: REC_LENGTH_MDR-1a-Sun											
NUM_RECS_MDR-1a-Sun											
b1	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	16954
b2	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	16956
b3	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	16958
b4	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	16960
b5	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	16962
b6	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	16964
b7	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	16966
b8	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	16968
b9	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	16970
b10	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	16972
End: NUM_RECS_MDR-1a-Sun											
BAND_1A	Band data record for Band 1a		BU	l1	b1	1	1	uinteger2	2	1762	16974
BAND_1B	Band data record for Band 1b		BU	l2	b2	1	1	uinteger2	2	9152	18736
BAND_2A	Band data record for Band 2a		BU	l3	b3	1	1	uinteger2	2	12288	27888
BAND_2B	Band data record for Band 2b		BU	l4	b4	1	1	uinteger2	2	53248	40176
BAND_3	Band data record for Band 3		BU	l5	b5	1	1	uinteger2	2	65536	93424
BAND_4	Band data record for Band 4		BU	l6	b6	1	1	uinteger2	2	65536	158960
BAND_PP	Band data record for PMD p		BU	l7	b7	1	1	uinteger2	2	9728	224496
BAND_PS	Band data record for PMD s		BU	l8	b8	1	1	uinteger2	2	9728	234224
BAND_SWPP	Band data record for short wavelength range (block B) PMD p		BU	l9	b9	1	1	uinteger2	2	70	243952
BAND_SWPS	Band data record for short wavelength range (block B) PMD s		BU	l10	b10	1	1	uinteger2	2	70	244022
											Total: 244092

MDR (name 'mdr-1a-moon', subclass 4, version 2)

class 8

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset

RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
GENERIC_QUALITY_INDICATORS											
DEGRADED_INST_MDR	Quality of MDR has been degraded from nominal due to an instrument degradation. Occurs if any of F_NN_DT, F_NN_PDP, F_NN_RAD, F_NN_WLS_U, F_NN_WLS_I, F_NN_SLS_U, F_NN_SLS_I, F_SAT, F_HOT, F_MIN in PCD_BASIC have been raised			1	1	1	1	boolean	1	1	20
DEGRADED_PROC_MDR	Quality of MDR has been degraded from nominal due to a processing degradation. Occurs if any of F_MISS, F_SAA, F_SUNGLINT, F_RAINBOW, F_OLD_CAL_DATA in PCD_BASIC have been raised			1	1	1	1	boolean	1	1	21
Moon_measurements_1a											
PCD_BASIC											
F_NN_DT	Flag indicating non-nominal detector temperature, per channel			6	1	1	1	boolean	1	6	22
F_NN_PDP	Flag indicating non-nominal pre-disperser temperature			1	1	1	1	boolean	1	1	28
F_NN_RAD	Flag indicating non-nominal radiator temperature			1	1	1	1	boolean	1	1	29
F_NN_WLS_U	Flag indicating non-nominal WLS voltage			1	1	1	1	boolean	1	1	30
F_NN_WLS_I	Flag indicating non-nominal WLS current			1	1	1	1	boolean	1	1	31
F_NN_SLS_U	Flag indicating non-nominal SLS voltage			1	1	1	1	boolean	1	1	32
F_NN_SLS_I	Flag indicating non-nominal SLS current			1	1	1	1	boolean	1	1	33
F_INV_UTC	Flag indicating invalid UTC			1	1	1	1	boolean	1	1	34
F_MISS	Flag indicating missing data packets			1	1	1	1	boolean	1	1	35
F_SAT	Flag indicating saturated pixels, per band			10	1	1	1	boolean	1	10	36
F_HOT	Flag indicating hot pixels, per band			10	1	1	1	boolean	1	10	46
F_SAA	Flag indicating whether scan is in the SAA			1	1	1	1	boolean	1	1	56
F_SUNGLINT	Flag indicating danger of sun-glint			1	1	1	1	enumerated	1	1	57
F_RAINBOW	Flag indicating danger of rainbow			1	1	1	1	boolean	1	1	58
F_MODE_GEOLOCATION	Flag indicating possible mismatch between observation mode and geolocation			1	1	1	1	boolean	1	1	59
F_MIN	Flag indicating that mean raw signal is below a specified threshold, per band			10	1	1	1	boolean	1	10	60
MEAN_UC	Mean raw signal per band	10^3	BU	10	1	1	1	integer4	4	40	70
F_OLD_CAL_DATA	Flag to indicate that old in-flight auxiliary calibration data is in use			1	1	1	1	enumerated	1	1	110
End: PCD_BASIC											
OBSERVATION_MODE	Observation mode			1	1	1	1	enumerated	1	1	111
PMD_TRANSFER	PMD transfer mode			1	1	1	1	enumerated	1	1	112
PMD_READOUT	PMD readout mode			1	1	1	1	enumerated	1	1	113
SCANNER_ANGLE	Scanner viewing angle with additional element at end of scan	10^6	deg	65	1	1	1	integer4	4	260	114
GEO_BASIC											
UTC_TIME	UTC time associated with every second scanner position (0,2,...,62)			32	1	1	1	time	6	192	374
SUB_SATELLITE_POINT				32	1	1	1	COORD	8	256	566
LATITUDE	Geodetic latitude (-90 to 90, -90 is the south pole, 90 the north pole, 0 the equator) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	
LONGITUDE	Geocentric longitude (-180 to 180, meridian is 0 and minus is going west) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	
SATELLITE_ALTITUDE	Geodetic altitude of satellite (earth-fixed CS)	10^3	m	32	1	1	1	integer4	4	128	822
SOLAR_ZENITH_ANGLE	Solar zenith angle (Satellite Relative Actual CS)	10^6	deg	32	1	1	1	integer4	4	128	950
SOLAR_AZIMUTH_ANGLE	Solar azimuth angle (Satellite Relative Actual CS)	10^6	deg	32	1	1	1	integer4	4	128	1078
End: GEO_BASIC											
GEO_MOON											

LUNAR_AZIMUTH	Lunar azimuth angle, points HJKLM (Satellite Relative Actual Reference CS)	10^6	deg	5	1	1	1	integer4	4	20	1206
LUNAR_ELEVATION	Lunar elevation angle, points HJKLM (Satellite Relative Actual Reference CS)	10^6	deg	5	1	1	1	integer4	4	20	1226
DISTANCE_SUN_MOON	Sun-Moon distance	10^-3	m	1	1	1	1	integer4	4	4	1246
DISTANCE_SAT_MOON	Satellite-Moon distance		m	1	1	1	1	integer4	4	4	1250
LUNAR_PHASE	Lunar phase angle (geometrical)	10^6	deg	1	1	1	1	integer4	4	4	1254
LUNAR_FRACTION	Illuminated fraction of lunar disc	10^6		1	1	1	1	integer4	4	4	1258
End: GEO_MOON											
PDP_TEMP	Temperature of the pre-disperser prism for reference to the corresponding spectral calibration parameters	10^3	K	1	1	1	1	integer4	4	4	1262
FPA_TEMP	FPA temperature, per channel	10^3	K	6	1	1	1	integer4	4	24	1266
RAD_TEMP	Radiator temperature	10^3	K	1	1	1	1	integer4	4	4	1290
INTEGRATION_TIMES	Integration times of the channel bands (1a, 1b, 2a, 2b, 3, 4, 5, 6, shortwave PS and PP)	10^6	s	10	1	1	1	integer4	4	40	1294
ISP_HEAD				16	1	1	1	ISP_HEAD	978	15648	1334
PRI_HEAD	Packet Primary Header			3	1	1	1	uinteger2	2	6	
SEC_HEAD	Packet secondary header (UTC)			4	1	1	1	uinteger2	2	8	
ANC_DATA	Ancillary data			14	1	1	1	uinteger2	2	28	
HK_375	Housekeeping data at 375 ms			199	1	1	1	uinteger2	2	398	
HK_1_5	Housekeeping data at 1.5 s			268	1	1	1	uinteger2	2	536	
CRC	Packet error control (CRC)			1	1	1	1	uinteger2	2	2	
REC_LENGTH_MDR-1a-Moon											
l1	Number of elements per band data record for the 10 bands that follow (l1, l2, ..., l10)			1	1	1	1	uinteger2	2	2	16982
l2	Number of elements per band data record for the 10 bands that follow (l1, l2, ..., l10)			1	1	1	1	uinteger2	2	2	16984
l3	Number of elements per band data record for the 10 bands that follow (l1, l2, ..., l10)			1	1	1	1	uinteger2	2	2	16986
l4	Number of elements per band data record for the 10 bands that follow (l1, l2, ..., l10)			1	1	1	1	uinteger2	2	2	16988
l5	Number of elements per band data record for the 10 bands that follow (l1, l2, ..., l10)			1	1	1	1	uinteger2	2	2	16990
l6	Number of elements per band data record for the 10 bands that follow (l1, l2, ..., l10)			1	1	1	1	uinteger2	2	2	16992
l7	Number of elements per band data record for the 10 bands that follow (l1, l2, ..., l10)			1	1	1	1	uinteger2	2	2	16994
l8	Number of elements per band data record for the 10 bands that follow (l1, l2, ..., l10)			1	1	1	1	uinteger2	2	2	16996
l9	Number of elements per band data record for the 10 bands that follow (l1, l2, ..., l10)			1	1	1	1	uinteger2	2	2	16998
l10	Number of elements per band data record for the 10 bands that follow (l1, l2, ..., l10)			1	1	1	1	uinteger2	2	2	17000
End: REC_LENGTH_MDR-1a-Moon											
NUM_RECS_MDR-1a-Moon											
b1	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	17002
b2	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	17004
b3	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	17006
b4	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	17008
b5	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	17010
b6	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	17012
b7	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	17014

b8	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	17016
b9	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	17018
b10	Number of band data records for the 10 bands that follow (b1, b2, ..., b10)			1	1	1	1	uinteger2	2	2	17020
End: NUM_RECS_MDR-1a-Moon											
BAND_1A	Band data record for Band 1a		BU	l1	b1	1	1	uinteger2	2	1762	17022
BAND_1B	Band data record for Band 1b		BU	l2	b2	1	1	uinteger2	2	9152	18784
BAND_2A	Band data record for Band 2a		BU	l3	b3	1	1	uinteger2	2	12288	27936
BAND_2B	Band data record for Band 2b		BU	l4	b4	1	1	uinteger2	2	53248	40224
BAND_3	Band data record for Band 3		BU	l5	b5	1	1	uinteger2	2	65536	93472
BAND_4	Band data record for Band 4		BU	l6	b6	1	1	uinteger2	2	65536	159008
BAND_PP	Band data record for PMD p		BU	l7	b7	1	1	uinteger2	2	9728	224544
BAND_PS	Band data record for PMD s		BU	l8	b8	1	1	uinteger2	2	9728	234272
BAND_SWPP	Band data record for short wavelength range (block B) PMD p		BU	l9	b9	1	1	uinteger2	2	70	244000
BAND_SWPS	Band data record for short wavelength range (block B) PMD s		BU	l10	b10	1	1	uinteger2	2	70	244070
											Total: 244140

MDR (name 'mdr-1a-other', subclass 5, version 1)

class 8

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
GENERIC_QUALITY_INDICATORS											
DEGRADED_INST_MDR	Quality of MDR has been degraded from nominal due to an instrument degradation			1	1	1	1	boolean	1	1	20
DEGRADED_PROC_MDR	Quality of MDR has been degraded from nominal due to a processing degradation			1	1	1	1	boolean	1	1	21
Other_measurements_1a											
OBSERVATION_MODE	Observation mode			1	1	1	1	enumerated	1	1	22
GEO_BASIC											
UTC_TIME	UTC time associated with every second scanner position (0,2,...,62)			32	1	1	1	time	6	192	23
SUB_SATELLITE_POINT				32	1	1	1	COORD	8	256	215
LATITUDE	Geodetic latitude (-90 to 90, -90 is the south pole, 90 the north pole, 0 the equator) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	
LONGITUDE	Geocentric longitude (-180 to 180, meridian is 0 and minus is going west) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	
SATELLITE_ALTITUDE	Geodetic altitude of satellite (earth-fixed CS)	10^3	m	32	1	1	1	integer4	4	128	471
SOLAR_ZENITH_ANGLE	Solar zenith angle (Satellite Relative Actual CS)	10^6	deg	32	1	1	1	integer4	4	128	599
SOLAR_AZIMUTH_ANGLE	Solar azimuth angle (Satellite Relative Actual CS)	10^6	deg	32	1	1	1	integer4	4	128	727
End: GEO_BASIC											
ISP				16	1	1	1	ISP	18738	299808	855
PRI_HEAD	Packet Primary Header			3	1	1	1	uinteger2	2	6	
SEC_HEAD	Packet secondary header (UTC)			4	1	1	1	uinteger2	2	8	
ANC_DATA	Ancillary data			14	1	1	1	uinteger2	2	28	
HK_375	Housekeeping data at 375 ms			199	1	1	1	uinteger2	2	398	
HK_1_5	Housekeeping data at 1.5 s			268	1	1	1	uinteger2	2	536	
PMD	Detector data of the two PMD channels			680	1	1	1	uinteger2	2	1360	
FPA	Detector data of the four main channels			8200	1	1	1	uinteger2	2	16400	
CRC	Packet error control (CRC)			1	1	1	1	uinteger2	2	2	
											Total: 300663

Enumeration BAND_NUMBER

Value	Name	Description
1		Main FPA band 1a
2		Main FPA band 1b

3		Main FPA band 2a
4		Main FPA band 2b
5		Main FPA band 3
6		Main FPA band 4
7		PMD p blocks CDE
8		PMD s blocks CDE
9		PMD p block B
10		PMD s block B

Enumeration CHANNEL_NUMBER

Value	Name	Description
1		Main FPA channel 1
2		Main FPA channel 2
3		Main FPA channel 3
4		Main FPA channel 4
5		PMD channel p
6		PMD channel s

Enumeration DISPOSITION_MODE

Value	Name	Description
T	Testing	
O	Operational	
C	Commissioning	

Enumeration ETALON_ALGO

Value	Name	Description
0	Algo1	Algorithm Option 1
1	Algo2	Algorithm Option 2

Enumeration ETALON_BACK

Value	Name	Description
0	WLS	WLS
1	Sun	SMR Backup

Enumeration F_DARK_MISS

Value	Name	Description
0	no_missing	No missing pixels
1	some_missing	Missing pixels filled by interpolation
2	all_missing	Complete channel/band missing

Enumeration F_OLD_CAL_DATA

Value	Name	Description
0		No in-flight auxiliary calibration data is old
1		Dark signal correction old
2		PPG correction old
3		Spectral calibration parameters old
4		Etalon correction old
5		SMR old

Enumeration F_SUNGLINT

Value	Name	Description
0	NoRisk	No risk
1	LowRisk	Low risk
2	HighRisk	High risk

Enumeration INSTRUMENT_ID

Value	Name	Description
AMSA	AMSU-A	
ASCA	ASCAT	
ATOV	ATOVS	instruments: AVHRR/3, HIRS/4, AMSU-A, MHS
AVHR	AVHRR/3	
GOME	GOME	
GRAS	GRAS	
HIRS	HIRS/4	
IASI	IASI	
MHSx	MHS	
NOAA	All NOAA	instruments specific to Level 0 NOAA product
SEMx	SEM	
ADCS	ADCS	
SBUV	SBUV	
xxxx	No specific instrument	
HKTM	VCDU34	data specific to Level 0

Enumeration INSTRUMENT_MODEL

Value	Name	Description
0	Reserved	
1	Flight Model 1	
2	Flight Model 2	
3	Engineering Model	
4	Protoflight Model	

Enumeration OBSERVATION_MODE

Value	Name	Description
0	Nadir_scan	Nadir
1	Nth_pole_scan	North Pole scanning
2	Sth_pole_scan	South Pole scanning
3	Other_scan	Other scanning
4	Nadir_static	Nadir static
5	Other_static	Other static
6	Dark	Dark
7	LED	LED
8	WLS	WLS
9	SLS	SLS
10	SLS_diff	SLS over diffuser
11	Sun	Sun
12	Moon	Moon
13	Idle	Idle
14	Test	Test
15	Dump	Dump
16	Invalid	Invalid

Enumeration PMD_READOUT

Value	Name	Description
0	Nominal	Nominal readout mode
1	Solar	Solar readout mode
2	Calibration	Calibration readout mode
3	Various	PMD readout mode changes within scan

Enumeration PMD_TRANSFER

Value	Name	Description
1	Band+Raw	Band + Raw
2	Band+Mixed	Band + Mixed
3	Raw	Raw Transfer
4	Various	PMD transfer changes within scan

Enumeration PPG_BACK

Value	Name	Description
0	LED	LED
1	WLS	WLS Backup

Enumeration PROCESSING_CENTRE

Value	Name	Description
CGS1		First EUMETSAT EPS Core Ground Segment
CGS2		Second EUMETSAT EPS Core Ground Segment
NSSx		NOAA/NESDIS
RUSx		Reference User Station
DMIx		DMI, Copenhagen (GRAS SAF)
DWDx		DWD, Offenbach (Climate SAF)
FMIx		FMI , Helsinki (Ozone SAF)
IMPx		IMP, Lisbon (Land SAF)
INMx		INM, Madrid (NCW SAF)
MFxx		MF, Lannion (OSI SAF)
UKMO		UKMO, Bracknell (NWP SAF)

Enumeration PROCESSING_LEVEL

Value	Name	Description
00	Level 0	
01	Level 1	
1A	Level 1a	
1B	Level 1b	
1C	Level 1c	
02	Level 2	
03	Level 3	
xx	No Specific Level	

Enumeration PROCESSING_MODE

Value	Name	Description
N	Nominal	NRT processing
B	Backlog Processing	
R	Reprocessing	
V	Validation	

Enumeration PRODUCT_TYPE

Value	Name	Description
ENG		IASI engineering data
GAC		NOAC Global Area Coverage AVHRR data
SND		Sounding Data
SZF		ASCAT calibrated s0 data at full resolution
SZO		ASCAT calibrated s0 data at operational resolution (50 km)
SZR		ASCAT calibrated s0 data at research resolution (25 km)
VER		IASI verification data
xxx		No specific product type specified
AIP		NOAA AIP/SAIP data
TIP		NOAA TIP/STIP data
HRP		HRPT data
LRP		LRPT data

Enumeration RECEIVING_GROUND_STATION

Value	Name	Description
SVL		Svalbard
WAL		Wallops Island, Virginia
FBK		Fairbanks, Alaska

SOC		SOCC (NESDIS Satellite Operations Control Centre), Suitland, Maryland
RUS		Reference User Station

Enumeration SPACECRAFT_ID

Value	Name	Description
xxx		No specific spacecraft
M01		METOP 01
M02		METOP 02
M02		METOP 03
N15		NOAA-K
N16		NOAA-L
N17		NOAA-M
N18		NOAA-N
N19		NOAA-N'

Enumeration BAND_NUMBER

Value	Name	Description
1		Main FPA band 1a
2		Main FPA band 1b
3		Main FPA band 2a
4		Main FPA band 2b
5		Main FPA band 3
6		Main FPA band 4
7		PMD p blocks CDE
8		PMD s blocks CDE
9		PMD p block B
10		PMD s block B

Enumeration CHANNEL_NUMBER

Value	Name	Description
1		Main FPA channel 1
2		Main FPA channel 2
3		Main FPA channel 3
4		Main FPA channel 4
5		PMD channel p
6		PMD channel s

Enumeration CHANNEL_NUMBER

Value	Name	Description
1		Main FPA channel 1
2		Main FPA channel 2
3		Main FPA channel 3
4		Main FPA channel 4
5		PMD channel p
6		PMD channel s

Enumeration F_PPG_MISS

Value	Name	Description
0	no_missing	No missing pixels
1	some_missing	Missing pixels filled by interpolation
2	all_missing	Complete channel/band missing

Parameters Table

Parameter	Value	Description
b1	1	Number of band data records (i.e., number of readouts) in Level 1a MDR. This number is specified in field NUM_RECS of the MDR.
b10	1	
b2	32	

b3	32	
b4	32	
b5	32	
b6	32	
b7	16	
b8	16	
b9	1	
l1	881	Length of band data records in Level 1a MDR. This number is specified in field REC_LENGTH of the MDR. For the main channels this number equals the number of detector pixels in a band.
l10	35	
l2	143	
l3	192	
l4	832	
l5	1024	
l6	1024	
l7	304	
l8	304	
l9	35	
m1	1	Number of band data records (i.e., number of readouts) in Level 1b MDR. This number is specified in field NUM_RECS of the MDR.
m10	1	
m2	32	
m3	32	
m4	32	
m5	32	
m6	32	
m7	256	
m8	256	
m9	1	
n1	881	Length of band data records (i.e., number of spectral elements within a readout) in Level 1b MDR. This number is specified in field REC_LENGTH of the MDR.
n10	35	
n2	143	
n3	192	
n4	832	
n5	1024	
n6	1024	
n7	15	
n8	15	
n9	35	
num_channels	6	Number of channels (4 main FPA, 2 PMD, see enumerated variables)
num_main_channels	4	Number of main FPA channels
num_PMD_channels	2	Number of PMD channels
num_bands	10	Number of bands (6 main FPA, 4 PMD, see enumerated variables)
num_main_bands	6	Number of main FPA bands
n_psi_f	21	MME: number of viewing angles (fine grid). This number is specified in field MME_N_PSI_F of record GIADR-1a-MME
n_e_f	33	MME: number of elevation angles (fine grid). This number is specified in field MME_N_E_F of record GIADR-1a-MME
n_phi_f	35	MME: number of azimuth angles (fine grid). This number is specified in field MME_N_PHI_F of record GIADR-1a-MME
n_lambda_FPA	1024	MME: number of wavelengths for a main channel
n_lambda_PMD	279	MME: number of wavelengths for a PMD channel
n_lambda_total	4654	MME: number of wavelengths (all channels)

Annex 7. Record description of the GOME-1B products

This GOME 1B description was generated using the GOME PFS Excel document Issue 7 Revision 0 (eps_gomel1_7.0.xls) and pfs2xml version 2.22 (Baseline: PFS April 2004) (MPHR Format Version: 5. 0,)

Contents:

MPHR (name 'mphr', subclass 0, version 2)

class 1

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
Product Details											
PRODUCT_NAME	Complete name of the product			1	1	1	1	string	67	100	20
PARENT_PRODUCT_NAME_1	Name of the parent product from which this product has been produced. For Level 0 products, this field is filled with lower case x's.			1	1	1	1	string	67	100	120
PARENT_PRODUCT_NAME_2	Name of the parent product from which this product has been produced. For Level 0 products or products for which this is not appropriate, this field is filled with lower case x's.			1	1	1	1	string	67	100	220
PARENT_PRODUCT_NAME_3	Name of the parent product from which this product has been produced. For Level 0 products or products for which this is not appropriate, this field is filled with lower case x's.			1	1	1	1	string	67	100	320
PARENT_PRODUCT_NAME_4	Name of the parent product from which this product has been produced. For Level 0 products or products for which this is not appropriate, this field is filled with lower case x's.			1	1	1	1	string	67	100	420
INSTRUMENT_ID	Instrument identification			1	1	1	1	enumerated	4	37	520
INSTRUMENT_MODEL	Instrument Model identification			1	1	1	1	enumerated	3	36	557
PRODUCT_TYPE	Product Type			1	1	1	1	enumerated	3	36	593
PROCESSING_LEVEL	Processing Level Identification			1	1	1	1	enumerated	2	35	629
SPACECRAFT_ID	Spacecraft identification			1	1	1	1	enumerated	3	36	664

SENSING_START	UTC Time of start of sensing data in this object (PDU, ROI or Full Product)			1	1	1	1	time	15	48	700
SENSING_END	UTC Time of end of sensing data in this object (PDU, ROI or Full Product)			1	1	1	1	time	15	48	748
SENSING_START_THEORETICAL	Theoretical UTC Time of start of sensing data in the dump from which this object is derived. This data is the predicted start time at the MPF level.			1	1	1	1	time	15	48	796
SENSING_END_THEORETICAL	Theoretical UTC Time of end of sensing data in the dump from which this object is derived. This data is the predicted end time at the MPF level.			1	1	1	1	time	15	48	844
PROCESSING_CENTRE	Processing Centre Identification			1	1	1	1	enumerated	4	37	892
PROCESSOR_MAJOR_VERSION	Processing chain major version number			1	1	1	1	uinteger	5	38	929
PROCESSOR_MINOR_VERSION	Processing chain minor version number			1	1	1	1	uinteger	5	38	967
FORMAT_MAJOR_VERSION	Dataset Format Major Version number			1	1	1	1	uinteger	5	38	1005
FORMAT_MINOR_VERSION	Dataset Format Minor Version number			1	1	1	1	uinteger	5	38	1043
PROCESSING_TIME_START	UTC time of the processing at start of processing for the product			1	1	1	1	time	15	48	1081
PROCESSING_TIME_END	UTC time of the processing at end of processing for the product			1	1	1	1	time	15	48	1129
PROCESSING_MODE	Identification of the mode of processing			1	1	1	1	enumerated	1	34	1177
DISPOSITION_MODE	Identification of the diposition mode			1	1	1	1	enumerated	1	34	1211
RECEIVING_GROUND_STATION	Acquisition Station Identification			1	1	1	1	enumerated	3	36	1245
RECEIVE_TIME_START	UTC time of the reception at CDA for first Data Item			1	1	1	1	time	15	48	1281
RECEIVE_TIME_END	UTC time of the reception at CDA for last Data Item			1	1	1	1	time	15	48	1329
ORBIT_START	Start Orbit Number, counted incrementally since launch			1	1	1	1	uinteger	5	38	1377
ORBIT_END	Stop Orbit Number			1	1	1	1	uinteger	5	38	1415
ACTUAL_PRODUCT_SIZE	Size of the complete product		bytes	1	1	1	1	uinteger	11	44	1453
ASCENDING NODE ORBIT PARAMETERS											
STATE_VECTOR_TIME	Epoch time (in UTC) of the orbital elements and the orbit state vector. this corresponds to the time of crossing the ascending node for ORBIT_START		UTC	1	1	1	1	longtime	18	51	1497
SEMI_MAJOR_AXIS	Semi major axis of orbit at time of the ascending node crossing.		mm	1	1	1	1	integer	11	44	1548
ECCENTRICITY	Orbit eccentricity at time of the ascending node crossing	10^6		1	1	1	1	integer	11	44	1592
INCLINATION	Orbit inclination at time of the ascending node crossing	10^3	deg	1	1	1	1	integer	11	44	1636
PERIGEE_ARGUMENT	Argument of perigee at time of the ascending node crossing	10^3	deg	1	1	1	1	integer	11	44	1680

RIGHT_ASCENSION	Right ascension at time of the ascending node crossing	10^3	deg	1	1	1	1	integer	11	44	1724
MEAN_ANOMALY	Mean anomaly at time of the ascending node crossing	10^3	deg	1	1	1	1	integer	11	44	1768
X_POSITION	X position of the orbit state vector in the orbit frame at ascending node	10^3	m	1	1	1	1	integer	11	44	1812
Y_POSITION	Y position of the orbit state vector in the orbit frame at ascending node	10^3	m	1	1	1	1	integer	11	44	1856
Z_POSITION	Z position of the orbit state vector in the orbit frame at ascending node	10^3	m	1	1	1	1	integer	11	44	1900
X_VELOCITY	X velocity of the orbit state vector in the orbit frame at ascending node	10^3	m/s	1	1	1	1	integer	11	44	1944
Y_VELOCITY	Y velocity of the orbit state vector in the orbit frame at ascending node	10^3	m/s	1	1	1	1	integer	11	44	1988
Z_VELOCITY	Z velocity of the orbit state vector in the orbit frame at ascending node	10^3	m/s	1	1	1	1	integer	11	44	2032
EARTH_SUN_DISTANCE_RATIO	Earth-Sun distance ratio - ratio of current Eart-Sun distance to Mean Earth-Sun distance			1	1	1	1	integer	11	44	2076
LOCATION_TOLERANCE_RADIAL	Nadir Earth location tolerance radial		m	1	1	1	1	integer	11	44	2120
LOCATION_TOLERANCE_CROSSTRACK	Nadir Earth location tolerance cross-track		m	1	1	1	1	integer	11	44	2164
LOCATION_TOLERANCE_ALONGTRACK	Nadir Earth location tolerance along-track		m	1	1	1	1	integer	11	44	2208
YAW_ERROR	Constant Yaw attitude error	10^3	deg	1	1	1	1	integer	11	44	2252
ROLL_ERROR	Constant Roll attitude error	10^3	deg	1	1	1	1	integer	11	44	2296
PITCH_ERROR	Constant Pitch attitude error	10^3	deg	1	1	1	1	integer	11	44	2340
LOCATION SUMMARY											
SUBSAT_LATITUDE_START	Latitude of sub-satellite point at start of the data set	10^3	Deg	1	1	1	1	integer	11	44	2384
SUBSAT_LONGITUDE_START	Longitude of sub-satellite point at start of the data set	10^3	Deg	1	1	1	1	integer	11	44	2428
SUBSAT_LATITUDE_END	Latitude of sub-satellite point at end of the data set	10^3	Deg	1	1	1	1	integer	11	44	2472
SUBSAT_LONGITUDE_END	Longitude of sub-satellite point at end of the data set	10^3	Deg	1	1	1	1	integer	11	44	2516
Leap Second Information											
LEAP_SECOND	Occurence of Leap second within the product. Field is set to -1, 0 or +1 dependent upon occurrence of leap second and direction.			1	1	1	1	integer	2	35	2560
LEAP_SECOND_UTC	UTC time of occurrence of the Leap Second (If no leap second in the product, value is null)			1	1	1	1	time	15	48	2595
Record counts											
TOTAL_RECORDS	Total count of all records in the product			1	1	1	1	uinteger	6	39	2643
TOTAL_MPHR	Total count of all MPHRs in product (should always be 1!)			1	1	1	1	uinteger	6	39	2682
TOTAL_SPHR	Total count of all SPHRs in product (should be 0 or 1 only)			1	1	1	1	uinteger	6	39	2721
TOTAL_IPR	Total count of all IPRs in the product			1	1	1	1	uinteger	6	39	2760
TOTAL_GEADR	Total count of all GEADRs in the product			1	1	1	1	uinteger	6	39	2799

TOTAL_GIADR	Total count of all GIADRs in the product			1	1	1	1	uinteger	6	39	2838
TOTAL_VEADR	Total count of all VEADRs in the product			1	1	1	1	uinteger	6	39	2877
TOTAL_VIADR	Total count of all VIADRs in the product			1	1	1	1	uinteger	6	39	2916
TOTAL_MDR	Total count of all MDRs in the product			1	1	1	1	uinteger	6	39	2955
Record Based Generic Quality Flags											
COUNT_DEGRADED_INST_MDR	Count of MDRs with degradation due to instrument problems			1	1	1	1	uinteger	6	39	2994
COUNT_DEGRADED_PROC_MDR	Count of MDRs with degradation due to processing problems			1	1	1	1	uinteger	6	39	3033
COUNT_DEGRADED_INST_MDR_BLOCKS	Count of the number of blocks of MDRs degraded due to degraded instrument			1	1	1	1	uinteger	6	39	3072
COUNT_DEGRADED_PROC_MDR_BLOCKS	Count of the number of blocks of MDRs degraded due to degraded processing			1	1	1	1	uinteger	6	39	3111
Time Based Generic Quality Flags											
DURATION_OF_PRODUCT	The duration of the product in milliseconds		ms	1	1	1	1	uinteger	8	41	3150
MILLISECONDS_OF_DATA_PRESENT	The total amount of data present in the product		ms	1	1	1	1	uinteger	8	41	3191
MILLISECONDS_OF_DATA_MISSING	The total amount of data missing from the prodcut		ms	1	1	1	1	uinteger	8	41	3232
Regional Product Information											
SUBSETTED_PRODUCT	Set when product has been subsetted (e.g. geographically subsetted using a region of interest filter). Implies the presence of one or more UMARF GIADRs in GAD section for product retrieved from UMARF.			1	1	1	1	boolean	1	34	3273
											Total: 3307

SPHR (name 'sphr', subclass 1, version 2)

class 2

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
Scans_Summary											
N_SCANS	Number of scans in the product			1	1	1	1	uinteger	5	38	20
N_VALID_WITH_MISS_DP	Number of valid scans with missing data packets			1	1	1	1	uinteger	5	38	58
N_MISS_DP	Number of missing data packets in valid scans			1	1	1	1	uinteger	5	38	96
N_MISSING_SCANS	Number of missing scans			1	1	1	1	uinteger	5	38	134
N_NN_DETECTOR_TEMP_1	Number of scans with non-nominal detector temperature, FPA 1			1	1	1	1	uinteger	5	38	172
N_NN_DETECTOR_TEMP_2	Number of scans with non-nominal detector temperature, FPA 2			1	1	1	1	uinteger	5	38	210
N_NN_DETECTOR_TEMP_3	Number of scans with non-nominal detector temperature, FPA 3			1	1	1	1	uinteger	5	38	248
N_NN_DETECTOR_TEMP_4	Number of scans with non-nominal detector temperature, FPA 4			1	1	1	1	uinteger	5	38	286
N_NN_DETECTOR_TEMP_5	Number of scans with non-nominal detector temperature, PMD p			1	1	1	1	uinteger	5	38	324
N_NN_DETECTOR_TEMP_6	Number of scans with non-nominal detector temperature, PMD s			1	1	1	1	uinteger	5	38	362
N_NN_PDP_TEMP	Number of scans with non-nominal pre-disperser temperature			1	1	1	1	uinteger	5	38	400
N_NN_RAD_TEMP	Number of scans with non-nominal radiator temperature			1	1	1	1	uinteger	5	38	438
N_NN_WLS_U	Number of scans with non-nominal WLS lamp voltage			1	1	1	1	uinteger	5	38	476

N_NN_WLS_I	Number of scans with non-nominal WLS lamp current			1	1	1	1	uinteger	5	38	514
N_NN_SLS_U	Number of scans with non-nominal SLS lamp voltage			1	1	1	1	uinteger	5	38	552
N_NN_SLS_I	Number of scans with non-nominal SLS lamp current			1	1	1	1	uinteger	5	38	590
N_INV_UTC	Number of scans with invalid UTC			1	1	1	1	uinteger	5	38	628
N_NADIR_SCAN	Number of scans in Nadir scanning observation mode			1	1	1	1	uinteger	5	38	666
N_NTH_POLE_SCAN	Number of scans in North pole scanning observation mode			1	1	1	1	uinteger	5	38	704
N_STH_POLE_SCAN	Number of scans in South pole scanning observation mode			1	1	1	1	uinteger	5	38	742
N_OTHER_SCAN	Number of scans in Other scanning observation mode			1	1	1	1	uinteger	5	38	780
N_NADIR_STATIC	Number of scans in Nadir static observation mode			1	1	1	1	uinteger	5	38	818
N_OTHER_STATIC	Number of scans in Other Static observation mode			1	1	1	1	uinteger	5	38	856
N_DARK	Number of scans in Dark observation observation mode			1	1	1	1	uinteger	5	38	894
N_LED	Number of scans in LED observation mode			1	1	1	1	uinteger	5	38	932
N_WLS	Number of scans in WLS observation mode			1	1	1	1	uinteger	5	38	970
N_SLS	Number of scans in SLS observation mode			1	1	1	1	uinteger	5	38	1008
N_SLS_DIFF	Number of scans in SLS over diffuser observation mode			1	1	1	1	uinteger	5	38	1046
N_SUN	Number of scans in Sun observation mode			1	1	1	1	uinteger	5	38	1084
N_MOON	Number of scans in Moon observation mode			1	1	1	1	uinteger	5	38	1122
N_IDLE	Number of scans in Idle observation mode			1	1	1	1	uinteger	5	38	1160
N_TEST	Number of scans in Test observation mode			1	1	1	1	uinteger	5	38	1198
N_DUMP	Number of scans in Dump observation mode			1	1	1	1	uinteger	5	38	1236
N_INVALID	Number of scans assigned Invalid observation mode			1	1	1	1	uinteger	5	38	1274
N_MIN_INTENSITY_1	Number of scans where the minimum mean uncalibrated radiance is below a specified threshold, band FPA 1a			1	1	1	1	uinteger	5	38	1312
N_MIN_INTENSITY_2	Number of scans where the minimum mean uncalibrated radiance is below a specified threshold, band FPA 1b			1	1	1	1	uinteger	5	38	1350
N_MIN_INTENSITY_3	Number of scans where the minimum mean uncalibrated radiance is below a specified threshold, band FPA 2a			1	1	1	1	uinteger	5	38	1388
N_MIN_INTENSITY_4	Number of scans where the minimum mean uncalibrated radiance is below a specified threshold, band FPA 2b			1	1	1	1	uinteger	5	38	1426
N_MIN_INTENSITY_5	Number of scans where the minimum mean uncalibrated radiance is below a specified threshold, band FPA 3			1	1	1	1	uinteger	5	38	1464
N_MIN_INTENSITY_6	Number of scans where the minimum mean uncalibrated radiance is below a specified threshold, band FPA 4			1	1	1	1	uinteger	5	38	1502
N_MIN_INTENSITY_7	Number of scans where the minimum mean uncalibrated radiance is below a specified threshold, band PMD p			1	1	1	1	uinteger	5	38	1540
N_MIN_INTENSITY_8	Number of scans where the minimum mean uncalibrated radiance is below a specified threshold, band PMD s			1	1	1	1	uinteger	5	38	1578
N_SATURATED_1	Number of scans with saturated pixels, band FPA 1a			1	1	1	1	uinteger	5	38	1616
N_SATURATED_2	Number of scans with saturated pixels, band FPA 1b			1	1	1	1	uinteger	5	38	1654
N_SATURATED_3	Number of scans with saturated pixels, band FPA 2a			1	1	1	1	uinteger	5	38	1692
N_SATURATED_4	Number of scans with saturated pixels, band FPA 2b			1	1	1	1	uinteger	5	38	1730
N_SATURATED_5	Number of scans with saturated pixels, band FPA 3			1	1	1	1	uinteger	5	38	1768

N_SATURATED_6	Number of scans with saturated pixels, band FPA 4			1	1	1	1	uinteger	5	38	1806
N_SATURATED_7	Number of scans with saturated pixels, band PMD p			1	1	1	1	uinteger	5	38	1844
N_SATURATED_8	Number of scans with saturated pixels, band PMD s			1	1	1	1	uinteger	5	38	1882
N_HOT_1	Number of scans with hot pixels, band FPA 1a			1	1	1	1	uinteger	5	38	1920
N_HOT_2	Number of scans with hot pixels, band FPA 1b			1	1	1	1	uinteger	5	38	1958
N_HOT_3	Number of scans with hot pixels, band FPA 2a			1	1	1	1	uinteger	5	38	1996
N_HOT_4	Number of scans with hot pixels, band FPA 2b			1	1	1	1	uinteger	5	38	2034
N_HOT_5	Number of scans with hot pixels, band FPA 3			1	1	1	1	uinteger	5	38	2072
N_HOT_6	Number of scans with hot pixels, band FPA 4			1	1	1	1	uinteger	5	38	2110
N_HOT_7	Number of scans with hot pixels, band PMD p			1	1	1	1	uinteger	5	38	2148
N_HOT_8	Number of scans with hot pixels, band PMD s			1	1	1	1	uinteger	5	38	2186
N_SAA	Number of scans in the SAA			1	1	1	1	uinteger	5	38	2224
N_SUNGLINT	Number of scans with sunglint danger			1	1	1	1	uinteger	5	38	2262
N_RAINBOW	Number of scans with rainbow danger			1	1	1	1	uinteger	5	38	2300
N_MODE_GEOLOCATION	Number of scans with possible mismatch between observation mode and geolocation			1	1	1	1	uinteger	5	38	2338
N_MISS_STOKES_1	Number of scans with missing Stokes fractions, PMD band 1			1	1	1	1	uinteger	5	38	2376
N_MISS_STOKES_2	Number of scans with missing Stokes fractions, PMD band 2			1	1	1	1	uinteger	5	38	2414
N_MISS_STOKES_3	Number of scans with missing Stokes fractions, PMD band 3			1	1	1	1	uinteger	5	38	2452
N_MISS_STOKES_4	Number of scans with missing Stokes fractions, PMD band 4			1	1	1	1	uinteger	5	38	2490
N_MISS_STOKES_5	Number of scans with missing Stokes fractions, PMD band 5			1	1	1	1	uinteger	5	38	2528
N_MISS_STOKES_6	Number of scans with missing Stokes fractions, PMD band 6			1	1	1	1	uinteger	5	38	2566
N_MISS_STOKES_7	Number of scans with missing Stokes fractions, PMD band 7			1	1	1	1	uinteger	5	38	2604
N_MISS_STOKES_8	Number of scans with missing Stokes fractions, PMD band 8			1	1	1	1	uinteger	5	38	2642
N_MISS_STOKES_9	Number of scans with missing Stokes fractions, PMD band 9			1	1	1	1	uinteger	5	38	2680
N_MISS_STOKES_10	Number of scans with missing Stokes fractions, PMD band 10			1	1	1	1	uinteger	5	38	2718
N_MISS_STOKES_11	Number of scans with missing Stokes fractions, PMD band 11			1	1	1	1	uinteger	5	38	2756
N_MISS_STOKES_12	Number of scans with missing Stokes fractions, PMD band 12			1	1	1	1	uinteger	5	38	2794
N_MISS_STOKES_13	Number of scans with missing Stokes fractions, PMD band 13			1	1	1	1	uinteger	5	38	2832
N_MISS_STOKES_14	Number of scans with missing Stokes fractions, PMD band 14			1	1	1	1	uinteger	5	38	2870
N_MISS_STOKES_15	Number of scans with missing Stokes fractions, PMD band 15			1	1	1	1	uinteger	5	38	2908
N_BAD_STOKES_1	Number of scans with bad Stokes fractions, PMD band 1			1	1	1	1	uinteger	5	38	2946
N_BAD_STOKES_2	Number of scans with bad Stokes fractions, PMD band 2			1	1	1	1	uinteger	5	38	2984
N_BAD_STOKES_3	Number of scans with bad Stokes fractions, PMD band 3			1	1	1	1	uinteger	5	38	3022
N_BAD_STOKES_4	Number of scans with bad Stokes fractions, PMD band 4			1	1	1	1	uinteger	5	38	3060
N_BAD_STOKES_5	Number of scans with bad Stokes fractions, PMD band 5			1	1	1	1	uinteger	5	38	3098
N_BAD_STOKES_6	Number of scans with bad Stokes fractions, PMD band 6			1	1	1	1	uinteger	5	38	3136
N_BAD_STOKES_7	Number of scans with bad Stokes fractions, PMD band 7			1	1	1	1	uinteger	5	38	3174
N_BAD_STOKES_8	Number of scans with bad Stokes fractions, PMD band 8			1	1	1	1	uinteger	5	38	3212

N_BAD_STOKES_9	Number of scans with bad Stokes fractions, PMD band 9			1	1	1	1	uinteger	5	38	3250
N_BAD_STOKES_10	Number of scans with bad Stokes fractions, PMD band 10			1	1	1	1	uinteger	5	38	3288
N_BAD_STOKES_11	Number of scans with bad Stokes fractions, PMD band 11			1	1	1	1	uinteger	5	38	3326
N_BAD_STOKES_12	Number of scans with bad Stokes fractions, PMD band 12			1	1	1	1	uinteger	5	38	3364
N_BAD_STOKES_13	Number of scans with bad Stokes fractions, PMD band 13			1	1	1	1	uinteger	5	38	3402
N_BAD_STOKES_14	Number of scans with bad Stokes fractions, PMD band 14			1	1	1	1	uinteger	5	38	3440
N_BAD_STOKES_15	Number of scans with bad Stokes fractions, PMD band 15			1	1	1	1	uinteger	5	38	3478
N_CLOUD	Number of scans with fractional cloud above a specified threshold			1	1	1	1	uinteger	5	38	3516
Processing_information											
PROCESSING_INDICATOR	Auxiliary information on processing details. May be filled as needed (no requirements imposed). If not used, this field is filled by lower case x's.			1	1	1	1	string	67	100	3554
											Total: 3654

GEADR (name 'geadr-elevation', subclass 3, version 1)

class 3

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
Identifier	Unique pointer to auxiliary dataset			1	1	1	1	POINTER	100	100	120
											Total: 120

GEADR (name 'geadr-configuration', subclass 6, version 1)

class 3

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
Identifier	Unique pointer to auxiliary dataset			1	1	1	1	POINTER	100	100	120
											Total: 120

GEADR (name 'geadr-intialisation', subclass 7, version 1)

class 3

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
Identifier	Unique pointer to auxiliary dataset			1	1	1	1	POINTER	100	100	120
											Total: 120

GEADR (name 'geadr-keydata', subclass 8, version 1)

class 3

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
Identifier	Unique pointer to auxiliary dataset			1	1	1	1	POINTER	100	100	120
											Total: 120

GEADR (name 'geadr-1b-transmittance', subclass 9, version 1)

class 3

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
Identifier	Unique pointer to auxiliary dataset			1	1	1	1	POINTER	100	100	120
											Total: 120

GEADR (name 'geadr-1b-reflectance', subclass 10, version 1)

class 3

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
Identifier	Unique pointer to auxiliary dataset			1	1	1	1	POINTER	100	100	120
											Total: 120

GEADR (name 'geadr-1b-tomsuv-reflectance', subclass 11, version 1)

class 3

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
Identifier	Unique pointer to auxiliary dataset			1	1	1	1	POINTER	100	100	120
											Total: 120

GIADR (name 'giadr-channels', subclass 4, version 2)

class 5

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
Band_Separation_Information											
CHANNEL_NUMBER	Channel number			6	1	1	1	enumerated	1	6	20
START_VALID_WAVELENGTHS	Start wavelength of the valid data in the specified channel	10^6	nm	6	1	1	1	integer4	4	24	26
END_VALID_WAVELENGTHS	End wavelength of the valid data in the specified channel	10^6	nm	6	1	1	1	integer4	4	24	50
START_VALID_PIXELS	Approximate start pixel of the valid data in the specified channel			6	1	1	1	uinteger2	2	12	74
END_VALID_PIXELS	Approximate end pixel of the valid data in the specified channel			6	1	1	1	uinteger2	2	12	86
											Total: 98

GIADR (name 'giadr-1b-bands', subclass 5, version 2)

class 5

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
Band_Separation_Information											
CHANNEL_NUMBER	Channel number			10	1	1	1	enumerated	1	10	20
BAND_NUMBER	Band number			10	1	1	1	enumerated	1	10	30
START_PIXEL	Start pixel of the band in the specified channel			10	1	1	1	uinteger2	2	20	40
NUMBER_OF_PIXELS	Number of pixels in the specified band			10	1	1	1	uinteger2	2	20	60
START_LAMBDA	Start wavelength	10^6	nm	10	1	1	1	integer4	4	40	80
END_LAMBDA	End wavelength	10^6	nm	10	1	1	1	integer4	4	40	120
											Total: 160

GIADR (name 'giadr-1b-steps', subclass 6, version 1)

class 5

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
Applicable_Calibration_Steps_Information											
APPLIED_CAL_STEPS	Calibration steps applied in level 0 to 1b processing for every observation mode - first dimension mode, second dimension calibration steps			20	30	1	1	boolean	1	600	20
											Total: 620

VIADR (name 'viadr-smr', subclass 5, version 1)

class 7

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0

Solar_Mean_Reference_Spectrum_Parameters											
START_UTC_SUN	Start UTC date/time of Sun calibration mode measurements			1	1	1	1	time	6	6	20
END_UTC_SUN	End UTC date/time of Sun calibration mode measurements			1	1	1	1	time	6	6	26
PCD_SMR											
N_INTENSITY	Number of Sun calibration mode spectra which pass the intensity check			1	1	1	1	uinteger2	2	2	32
F_N_INTENSITY	Flag indicating that number of sun calibration mode spectra passing the intensity check was too low			1	1	1	1	boolean	1	1	34
F_SMR_MISS	Flag indicating that no SMR was generated due to missing Sun calibration mode measurements, per channel			6	1	1	1	boolean	1	6	35
End: PCD_SMR											
PMD_TRANSFER	PMD transfer mode			1	1	1	1	enumerated	1	1	41
PMD_READOUT	PMD readout mode			1	1	1	1	enumerated	1	1	42
LAMBDA_SMR	Wavelength grid for SMR spectrum (after Doppler correction)	10^6	nm	1024	6	1	1	integer4	4	24576	43
SMR	Solar Mean Reference spectrum		photons/(s.cm^2.nm)	1024	6	1	1	vinteger4	5	30720	24619
E_SMR	Absolute error on Solar Mean Reference spectrum		photons/(s.cm^2.nm)	1024	6	1	1	vinteger4	5	30720	55339
E_REL_SUN	Relative error in the mean of the Nsun spectra having passed the intensity check before correction for the irradiance response of the instrument			1024	6	1	1	vinteger4	5	30720	86059
											Total: 116779

MDR (name 'mdr-1b-earthshine', subclass 6, version 3)

class 8

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
GENERIC_QUALITY_INDICATORS											
DEGRADED_INST_MDR	Quality of MDR has been degraded from nominal due to an instrument degradation. Occurs if any of F_NN_DT, F_NN_PDP, F_NN_RAD, F_NN_WLS_U, F_NN_WLS_I, F_NN_SLS_U, F_NN_SLS_I, F_SAT, F_HOT, F_MIN in PCD_BASIC have been raised			1	1	1	1	boolean	1	1	20
DEGRADED_PROC_MDR	Quality of MDR has been degraded from nominal due to a processing degradation. Occurs if any of F_MISS, F_SAA, F_SUNGLINT, F_RAINBOW, F_OLD_CAL_DATA in PCD_BASIC, or F_INV_STOKES in PCD_EARTH have been raised			1	1	1	1	boolean	1	1	21
Earthshine_measurements_1b											
OUTPUT_SELECTION	Calibrated radiance or sun-normalised radiance			1	1	1	1	enumerated	1	1	22
PCD_BASIC											
F_NN_DT	Flag indicating non-nominal detector temperature, per channel			6	1	1	1	boolean	1	6	23
F_NN_PDP	Flag indicating non-nominal pre-disperser temperature			1	1	1	1	boolean	1	1	29
F_NN_RAD	Flag indicating non-nominal radiator temperature			1	1	1	1	boolean	1	1	30
F_NN_WLS_U	Flag indicating non-nominal WLS voltage			1	1	1	1	boolean	1	1	31
F_NN_WLS_I	Flag indicating non-nominal WLS current			1	1	1	1	boolean	1	1	32
F_NN_SLS_U	Flag indicating non-nominal SLS voltage			1	1	1	1	boolean	1	1	33

F_NN_SLS_I	Flag indicating non-nominal SLS current			1	1	1	1	boolean	1	1	34
F_INV_UTC	Flag indicating invalid UTC			1	1	1	1	boolean	1	1	35
F_MISS	Flag indicating missing data packets			1	1	1	1	boolean	1	1	36
F_SAT	Flag indicating saturated pixels, per band			10	1	1	1	boolean	1	10	37
F_HOT	Flag indicating hot pixels, per band			10	1	1	1	boolean	1	10	47
F_SAA	Flag indicating whether scan is in the SAA			1	1	1	1	boolean	1	1	57
F_SUNGLINT	Flag indicating danger of sun-glint			1	1	1	1	enumerated	1	1	58
F_RAINBOW	Flag indicating danger of rainbow			1	1	1	1	boolean	1	1	59
F_MODE_GEOLOCATION	Flag indicating possible mismatch between observation mode and geolocation			1	1	1	1	boolean	1	1	60
F_MIN	Flag indicating that mean raw signal is below a specified threshold, per band			10	1	1	1	boolean	1	10	61
MEAN_UC	Mean raw signal per band	10^3	BU	10	1	1	1	integer4	4	40	71
F_OLD_CAL_DATA	Flag to indicate that old in-flight auxiliary calibration data is in use			1	1	1	1	enumerated	1	1	111
End: PCD_BASIC											
PCD_EARTH											
F_MISS_STOKES	Flag indicating missing (formerly called 'invalid') Stokes fractions, per PMD band			15	1	1	1	boolean	1	15	112
F_BAD_STOKES	Flag indicating bad Stokes fractions, per PMD band, and main channel readout			15	32	1	1	boolean	1	480	127
SIGMA_SCENE	Scene variability within a 187.5 ms groundpixel	10^6		32	1	1	1	integer4	4	128	607
End: PCD_EARTH											
PCD_EARTH_1B											
F_CLOUD	Flag indicating that effective cloud fraction is above a specified level			1	1	1	1	boolean	1	1	735
End: PCD_EARTH_1B											
CLOUD											
FIT_MODE	Cloud fitting mode (default or snow/ice)			32	1	1	1	enumerated	1	32	736
FAIL_FLAG	Fail flag			32	1	1	1	enumerated	1	32	768
FIT_1	Cloud fitting parameter 1 - depending on FIT_MODE this is either cloud top pressure or lower reflecting surface pressure	10^3	hPa	32	1	1	1	integer4	4	128	800
FIT_2	Cloud fitting parameter 2 - depending on FIT_MODE this is either effective cloud fraction or albedo for lower reflecting surface	10^6		32	1	1	1	integer4	4	128	928
E_FIT_1	Error in Cloud fitting parameter 1	10^6	hPa	32	1	1	1	uinteger2	2	64	1056
E_FIT_2	Error in Cloud fitting parameter 2	10^9		32	1	1	1	uinteger2	2	64	1120
GOOD_FIT	Goodness of fit	10^6		32	1	1	1	uinteger2	2	64	1184
FINAL_CHI_SQUARE	Final Chi-Square perturbation	10^6		32	1	1	1	uinteger2	2	64	1248
CLOUD_ALBEDO	Cloud albedo. This is always greater than or equal to the a priori cloud albedo	10^6		32	1	1	1	integer4	4	128	1312
SURFACE_ALBEDO	Surface albedo used in the retrieval (at 2 wavelengths)	10^6		32	2	1	1	integer4	4	256	1440
SURFACE_PRESSURE	Surface pressure	10^3	hPa	32	1	1	1	integer4	4	128	1696
End: CLOUD											
OBSERVATION_MODE	Observation mode			1	1	1	1	enumerated	1	1	1824
PMD_TRANSFER	PMD transfer mode			1	1	1	1	enumerated	1	1	1825
PMD_READOUT	PMD readout mode			1	1	1	1	enumerated	1	1	1826
SCANNER_ANGLE	Scanner viewing angle with additional element at end of scan	10^6	deg	65	1	1	1	integer4	4	260	1827
GEO_BASIC											
UTC_TIME	UTC time associated with every second scanner position (0,2,...,62)			32	1	1	1	time	6	192	2087
SUB_SATELLITE_POINT				32	1	1	1	COORD	8	256	2279

LATITUDE	Geodetic latitude (-90 to 90, -90 is the south pole, 90 the north pole, 0 the equator) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	
LONGITUDE	Geocentric longitude (-180 to 180, meridian is 0 and minus is going west) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	
SATELLITE_ALTITUDE	Geodetic altitude of satellite (earth-fixed CS)	10^3	m	32	1	1	1	integer4	4	128	2535
SOLAR_ZENITH_ANGLE	Solar zenith angle (Satellite Relative Actual CS)	10^6	deg	32	1	1	1	integer4	4	128	2663
SOLAR_AZIMUTH_ANGLE	Solar azimuth angle (Satellite Relative Actual CS)	10^6	deg	32	1	1	1	integer4	4	128	2791
End: GEO_BASIC											
GEO_EARTH											
SCAN_CORNER				4	1	1	1	COORD	8	32	2919
LATITUDE	Geodetic latitude (-90 to 90, -90 is the south pole, 90 the north pole, 0 the equator) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	
LONGITUDE	Geocentric longitude (-180 to 180, meridian is 0 and minus is going west) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	
SCAN_CENTRE											
LATITUDE	Geodetic latitude (-90 to 90, -90 is the south pole, 90 the north pole, 0 the equator) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	2951
LONGITUDE	Geocentric longitude (-180 to 180, meridian is 0 and minus is going west) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	2955
End: SCAN_CENTRE											
CORNER				32	4	1	1	COORD	8	1024	2959
LATITUDE	Geodetic latitude (-90 to 90, -90 is the south pole, 90 the north pole, 0 the equator) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	
LONGITUDE	Geocentric longitude (-180 to 180, meridian is 0 and minus is going west) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	
CENTRE				32	1	1	1	COORD	8	256	3983
LATITUDE	Geodetic latitude (-90 to 90, -90 is the south pole, 90 the north pole, 0 the equator) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	
LONGITUDE	Geocentric longitude (-180 to 180, meridian is 0 and minus is going west) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	
SOLAR_ZENITH	Solar zenith angle at height h0 (specified as initialisation parameter), points EFG (topocentric CS)	10^6	deg	32	3	1	1	integer4	4	384	4239
SOLAR_AZIMUTH	Solar azimuth angle at height h0, points EFG (topocentric CS)	10^6	deg	32	3	1	1	integer4	4	384	4623
SAT_ZENITH	Satellite zenith angle at height h0, points EFG (topocentric CS)	10^6	deg	32	3	1	1	integer4	4	384	5007
SAT_AZIMUTH	Satellite azimuth angle at height h0, points EFG (topocentric CS)	10^6	deg	32	3	1	1	integer4	4	384	5391
SCAT_ANGLE	Scattering angle at height h0, point F(topocentric CS)	10^6	deg	32	1	1	1	integer4	4	128	5775
SURFACE_ELEVATION	Land/sea floor elevation (above sea level), point F	10^3	m	32	1	1	1	integer4	4	128	5903
EARTH_RADIUS	Radius of the earth		m	1	1	1	1	integer4	4	4	6031
End: GEO_EARTH											
GEO_EARTH_ACTUAL											
N_UNIQUE_INT	Number of unique integration times in scan			1	1	1	1	uinteger1	1	1	6035
UNIQUE_INT	Unique integration times in scan	10^6	s	6	1	1	1	integer4	4	24	6036
INT_INDEX	Index to unique integration times for each main channel band			6	1	1	1	uinteger1	1	6	6060
SCANNER_ANGLE_ACTUAL	Scanner viewing angle corresponding to actual integration time	10^6	deg	32	6	1	1	integer4	4	768	6066
CORNER_ACTUAL				32	4	6	1	COORD	8	6144	6834

LATITUDE	Geodetic latitude (-90 to 90, -90 is the south pole, 90 the north pole, 0 the equator) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	
LONGITUDE	Geocentric longitude (-180 to 180, meridian is 0 and minus is going west) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	
CENTRE_ACTUAL				32	6	1	1	COORD	8	1536	12978
LATITUDE	Geodetic latitude (-90 to 90, -90 is the south pole, 90 the north pole, 0 the equator) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	
LONGITUDE	Geocentric longitude (-180 to 180, meridian is 0 and minus is going west) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	
SOLAR_ZENITH_ACTUAL	Solar zenith angle corresponding to actual integration time at height h0, points EFG (topocentric CS)	10^6	deg	32	3	6	1	integer4	4	2304	14514
SOLAR_AZIMUTH_ACTUAL	Solar azimuth angle corresponding to actual integration time at height h0, points EFG (topocentric CS)	10^6	deg	32	3	6	1	integer4	4	2304	16818
SAT_ZENITH_ACTUAL	Satellite zenith angle corresponding to actual integration time at height h0, points EFG (topocentric CS)	10^6	deg	32	3	6	1	integer4	4	2304	19122
SAT_AZIMUTH_ACTUAL	Satellite azimuth angle corresponding to actual integration time at height h0, points EFG (topocentric CS)	10^6	deg	32	3	6	1	integer4	4	2304	21426
End: GEO_EARTH_ACTUAL											
PDP_TEMP	Temperature of the pre-disperser prism for reference to the corresponding spectral calibration parameters	10^3	K	1	1	1	1	integer4	4	4	23730
FPA_TEMP	FPA temperature, per channel	10^3	K	6	1	1	1	integer4	4	24	23734
RAD_TEMP	Radiator temperature	10^3	K	1	1	1	1	integer4	4	4	23758
INTEGRATION_TIMES	Integration times per band	10^6	s	10	1	1	1	integer4	4	40	23762
POL_SS				32	1	1	1	POLSS	20	640	23802
WL_POL_SS	Wavelength assigned to the single scattering Stokes fractions	10^6	nm	1	1	1	1	integer4	4	4	
P_POL_SS	Degree of polarisation P (single scattering)	10^6		1	1	1	1	integer4	4	4	
CHI_POL_SS	Polarisation angle (single scattering)	10^6	deg	1	1	1	1	integer4	4	4	
Q_POL_SS	Stokes fraction q (theoretical value for single scattering)	10^6		1	1	1	1	integer4	4	4	
U_POL_SS	Stokes fraction u (theoretical value for single scattering)	10^6		1	1	1	1	integer4	4	4	
POL_M				4	32	1	1	POLV	150	19200	24442
Q_POL	Stokes fractions q (15 values from the PMD bands)	10^6		15	1	1	1	integer4	4	60	
Q_POL_ERR	Errors on the Stokes fractions q	10^6		15	1	1	1	uinteger2	2	30	
WL_POL	Wavelengths assigned to the Stokes fractions q	10^6	nm	15	1	1	1	integer4	4	60	
POL_M_P				256	1	1	1	POLV	150	38400	43642
Q_POL	Stokes fractions q (15 values from the PMD bands)	10^6		15	1	1	1	integer4	4	60	
Q_POL_ERR	Errors on the Stokes fractions q	10^6		15	1	1	1	uinteger2	2	30	
WL_POL	Wavelengths assigned to the Stokes fractions q	10^6	nm	15	1	1	1	integer4	4	60	
POL_M_SW	Fractional polarisation value for the short-wave PMD region (currently not used, set to zero)	10^6		1	1	1	1	integer4	4	4	82042
REC_LENGTH_MDR-1b-Earthshine											
n1	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	82046
n2	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	82048
n3	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	82050

n4	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	82052
n5	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	82054
n6	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	82056
n7	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	82058
n8	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	82060
n9	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	82062
n10	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	82064
End: REC_LENGTH_MDR-1b-Earthshine											
NUM_RECS_MDR-1b-Earthshine											
m1	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	82066
m2	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	82068
m3	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	82070
m4	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	82072
m5	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	82074
m6	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	82076
m7	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	82078
m8	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	82080
m9	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	82082
m10	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	82084
End: NUM_RECS_MDR-1b-Earthshine											
WAVELENGTH_1A	Wavelength for Band 1a	10^6	nm	n1	1	1	1	integer4	4	3524	82086
WAVELENGTH_1B	Wavelength for Band 1b	10^6	nm	n2	1	1	1	integer4	4	572	85610
WAVELENGTH_2A	Wavelength for Band 2a	10^6	nm	n3	1	1	1	integer4	4	768	86182
WAVELENGTH_2B	Wavelength for Band 2b	10^6	nm	n4	1	1	1	integer4	4	3328	86950
WAVELENGTH_3	Wavelength for Band 3	10^6	nm	n5	1	1	1	integer4	4	4096	90278
WAVELENGTH_4	Wavelength for Band 4	10^6	nm	n6	1	1	1	integer4	4	4096	94374
WAVELENGTH_PP	Wavelength for PMD p	10^6	nm	n7	1	1	1	integer4	4	60	98470
WAVELENGTH_PS	Wavelength for PMD s	10^6	nm	n8	1	1	1	integer4	4	60	98530
WAVELENGTH_SWPP	Wavelength for short wavelength range (block B) PMD p	10^6	nm	n9	1	1	1	integer4	4	140	98590
WAVELENGTH_SWPS	Wavelength for short wavelength range (block B) PMD s	10^6	nm	n10	1	1	1	integer4	4	140	98730
BAND_1A				n1	m1	1	1	BAND_M	12	10572	98870
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	
STOKES_FRACTION	Stokes fraction	10^6		1	1	1	1	integer4	4	4	
BAND_1B				n2	m2	1	1	BAND_M	12	54912	109442
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	

STOKES_FRACTION	Stokes fraction	10^6		1	1	1	1	integer4	4	4	
BAND_2A				n3	m3	1	1	BAND_M	12	73728	164354
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	
STOKES_FRACTION	Stokes fraction	10^6		1	1	1	1	integer4	4	4	
BAND_2B				n4	m4	1	1	BAND_M	12	319488	238082
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	
STOKES_FRACTION	Stokes fraction	10^6		1	1	1	1	integer4	4	4	
BAND_3				n5	m5	1	1	BAND_M	12	393216	557570
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	
STOKES_FRACTION	Stokes fraction	10^6		1	1	1	1	integer4	4	4	
BAND_4				n6	m6	1	1	BAND_M	12	393216	950786
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	
STOKES_FRACTION	Stokes fraction	10^6		1	1	1	1	integer4	4	4	
BAND_PP				n7	m7	1	1	BAND_P	8	30720	1344002
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	
BAND_PS				n8	m8	1	1	BAND_P	8	30720	1374722
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	
BAND_SWPP				n9	m9	1	1	BAND_P	8	280	1405442
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	
BAND_SWPS				n10	m10	1	1	BAND_P	8	280	1405722
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	
											Total: 1406002

MDR (name 'mdr-1b-calibration', subclass 7, version 3)

class 8

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
GENERIC_QUALITY_INDICATORS											
DEGRADED_INST_MDR	Quality of MDR has been degraded from nominal due to an instrument degradation. Occurs if any of F_NN_DT, F_NN_PDP, F_NN_RAD, F_NN_WLS_U, F_NN_WLS_I, F_NN_SLS_U, F_NN_SLS_I, F_SAT, F_HOT, F_MIN in PCD_BASIC have been raised			1	1	1	1	boolean	1	1	20
DEGRADED_PROC_MDR	Quality of MDR has been degraded from nominal due to a processing degradation. Occurs if any of F_MISS, F_SAA, F_SUNGLINT, F_RAINBOW, F_OLD_CAL_DATA in PCD_BASIC have been raised			1	1	1	1	boolean	1	1	21
Calibration_measurements_1b											
PCD_BASIC											
F_NN_DT	Flag indicating non-nominal detector temperature, per channel			6	1	1	1	boolean	1	6	22
F_NN_PDP	Flag indicating non-nominal pre-disperser temperature			1	1	1	1	boolean	1	1	28
F_NN_RAD	Flag indicating non-nominal radiator temperature			1	1	1	1	boolean	1	1	29

F_NN_WLS_U	Flag indicating non-nominal WLS voltage			1	1	1	1	boolean	1	1	30
F_NN_WLS_I	Flag indicating non-nominal WLS current			1	1	1	1	boolean	1	1	31
F_NN_SLS_U	Flag indicating non-nominal SLS voltage			1	1	1	1	boolean	1	1	32
F_NN_SLS_I	Flag indicating non-nominal SLS current			1	1	1	1	boolean	1	1	33
F_INV_UTC	Flag indicating invalid UTC			1	1	1	1	boolean	1	1	34
F_MISS	Flag indicating missing data packets			1	1	1	1	boolean	1	1	35
F_SAT	Flag indicating saturated pixels, per band			10	1	1	1	boolean	1	10	36
F_HOT	Flag indicating hot pixels, per band			10	1	1	1	boolean	1	10	46
F_SAA	Flag indicating whether scan is in the SAA			1	1	1	1	boolean	1	1	56
F_SUNGLINT	Flag indicating danger of sun-glint			1	1	1	1	enumerated	1	1	57
F_RAINBOW	Flag indicating danger of rainbow			1	1	1	1	boolean	1	1	58
F_MODE_GEOLOCATION	Flag indicating possible mismatch between observation mode and geolocation			1	1	1	1	boolean	1	1	59
F_MIN	Flag indicating that mean raw signal is below a specified threshold, per band			10	1	1	1	boolean	1	10	60
MEAN_UC	Mean raw signal per band	10^3	BU	10	1	1	1	integer4	4	40	70
F_OLD_CAL_DATA	Flag to indicate that old in-flight auxiliary calibration data is in use			1	1	1	1	enumerated	1	1	110
End: PCD_BASIC											
OBSERVATION_MODE	Observation mode			1	1	1	1	enumerated	1	1	111
PMD_TRANSFER	PMD transfer mode			1	1	1	1	enumerated	1	1	112
PMD_READOUT	PMD readout mode			1	1	1	1	enumerated	1	1	113
SCANNER_ANGLE	Scanner viewing angle with additional element at end of scan	10^6	deg	65	1	1	1	integer4	4	260	114
GEO_BASIC											
UTC_TIME	UTC time associated with every second scanner position (0,2,...,62)			32	1	1	1	time	6	192	374
SUB_SATELLITE_POINT				32	1	1	1	COORD	8	256	566
LATITUDE	Geodetic latitude (-90 to 90, -90 is the south pole, 90 the north pole, 0 the equator) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	
LONGITUDE	Geocentric longitude (-180 to 180, meridian is 0 and minus is going west) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	
SATELLITE_ALTITUDE	Geodetic altitude of satellite (earth-fixed CS)	10^3	m	32	1	1	1	integer4	4	128	822
SOLAR_ZENITH_ANGLE	Solar zenith angle (Satellite Relative Actual CS)	10^6	deg	32	1	1	1	integer4	4	128	950
SOLAR_AZIMUTH_ANGLE	Solar azimuth angle (Satellite Relative Actual CS)	10^6	deg	32	1	1	1	integer4	4	128	1078
End: GEO_BASIC											
PDP_TEMP	Temperature of the pre-disperser prism for reference to the corresponding spectral calibration parameters	10^3	K	1	1	1	1	integer4	4	4	1206
FPA_TEMP	FPA temperature, per channel	10^3	K	6	1	1	1	integer4	4	24	1210
RAD_TEMP	Radiator temperature	10^3	K	1	1	1	1	integer4	4	4	1234
INTEGRATION_TIMES	Integration times per band	10^6	s	10	1	1	1	integer4	4	40	1238
REC_LENGTH_MDR-1b-Calibration											
n1	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	1278
n2	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	1280
n3	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	1282
n4	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	1284
n5	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	1286

n6	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	1288
n7	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	1290
n8	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	1292
n9	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	1294
n10	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	1296
End: REC_LENGTH_MDR-1b-Calibration											
NUM_RECS_MDR-1b-Calibration											
m1	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	1298
m2	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	1300
m3	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	1302
m4	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	1304
m5	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	1306
m6	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	1308
m7	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	1310
m8	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	1312
m9	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	1314
m10	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	1316
End: NUM_RECS_MDR-1b-Calibration											
WAVELENGTH_1A	Wavelength for Band 1a	10^6	nm	n1	1	1	1	integer4	4	3524	1318
WAVELENGTH_1B	Wavelength for Band 1b	10^6	nm	n2	1	1	1	integer4	4	572	4842
WAVELENGTH_2A	Wavelength for Band 2a	10^6	nm	n3	1	1	1	integer4	4	768	5414
WAVELENGTH_2B	Wavelength for Band 2b	10^6	nm	n4	1	1	1	integer4	4	3328	6182
WAVELENGTH_3	Wavelength for Band 3	10^6	nm	n5	1	1	1	integer4	4	4096	9510
WAVELENGTH_4	Wavelength for Band 4	10^6	nm	n6	1	1	1	integer4	4	4096	13606
WAVELENGTH_PP	Wavelength for PMD p	10^6	nm	n7	1	1	1	integer4	4	60	17702
WAVELENGTH_PS	Wavelength for PMD s	10^6	nm	n8	1	1	1	integer4	4	60	17762
WAVELENGTH_SWPP	Wavelength for short wavelength range (block B) PMD p	10^6	nm	n9	1	1	1	integer4	4	140	17822
WAVELENGTH_SWPS	Wavelength for short wavelength range (block B) PMD s	10^6	nm	n10	1	1	1	integer4	4	140	17962
BAND_1A				n1	m1	1	1	BAND_M	12	10572	18102
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	
STOKES_FRACTION	Stokes fraction	10^6		1	1	1	1	integer4	4	4	
BAND_1B				n2	m2	1	1	BAND_M	12	54912	28674
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	
STOKES_FRACTION	Stokes fraction	10^6		1	1	1	1	integer4	4	4	
BAND_2A				n3	m3	1	1	BAND_M	12	73728	83586
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	

STOKES_FRACTION	Stokes fraction	10^6		1	1	1	1	integer4	4	4	
BAND_2B				n4	m4	1	1	BAND_M	12	319488	157314
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	
STOKES_FRACTION	Stokes fraction	10^6		1	1	1	1	integer4	4	4	
BAND_3				n5	m5	1	1	BAND_M	12	393216	476802
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	
STOKES_FRACTION	Stokes fraction	10^6		1	1	1	1	integer4	4	4	
BAND_4				n6	m6	1	1	BAND_M	12	393216	870018
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	
STOKES_FRACTION	Stokes fraction	10^6		1	1	1	1	integer4	4	4	
BAND_PP				n7	m7	1	1	BAND_P	8	30720	1263234
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	
BAND_PS				n8	m8	1	1	BAND_P	8	30720	1293954
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	
BAND_SWPP				n9	m9	1	1	BAND_P	8	280	1324674
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	
BAND_SWPS				n10	m10	1	1	BAND_P	8	280	1324954
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	
											Total: 1325234

MDR (name 'mdr-1b-sun', subclass 8, version 3)

class 8

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
GENERIC_QUALITY_INDICATORS											
DEGRADED_INST_MDR	Quality of MDR has been degraded from nominal due to an instrument degradation. Occurs if any of F_NN_DT, F_NN_PDP, F_NN_RAD, F_NN_WLS_U, F_NN_WLS_I, F_NN_SLS_U, F_NN_SLS_I, F_SAT, F_HOT, F_MIN in PCD_BASIC have been raised			1	1	1	1	boolean	1	1	20
DEGRADED_PROC_MDR	Quality of MDR has been degraded from nominal due to a processing degradation. Occurs if any of F_MISS, F_SAA, F_SUNGLINT, F_RAINBOW, F_OLD_CAL_DATA in PCD_BASIC have been raised			1	1	1	1	boolean	1	1	21
Sun_measurements_1b											
PCD_BASIC											
F_NN_DT	Flag indicating non-nominal detector temperature, per channel			6	1	1	1	boolean	1	6	22
F_NN_PDP	Flag indicating non-nominal pre-disperser temperature			1	1	1	1	boolean	1	1	28
F_NN_RAD	Flag indicating non-nominal radiator temperature			1	1	1	1	boolean	1	1	29
F_NN_WLS_U	Flag indicating non-nominal WLS voltage			1	1	1	1	boolean	1	1	30
F_NN_WLS_I	Flag indicating non-nominal WLS current			1	1	1	1	boolean	1	1	31
F_NN_SLS_U	Flag indicating non-nominal SLS voltage			1	1	1	1	boolean	1	1	32

F_NN_SLS_I	Flag indicating non-nominal SLS current			1	1	1	1	boolean	1	1	33
F_INV_UTC	Flag indicating invalid UTC			1	1	1	1	boolean	1	1	34
F_MISS	Flag indicating missing data packets			1	1	1	1	boolean	1	1	35
F_SAT	Flag indicating saturated pixels, per band			10	1	1	1	boolean	1	10	36
F_HOT	Flag indicating hot pixels, per band			10	1	1	1	boolean	1	10	46
F_SAA	Flag indicating whether scan is in the SAA			1	1	1	1	boolean	1	1	56
F_SUNGLINT	Flag indicating danger of sun-glint			1	1	1	1	enumerated	1	1	57
F_RAINBOW	Flag indicating danger of rainbow			1	1	1	1	boolean	1	1	58
F_MODE_GEOLOCATION	Flag indicating possible mismatch between observation mode and geolocation			1	1	1	1	boolean	1	1	59
F_MIN	Flag indicating that mean raw signal is below a specified threshold, per band			10	1	1	1	boolean	1	10	60
MEAN_UC	Mean raw signal per band	10^3	BU	10	1	1	1	integer4	4	40	70
F_OLD_CAL_DATA	Flag to indicate that old in-flight auxiliary calibration data is in use			1	1	1	1	enumerated	1	1	110
End: PCD_BASIC											
OBSERVATION_MODE	Observation mode			1	1	1	1	enumerated	1	1	111
PMD_TRANSFER	PMD transfer mode			1	1	1	1	enumerated	1	1	112
PMD_READOUT	PMD readout mode			1	1	1	1	enumerated	1	1	113
SCANNER_ANGLE	Scanner viewing angle with additional element at end of scan	10^6	deg	65	1	1	1	integer4	4	260	114
GEO_BASIC											
UTC_TIME	UTC time associated with every second scanner position (0,2,...,62)			32	1	1	1	time	6	192	374
SUB_SATELLITE_POINT				32	1	1	1	COORD	8	256	566
LATITUDE	Geodetic latitude (-90 to 90, -90 is the south pole, 90 the north pole, 0 the equator) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	
LONGITUDE	Geocentric longitude (-180 to 180, meridian is 0 and minus is going west) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	
SATELLITE_ALTITUDE	Geodetic altitude of satellite (earth-fixed CS)	10^3	m	32	1	1	1	integer4	4	128	822
SOLAR_ZENITH_ANGLE	Solar zenith angle (Satellite Relative Actual CS)	10^6	deg	32	1	1	1	integer4	4	128	950
SOLAR_AZIMUTH_ANGLE	Solar azimuth angle (Satellite Relative Actual CS)	10^6	deg	32	1	1	1	integer4	4	128	1078
End: GEO_BASIC											
GEO_SUN											
DISTANCE_SAT_SUN	Satellite-Sun distance	10^-3	m	1	1	1	1	integer4	4	4	1206
VEL_SAT_SUN	Relative speed of satellite and sun (negative if satellite is moving towards the sun)	10^3	m/s	1	1	1	1	integer4	4	4	1210
End: GEO_SUN											
PDP_TEMP	Temperature of the pre-disperser prism for reference to the corresponding spectral calibration parameters	10^3	K	1	1	1	1	integer4	4	4	1214
FPA_TEMP	FPA temperature, per channel	10^3	K	6	1	1	1	integer4	4	24	1218
RAD_TEMP	Radiator temperature	10^3	K	1	1	1	1	integer4	4	4	1242
INTEGRATION_TIMES	Integration times per band	10^6	s	10	1	1	1	integer4	4	40	1246
REC_LENGTH_MDR-1b-Sun											
n1	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	1286
n2	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	1288
n3	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	1290
n4	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	1292

n5	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	1294
n6	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	1296
n7	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	1298
n8	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	1300
n9	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	1302
n10	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	1304
End: REC_LENGTH_MDR-1b-Sun											
NUM_RECS_MDR-1b-Sun											
m1	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	1306
m2	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	1308
m3	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	1310
m4	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	1312
m5	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	1314
m6	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	1316
m7	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	1318
m8	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	1320
m9	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	1322
m10	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	1324
End: NUM_RECS_MDR-1b-Sun											
WAVELENGTH_1A	Wavelength for Band 1a	10^6	nm	n1	1	1	1	integer4	4	3524	1326
WAVELENGTH_1B	Wavelength for Band 1b	10^6	nm	n2	1	1	1	integer4	4	572	4850
WAVELENGTH_2A	Wavelength for Band 2a	10^6	nm	n3	1	1	1	integer4	4	768	5422
WAVELENGTH_2B	Wavelength for Band 2b	10^6	nm	n4	1	1	1	integer4	4	3328	6190
WAVELENGTH_3	Wavelength for Band 3	10^6	nm	n5	1	1	1	integer4	4	4096	9518
WAVELENGTH_4	Wavelength for Band 4	10^6	nm	n6	1	1	1	integer4	4	4096	13614
WAVELENGTH_PP	Wavelength for PMD p	10^6	nm	n7	1	1	1	integer4	4	60	17710
WAVELENGTH_PS	Wavelength for PMD s	10^6	nm	n8	1	1	1	integer4	4	60	17770
WAVELENGTH_SWPP	Wavelength for short wavelength range (block B) PMD p	10^6	nm	n9	1	1	1	integer4	4	140	17830
WAVELENGTH_SWPS	Wavelength for short wavelength range (block B) PMD s	10^6	nm	n10	1	1	1	integer4	4	140	17970
BAND_1A				n1	m1	1	1	BAND_M	12	10572	18110
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	
STOKES_FRACTION	Stokes fraction	10^6		1	1	1	1	integer4	4	4	
BAND_1B				n2	m2	1	1	BAND_M	12	54912	28682
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	
STOKES_FRACTION	Stokes fraction	10^6		1	1	1	1	integer4	4	4	
BAND_2A				n3	m3	1	1	BAND_M	12	73728	83594

RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	
STOKES_FRACTION	Stokes fraction	10^6		1	1	1	1	integer4	4	4	
BAND_2B				n4	m4	1	1	BAND_M	12	319488	157322
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	
STOKES_FRACTION	Stokes fraction	10^6		1	1	1	1	integer4	4	4	
BAND_3				n5	m5	1	1	BAND_M	12	393216	476810
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	
STOKES_FRACTION	Stokes fraction	10^6		1	1	1	1	integer4	4	4	
BAND_4				n6	m6	1	1	BAND_M	12	393216	870026
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	
STOKES_FRACTION	Stokes fraction	10^6		1	1	1	1	integer4	4	4	
BAND_PP				n7	m7	1	1	BAND_P	8	30720	1263242
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	
BAND_PS				n8	m8	1	1	BAND_P	8	30720	1293962
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	
BAND_SWPP				n9	m9	1	1	BAND_P	8	280	1324682
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	
BAND_SWPS				n10	m10	1	1	BAND_P	8	280	1324962
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	
											Total: 1325242

MDR (name 'mdr-1b-moon', subclass 9, version 3)

class 8

Name	Description	Scaling factor	Units	Dim1	Dim2	Dim3	Dim4	Type	Type size	Field size	Offset
RECORD_HEADER	Generic Record Header			1	1	1	1	REC_HEAD	20	20	0
GENERIC_QUALITY_INDICATORS											
DEGRADED_INST_MDR	Quality of MDR has been degraded from nominal due to an instrument degradation. Occurs if any of F_NN_DT, F_NN_PDP, F_NN_RAD, F_NN_WLS_U, F_NN_WLS_I, F_NN_SLS_U, F_NN_SLS_I, F_SAT, F_HOT, F_MIN in PCD_BASIC have been raised			1	1	1	1	boolean	1	1	20
DEGRADED_PROC_MDR	Quality of MDR has been degraded from nominal due to a processing degradation. Occurs if any of F_MISS, F_SAA, F_SUNGLINT, F_RAINBOW, F_OLD_CAL_DATA in PCD_BASIC have been raised			1	1	1	1	boolean	1	1	21
Moon_measurements_1b											
PCD_BASIC											
F_NN_DT	Flag indicating non-nominal detector temperature, per channel			6	1	1	1	boolean	1	6	22
F_NN_PDP	Flag indicating non-nominal pre-disperser temperature			1	1	1	1	boolean	1	1	28
F_NN_RAD	Flag indicating non-nominal radiator temperature			1	1	1	1	boolean	1	1	29
F_NN_WLS_U	Flag indicating non-nominal WLS voltage			1	1	1	1	boolean	1	1	30

F_NN_WLS_I	Flag indicating non-nominal WLS current			1	1	1	1	boolean	1	1	31
F_NN_SLS_U	Flag indicating non-nominal SLS voltage			1	1	1	1	boolean	1	1	32
F_NN_SLS_I	Flag indicating non-nominal SLS current			1	1	1	1	boolean	1	1	33
F_INV_UTC	Flag indicating invalid UTC			1	1	1	1	boolean	1	1	34
F_MISS	Flag indicating missing data packets			1	1	1	1	boolean	1	1	35
F_SAT	Flag indicating saturated pixels, per band			10	1	1	1	boolean	1	10	36
F_HOT	Flag indicating hot pixels, per band			10	1	1	1	boolean	1	10	46
F_SAA	Flag indicating whether scan is in the SAA			1	1	1	1	boolean	1	1	56
F_SUNGLINT	Flag indicating danger of sun-glint			1	1	1	1	enumerated	1	1	57
F_RAINBOW	Flag indicating danger of rainbow			1	1	1	1	boolean	1	1	58
F_MODE_GEOLOCATION	Flag indicating possible mismatch between observation mode and geolocation			1	1	1	1	boolean	1	1	59
F_MIN	Flag indicating that mean raw signal is below a specified threshold, per band			10	1	1	1	boolean	1	10	60
MEAN_UC	Mean raw signal per band	10^3	BU	10	1	1	1	integer4	4	40	70
F_OLD_CAL_DATA	Flag to indicate that old in-flight auxiliary calibration data is in use			1	1	1	1	enumerated	1	1	110
End: PCD_BASIC											
OBSERVATION_MODE	Observation mode			1	1	1	1	enumerated	1	1	111
PMD_TRANSFER	PMD transfer mode			1	1	1	1	enumerated	1	1	112
PMD_READOUT	PMD readout mode			1	1	1	1	enumerated	1	1	113
SCANNER_ANGLE	Scanner viewing angle with additional element at end of scan	10^6	deg	65	1	1	1	integer4	4	260	114
GEO_BASIC											
UTC_TIME	UTC time associated with every second scanner position (0,2,...,62)			32	1	1	1	time	6	192	374
SUB_SATELLITE_POINT				32	1	1	1	COORD	8	256	566
LATITUDE	Geodetic latitude (-90 to 90, -90 is the south pole, 90 the north pole, 0 the equator) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	
LONGITUDE	Geocentric longitude (-180 to 180, meridian is 0 and minus is going west) (Earth-fixed CS)	10^6	deg	1	1	1	1	integer4	4	4	
SATELLITE_ALTITUDE	Geodetic altitude of satellite (earth-fixed CS)	10^3	m	32	1	1	1	integer4	4	128	822
SOLAR_ZENITH_ANGLE	Solar zenith angle (Satellite Relative Actual CS)	10^6	deg	32	1	1	1	integer4	4	128	950
SOLAR_AZIMUTH_ANGLE	Solar azimuth angle (Satellite Relative Actual CS)	10^6	deg	32	1	1	1	integer4	4	128	1078
End: GEO_BASIC											
GEO_MOON											
LUNAR_AZIMUTH	Lunar azimuth angle, points HJKLM (Satellite Relative Actual Reference CS)	10^6	deg	5	1	1	1	integer4	4	20	1206
LUNAR_ELEVATION	Lunar elevation angle, points HJKLM (Satellite Relative Actual Reference CS)	10^6	deg	5	1	1	1	integer4	4	20	1226
DISTANCE_SUN_MOON	Sun-Moon distance	10^-3	m	1	1	1	1	integer4	4	4	1246
DISTANCE_SAT_MOON	Satellite-Moon distance		m	1	1	1	1	integer4	4	4	1250
LUNAR_PHASE	Lunar phase angle (geometrical)	10^6	deg	1	1	1	1	integer4	4	4	1254
LUNAR_FRACTION	Illuminated fraction of lunar disc	10^6		1	1	1	1	integer4	4	4	1258
End: GEO_MOON											
PDP_TEMP	Temperature of the pre-disperser prism for reference to the corresponding spectral calibration parameters	10^3	K	1	1	1	1	integer4	4	4	1262
FPA_TEMP	FPA temperature, per channel	10^3	K	6	1	1	1	integer4	4	24	1266
RAD_TEMP	Radiator temperature	10^3	K	1	1	1	1	integer4	4	4	1290
INTEGRATION_TIMES	Integration times per band	10^6	s	10	1	1	1	integer4	4	40	1294
REC_LENGTH_MDR-1b-Moon											
n1	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	1334

n2	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	1336
n3	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	1338
n4	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	1340
n5	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	1342
n6	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	1344
n7	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	1346
n8	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	1348
n9	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	1350
n10	Number of elements per band data record for the 10 bands that follow (n1, n2, ..., n10)			1	1	1	1	uinteger2	2	2	1352
End: REC_LENGTH_MDR-1b-Moon											
NUM_RECS_MDR-1b-Moon											
m1	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	1354
m2	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	1356
m3	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	1358
m4	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	1360
m5	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	1362
m6	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	1364
m7	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	1366
m8	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	1368
m9	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	1370
m10	Number of band data records for the 10 bands that follow (m1, m2, ..., m10)			1	1	1	1	uinteger2	2	2	1372
End: NUM_RECS_MDR-1b-Moon											
WAVELENGTH_1A	Wavelength for Band 1a	10^6	nm	n1	1	1	1	integer4	4	3524	1374
WAVELENGTH_1B	Wavelength for Band 1b	10^6	nm	n2	1	1	1	integer4	4	572	4898
WAVELENGTH_2A	Wavelength for Band 2a	10^6	nm	n3	1	1	1	integer4	4	768	5470
WAVELENGTH_2B	Wavelength for Band 2b	10^6	nm	n4	1	1	1	integer4	4	3328	6238
WAVELENGTH_3	Wavelength for Band 3	10^6	nm	n5	1	1	1	integer4	4	4096	9566
WAVELENGTH_4	Wavelength for Band 4	10^6	nm	n6	1	1	1	integer4	4	4096	13662
WAVELENGTH_PP	Wavelength for PMD p	10^6	nm	n7	1	1	1	integer4	4	60	17758
WAVELENGTH_PS	Wavelength for PMD s	10^6	nm	n8	1	1	1	integer4	4	60	17818
WAVELENGTH_SWPP	Wavelength for short wavelength range (block B) PMD p	10^6	nm	n9	1	1	1	integer4	4	140	17878
WAVELENGTH_SWPS	Wavelength for short wavelength range (block B) PMD s	10^6	nm	n10	1	1	1	integer4	4	140	18018
BAND_1A				n1	m1	1	1	BAND_M	12	10572	18158
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	

STOKES_FRACTION	Stokes fraction	10^6		1	1	1	1	integer4	4	4	
BAND_1B				n2	m2	1	1	BAND_M	12	54912	28730
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	
STOKES_FRACTION	Stokes fraction	10^6		1	1	1	1	integer4	4	4	
BAND_2A				n3	m3	1	1	BAND_M	12	73728	83642
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	
STOKES_FRACTION	Stokes fraction	10^6		1	1	1	1	integer4	4	4	
BAND_2B				n4	m4	1	1	BAND_M	12	319488	157370
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	
STOKES_FRACTION	Stokes fraction	10^6		1	1	1	1	integer4	4	4	
BAND_3				n5	m5	1	1	BAND_M	12	393216	476858
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	
STOKES_FRACTION	Stokes fraction	10^6		1	1	1	1	integer4	4	4	
BAND_4				n6	m6	1	1	BAND_M	12	393216	870074
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	
STOKES_FRACTION	Stokes fraction	10^6		1	1	1	1	integer4	4	4	
BAND_PP				n7	m7	1	1	BAND_P	8	30720	1263290
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	
BAND_PS				n8	m8	1	1	BAND_P	8	30720	1294010
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	
BAND_SWPP				n9	m9	1	1	BAND_P	8	280	1324730
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	
BAND_SWPS				n10	m10	1	1	BAND_P	8	280	1325010
RAD	Radiance or reflectivity		(various)	1	1	1	1	vinteger4	5	5	
ERR_RAD	Absolute error on radiance or reflectivity		(various)	1	1	1	1	vinteger2	3	3	
											Total: 1325290

Enumeration DISPOSITION_MODE

Value	Name	Description
T	Testing	
O	Operational	
C	Commissioning	

Enumeration F_OLD_CAL_DATA

Value	Name	Description
0		No in-flight auxiliary calibration data is old
1		Dark signal correction old
2		PPG correction old
3		Spectral calibration parameters old
4		Etalon correction old
5		SMR old

Enumeration F_SUNGLINT

Value	Name	Description
0	NoRisk	No risk
1	LowRisk	Low risk

2	HighRisk	High risk

Enumeration INSTRUMENT_ID

Value	Name	Description
AMSA	AMSU-A	
ASCA	ASCAT	
ATOV	ATOVS	instruments: AVHRR/3, HIRS/4, AMSU-A, MHS
AVHR	AVHRR/3	
GOME	GOME	
GRAS	GRAS	
HIRS	HIRS/4	
IASI	IASI	
MHSx	MHS	
NOAA	All NOAA	instruments specific to Level 0 NOAA product
SEMx	SEM	
ADCS	ADCS	
SBUV	SBUV	
xxxx	No specific instrument	
HKTM	VCDU34	data specific to Level 0

Enumeration INSTRUMENT_MODEL

Value	Name	Description
0	Reserved	
1	Flight Model 1	
2	Flight Model 2	
3	Engineering Model	
4	Protoflight Model	

Enumeration OBSERVATION_MODE

Value	Name	Description
0	Nadir_scan	Nadir
1	Nth_pole_scan	North Pole scanning
2	Sth_pole_scan	South Pole scanning
3	Other_scan	Other scanning
4	Nadir_static	Nadir static
5	Other_static	Other static
6	Dark	Dark
7	LED	LED
8	WLS	WLS
9	SLS	SLS
10	SLS_diff	SLS over diffuser
11	Sun	Sun
12	Moon	Moon
13	Idle	Idle
14	Test	Test
15	Dump	Dump
16	Invalid	Invalid

Enumeration OUTPUT_SELECTION

Value	Name	Description
0	AbsRad	Absolutely calibrated radiance
1	NormRad	Sun normalised radiance

Enumeration PMD_READOUT

Value	Name	Description
0	Nominal	Nominal readout mode
1	Solar	Solar readout mode
2	Calibration	Calibration readout mode

3	Various	PMD readout mode changes within scan

Enumeration PMD_TRANSFER

Value	Name	Description
1	Band+Raw	Band + Raw
2	Band+Mixed	Band + Mixed
3	Raw	Raw Transfer
4	Various	PMD transfer changes within scan

Enumeration PROCESSING_CENTRE

Value	Name	Description
CGS1		First EUMETSAT EPS Core Ground Segment
CGS2		Second EUMETSAT EPS Core Ground Segment
NSSx		NOAA/NESDIS
RUSx		Reference User Station
DMIx		DMI, Copenhagen (GRAS SAF)
DWDx		DWD, Offenbach (Climate SAF)
FMIx		FMI , Helsinki (Ozone SAF)
IMPx		IMP, Lisbon (Land SAF)
INMx		INM, Madrid (NCW SAF)
MFxx		MF, Lannion (OSI SAF)
UKMO		UKMO, Bracknell (NWP SAF)

Enumeration PROCESSING_LEVEL

Value	Name	Description
00	Level 0	
01	Level 1	
1A	Level 1a	
1B	Level 1b	
1C	Level 1c	
02	Level 2	
03	Level 3	
xx	No Specific Level	

Enumeration PROCESSING_MODE

Value	Name	Description
N	Nominal	NRT processing
B	Backlog Processing	
R	Reprocessing	
V	Validation	

Enumeration PRODUCT_TYPE

Value	Name	Description
ENG		IASI engineering data
GAC		NOAC Global Area Coverage AVHRR data
SND		Sounding Data
SZF		ASCAT calibrated s0 data at full resolution
SZO		ASCAT calibrated s0 data at operational resolution (50 km)
SZR		ASCAT calibrated s0 data at research resolution (25 km)
VER		IASI verification data
xxx		No specific product type specified
AIP		NOAA AIP/SAIP data
TIP		NOAA TIP/STIP data
HRP		HRPT data
LRP		LRPT data

Enumeration RECEIVING_GROUND_STATION

Value	Name	Description
SVL		Svalbard
WAL		Wallops Island, Virginia
FBK		Fairbanks, Alaska
SOC		SOCC (NESDIS Satellite Operations Control Centre), Suitland, Maryland
RUS		Reference User Station

Enumeration SPACECRAFT_ID

Value	Name	Description
xxx		No specific spacecraft
M01		METOP 01
M02		METOP 02
M02		METOP 03
N15		NOAA-K
N16		NOAA-L
N17		NOAA-M
N18		NOAA-N
N19		NOAA-N'

Enumeration BAND_NUMBER

Value	Name	Description
1		Main FPA band 1a
2		Main FPA band 1b
3		Main FPA band 2a
4		Main FPA band 2b
5		Main FPA band 3
6		Main FPA band 4
7		PMD p blocks CDE
8		PMD s blocks CDE
9		PMD p block B
10		PMD s block B

Enumeration CHANNEL_NUMBER

Value	Name	Description
1		Main FPA channel 1
2		Main FPA channel 2
3		Main FPA channel 3
4		Main FPA channel 4
5		PMD channel p
6		PMD channel s

Enumeration CHANNEL_NUMBER

Value	Name	Description
1		Main FPA channel 1
2		Main FPA channel 2
3		Main FPA channel 3
4		Main FPA channel 4
5		PMD channel p
6		PMD channel s

Enumeration FAIL_FLAG

Value	Name	Description
0	success	Successful fit
1	reflectivity_out_of_range	R out of range
2	solar_zenith_out_of_range	Theta-not out of range
3	satellite_zenith_out_of_range	Theta out of range
4	no_convergence	Fit did not converge
5	missing_input	Missing input data

Enumeration FIT_MODE

Value	Name	Description
0	cloud	Default fitting for c and z_c
1	snow_ice	Snow/ice mode for A and z

Parameters Table

Parameter	Value	Description
b1	1	Number of band data records (i.e., number of readouts) in Level 1a MDR. This number is specified in field NUM_RECS of the MDR.
b10	1	
b2	32	
b3	32	
b4	32	
b5	32	
b6	32	
b7	16	
b8	16	
b9	1	
l1	881	Length of band data records in Level 1a MDR. This number is specified in field REC_LENGTH of the MDR. For the main channels this number equals the number of detector pixels in a band.
l10	35	
l2	143	
l3	192	
l4	832	
l5	1024	
l6	1024	
l7	304	
l8	304	
l9	35	
m1	1	Number of band data records (i.e., number of readouts) in Level 1b MDR. This number is specified in field NUM_RECS of the MDR.
m10	1	
m2	32	
m3	32	
m4	32	
m5	32	
m6	32	
m7	256	
m8	256	
m9	1	
n1	881	Length of band data records (i.e., number of spectral elements within a readout) in Level 1b MDR. This number is specified in field REC_LENGTH of the MDR.
n10	35	
n2	143	
n3	192	
n4	832	
n5	1024	
n6	1024	
n7	15	
n8	15	
n9	35	
num_channels	6	Number of channels (4 main FPA, 2 PMD, see enumerated variables)
num_main_channels	4	Number of main FPA channels
num_PMD_channels	2	Number of PMD channels
num_bands	10	Number of bands (6 main FPA, 4 PMD, see enumerated variables)
num_main_bands	6	Number of main FPA bands
n_psi_f	21	MME: number of viewing angles (fine grid). This number is specified in field MME_N_PSI_F of record GIADR-1a-MME
n_e_f	33	MME: number of elevation angles (fine grid). This number is specified in field MME_N_E_F of record GIADR-1a-MME
n_phi_f	35	MME: number of azimuth angles (fine grid). This number is specified in field MME_N_PHI_F of record GIADR-1a-MME
n_lambda_FPA	1024	MME: number of wavelengths for a main channel
n_lambda_PMD	279	MME: number of wavelengths for a PMD channel
n_lambda_total	4654	MME: number of wavelengths (all channels)