Product Quality README file for

GOME Level 1b version 5.1 dataset

Field	*Content*
Document Title	Product Quality Readme file: GOME Level 1b version 5.1 dataset
Reference	ESA-EOPG-MOM-TN-13, issue 1.0, 15/06/2018
Abstract	This document describes the major fields of improvement in the GOME Level 1 processor baseline version 5.1 compared to previous version 4.0, and details the new Level 1b dataset resulting from the full mission reprocessing campaign completed in 2017.
Applicability	This README file applies to the latest GOME Level 1b consolidated products (ER2_RPRO_GOM_L1B) version 5.1. The dataset covers ERS-2 orbits from 28 June 1995 (orbit 979) to 02 July 2011 (orbit 84699). This is the first GOME dataset version generated with NetCDF product format.
Reference Documents	Documents can be downloaded from https://earth.esa.int/web/sppa/mission-performance/esa-missions/ers-2/gome/products-and-algorithms/products-information [RD1] ERS-2 GOME Level 0 to 1b Processing Product User Manual (PUM), ER-PS-DLR-GO-0016, issue 6D, 2018. [RD2] ERS-2 GOME Level 0 to 1b Processing Algorithm Theoretical Baseline Document (ATBD) for processor version 5, GOME-DLR-L1-ATBD, Issue 7A, 2016. [RD3] GOME Level 1 V5 Verification, Gome1-Evolution-IUP-L1VAL-TN, Version 1, 2016. [RD4] GOME Level 1 Version 5 Radiance Validation, gome1 lv1 rad val v1.0, 2017.
Change log	The table below records history and status of this Product Quality Readme file. <table><tr><th>Issue</th><th>Date</th><th>Change</th></tr><tr><td>1.0</td><td>15/06/2018</td><td>First release for new dataset version 5.1</td></tr><tr><td></td><td></td><td></td></tr></table>

Content	Level 1 processor version 5.1 Data Reprocessing Processor Verification Product Format Known Instrument Features Known Processing Issues WWW References
	Level 1 processor version 5.1 The implementation of GOME processor version 5.1 was completed after the end of the operational phase of the ERS-2 mission (July 2th 2011), as part of ESA's post-operational algorithm improvement activity. The following changes and updates have been introduced in the Level 1b version 5.1 processing baseline, compared to version 4.0: • The degradation correction parameter file has been completed to cover the whole GOME ERS-2 mission. • The polarisation correction has been improved. It now uses ozone values derived from GOME own measured spectra and generated by a Level 2 processing step instead of values from a climatological database. • The filtering of calibration measurements from the South Atlantic Anomaly (SAA) region has been revised. • The calibration data stored in the calibration database has been revised, especially spectral lines used for wavelength calibration. • The Level 1b product format has been changed from the specific ERS-2 format to NetCDF. • Cloud products derived from the Level 2 processing of GOME own Level-1b products have been integrated in the new product. • The new Level 1b product contains fully calibrated spectra ready for specific end-user analyses or higher level processing. The application of an extractor software (i.e. gdp01_ex) originally required for the Level 1 data is no longer necessary. Calibration algorithms and corrections, including radiometric calibration, have been moved from the extractor software to the processor software (GDP-L1 version 5.1) and are nominally applied. Details are in [RD2]. An overview of the evolution of the GOME baseline is provided in Coldewey-Egbers, M., Slijkhuis, S., Aberle, B., Loyola, D., and Dehn, A.: The Global Ozone Monitoring Experiment: Review of in-flight performance and new reprocessed 1995–2011 level 1 product, Atmos. Meas. Tech. Discuss., DOI:10.5194/amt-2018-118 in review, 2018, https://www.atmos-meas-tech-discuss.net/amt-2018-118/.

Data Reprocessing

Data reprocessing is fundamental to improve the quality of existing datasets, and to generate coherent long-term series of geophysical parameters to be used for atmospheric applications, such as climate studies and trend analysis. The GOME consolidated Level 1b version 5.1 dataset is the result of the latest full-mission reprocessing campaign, completed in 2017 in the frame of the *GOME Evolution project*. The new dataset represents the first complete reprocessing after the conclusion of the in-flight phase of the ERS-2 mission.

The Level 0 to 1 reprocessing was executed in several iterations in order to generate all the input parameters required for the processing. In particular

- step-1.   Generation of the calibration database by only processing calibration measurements (e.g. dark, PPG, lamp, sun measurements).
- step-2.   Generation of preliminary Level 1b products for Level 2 processing in order to generate Level 2 products containing cloud and ozone data.
- step-3.   Transferring the cloud and ozone data from the Level 2 products into the calibration database.
- step-4.   Processing and generation of final Level 1b products using ozone data for polarisation correction, and cloud data both from the calibration database.

In order to improve the processing speed and optimize computing resources, each year of GOME data has been processed on one computer node. Also step 1 (generation of calibration database) has been done for each year in parallel. To avoid missing calibration data for the first days of each year, we started each stream processing data from July of the previous year. This big overlap was chosen because some calibration measurements became sparse after 2003 due to the tape recorder failure.

Table 1 reports the number of Level 1b products available for every year of the mission. In total 75286 products have been generated, with a total data volume of about 3.45 TB.

Year	Level 0 products	Level 1 products	Data volume
1995	2699	2497	160GB
1996	5030	4781	304GB
1997	5187	5078	318GB
1998	5145	5037	315GB
1999	5190	5102	329GB
2000	5002	4840	316GB
2001	4812	4703	307GB
2002	4992	4898	320GB
2003	4808	4309	186GB
2004	5119	4433	88GB
2005	5133	4753	108GB
2006	5105	4683	123GB
2007	4881	4699	122GB
2008	5045	4688	115GB
2009	4827	4105	91GB
2010	4744	4367	98GB
2011	2499	2313	48GB
Total	**80218**	**75286**	**3.3TB**

Table 1: Number of GOME Level 1b products obtained from the reprocessing campaign with baseline version 5.1.

GOME data are made available to the user community via direct download from ESA archives. For new users, access to GOME products is provided through ESA Fast Registration at https://earth.esa.int/web/guest/data-access/browse-data-products?p_p_id=datasetlist_WAR_ospportlet&instruments=GOME. Users already having access to GOME data can retrieve the details for the account via the "My Online data" area on the My Earthnet pages at https://earth.esa.int/ using their SSO credentials.

Processor Verification

The validation and verification of the entire Level 1b dataset was carried out by IUP at University of Bremen, see [RD3] and [RD4]. Documents are available from

https://earth.esa.int/web/sppa/mission-performance/esa-missions/ers-2/gome/cal-val/validation-activities.

Quality checks on the new Level 1b version 5.1 products revealed only minor inconsistencies (listed in Section "Known Processing Issues").

Product Format

The product format is NetCDF-4 see 0.

Standard NetCDF or HDF5 tools and interfaces can be used to access the data.
For example, to get a content overview users may use the following commands:

> *ncdump –h product-file-name*

or

> *h5dump –n product-file-name*

To dump the radiance data of band 2 users may use:

h5dump -d /MODE_NADIR/BAND_2B/OBSERVATIONS/radiance product-file-name

Panoply offers a convenient interactive tool for HDF5 data evaluation.
Please see section WWW References for downloads and documentation.

Known Instrument Features

This section reports a list of known instrument features for Level 1b version 5.1 products:

- Starting from July 2003, many products are smaller in size and cover only partial orbits due to the tape recorder loss. Data could not be stored on-board ERS-2 any longer, and only direct transmission to on-ground receiving stations distributed over the globe was possible.
- Orbits containing only calibration data were not used for the generation of Level 1b products.
- Special events like switching-off the instrument or other satellite components caused data corruption, especially through significant changes in the temperature of detectors and other instrument parts. Other events like downlink problems, power supply problems, shutter problems, cooler switching also caused decreased data quality in some orbits. Details are provided on the GOME Mission Operations Overview web page at the following link https://earth.esa.int/web/sppa/mission-performance/esa-missions/ers-2/gome/mission-operations-overview.

Known Processing Issues

This section reports the problems identified during the verification of the GOME consolidated Level 1b dataset generated with processing baseline version 5.1. Currently very minor findings have been identified and are reported below.

Wrong variable content

The following variables report wrong values and should not be used:

> polarisation_q_theoretic
> polarisation_q_theoretic_error
> polarisation_q_theoretic_wavelength

Incorrect update of solar information

For a limited number of products begin of 2006 (orbits 56077-56088 on 10/11 January 2006), the selection from the calibration database of not up-to-date solar information occurred. For those days, the sun mean reference (SMR) spectra enclosed within the Level 1 products do not correspond to the latest solar measurement available (2005-12-31). The most recent solar measurement should have been selected.

Acronyms		
	ATBD	Algorithm Theoretical Baseline Document
	DLR	Deutsches Zentrum für Luft und Raumfahrt (German Aerospace Center)
	ERS-2	European Remote Sensing Satellite 2
	ESA	European Space Agency
	GDP-L1	GOME Data Processor Level 1
	GOME	Global Ozone Monitoring Experiment
	HDF	Hierarchical Data Format
	NetCDF	Network Common Data Form
	PPG	Pixel-to-Pixel Gain
	PUM	Product User Manual
	SAA	South Atlantic Anomaly
	SMR	Sun Mean Reference
	SPPA	Sensor Performance, Products and Algorithm

WWW References

WWW References

Additional information on the GOME instrument, its data processing, anomalies, products' quality, calibration activities and validation campaigns can be found on-line.

Instrument operations
The list of events affecting the GOME mission can be found on:

> ESA SPPA portal at https://earth.esa.int/web/sppa/mission-performance/esa-missions/ers-2/gome/mission-operations-overview

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Processors documentation

ESA web-page at https://earth.esa.int/web/sppa/mission-performance/esa-missions/ers-2/gome/products-and-algorithms/products-information

DLR web-page at http://atmos.eoc.dlr.de/gome/

Consolidated data sets

ESA web-page at https://earth.esa.int/web/sppa/mission-performance/esa-missions/ers-2/gome/quality-control-reports/products-availability

Tools

ESA Atmospheric Toolbox (BEAT, CODA, HARP, VISAN):
http://www.stcorp.nl/beat/
NetCDF-4 library and tools:
https://www.unidata.ucar.edu/downloads/netcdf/index.jsp
HDF5 library and tools:
https://support.hdfgroup.org/products/hdf5_tools/
Panoply HDF5 viewer:
https://www.giss.nasa.gov/tools/panoply/
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