Product Quality Readme File for

GOMOS ALGOM User Friendly Dataset

Field	*Contents*
Document Title	Product Quality Readme File for GOMOS ALGOM User Friendly Dataset
Reference	FMI-ALGOM-TN-005, Issue 1.1, 23/5/2017
Affected Dataset	This Readme file applies to GOMOS ALGOM User Friendly Dataset v1, issue 2
Reference Documents	[RD1] GOMOS IPF v6.01 Algorithm Theoretical Basis Document (ATBD): GOM-FMI-TN-040, Issue 3.0, 05/12/2012 [RD2] GOMOS IPF v6.01 Input/Output Data Definition (IODD): PO-RS-ACR-GS-0003, Issue 7.0, 30/09/2009 [RD3] GOMOS IPF v6.01 Product Specification: PO-RS-MDA-GS-2009, Issue 3.0, Revision K, 15/10/2012 [RD4] GOMOS IPF v6.01 Products Quality Readme File Level 2: ENVI-GSOP-EOGD-QD-12-0017, issue 1.0
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Summary	

Change record

Document version	Date	GOMOS data version	UFP data version	Changes in data sets	Changes in this document
Issue 1.0	17.10.2016	IPF 6.01	v1 Issue 1		
Issue 1.1	23.05.2017	IPF 6.01	v1 Issue 2	Variables time time_start, time_end, mpv, h2o_density_std corrected. Some ozone_star_flag values corrected. Data issue variable added.	Change record added. mpv and hrtp_std units corrected.

1 Introduction

The Global Ozone Monitoring Instrument by Occultation of Stars instrument (GOMOS) measured middle atmosphere constituent profiles during the ENVISAT satellite's operational life 2002-2012. During ten years GOMOS measured about 880 000 stellar occultations. Occultations were measured during day and night.

The spectral ranges of GOMOS detectors are 248-690 nm, 755-774 nm, and 926-954 nm. From these bands it possible to retrieve vertical profiles of O3, NO2, NO3, H2O, O2, and aerosols. The high resolution temperature profile (HRTP) is retrieved from two fast photometers. The instrument, data, retrieval and validation are discussed in the references listed at the end of this document.

All data from these GOMOS measurements are available in the ESA's ENVISAT-format and accessible by the BEAT-software (see https://earth.esa.int/web/guest/data-access/browse-data-products). So-called local constituent profiles and high resolution temperature profiles from GOMOS are now also available as user friendly products in the NetCDF4-format. These new data are:

- GOMOS_UFP: These files are occultation based and include all GOMOS Level 2 constituent profiles and HRTP profiles with all the essential parameters
- GOMOS_UFP_gridded: These files Level 2 constituent profiles are altitude gridded and quality flags are included. These files are constituent based and collected on yearly basis.

This Read Me document provides the essential information about these two products and how to use them. In Section 2 we introduce those GOMOS quality issues that are most important for users of data and which have been taken into account in constructing user friendly products. In Sections 3-4 the two products are presented with the data selection guidance and the detail contents of the NetCDF4 files.

2 Quality considerations

GOMOS product quality depends mainly on the relation of the target signal to the total noise (instrumental and photon noise), the presence of scattered solar radiation on the detectors and the properties of the target star spectrum. These are briefly discussed in the following:

1. **Increasing noise.** GOMOS detectors suffered from yearly increasing dark current. The total noise present in the constituent retrieval consists of instrumental noise (mainly dark current) and photon noise from the incoming radiance. In the full dark limb conditions (illumination flag=0, see Section 3) photon noise is from the occulted star target whereas in bright limb conditions (illumination flag=1) solar radiation is the greatest component of photon noise and also exceeds instrumental noise. In the dark limb occultations with

brightest stars, photon noise dominates the total noise, but with weak stars the instrumental noise can overpass the photon noise and the retrieval quality will depend on the amount of dark current during the time of measurement. Regarding the quality in time we see decreasing valid altitude ranges for all gases and worsening corruption patterns for ozone profiles from weak and cool stars (see item 4 below). This has been analysed and it has been shown that many corruption features originate from inaccurate dark current removal (Technical note by L. Blanot, ACRI, 2016a).

2. **Illumination conditions at the tangent point:** If the tangent point is illuminated by solar radiation, the detectors are also illuminated by this radiation. In the full bright limb condition (solar zenith angle at the tangent point smaller than 97 deg.) solar light dominates over stellar radiation, which makes the retrieval a challenging task. In this case only the retrieval of ozone is possible and moreover only high altitude retrievals are useful. In twilight situations (solar zenith >97 deg., but smaller than 110 deg.) variable amount of solar light is present on the detectors. The full darkness condition for GOMOS is defined by requiring the solar zenith angle at the tangent point being larger than 110 deg. and requiring the solar zenith angle at the satellite location angle (see Fig. 2-1) to be larger than 120 deg. Science studies have often relaxed this limit down to 105-108 deg. with the purpose of increasing the number of available data. The risk of this relaxation is estimated to be small. An extensive analysis with respect to the limits has been performed and a limit of 104 deg. would lead to an increased number of occultations. (Technical note by L. Blanot, ACRI, 2016b).

3. **Illumination conditions at the satellite location:** GOMOS detectors receive some radiation that is not coming from the intended target star or from scattered solar light along the line of sight from the star to the instrument. For GOMOS the nature of this radiation (called stray light) is not yet well understood, but its magnitude seems to depend on the solar zenith angle at the satellite location. Requiring this angle to be larger than 120 deg. no stray light is detected. This and the previous requirement for the solar zenith angle at the tangent point (110 deg.) define the full dark limb condition (illumination flag=0). In many science studies also the 120 deg. limit for the solar zenith angle at the satellite location has been relaxed. The new limit under discussion is 118 deg. as new value for the limit would lead to an increased number of data. (Technical note by L. Blanot, ACRI, 2016b).

4. **Star properties:** Star's (apparent) visual magnitude tells how much radiation is available at 550 nm seen from Earth. Star's temperature defines how the radiation is distributed over other wavelengths when star's spectrum is approximated by the blackbody model. Star's magnitude affects the valid altitude ranges. Star's temperature has more significant consequences for ozone retrieval. Ozone at high altitudes is retrievable only in the UV-wavelengths where cool and weak stars have too little radiation for proper retrieval. During the GOMOS quality research work we have found 77 stars that belong to this class of stars (see list in Section 3, this list is an update to the list in the GOMOS disclaimer (see below). These stars are not able to

provide reliable ozone profiles in the mesosphere. At the opposite end of the GOMOS wavelength spectrum, 959 nm, where H2O is retrieved, we need to have either a very bright star or very cool star to provide necessary signal-to-noise ratio. Only 8 stars fulfill this requirement (see list in Section 3).

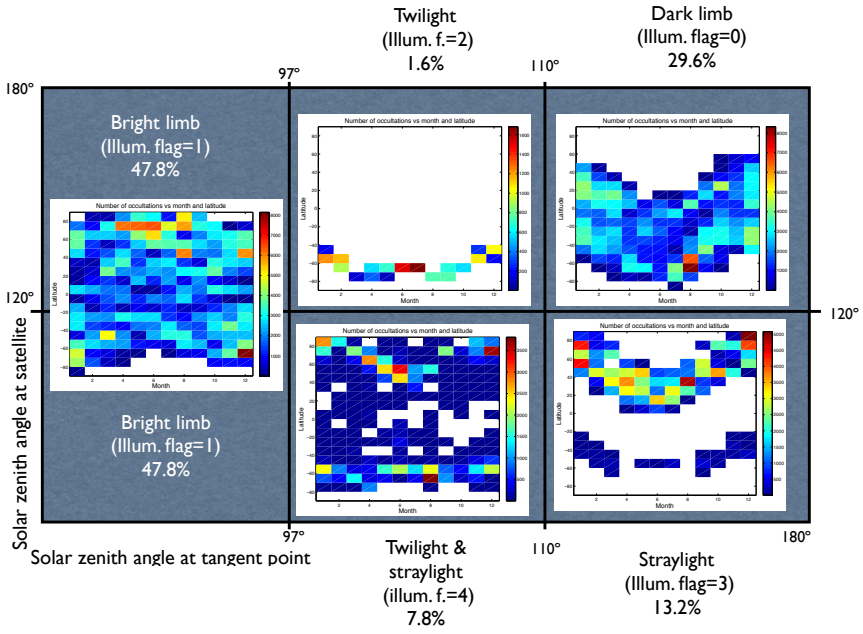

Figure 2-1. Illumination classes with relative number of measurements. The immersed figures show month-latitude distributions.

More detailed information about these topics can be found from the reference at the end of this document and from the GOMOS Level 2 data disclaimer in https://earth.esa.int/documents/700255/708000/RMF_0117_GOM_NL__2P_Disclaimers.pdf/63c11e5d-dcf3-4c7a-a733-dc7abbce51c3?version=1.0.

3 GOMOS_UFP

3.1 Introduction

There are about 880 000 GOMOS occultations. The GOMOS_UFP product includes all these except the ones with

- Level 2 Product error flag is not zero
- Measurements that have not been processed to Level 3

The total number of these exceptions is 29525 (3%).

Data are organized in two directories:

- dark/year/month/
- bright/year/month/

'Bright' includes data with illumination_flag=1, whereas 'Dark' includes the remaining data.

File names like 'GOMOS_UFP_20110101T000408_R46209_S113v01.nc' are constructed as follows:

GOMOS_UFP_date+T+hourminsec_R+orbitnumber_S+starnumber+ v+versionnumber.nc

where 'date' is an 8-digit number yearmonthday of the measurement (for example 20030107), 'hourminsec' is a 6-digit number hourminsec of the measurement (for example 010709), 'orbitnumber' is a 5-digit ENVISAT orbit number (for example 00001), 'starnumber' is a 3-digit star number from the GOMOS star catalogue (for example S001). The original ENVISAT file name from the IPF-file is included as a global variable.

Data from altitudes with the flag product_confidence not equal to zero are invalid. Other product quality considerations can be found in the following table:

3.2 User guidance

Table 3-1: GOMOS_UFP product selection guidance

Product	**Best result parameters and valid altitudes**	**Quality not guaranteed**	**Not valid**
Applies to all below!	illumination_ flag=0 and abs(obliquity) <80 (see note 1)	illumination_flag= 2, 3, 4	illumination_flag=1 (i.e. the 'bright' directory)
o3_density	Up to 100 km	below 40 km if the star belongs to the list of bad or variable bad stars (see note 2 below) + a possible bias in UTLS for all stars	above 40 km if the star belongs to the list of bad or variable bad star (see note 2 below)
no2_density	20-50 km Polar areas up to 75 km		
no3_density	20-50 km		
o2_density	Do not use this product in the present version.	Do not use this product in the present version.	Do not use this product in the present version.
h2o_density	star_id= h2o_vstars 0-50 km (see note 2)		if star_id is not equal to h2o_vstars
aerext_500	10-35 km		
hrtp	abs(obliquity) <10 18-35 km		

Note 1: Occultations that take place in the orbital plane are short and therefore the tangent point latitude and longitude have little time for change. Scintillation fluctuations can be removed accurately using two fast photometers. If the field of view is off the orbital plane, the tangent point latitude and longitude are changing rapidly during the occultation. The upper part of the retrieved profile has different geolocation than the lower part. The elimination of scintillations is more uncertain.

Note 2: The following 48 stars have been found to lead to corrupted ozone profiles for all years 2002-2012 in the dark limb occultations:
o3_badstars: 3 13 14 17 21 26 43 48 50 51 52 53 54 61 63 65 66 75 84 92 93 94 102 106 113 114 116 118 120 126 127 137 138 139 141 148 151 154 161 162 164 165 166 167 169 170 171 178.

The degree of corruption varies as a function of the measurement year for the following 29 stars:
o3_varbadstars: 16 37 40 59 71 86 90 101 103 105 111 117 121 122 123 128 132 133 134 135 142 143 146 155 157 159 163 168 173.
This variation is shown in Appendix and it is included in the ozone_star_flag of the gridded data set in Sec. 4.

Note 3: Reasonable water vapour retrievals are limited to the following 8 stars: h2o_vstars= 1, 2, 3, 13, 14, 16, 26, 63.

3.3 GOMOS_UFP NetCDF4 structure

Table 3-1: GOMOS_UFP NetCDF4 structure (N_{alt} is the number of measurement altitudes, N_{hrtp} is the number of altitudes in the high resolution temperature profile)

No	Variable	Unit	Dim	Attribute
	Geolocation			
1	time	days since 0h Jan 1, 1900	1	Time since 1.1. 1900 between altitudes 20 and 50 km
2	latitude	degrees_north	1	Mean latitude between tangent altitudes 20 and 50 km
3	longitude	degrees_east	1	Mean longitude between tangent altitudes 20 and 50 km
4	time_start	days since 0h Jan 1, 1900	1	Occultation first measurement time
5	time_end	days since 0h Jan 1,	1	Occultation last measurement time

		1900		
6	latitude_start	degrees_north	1	Occultation first measurement latitude
7	latitude_end	degrees_north	1	Occultation last measurement latitude
8	longitude_start	degrees_east	1	Occultation first measurement longitude
9	longitude_end	degrees_east	1	Occultation last measurement longitude
10	altitude	km	N_{alt}	Tangent altitude
11	altitude_min	km	1	Minimum tangent altitude reached by the occultation
12	altitude_parameters	km	1	Mean tangent altitude for mean values of parameters. Usually parameters are mean over 20-50 km.
13	duration	sec	1	The duration of the occultation
14	obliquity	degrees	1	Obliquity is the angle between the vector velocity of the line of sight in the atmosphere and the local vertical at altitude 35 km.
	Radiation			
15	sza_tangentpoint	degrees	1	Mean solar zenith angle between tangent altitudes 20 and 50 km at tangent point
16	sza_satellite	degrees	1	Mean solar zenith angle at satellite location between tangent altitudes 20 and 50 km
17	illumination_flag	number	1	Illumination condition flag: 0=dark, 1=bright, 2=twilight, 3=stray light, 4=stray+twilight
18	saa_flag	number	1	South Atlantic Anomaly-flag:0=outside SAA, 1=inside SAA
	Star target			
19	star_id	number	1	Star number in the GOMOS star catalogue
20	star_temperature	K	1	GOMOS star temperature
21	star_magnitude	number	1	GOMOS star magnitude
	Satellite geolocation			
22	orbit_number	number	1	ENVISAT orbit number
23	latitude_satellite	degrees_north	1	Mean latitude of satellite between tangent altitudes 20 and 50 km

24	longitude_satellite	degrees_east	1	Mean longitude of satellite between tangent altitudes 20 and 50 km
25	latitude_satellite_start	degrees_north	1	First measurement satellite latitude
26	latitude_satellite_end	degrees_north	1	Last measurement satellite latitude
27	longitude_satellite_start	degrees_east	1	First measurement satellite longitude
28	longitude_satellite_end	degrees_east	1	Last measurement satellite longitude
	O3 density			
29	o3_density	cm-3	N_{alt}	Ozone number density at tangent altitude
30	o3_density_std	cm-3	N_{alt}	Ozone number density error estimate at tangent altitude
31	o3_density_confidence	number	N_{alt}	Product confidence for o3_density: Value 0 for no flags issued
32	o3_vert_res	km	3	O3 vertical resolution at 30, 35, 40 km from Tikhonov target resolution retrieval. First value applies below 30 km, last value above 40 km. In 30-40 km a linear interpolation between these values.
	NO2 density			
33	no2_density	cm-3	N_{alt}	Nitrogen dioxide number density at tangent altitude
34	no2_density_std	cm-3	N_{alt}	Nitrogen dioxide number density error estimate at tangent altitude
35	no2_density_confidence	number	N_{alt}	Product confidence for no2_density: Value 0 for no flags issued
36	no2_vert_res	km	1	NO2 vertical resolution from Tikhonov target resolution retrieval. Constant in altitude.
	NO3 density			
37	no3_density	cm-3	N_{alt}	Nitrogen trioxide number density at tangent altitude
38	no3_density_std	cm-3	N_{alt}	Nitrogen trioxide number density error estimate at tangent altitude
39	no3_density_confidence	number	N_{alt}	Product confidence for no3_density: Value 0 for no flags issued
40	no3_vert_res	km	1	NO3 vertical resolution from

				Tikhonov target resolution retrieval. Constant in altitude.
	O2 density			
41	o2_density	cm-3	N_{alt}	Oxygen number density at tangent altitude
42	o2_density_std	cm-3	N_{alt}	Oxygen number density error estimate at tangent altitude
43	o2_density_confidence	number	N_{alt}	Product confidence for o2_density: Value 0 for no flags issued
44	o2_vert_res	km	3	O2 vertical resolution at 30, 35, 40 km from Tikhonov target resolution retrieval. First value applies below 30 km, last value above 40 km. In 30-40 km a linear interpolation between these values.
	H2O density			
45	h2o_density	cm-3	N_{alt}	Water vapour number density at tangent altitude
46	h2o_density_std	cm-3	N_{alt}	Water vapour number density error estimate at tangent altitude
47	h2o_density_confidence	number	N_{alt}	Product confidence for h2o_density: Value 0 for no flags issued
48	h2o_vert_res	km	3	H2Overtical resolution at 20, 25, 30 km from Tikhonov target resolution retrieval. First value applies below 20 km, last value above 30 km. In 20-30 km a linear interpolation between these values.
	HRTP density			
49	hrtp_flag	number	1	Flag for hrtp: 0=valid, 1=missing product for restricted altitude coverage, 2= missing product because of daytime measurement
50	altitude_hrtp	km	N_{hrtp}	High resolution temperature altitudes
51	hrtp	K	N_{hrtp}	High resolution temperature profile
52	hrtp_std	K	N_{hrtp}	High resolution temperature profile error estimate at hrtp-altitude
	Aerosol extinction 500 nm			

53	aerext_500	1/km	N_{alt}	Aerosol extinction at 500 nm at tangent altitude
54	aerext_500_std	%	N_{alt}	Aerosol extinction at 500 nm error estimate (%) at tangent altitude
55	aerext_500_confidence	number	N_{alt}	Product confidence for aerext_500: Value 0 for no flags issued
56	aerext_vert_res	km	1	Aerosol extinction vertical resolution from Tikhonov target resolution retrieval. Constant in altitude.
	Retrieval quality		N_{alt}	
57	chi2	number		Chi2 (normalised by the degrees of freedom)
	A prior data			
58	air_density_ecmwf	cm-3	N_{alt}	Neutral number density from ECMWF/MSIS90 at tangent altitude
59	air_pressure_ecmwf	hPa	N_{alt}	Pressure from ECMWF/MSIS90 at tangent altitude
60	air_temperature_ecmwf	K	N_{alt}	Temperature from ECMWF/MSIS90 at tangent altitude
	Metadata			
61	title	string		GOMOS User Friendly Product
62	filename_netcdffile	string		Filename of this file
63	source_file	string		GOMOS Level 2 NL-file used for the production of this file
64	gomos_ipf_version	number		GOMOS_IPF_dataversion
65	gomos_ufp_dataversion	number		GOMOS_UFP_dataversion
66	gomos_ufp_dataversion_issue	string		Issue of ufp_dataversion
67	file_creation_date	date		Date these data were created
68	file_created_by	string		Person responsible name
69	file_created_by_email	string		Person responsible email
70	project	string		Person responsible institute
71	institute	string		Processing institute
72	value_for_nodata	string or number		NaN
73	platform	number		Satellite name
74	instrument	string		Instrument name

4 GOMOS_UFP_gridded

4.1 Introduction

This product is based on GOMOS_UFP, but data are gridded to the altitude grid 1, 2,…, 110 km with a linear interpolation. Profile values with product_confidence>0 are ignored in this interpolation. In addition we have the following changes:

- Occultations with illumination_flag=1 are removed.
- Occultations terminated above 100 km are removed.
- Ozone star_id restrictions (o3_badstars and o3_varbadstars) are coded in the ozone_star_flag. Missing values in the table of Appendix are filled by the nearest available values.
- Information about ozone mixing ratio outliers and truncated ozone profiles are stored in the ozone_strato_flag and ozone_meso_flag.
- Altitude validity ranges are estimated for O3, NO2, NO3 and aerosol extinction in the variable altitude_ranges (see Fig.4-1).
- HRTP and O2 are not included.
- H2O star_id restrictions (h2o_vstars) are coded in the h2o_flag.

For each constituent data are collected to yearly NetCDF4-file. Data are organized as year/gas-directories. File names like 'GOMOS_UFP_gridded_O3_2011v01.nc'are constructed as:

GOMOS_UFP_gridded_gas_year_S+starnumber+v+versionnumber.nc

where gas is one of the list: O3, NO2, NO3, AerExt, H2O. Here AerExt is the aerosol extinction at 500 nm.

Some indications of the individual profile quality can be obtained from the error estimates and chi2-values available in the product. The flags ozone_strato_flag, and ozone_meso_flag provide information about probable outliers and truncated profiles. The stratospheric flag inspects ozone profiles in the range 20-50 km and mesospheric in the range 50-100 km. Profiles are flagged (flag=1) if the mixing ratio (calculated by ECMWF data) exceeds 30 pm or is below -1 pm. A profile is also flagged if more than 30% of the profile in the considered range is missing (flagged or not measured).

Based on statistical analysis of several profiles quality estimates are also available from the flag ozone_star_flag, h2o_star_flag and the variable altitude_ranges. The ozone_star_flag and h2o_star_flag provide the ozone and H2O quality information discussed in connection of table 3-1. The altitude_ranges variable (not available for H2O) is based on statistical analysis using the same star during the same year and in the 20 deg. latitudinal band where the present occultation is taking place. Some missing information is interpolated from the data of the same star at different latitudes and years. The first two values are min and max altitudes from the error estimates (50% as the limit), the last two values are min and max altitudes from t-values (t=2 as the limit).

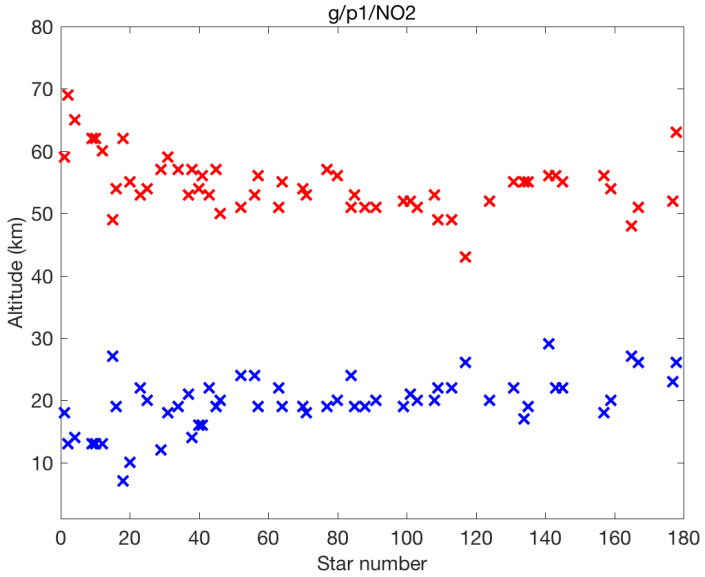

Figure 4-1. Estimated valid altitude ranges for NO2 in 2004 at Equator. Red crosses are upper limits and blue crosses lower limits. The limits are determined from t-value analysis.

4.2 User guidance

1) Best results for all products are obtained with illumination_flag=0 and obliquity<80. All the occultations with illumination_flag different from 0 might not have the highest quality. In case there is a need to include these data, please use them with caution.

2) Best results for O3 are obtained by setting ozone_star_flag=0 or 1. Values with ozone_flag=2 are either from permanently bad ozone stars or variable bad stars (see Section 3.2 Note 2 and Appendix) and cannot be trusted above 40 km. The values below 40 km may also be biased. The presence of outliers and/or truncated profiles is indicated in the ozone_strato_flag and ozone_meso_flag.

3) Best results for O3, NO2, NO3, and AerExt are expected from altitudes inside the altitude limits in the variable altitude_ranges. Ozone in the UTLS may show a positive bias in all cases. Notice that these statistically estimated altitude ranges are not always reliable indicators of the profile quality of individual occultations.

4) H2O results are limited to the specified 8 stars (see Section 3.2).

4.3 GOMOS_UFP_gridded NetCDF4 structure

Table 4-2 GOMOS_UFP_gridded NetCDF4 contents (N=number of profiles, N_g =number of altitude grid levels)

No	Variable	Unit	Dim	Attribute
1	time	days since 0h Jan 1, 1900	Nx1	Time since 1.1.1900. Mean time between tangent altitudes 20 and 50 km
2	latitude	degrees_	Nx1	Mean latitude between

		north		tangent altitudes 20 and 50 km
3	longitude	degrees_ north	N x 1	Mean longitude between tangent altitudes 20 and 50 km
4	altitude_grid	km	N_g	Data are interpolated to this altitude grid
5	density/aerext_500	cm-3 /km-1	N x N_g	Number density/aerosol extinction at 500 nm at tangent altitudes
6	density_std/ aerext_500_std	cm-3 /%	N x N_g	Number density error estimate/aerosol extinction estimate at 500 nm error estimate at tangent altitudes
7	illumination_flag	number	N x 1	Illumination condition flag: 0=dark, 1=bright, 2=twilight, 3=stray light, 4=stray + twilight
8	ozone_star_flag	number	N x 1	Ozone star flag: 0=valid ozone star, 1=variable quality ozone star valid this year, 2=bad star. Available for all gases.
9	ozone_strato_flag	number	N x 1	Outlier detector in 20-50 km. 0=at most one outlier, 1=several outliers and/or truncated profile. Available for all gases.
10	ozone_meso_flag	number	N x 1	Outlier detector in 50-100 km. 0=at most one outlier, 1=several outliers and/or truncated profile. Available for all gases.
11	h2o_star_flag	number	N x 1	H2O_star_flag (only for H2O product): 0=valid H2O profile, 1=non-valid H2O profile
12	altitude_ranges	number	N x 4	Estimated valid altitude ranges from statistical studies for similar conditions (star, year, latitude). The first two values are min and max altitudes from error estimates (50% limit), the last two values are min and max altitudes from t-values (t=2 limit). Not available for H2O.

13	saa_flag	number	N x 1	South Atlantic Anomaly-flag:0=outside SAA, 1=inside SAA
14	vert_res	km	3 (O3, H2O) 1 (NO2, NO3, AerExt)	Vertical resolution from Tikhonov target resolution retrieval. For NO2, NO3 and AerExt constant in altitude. For O3 and H2O resolution is given at three altitude values (*a, b, c*). The first value is true below *a* km, the last value above *c* km. In the transition region *a-b* km a linear interpolation of the first and last value.
	Parameters			
15	orbit_number	number	N x 1	ENVISAT orbit number
16	star_id	number	N x 1	Target star number in GOMOS star catalogue
17	star_temperature	K	N x 1	Target star temperature
18	star_magnitude	number	N x 1	Target star magnitude
19	sza_tangentpoint	degrees	N x 1	Mean solar zenith angle between tangent altitudes 20 and 50 km at tangent point
20	sza_satellite	degrees	N x 1	Mean solar zenith angle at satellite location between tangent altitudes 20 and 50 km
21	obliquity	degrees	N x 1	Obliquity of the occultation: The angle between the orbital plane and line of sight at altitude 35 km
22	chi2	number	N x N_g	Chi2 (normalised by the degrees of freedom)
23	altitude_min	km	N x 1	Minimum tangent altitude reached by the occultation
24	duration	s	N x 1	The duration of the occultation
25	mpv	1.e-6 K m2/(s kg)	N x 1	Modified potential vorticity at 450K surface from ECMWF
	A priori group			
26	air_density_ecmwf	cm-3	N x N_g	Neutral number density from ECMWF/MSIS90 at tangent altitude
27	air_pressure_ecmwf	hPa	N x N_g	Pressure from

				ECMWF/MSIS90 at tangent altitude
28	air_temperature_ecmwf	K	N x N_g	Temperature from ECMWF/MSIS90 at tangent altitude
	Metadata group			
29	title	string		GOMOS User Friendly gridded product
30	constituent	string		Constituent name
31	data filtering	string		Solar zenith at tangent point >97 deg.
32	number of occultations	number		Number of occultations included
33	data_coverage_time_start	date		First measurement date
34	data_coverage_time_start	date		Last measurement date
35	orbit_start	number		First orbit included
36	orbit_end	number		Last orbit included
37	gomos_ipf_version	number		GOMOS Level 2 data version used for UFP_all file
38	gomos_ufp_dataversion	number		UFP_gridded version
39	gomos_ufp_dataversion_issue	string		Issue of ufp_dataversion
40	file_creation_date	date		Date of file creation
41	file_created_by	string		Person responsible name
42	file_created_by_email	string		Person responsible email
43	project	string		Project
44	institute	string		Institute
45	value_for_nodata	string or number		NaN
46	platform	string		Satellite name
47	instrument	string		Instrument name

5 References

GOMOS overview, retrieval, quality

Bertaux, J. L., et al., Global ozone monitoring by occultation of stars: an overview of GOMOS measurements on ENVISAT, Atmospheric Chemistry & Physics, 10: 12091-12148, 2010.

Blanot, L., Ozone Bias and Dark Charge Correction, A1331-TN-003-ACR, 2016a.

Blanot, L. SZA thresholds optimization, A1331-TN-004-ACR, 2016b.

Kyrölä, E., et al., Retrieval of atmospheric parameters from GOMOS data. Atmospheric Chemistry & Physics, 10: 11881-11849, 2010.

Kyrölä, E., Blanot, L., et al, GOMOS-Algorithm Theoretical Basis Document, version 3.0, Tech. rep., ESA, 2012.

Sofieva, V., et al., Retrievals from GOMOS stellar occultation measurements using characterization of modeling errors, Atmos. Meas. Tech.,3, 1019-1027, 2010.

Tamminen, et al., GOMOS data characterization and error estimation. Atmospheric Chemistry & Physics, 10:9505–9519, October 2010.

Tukiainen, S., et al., Retrieval of ozone profiles from GOMOS limb scattered measurements, Atmospheric Chemistry & Physics, 4: 659-667. 2011.

GOMOS O3

van Gijsel et al., GOMOS ozone profile validation using ground-based and balloon sonde measurements, Atmos. Chem. Phys., 10, 10473-10488, 2010.

Kyrölä, E., et al., GOMOS O3, NO2, and NO3 observations in 2002-2008. Atmospheric Chemistry & Physics, 10:7723–7738, August 2010.

Kyrölä, E., et al., Nighttime ozone profiles in the stratosphere and mesosphere by GOMOS on Envisat J. Geophys. Res., 111, D24306, doi:10.1029/2006JD007193, 2006.

GOMOS NO2, NO3

Hauchecorne, A., et al., First simultaneous global measurements of nighttime stratospheric NO2 and NO3 observed by Global Ozone Monitoring by Occultation of Stars (GOMOS)/Envisat in 2003 J. Geophys. Res., Vol. 110, No. D18, D18301, doi: 10.1029/2004JD005711, 2005.

Kyrölä, E., et al., GOMOS O3, NO2, and NO3 observations in 2002-2008. Atmospheric Chemistry & Physics, 10:7723–7738, August 2010.

Hakkarainen, J., et al., Direct comparisons of GOMOS and SAGE III NO_3 vertical profiles. Atmospheric Measurement Techniques, 5:1841–1846, July 2012.

GOMOS aerosols

Vanhellemont, F., et al., Optical extinction by upper tropospheric/stratospheric aerosols and clouds: GOMOS observations for the period 2002-2008. Atmospheric Chemistry & Physics, 10:7997–8009, 2010.

6 Appendix: Variable bad ozone stars

The table shows those bad ozone stars whose quality is changing with time. Value 0 means valid retrievals during this year (statistically estimated), value -1 means "not enough data", and finally value 1 corrupted retrievals.

Star	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
16	-1	0	1	1	1	1	1	1	1	1	1
37	0	1	1	1	1	1	1	1	1	1	1
40	0	0	0	0	1	1	1	1	1	1	1
59	-1	0	0	-1	-1	-1	-1	-1	-1	1	1
71	0	0	0	0	0	0	0	1	1	1	1
86	-1	0	0	0	0	0	0	1	1	1	1
90	0	0	0	-1	0	0	-1	0	0	1	1
101	0	0	1	1	1	1	1	1	1	1	1
103	0	0	0	-1	0	0	0	1	1	1	1
105	-1	0	0	-1	0	1	1	1	1	1	1
111	-1	0	1	1	1	1	1	1	1	1	1
117	0	1	1	1	1	1	1	1	1	1	1
121	0	0	0	-1	1	1	1	1	1	1	1
122	0	0	0	0	1	1	1	1	1	1	1
123	0	0	0	0	0	0	1	1	1	1	1
128	-1	-1	0	0	0	0	-1	0	1	1	1
132	0	0	0	0	1	1	1	1	1	1	1
133	-1	0	1	1	1	1	1	1	1	1	1
134	-1	0	0	0	1	1	1	1	1	1	1
135	0	0	1	1	1	1	1	1	1	1	1
142	0	0	0	1	1	1	1	1	1	1	1
143	0	0	0	0	1	1	1	1	1	1	1
146	-1	-1	0	-1	0	0	0	-1	-1	1	1
155	-1	0	1	1	1	1	1	1	1	1	1
157	0	0	0	0	0	1	1	1	1	1	1
159	0	0	0	1	1	1	1	1	1	1	1
163	0	0	0	0	0	0	0	1	1	1	1
168	-1	0	0	-1	-1	0	1	1	1	1	1
173	0	0	0	-1	1	1	1	1	1	1	1
163	0	0	0	0	0	0	0	1	1	1	1
168	-1	0	0	-1	-1	0	1	1	1	1	1
173	0	0	0	-1	1	1	1	1	1	1	1