Product_User_Guide_GOME2_FDR_R3

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V1c	19 January 2022		Editorial changes before DRR
V2	24 March 2022		Update after DRR review
V2a	22 April 2022		Final update

DCR = Document Change Request

Table of Contents

Table of Figures

Table of Tables

1 INTRODUCTION

1.1 Purpose and Scope

The purpose of this guide is to provide users with detailed information about the Release 3 of the Fundamental Data Record (FDR) of GOME-2 level 1b product, from Metop-A and B. The main objective for the GOME-2 measurements is to provide atmospheric reflectance spectra in the ultra violet (UV), visible (VIS) and short wave infrared (SWIR) range to derive ozone and other atmospheric composition profiles with high spectral and vertical resolution and accuracy.

The scope of this document is to inform about the data and method used to derive the FDR, the format the product is available in and to give some information on the validation of the data record. Several documents listed under reference documents provide complementary information.

This document describes the Metop-A and B GOME-2 level 1b Release 3 data record. This release consists of one data record generated with the version 6.3 of the EUMETSAT operational GOME-2 L0 to L1 processing chain, using the full orbit level 0 products retrieved from the EUMETSAT archive.

This release comprises level 1b data from the Metop-A satellite for the period ranging from the 1 April 2007 until the 31 December 2018 and from Metop-B data from 1 December 2012 to 31 July 2020. For dates before 1 April 2007 a bug in the processing of Metop-A data occurred and will be addressed with the next release. For the period from 2018 to 2020 Metop-A experienced a total of 13 months loss of solar visibility and updated solar model is required to process this period, and will be provided with the next release.

The GOME-2 L1b product contains atmospheric reflectance spectra at a high spectral resolution between 0.26 nm and 0.51 nm. The level 1b product consists of four bands with 1024 pixels each, ranging from 240 to 790 nm, yielding a total of 4096 spectral points per measurement.

It can be regarded as a Fundamental Data Record (FDR), i.e., a long-term data record of calibrated and quality-controlled sensor data without multi-sensor cross-calibration. It is designed to allow data assimilation for re-analysis of the recent climate and the generation of accurate products, that may need additional homogenisation to be stable enough for climate monitoring.

This guide provides:
1. Specifications of the data record;
2. Scientific details on the generation and definition of the data record;
3. Characteristics and limitations of the product, aiming to assist the users in the decision of whether they can or should use this data record for their applications;
4. Technical details on the format and the ordering of the data record, as well as information on the mechanisms to provide feedback.

1.2 Structure of this Document

This document has the following structure:

- An introduction and overview of the content (this section)
- Some background information (section 2)
- An overview of the CDR (section 3)
- Product definition and generation (section 4 and 5)
- A summary of the validation and limitations to the CDR (section 6 and 7)
- Finally information on ordering, support and feedback (section 8 to 10)

1.3 Reference Documents

EUMETSAT: Eugene Users Guide, https://www-cdn.eumetsat.int/files/2020-04/pdf_ten_02030_ug_eugene.pdf, 2007.

EUMETSAT: GOME-2 Level 1 Product User Guide, https://www.eumetsat.int/media/7319, 2011.

EUMETSAT: GOME Annual In-Flight Performance Review 2011, 2012.

EUMETSAT: Metop-A GOME Annual In-Flight Performance Report 2014, https://www.eumetsat.int/media/39722, 19 February 2015.

EUMETSAT: Generic Product Format Specification, https://www-cdn.eumetsat.int/files/2020-04/pdf_gen_pfs.pdf, 2016a.

EUMETSAT: GOME-2 Level 1 Product Generation Specification, https://www.eumetsat.int/media/37723, 2016b.

EUMETSAT: EUMETSAT data policy, https://www.eumetsat.int/media/45173, 1 January 2020.

EUMETSAT: GOME-2 Level 1 Product Format Specification, 2021a.

EUMETSAT: Quality Evaluation Report for the Polar Multi-sensor Aerosol product (PMAp) Climate Data Record release 1, 2021b.

EUMETSAT: Validation Report GOME2 FDR R3, 2021c.

S. Dikty and A. Richter: GOME-2 on MetOp-A Support for Analysis of GOME-2 In-Orbit Degradation and Impacts on Level 2 Data Products, https://www.eumetsat.int/media/7920, 14 October 2011.

WMO, W. M., (UNESCO) United Nations Educational, S. and C. O., Programme, (UNEP) United Nations Environment, Science, (ICSU) International Council for, and World Meteorological Organization (WMO): GCOS, 154. Systematic Observation Requirements for Satellite-based Products for Climate Supplemental details to the satellite-based component of the Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC : 2011 update, WMO, Geneva, 138 p. pp., 2011.

1.4 Definitions

1.4.1 GOME-2 data levels definitions

Level 1a - GOME-2 level 1a products (EUMETSAT, 2016b), contain reformatted raw instrument data along with all supplementary data needed for further processing, including geolocation and quality flags

Level 1b - GOME-2 level 1b products (EUMETSAT, 2016b), contain radiometrically and spectrally calibrated (ir)radiances, along with auxiliary information such as geolocation, quality flags, cloud parameters and polarisation information

1.4.2 Climate data record definitions

The terminology for Climate Data records have been defined by the joint CEOS/CGMS working group on climate[1] [2020].

Fundamental Climate Data Records (**FCDR**s) consist of a consistently processed time series of uncertainty-quantified sensor observations calibrated to physical units, located in time and space, and of sufficient length and quality to be useful for climate science or applications. FCDRs are typically calibrated radiances, backscatter of active instruments, or radio occultation bending-angles, and include the ancillary data used to calibrate them (WMO et al., 2011).

Climate Data Records (**CDR**s) consist of a consistently processed time series of uncertainty-quantified retrieved values of a geophysical variable or related indicator, located in time and space, and of sufficient length and quality to be useful for climate science or applications.

Interim Climate Data Records (**ICDR**s) are consistently processed times series of uncertainty-quantified estimates of CDR values produced with better timeliness than, but otherwise minimizing differences with, the estimated CDR values.

EUMETSAT produces climate data records (both FCDRs and CDRs) by applying state-of-art data processors, which have advanced significantly during the last decade, to historical and present-day satellite data. EUMETSAT uses in addition the term **Fundamental Data Record** (**FDR**) that is similar to a FCDR but contains only best possible calibrated single-sensor series. This is often the first important step to create multi-sensor cross-calibrated FCDRs. Our climate data records are operationally generated and are routinely checked on quality (***https://www.eumetsat.int/what-we-monitor/climate***)

[1] https://climatemonitoring.info/

1.5 Acronyms and Abbreviations

Acronym	Meaning
AVHRR	Advanced Very High Resolution Radiometer
BEAT	Basic Envisat Atmospheric Toolbox
CDR	Climate Data Record
DOI	Digital Object Identifier
EPS	EUMETSAT Polar System
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
FCDR	Fundamental Climate Data Record
FDR	Fundamental Data Record
GOME-2	Global Ozone Monitoring Experiment-2
ICDR	Interim Climate Data Record
L0	Level 0
L1	Level 1
MDR	Measurement Data Records
Metop	Meteorological operational satellite
MPHR	Main Product Header
NRT	Near Real Time
PDU	Product Data Unit
PPF	Product Processing Facility
q_ss	Single scattering Stoke Fraction
SWIR	Short Wave Infrared
UV	Ultra Violet
VIS	Visible
WMO	World Meteorological Organisation

2 BACKGROUND

The Global Ozone Monitoring Experiment 2 (GOME-2) is an optical 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 (Figure 1). GOME-2 senses the Earth's backscattered radiance and extra-terrestrial solar irradiance in the ultraviolet and visible part of the spectrum (240 nm – 790 nm) at a high spectral resolution between 0.26 nm and 0.51 nm. There are 4096 spectral points from four detector channels transferred for each individual GOME-2 measurement (see Figure 1).

The nominal footprint size is 80 x 40 km, the narrow swath setup has a 40 x 40 km (Metop-A, from 2013 onwards) for main channel data (see Figure 2). The instrument also measures the state of linear polarisation of the backscattered earthshine radiances in two perpendicular directions. The polarisation data is down-linked in 15 spectral bands covering the region from 312 nm to 800 nm for both polarisation directions with a footprint of 10 km x 40 km (5 km x 40 km for narrow swath).

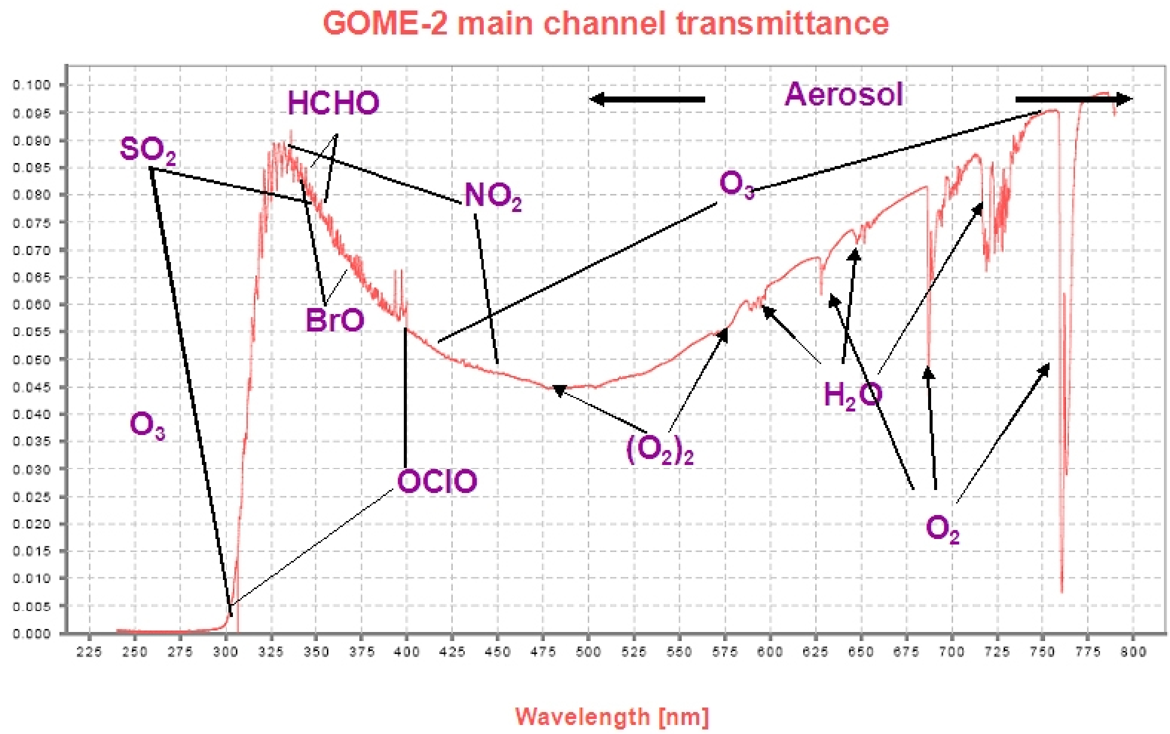

Figure 1: *GOME-2 transmittance as derived from the GOME-2 level 1b radiance product*

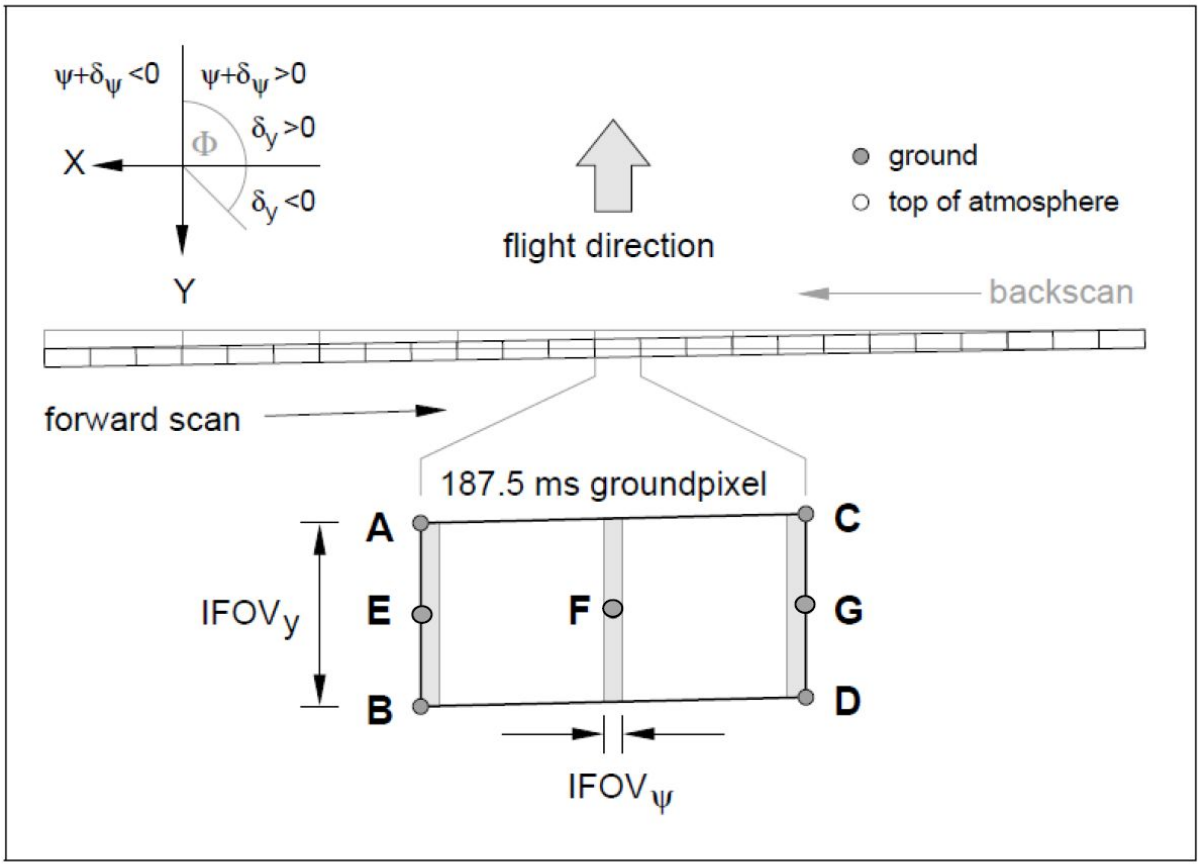

Figure 2: *Ground pixel geometry for the level 0 to 1 processing.*

The instrument has four physical detectors in the main channels, with 1024 pixels each and two detectors in the polarisation channels, with 256 pixels each. The data acquired from these detectors is then saved in bands in the level 1b product. The detectors one and two are split into two bands, while detectors three and four only have one band each. See Table 1 for details on the band separation.

Table 1: *Main channel band settings of GOME-2*

Channel	**1**	**1**	**2**	**2**	**3**	**4**	**5/6**
Band	1A	1B	2A	2B	3	4	PMD P/S
Nr of Pixels	877/659[2]	147/365[2]	71	953	1024	1024	256
Spectral range [nm]	240-307/283[2]	307/283-314[2]	Not valid	310-403	397-604	593-790	312 – 790
nm/pixel	0.07	0.07	0.09	0.09	0.2	0.2	2

[2] settings changed on 10 December 2008 on orbit 11119

3 DATA RECORD OVERVIEW

General	Data record name	GOME-2 level 1b release 3
	Data record digital identifier	10.15770/EUM_SEC_CLM_0039
	Data record short description	Reprocessed FDR level 1b GOME-2 data onboard Metop-A and -B satellites
	Record type	Fundamental Data Record
	Period covered	Metop-A: 01 April 2007 – 31 December 2018 Metop-B: 22 September 2012 – 31 July 2020
	Content	GOME-2 level 1b products (FDR)
Instrument	Instrument name	Global Ozone Monitoring Experiment – 2 (GOME-2)
	Instrument description	The Global Ozone Monitoring Experiment–2 (GOME-2) is an optical 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. GOME-2 senses the Earth's backscattered radiance and extraterrestrial solar irradiance, in the ultraviolet and visible part of the spectrum (240-790 nm), at a high spectral resolution, between 0.2–0.4 nm. 4096 spectral points from four detector channels are transferred per individual GOME-2 measurement.
Data	Input data	GOME-2 level 0
	Output data	GOME-2 level 1b radiance data
	Format	The products are provided in native EPS format
	Version	Algorithm version 6.3.3
Access	EUMETSAT Data Centre	The data record is available from EUMETSAT Data Centre https://eoportal.eumetsat.int
	Delivery	• ftp • offline delivery
Coverage	Spatial	• global
	Frequency	~100 minutes

4 PRODUCT DEFINITION

This chapter provides summary information on file-size, file content, file formats, and file-names for the Metop-A and -B GOME-2 level 1b Release 3 FDR.

4.1 Physical Structure

Reprocessed GOME-2 level 1b products contain calibrated radiances of earthshine (example see Figure 3), solar measurements, and all on-board calibration source measurements, together with geo reference data and quality indicators.

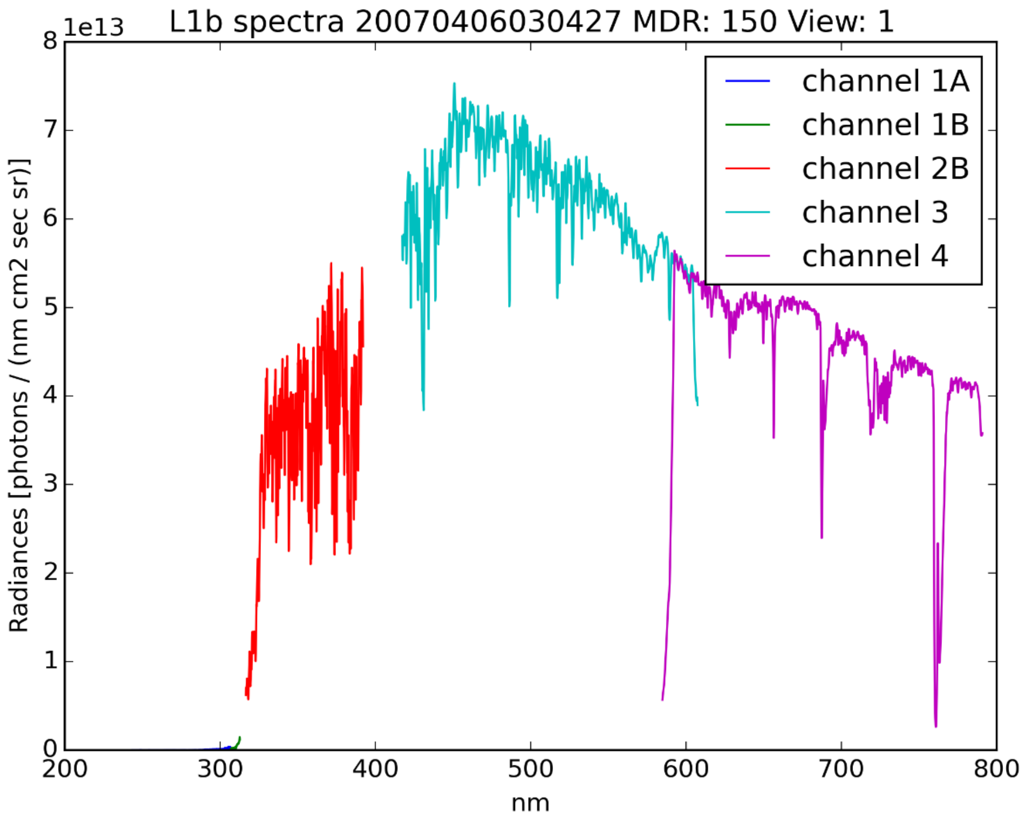

Figure 3*: Radiance spectra of one GOME-2 main channel measurement.*

4.2 Product Contents

GOME-2 level 1b reprocessed products are processed according to the GOME-2 product generation specification (EUMETSAT, 2016b), and formatted according to the GOME-2 product format specifications (EUMETSAT, 2021a), unless alternate processing is specified in this document. For details on GOME-2 level 1b products, we also refer to the GOME-2 product user guide (EUMETSAT, 2011).

4.3 File Specifications

4.3.1 File Format

The GOME-2 L1b files come in the EPS-native file format, described in (EUMETSAT, 2021a). One file contains a data dump spanning two orbits (Svalbard to Svalbard).

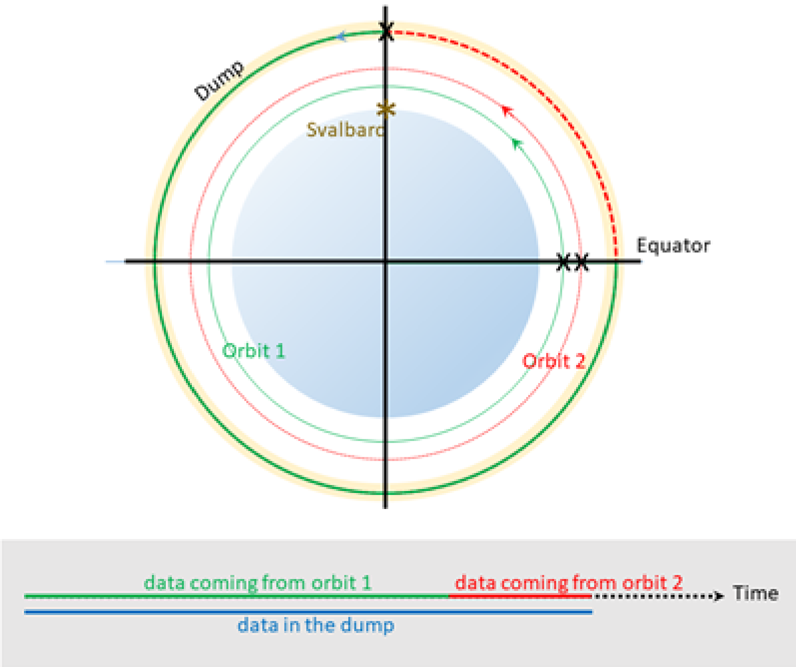

Figure 4: *Simplistic view of the data included in a dump file. The outer circle shows that data included in a dump contains 3/4 of data coming from the orbit 1 (green) and 1/4 of data from the orbit 2 (red).*

4.3.2 Filenames

The file naming conventions used is described in Table 2. Detailed information can be found in (EUMETSAT, 2016a).

Table 2: *Filename conventions of GOME-2 L1b file*

Convention	<instrument>_<product_type>_<processing_level>_<satellite>_<sensingstart>_<sensing_stop>_<processing_mode>_<disposition_mode>_<processing_time>_<reprocessing_baseline>
Product name	GOME_xxx_1B_M02_20070201002059Z_20070201020553Z_R_O_20190910080509Z_0300

4.3.3 File Sizes

The minimum and maximum files sizes are given in Table 3, whereas the sizes (per year) of the complete data record is given in Table 4.

Table 3: *Estimated file sizes*

Type	Minimum file size [Mb per file]	Maximum file size [Mb per file]
GOME-L1b	1000	1500

Table 4: *Data record sizes for GOME-2 L1b (Metop-A and Metop-B)*

File type	2007 [TB]	2008 [TB]	2009 [TB]	2010 [TB]
GOME-L1b (Metop-A)	6.0	6.2	6.3	6.2
GOME-L1b (Metop-B)	--	--	--	--
Total sizes	**6.0**	**6.2**	**6.3**	**6.2**

File type	2011 [TB]	2012 [TB]	2013 [TB]	2014 [TB]	2015 [TB]
GOME-L1b (Metop-A)	6.4	6.7	6.7	6.6	6.6
GOME-L1b (Metop-B)	--	1.9	6.8	6.6	6.6
Total sizes	**6.4**	**8.8**	**13.3**	**13.2**	**13.2**

File type	2016 [TB]	2017 [TB]	2018 [TB]	2019 [TB]	2020 [TB]
GOME-L1b (Metop-A)	6.7	6.7	6.7	--	--
GOME-L1b (Metop-B)	6.6	6.7	6.7	6.7	3.9
Total sizes	**13.3**	**13.4**	**13.4**	**6.7**	**3.9**

4.3.4 File Visualization and reading

Simple visualisation tools currently do not exist. Nevertheless several software packages enable the reading and plotting of GOME-2 data:

- EUGENE: EUMETSAT's own python based generic reader software for EPS products (EUMETSAT, 2007)
- Atmospheric Toolbox: Containing CODA, VISAN and HARP. This toolbox can read GOME-2 and other data in Python, C++, Fortran, IDL and MATLAB. https://atmospherictoolbox.org/

5 PRODUCT GENERATION

This section gives an overview of how the data record was produced and describes the input data, the processing software, and the setup of the CDR processing environment. See Figure 5 for a schematic overview of the processing system.

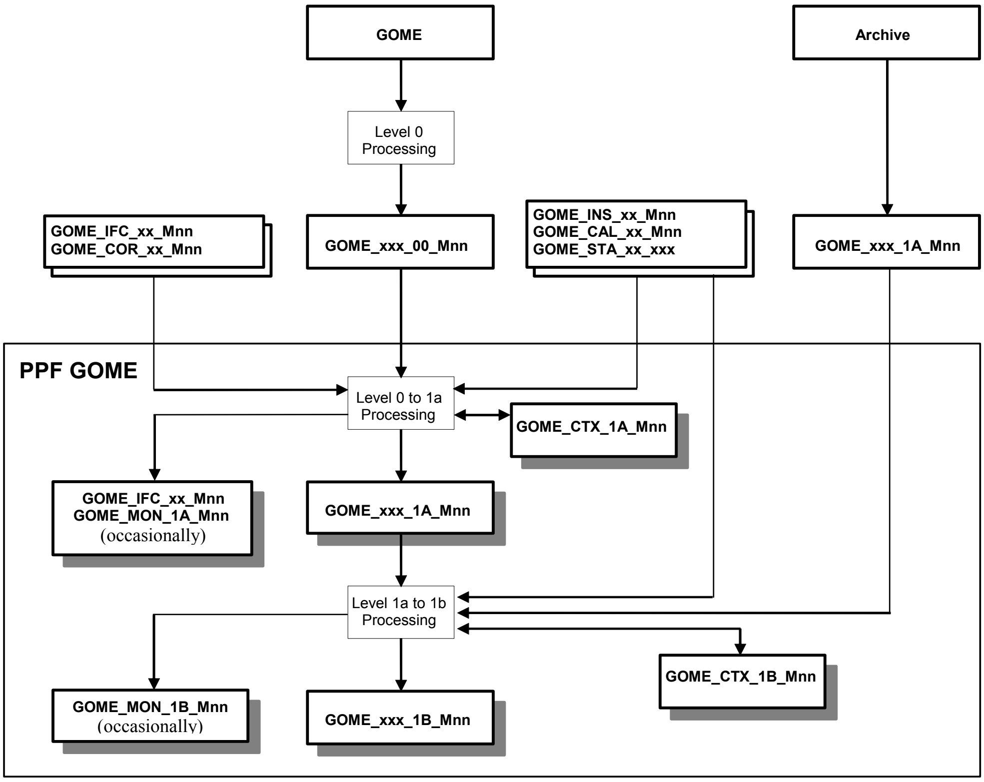

Figure 5: *Schematic overview of the processing system*

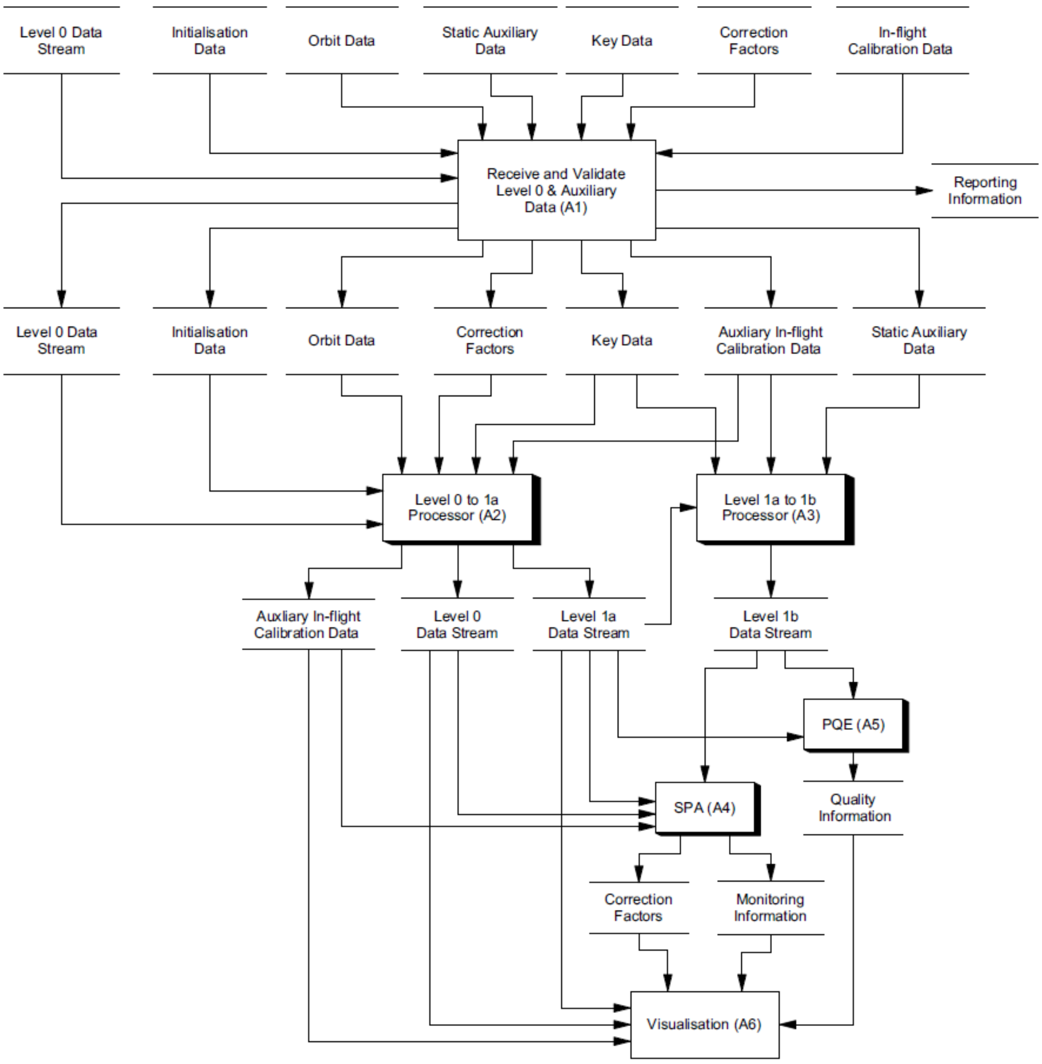

Figure 6: *Functional decomposition of the GOME-2 processing function*

The Level 0 to Level1A processing (A2) has been carried out in single-thread for the sake of carrying over from one PDU to the following the properly updated calibration correction coefficients (see Figure 6).
Level 1A to Level1B (A3) processing has been carried out in multi-thread.

5.1 Input Data

Input to the processing are L0 dumps from the EUMETSAT Data Centre.
Further the following files (file name start in EPS file naming convention, details see (EUMETSAT, 2016a)) are also used as input:

- AVHRR_xxx
- GOME_CAL

- GOME_COR
- GOME_CTX
- GOME_IFC
- GOME_INS
- Xxxx_OSV

5.2 Processor

The software used was version 6.3 of the operational NRT level 0 to level 1b processing.

6 VALIDATION SUMMARY

The GOME-2 L1 FDR was validated and the findings reported in (EUMETSAT, 2021c).
The validation targets of the GOME-2 L1 FDR campaign have been to demonstrate that:

- any spurious effects on the level 1b data quality due to processor and auxiliary-data changes have been removed,
- the consistent evaluation and validation of level 2 data processing over multiple seasonal cycles can be supported,
- the long-term degradation of the instrument has been evaluated,
- the development of a level 1C processor and product, mitigating the effects of long-term instrument degradation (S. Dikty and A. Richter, 2011), can be supported and
- the preparation and execution of atmospheric composition and climate monitoring studies (extension of the GOME-1 and SCIAMACHY datasets) can be supported.

All reprocessed on board measurements crucial for the evaluation of the long terms performance, such as dark measurements, the spectral calibration and the etalon correction show a signal evolution which is solely related to instrument events.

Dark signal offsets and dark signal-derived noise values are essentially constant, whereas detector leakage signal is increasing within the predicted limits of 1 BU/s per year (EUMETSAT, 2012, 2015).

The spectral signal is stable during most of the reprocessing period, changing only at sub-detector pixel level, which is closely related to the temperature variations of the on-board optical bench.

At short wavelengths, anyhow, an unstable behaviour is recognised, with jumps in the pixel to spectral assignment (e.g. for GOME-2 / Metop-B in the last part of the FDR period, jumps are found in the spectral assignment of the order of 0.01 nm at around 315 nm, 0.004 nm at around 340 nm and 0.02 nm around 380 nm). These jumps are usually the result of a different solution (change in coefficients) of the polynomial dispersion fitting for main channel spectral calibration. The results are, as expected, fully consistent with the findings of the operational monitoring. The processing functions used for the FDR dataset production include the same spectral calibration algorithm as in the operational processing function.
The processing of etalon correction spectra has been demonstrated to be consistent over the whole reference period using WLS reference spectra and the observed changes in etalon patterns are linked to long-term changes of the instrument (such as degradation) or triggered and related to instrument events (PLSOL and throughput tests).

In the validation process, Stokes fractions and polarisation correction quality have been evaluated. The Stokes fractions are stable and homogeneous for both instruments. The seasonal cycle, due to changing solar geometry and viewing angle under which the measurements for q_ss->0 have been taken over the year, is visible. Overall, the results indicate high quality of the Stokes fractions for special geometries, with values very close to zero for all PMDs, and significantly smaller than the original target level of 0.05.

Then an evaluation of the degradation of signals from solar and earthshine measurements has been carried out together with evaluation of the "differential degradation" between the two, both in time and with respect to viewing angles. Differential degradation impacts the long-term change in reflectivity; the main quantity used for level-2 retrievals. In case both optical paths would degrade in exactly the same way the reflectivity degradation would be zero and level-2 retrievals would be predominantly affected by increasing noise on the derived columns or/and increase in fit residuals (error on the derived column).

The reflectivity degradation rates throughout the full reprocessing period are reported providing an estimate of the differential degradation for all the FPA and PMD channels. For both datasets, there are differences in degradation with respect to viewing angle, with the East part of the swath being more impacted and less stable. The reflectivity degradation is also dependent on wavelength. Below 300 nm, the degradation rate is increasing at a higher pace than for wavelengths above 300 nm.

The scan angle related differences in the degradation rate of the signals are different for GOME-2 / Metop-A before and after the throughput tests (January and September 2009) and before and after the swath configuration change.

The signal degradation rates have then been used to calculate a set of correction coefficients, as a function of wavelength and viewing angle, allowing the GOME-2 radiances to be corrected separately for the solar and the earthshine data. This can provide level 1b corrected products for mitigating the effects of long-term instrument degradation, as has been used in the reprocessing of the PMAp dataset (EUMETSAT, 2021b).

7 LIMITATIONS AND OPEN ISSUES

The GOME-2 / Metop-A data relative to the time period between end of January 2007 and April 2007 has not been included in this FDR dataset due to a bug in the processing. This subset of data will be included in the next reprocessing campaign.

The GOME-2 / Metop-A data in channel 3, and in particular in the 400 – 450 nm spectral range, for the period between the end of April 2007 and April 2009 should be used carefully when applying DOAS retrieval, due to some intermitting instability in the solar signal.

As described in Section 7.3 and Section 8.3 of (EUMETSAT, 2021c) the spectral calibration algorithm currently in use in the GOME 2 L1 Product Processing Function (PPF 6.3.3) shows some weakness in stability in the detector to wavelength assignment for some selected regions. An alternative calibration algorithm based on the Fraunhofer lines calibration is in the verification and validation phase, and will correct the instability observed. This will be then employed in the next reprocessing campaign.

8 PRODUCT ORDERING

Access to the data record is granted to all users without charge but accepting the EUMETSAT Data Policy provided in (EUMETSAT, 2020) and the corresponding EUMETSAT webpage: https://www.eumetsat.int/legal-framework/data-policy.
To access data, you need to register with the EUMETSAT Data Centre. When registered, you can order the data through a written request send to EUMETSAT's helpdesk.

8.1 Register with the Data Centre

Do this to register with the EUMETSAT Data Centre:

1. Register in the EUMETSAT EO-Portal (*https://eoportal.eumetsat.int/*) by clicking on the New User – Create New Account tab;
2. After finalisation of the registration process, an e-mail is sent to the e-mail address entered in the registration. Click the confirmation link in the e-mail to activate your account;
3. Login and subscribe to the Data Centre Service by going to the Service Subscription Tab and selecting Data Centre Service. Follow instructions issued from the web page to add needed information.

8.2 Order Data

The data record described in this product user guide can also be ordered via the EUMETSAT User Service Helpdesk in Darmstadt, Germany. Please send a written request to the helpdesk, email *ops@eumetsat.int,* indicating the data record that you want to order including its Digital Object Identifier (DOI) number: *10.15770/EUM_SEC_CLM_0039.*

9 PRODUCT SUPPORT AND FEEDBACK

For enquiries and feedback specifically about the GOME-2 FDR described in this product user guide, please contact the EUMETSAT User Service Helpdesk by email: *ops@eumetsat.int.*

10 PRODUCT REFERENCING

The data record described in this product user guide has a unique DOI that should be used for referencing. The product's filename provide a unique identifier for each product, which is also given in the *id* global attribute.

11 APPENDIX 1: EPS FORMAT PRODUCT RECORD EXAMPLE

The following shows an example of a dump of a native-eps GOME-2 L1b file named *GOME_xxx_1B_M02_20070201002059Z_20070201020553Z_R_O_20210110080509Z_0300.*
The header information (MPHR) of this file is displayed.

```
MPHR:
    RECORD_HEADER
        RECORD_CLASS: 1 (MPHR)
        INSTRUMENT_GROUP: 0 (Generic)
        RECORD_SUBCLASS: 0
        RECORD_SUBCLASS_VERSION: 2
        RECORD_SIZE: 3307
        RECORD_START_TIME: 2007/02/01 00:20:59.001
        RECORD_STOP_TIME: 2007/02/01 02:05:53.571
    PRODUCT_NAME: GOME_xxx_1B_M02_20070201002059Z_20070201020553Z_R_O_20190910080509Z
    PARENT_PRODUCT_NAME_1: GOME_xxx_1A_M02_20070201002059Z_20070201020559Z_R_O_20190810142628Z
    PARENT_PRODUCT_NAME_2: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
    PARENT_PRODUCT_NAME_3: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
    PARENT_PRODUCT_NAME_4: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
    INSTRUMENT_ID: GOME (GOME)
    INSTRUMENT_MODEL: 1 ()
    PRODUCT_TYPE: xxx ()
    PROCESSING_LEVEL: 1B (Level 1b)
    SPACECRAFT_ID: M02 ()
    SENSING_START: 2007/02/01 00:20:59.000
    SENSING_END: 2007/02/01 02:05:53.000
    SENSING_START_THEORETICAL: 2000/01/01 00:00:00.000
    SENSING_END_THEORETICAL: 2000/01/01 00:00:00.000
    PROCESSING_CENTRE: CDR_ ()
    PROCESSOR_MAJOR_VERSION: 6
    PROCESSOR_MINOR_VERSION: 3
    FORMAT_MAJOR_VERSION: 12
    FORMAT_MINOR_VERSION: 0
    PROCESSING_TIME_START: 2021/01/10 08:05:09.000
    PROCESSING_TIME_END: 2021/01/10 08:23:26.000
    PROCESSING_MODE: R (Reprocessing)
    DISPOSITION_MODE: O (Operational)
    RECEIVING_GROUND_STATION: xxx ()
    RECEIVE_TIME_START: 2000/01/01 00:00:00.000
    RECEIVE_TIME_END: 2000/01/01 00:00:00.000
    ORBIT_START: 1482
    ORBIT_END: 1483
    ACTUAL_PRODUCT_SIZE: 1111100637 bytes
    STATE_VECTOR_TIME: 20070131235410000Z UTC
    SEMI_MAJOR_AXIS: 7204572632 mm
    ECCENTRICITY: 0.001224
    INCLINATION: 98.721 deg
    PERIGEE_ARGUMENT: 72.706 deg
    RIGHT_ASCENSION: 93.425 deg
    MEAN_ANOMALY: 287.427 deg
    X_POSITION: 5831118.591 m
    Y_POSITION: -4226820.754 m
    Z_POSITION: -115.215 m
    X_VELOCITY: -977.308 m/s
    Y_VELOCITY: -1333.636 m/s
    Z_VELOCITY: 7354.831 m/s
    EARTH_SUN_DISTANCE_RATIO: 0
    LOCATION_TOLERANCE_RADIAL: 0 m
    LOCATION_TOLERANCE_CROSSTRACK: 0 m
    LOCATION_TOLERANCE_ALONGTRACK: 0 m
    YAW_ERROR: 0 deg
    ROLL_ERROR: 0 deg
    PITCH_ERROR: 0 deg
    SUBSAT_LATITUDE_START: 79.815 Deg
    SUBSAT_LONGITUDE_START: -164.461 Deg
    SUBSAT_LATITUDE_END: 70.154 Deg
    SUBSAT_LONGITUDE_END: 136.152 Deg
    LEAP_SECOND: 0
    LEAP_SECOND_UTC: 2000/01/01 00:00:00.000
    TOTAL_RECORDS: 1081
```

```
TOTAL_MPHR: 1
TOTAL_SPHR: 1
TOTAL_IPR: 18
TOTAL_GEADR: 3
TOTAL_GIADR: 4
TOTAL_VEADR: 3
TOTAL_VIADR: 1
TOTAL_MDR: 1050
COUNT_DEGRADED_INST_MDR: 0
COUNT_DEGRADED_PROC_MDR: 627
COUNT_DEGRADED_INST_MDR_BLOCKS: 0
COUNT_DEGRADED_PROC_MDR_BLOCKS: 2
DURATION_OF_PRODUCT: 6294570 ms
MILLISECONDS_OF_DATA_PRESENT: 6293961 ms
MILLISECONDS_OF_DATA_MISSING: 609 ms
SUBSETTED_PRODUCT:  false
```