

G-HILAT(AO429)MIDTERMREVIEWREPORT: PRELIMINARYASSESSMENTOF THEACCURACYOF THEGOMOS LEVEL2 OZONEPRODUCT

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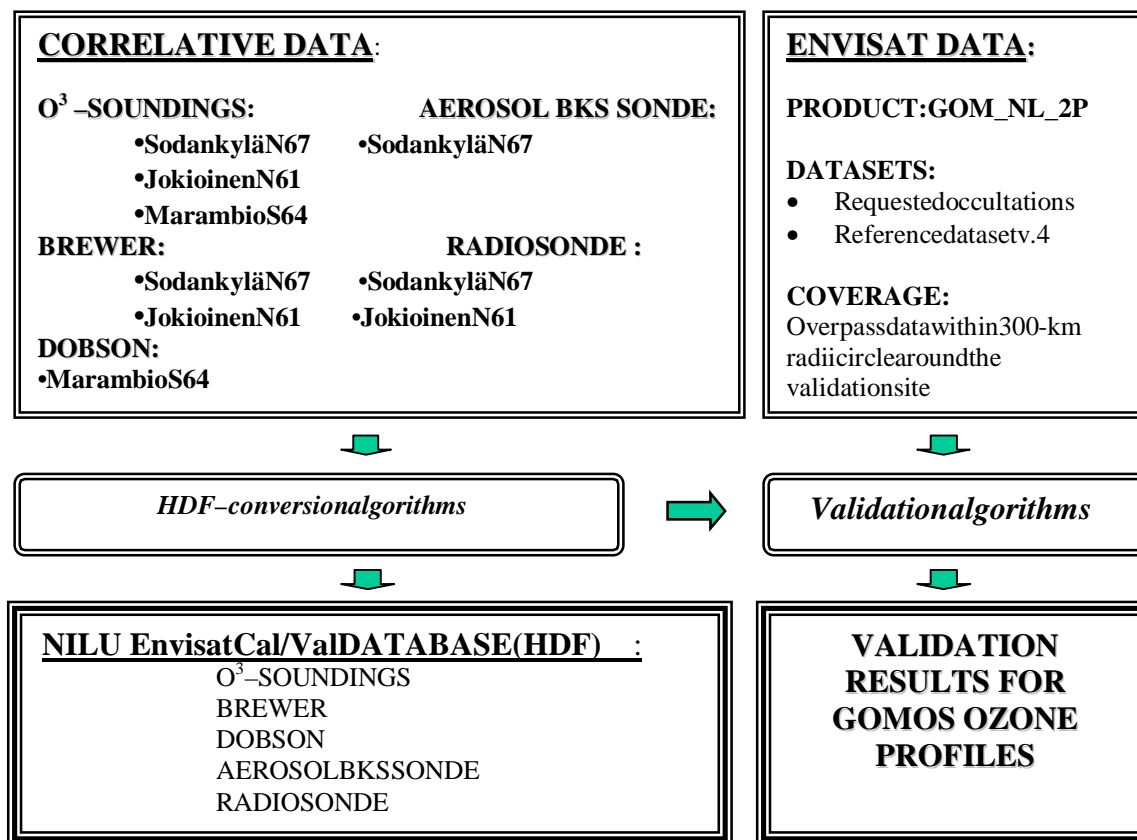
ABSTRACT/RESUME

G-HiLatproject(AO429)assesstheaccuracyofGOMOSL evel2dataproducsathighlatitudeswithspecialemphasis in vertically resolved wintertime ozone data. The mai n tool is an intensive balloon borne validation campai gn at Sodankyla(67N)andJokioinen(61N)observatoriesduringt hecommissioningphase.Thecampaignstartedon15thof August2002andwillendbytheendoftheJanuary2003withaltoget her30collocatedmeasurements.Duetothe inavailabilityoftheprocessedGOMOSdataforcolloca tedsoundingsofourvalidationcampaignwecanonlyofferthe resultsofthestatisticalanalysis,whichwasmadefo rtheglobalreferencedataset(softwareversion5.3). Therresults showforGOMOSdarklimbOzonemeasurementsthefollo wingfindings.Thefirstofallnoobservablebiaswas found. At18–30kmheightinterval,GOMOSozonehasitsbest quality,whenrelative differences are between 15-17%. Above30kmheightrelative differences increase slightly o24%. Under18kmheightlarge deviations are observed, whenrelative differencesuptoseveralhundredpercentm ayoccur.Ingeneral,thequalityofbrightlimbmeasure ments havebeenpoorcomparedtothedarklimb.

1.INTRODUCTION

G-HiLatproject(AO429)assesstheaccuracyofGOMOSL evel2dataproducsathighlatitudeswithspecialemphasis in vertically resolved wintertime ozone data. The mai n tool is an intensive validation campaign at Sodankyla(67 N)and Jokioinen(61N)observatoryduringthecommissioningpha se.Thecampaignstartedon15thofAugust2002andwill endbytheendoftheJanuary2003. Several well-establishe d ground-based instruments including Brewer, SAOZ and ozonesondeshavebeenperformingcoincidentobservations withGOMOS,i.e.tangentpointoftheoccultationnearthe site.Threeotherobservatories,Kiruna(68N),Jokioin en(60N)andMarambio(64S)willcontribute tothev alidation databasewiththeirregularmeasurements.Theozone datafromNiluCal/Valdatabase,isusedfor global asse ssment. Ananalysisofmeteorologicalsituations,mainlyfordia gnosticpurposes,willbeincludedinthedataanalysispa rtofthe project.Afterthecampaign,acarefulassessmentoft heGOMOSinstrumentandalgorithmswillbemade.This reportis anintermediate report and does not include the validatio n campaign results hence the inavailability of processed GOMOSdata.TheprojectstrategyisexplainedintheG-H iLatflowchartshownbelow(Fig.1.).

Figure 1. G-HiLat project flowchart.



2. PREPARATIONS

The preparations for G-HiLat-project started in year 2000. FMI-ARC took part to the both rehearsal campaigns during which the communications with ESA User Service Facility (USF) and NILU Cal/Val database were established. Functioning link to USF was founded without troubles, but with NILU database it was more complicated. There the HDF-file format induced extra work. Especially it was difficult to generate working metadata files for Brewer instrument. Anyhow, these difficulties were settled well before the start of the validation campaign at Sodankylä and Jokioinen and the data has been transferred regularly with these instruments.

During the rehearsal campaigns the Envisat tools, which were provided by the ESA, were installed to workstation devoted for G-HiLat project. This software include EnviView, ESOV and USF Perl interface. All of these software elements are tested in FMI-ARC and they are fully functional. During the preparatory phase a range of other software tools for data handling and Envisat validation were developed. The main part of the FMI-ARC GOMOS validation software is these local software tools, which have been developed with Matlab 6.0 and IDL 5.3. The main utilities are file format converters, readers, plotting algorithms, and statistical tools for GOMOS validation.

3. INSTRUMENTS

The correlative data is produced with both balloon borne in-situ instruments and surface instruments. Balloon borne instruments include ECCO ozone sondes, Vaisala RS90 radio sondes for regular PTU measurements and aerosol sondes for determination of the atmospheric aerosol backscatter profile. Backscatter sondes are operated only in the darkness of polar night and the use of them is planned on the late phase of the validation campaign. Aerosol sonde data will be available from NILU Cal/Val database after the final correction to the data at the home institute of the instrument, The University of Wyoming, USA. Surface instruments include spectrophotometer Brewer and Dobson, which are used to determine the total thickness of overlying ozone layer. This option is used to verify the quality of the ozone

soundings (see tables 2, 3, 4, and 5). Dobson instrument data has been shut down during the early part of the campaign, the data will be uploaded to NILU before end of the year 2002.

4. OBSERVATIONS

The planned validation work in G-HiLat is based on the data obtained with the ozone sonde campaign and the sonde data stored in NILU Cal/Val database. The key to the success is the acquiring of the correlative data with the closest possible collocation. All of the correlative data has been uploaded into the NILU Cal/Val database. Statistics of the data flow have been presented in the table 1.

Table 1. Uploaded files to NILU Cal/Val database

INSTRUMENT	SITE NAME		
	Sodankylä	Jokioinen	Marambio
Ozone sonde	36	9	31
PTU sonde	262	259	-
Brewer	87	95	-

The validation campaign in G-HiLat is based on the proper planning of correlative data acquisition compared to the GOMOS overpasses at the Sodankylä and Jokioinen sites. The selection of occultations, which are compared with the correlative data, is based on the horizontal distance and time difference with respect to the ozone soundings, and synoptic situation. The radius of 300 km around the site and the time frame of two hours are applicable in most meteorological conditions. The ultimate aim was to launch ozone sonde at Sodankylä and Jokioinen sites every time when a GOMOS occultation was in the vicinity. The launch time was adjusted to be approximately one hour before the GOMOS overpass, so that the sonde had time to rise up to 20 km height before the GOMOS measurement. In statistical sense these goals were achieved in the majority of cases. The collocated occultations are listed in the table 2. In the table the processed flag indicates if the occultation is processed and available. There is also a flag, which indicates if it has been requested from ESA. Balloon campaign soundings are listed in the table 3. Overall quality of ozone sounding data is excellent. All data flaws are flagged or the data discarded (also indicated in the table 3.).

The validation campaign over Sodankylä and Jokioinen sites was started on 15th of August 2002 and is still continuing until the end of the January 2003. The campaign was planned for getting 30 co-located observations for GOMOS measurements. The prolonging of the campaign is due to the fact that available GOMOS occultations over the sites have been more sparse than assumed during the campaign planning phase. Anyhow, the goal will be fulfilled well before the end of the January 2003.

During the early phase of the campaign, before the first request for the processed GOMOS data on September, all possible overpasses were utilized. This period consisted mainly on bright limb observations and the quality of GOMOS data was poor. Since that only the dark limb measurements were included, and in the most cases only with the brightest stars of magnitude below 2 or even 1. This has caused a lot of nighttime work for our sounding crew on the later phase of the campaign. GOMOS data from this period is not processed yet.

The other sites, Kiruna and Marambio have participated with their regular observations. The matching soundings with GOMOS observations are referred in the table 2 as accidental hits. The observations of ground based instruments were used for quality check of ozone soundings (See table 3.).

Table2. Collocated occultations during validation campaign 15th Aug – 20th Dec 2002.

Sodankylä(so) *														
GOMOSoccultations[Validationcampaign]														
ORBIT	Star_ID	Time	Date	UTC_Time	Longitude	Latitude	Altitude	Magnit.	Brightlimb	Temp.	GS_dist.	GS_Az	Processed	DataRequest
2400	155	958	15-AUG-2002	18:10:49	23.77	66.72	20	2.90	1	6600	145.6	241.3	1	1
2467	168	962	20-AUG-2002	10:40:58	28.04	68.72	20	2.99	1	11000	160.9	20.2	1	1
2481	168	963	21-AUG-2002	10:09:25	36.29	68.15	20	2.99	1	11000	415.4	73.4	1	1
2937	140	995	22-SEP-2002	6:43:04	28.66	65.65	20	2.83	1	26000	211.0	154.3	1	1
3391		1348.7	23-OCT-2002	23:39:34	23.80	66.20	20	2.83	0	5600	182.1	223.9	0	1
3491		1411.3	30-OCT-2002	23:20:30	29.00	67.50	20	2.83	0	5600	104.5	78.1	0	1
3531		1663.9	02-NOV-2002	18:28:39	23.10	69.70	20	2.04	0	4500	300.4	333.3	0	1
3580			06-NOV-2002	4:42:49	33.80	66.00	20	0.10	0	14000	352.1		0	1
3602		1677.6	07-NOV-2002	17:31:24	30.24	69.30	20	2.04	0	4500	262.0	32.9	0	1
3609		1953.6	08-NOV-2002	5:20:11	21.80	66.90	20	0.10	0	14000	216.6	258.2	0	1
3623		1937.3	09-NOV-2002	4:48:18	27.50	68.10	20	0.10	0	14000	92.8	23.0	0	1
3824	33	2059.4	23-NOV-2002	5:50:41	21.24	66.11	20	1.77	0	30000	275.1	242	0	1
3838	33	2046.2	24-NOV-2002	5:18:51	27.99	67.3	20	1.77	0	30000	59	96.8	0	1
3953	27	2141.6	02-DEC-2002	6:09:18	24.94	68.86	20	1.64	0	26000	180.4	337.9	0	1
3954	146	2364.2	02-DEC-2002	7:53:37	28.60	64.62	20	2.87	0	15200	318.4	162.7	0	1
3967	27	2133.7	03-DEC-2002	5:37:33	32.76	69.75	20	1.64	0	26000	365.1	40.3	0	1
3968	13	3968.0	03-DEC-2002	7:20:20	23.95	67.86	20	0.87	0	3800	126.0	297.0	0	1

Jokioinen(jo)														
GOMOSoccultations[Validationcampaign]														
ORBIT	Star_ID	Time	Date	UTC_Time	Longitude	Latitude	Altitude	Magnit.	Brightlimb	Temp.	GS_dist.	GS_Az	Processed	DataRequest
2888		991.8	18-SEP-2002	20:19:25	20.70	58.60	20	1.17	0	9700	289.0		0	1
2988		998.8	25-SEP-2002	19:59:36	20.10	58.80	20	1.17	0	9700	292.8		0	1

Marambio(ma)														
GOMOSoccultations[Accidentalhits,14Jul-21Aug]														
ORBIT	Star_ID	Time	Date	UTC_Time	Longitude	Latitude	Altitude	Magnit.	Brightlimb	Temp.	GS_dist.	GS_Az	Processed	DataRequest
1937		925.4	14-JUL-2002	10:43:54	296.20	-63.21	20	2.87		15200	366.2		0	1
2222		945.4	03-AUG-2002	8:37:40	297.67	-65.16	20	0.87		3800	285.8		0	1
2223		945.4	03-AUG-2002	10:15:35	308.31	-65.84	20	3.02		22000	296.0		0	1
2279		949.3	07-AUG-2002	8:12:16	297.24	-63.76	20	0.87		3800	298.6		0	1
2380		956.4	14-AUG-2002	9:30:20	303.92	-64.64	20	3.02		22000	55.4		0	1
2478		963.2	21-AUG-2002	5:55:13	304.30	-60.13	20	1.64		26000	459.1		0	1

Table3. Collocated validation campaign ozonesoundings. (Key; BO3=Bad O3, MP=Minor Problem, and OK=Okay)

Ozonesoundings						Plots
Filename	Filename_HDF	Launchtime(utc)	Flag	Note	Filename	
so020815.p17	balloon_sonde.o3_fmi000_sodankyla_s2_20020815t170900z_002.hdf	17:09	OK		So2400_155	
so020820.p11	balloon_sonde.o3_fmi000_sodankyla_s2_20020820t111200z_002.hdf	11:12	OK		So2467_168	
so020821.p11	balloon_sonde.o3_fmi000_sodankyla_s2_20020821t111400z_002.hdf	11:14	OK		So2481_168	
so020922.p06	balloon_sonde.o3_fmi000_sodankyla_s2_20020922t054600z_002.hdf	5:46	MP	BO3above34484m.	So2937_140	
so021023.p24		23:31	OK			
so021030.p23		23:14	OK			
so021102.p17		17:28	MP	BO3above33464m.		
so021106.p04		3:43	OK			
so021107.p17		16:59	OK			
so021108.p04		4:19	OK			
so021109.p05		5:23	OK			
so021123.p05		6:48	OK			
so021124.p04		6:19	OK			
so021202.Q05		7:09	OK			
so021202.Q05		7:09	OK			
so021203.Q06		8:20	OK	Lowburstat62.5hPa(18.4km)		
so021203.Q06		8:20	OK	Lowburstat62.5hPa(18.4km)		

Ozonesoundings						Plots
Filename	Filename_HDF	Launchtime(utc)	Flag	Note	Filename	
jo020918.p17		16:59	OK			
jo020925.p17		17:08	MP	MaybetoohighO3-profile.		

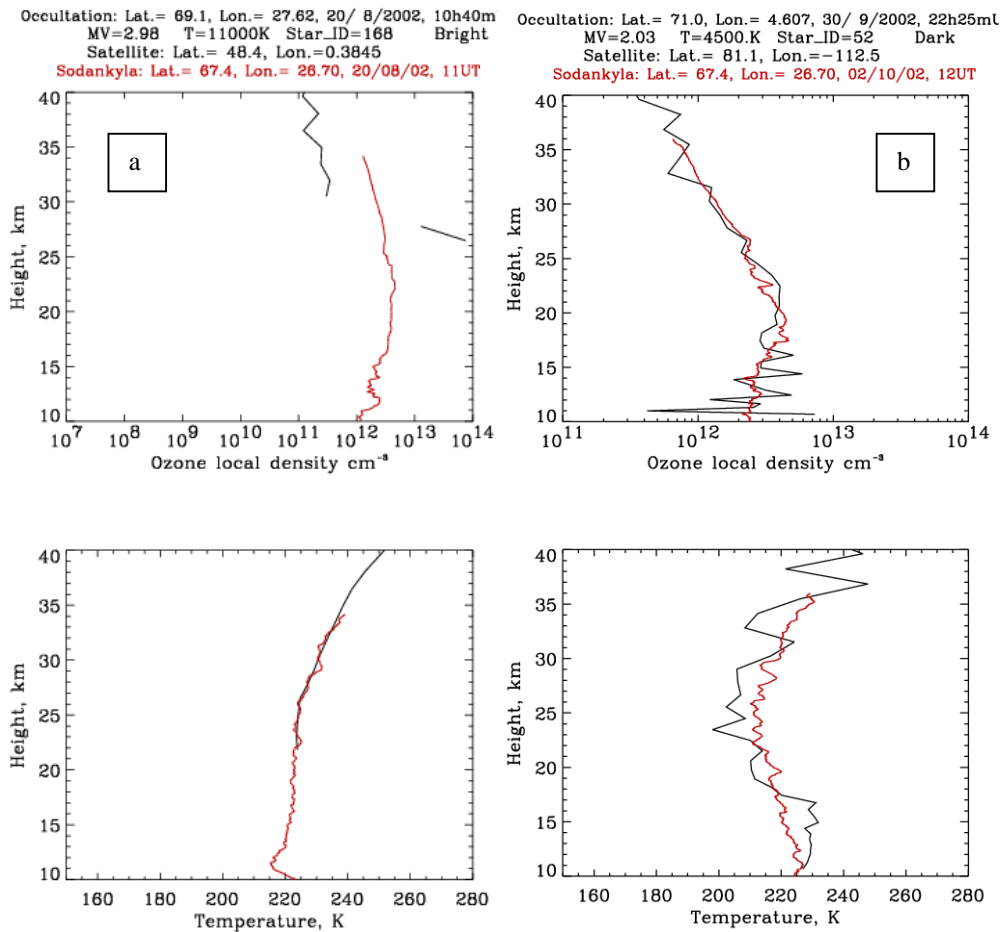
Ozonesoundings						Plots
Filename	Filename_HDF	Launchtime(utc)	Flag	Note	Filename	
ma020714.p11		11:04				
ma020803.p11		11:11				
ma020803.p11		11:11				
ma020807.p11		11:14				
ma020814.p11		11:15				
ma020821.p11		11:08				

5. INTERCOMPARISON RESULTS

As it is known, the late availability of only sparse datasets have delayed analysis activities. For this reason only a preliminary analysis have been made from individual collocations produced by the validation campaign. Anyhow, some statistically-relevant results for quality assessment have been produced from the global referenced dataset (v. 5.3). These results and examples of two individual intercomparisons are represented in this chapter.

5.1 Individual intercomparisons

The bottleneck for utilization of the validation campaign data has been the inavailability of the processed GOMOS data for collocated soundings of our validation campaign. Only such results are from the early phase of validation activities, which consists of only four bright limb collocated occultations. The analysis of this sparse set of measurements is not statistically sensible and the results are not reported here. Instead of this, an example of the quality of the bright limb measurements, one collocated occultation over Sodankylä site on 20.8.2002 is shown herein in Fig 2a. It is clear from the figure 2a. that for the bright limb measurements large oscillations and negative bias are characteristic. If looking at the temperature plot, it is obvious in this case that the temperature profile is derived from the ECMWF-analysis, it is not a GOMOS measurement.



Figs. 2a and 2b. a) GOMOS bright limb measurement over Sodankylä (black) plotted with collocated O₃-sounding (red). b) GOMOS dark limb measurement over Sodankylä (black) plotted with collocated ozone sounding (red)

The performance of GOMOS instrument is clearly better in dark limb measurements (Figure 2b.) compared to the bright limb measurements. There is no observable bias, but the lower stratospheric part of the profile is characterized usually with large oscillations, which grow rapidly with decreasing altitude. Above approximately 20 km GOMOS

follows nicely the ozone sounding profile until the approximate height of 35 km where the GOMOS measurement starts to oscillate slightly more.

5.2 Statistical analysis for dark limb measurements

The main part of the validation work in G-HiLat (AO429) has been done in statistical analysis of the reference dataset (v. 5.3). These GOMOS measurements have been validated against ozone soundings, which have been stored in the NILU Cal/Val database. The criteria for selection of collocated data is based on the horizontal distance and time difference with respect to the ozone soundings. The criteria for horizontal distance is 1000 km distance limit and ± 4 latitude degrees. The time difference criteria is ± 48 hours. In addition, also all bright limb measurement sweres singled out. The previous criteria give 19 for the total number of collocated measurements. This ozone sonde data is from Sodankylä, Payerne, Hohenpeissenberg and Scoresbysund sites. The specifications of collocated occultations are listed in the table 4. and the ozone soundings in the table 5. The analysis does not make difference between the temperature or the magnitude of the stars since the number of the collocated measurements was decided to be not sufficient for this kind of analysis. Though, the temperatures and magnitudes of the stars are reported in the table 4.

Table 4. Collocated occultations from referenced dataset

Hohenpeissenberg(ho)														
GOMOS occultations [Accidental hits, Time +/- 48h, Dist. 1000 km & lat +/- 4 deg., Software version 5.3]														
ORBIT	Star_ID	Time	Date	UTC_Time	Longitude	Latitude	Altitude	Magnit.	Bright limb	Temp.	GS_dist.	GS_Az	Processed	DataRequest
3060	84		30-SEP-2002	20:37:50	21.16	41.73	20	2.40	0	4500	840.2		1	0
3060	84		30-SEP-2002	20:37:50	21.16	41.73	20	2.40	0	4500	840.2		1	0
3075	84		01-OCT-2002	21:46:53	3.40	44.85	20	2.40	0	4500	654.4		1	0
3075	84		01-OCT-2002	21:46:53	3.40	44.85	20	2.40	0	4500	654.4		1	0
Payerne(pa)														
GOMOS occultations [Accidental hits, Time +/- 48h, Dist. 1000 km & lat +/- 4 deg., Software version 5.3]														
ORBIT	Star_ID	Time	Date	UTC_Time	Longitude	Latitude	Altitude	Magnit.	Bright limb	Temp.	GS_dist.	GS_Az	Processed	DataRequest
3061	84		30-SEP-2002	22:18:26	-4.03	44.72	20	2.40	0	4500	885.3		1	0
3061	84		30-SEP-2002	22:18:26	-4.03	44.72	20	2.40	0	4500	885.3		1	0
3075	84		01-OCT-2002	21:46:53	3.40	44.85	20	2.40	0	4500	353.1		1	0
3075	84		01-OCT-2002	21:46:53	3.40	44.85	20	2.40	0	4500	353.1		1	0
Scoresbysund(sc)														
GOMOS occultations [Accidental hits, Time +/- 48h, Dist. 1000 km & lat +/- 4 deg., Software version 5.3]														
ORBIT	Star_ID	Time	Date	UTC_Time	Longitude	Latitude	Altitude	Magnit.	Bright limb	Temp.	GS_dist.	GS_Az	Processed	DataRequest
3061	52		30-SEP-2002	22:25	4.60	71.00	20	2.04	0	4500			1	0
3090	52		02-OCT-2002	23:02:48	-4.58	71.30	20	2.04	0	4500	637.4		1	0
3091	52		03-OCT-2002	0:43:25	-30.01	71.22	20	2.04	0	4500	302.6		1	0
3097	52		03-OCT-2002	10:47:01	-1.30	71.28	20	2.04	0	4500	754.3		1	0
Sodankylä(so)														
GOMOS occultations [Accidental hits, Time +/- 48h, Dist. 1000 km & lat +/- 4 deg., Software version 5.3]														
ORBIT	Star_ID	Time	Date	UTC_Time	Longitude	Latitude	Altitude	Magnit.	Bright limb	Temp.	GS_dist.	GS_Az	Processed	DataRequest
3060	52		30-SEP-2002	20:44:46	32.54	71.34	20	2.04	0	4500	495.1		1	0
3061	52		30-SEP-2002	22:25:22	7.28	71.33	20	2.04	0	4500	867.9		1	0
3074	52		01-OCT-2002	20:13:12	39.19	71.30	20	2.04	0	4500	654.5		1	0
3075	52		01-OCT-2002	21:53:47	13.89	71.29	20	2.04	0	4500	657.6		1	0
3088	52		02-OCT-2002	19:41:36	45.75	71.25	20	2.04	0	4500	859.1		1	0
3089	52		02-OCT-2002	21:22:12	20.60	71.28	20	2.04	0	4500	490.6		1	0
3103	52		03-OCT-2002	20:50:38	27.05	71.18	20	2.04	0	4500	420.5		1	0

Table5.Collocatedozonesoundingswithreferencedata set

Ozonesoundings						
Filename	Filename_HDF	Launchtime(utc)	Flag	Note	Plots	Filename
ho020930.b04	balloon_sonde.o3_dwd001_hohenpeissenberg_s2_20020930t044058z_001.hdf	30-SEP-2002/4:00	OK			ho3060_84_1
ho021002.b04	balloon_sonde.o3_dwd001_hohenpeissenberg_s2_20021002t043900z_001.hdf	02-OCT-2002/4:00	MP	Noozonedataabove8.03hPa.		Ho3060_84
ho020930.b04	balloon_sonde.o3_dwd001_hohenpeissenberg_s2_20020930t044058z_001.hdf	30-SEP-2002/4:00	OK			Ho3075_84
ho021002.b04	balloon_sonde.o3_dwd001_hohenpeissenberg_s2_20021002t043900z_001.hdf	02-OCT-2002/4:00	MP	Noozonedataabove8.03hPa.		ho3075_84_1
Ozonesoundings						
Filename	Filename_HDF	Launchtime(utc)	Flag	Note	Plots	Filename
pa020930.b12	balloon_sonde.o3_mch001_payern_d2_20020930t110400z_001.hdf	30-SEP-2002/12:00	OK			pa3061_84_1
pa021002.b12	balloon_sonde.o3_mch001_payern_d2_20021002t110400z_001.hdf	02-OCT-2002/12:00	OK			Pa3061_84
pa020930.b12	balloon_sonde.o3_mch001_payern_d2_20020930t110400z_001.hdf	30-SEP-2002/12:00	OK			pa3075_84_1
pa021002.b12	balloon_sonde.o3_mch001_payern_d2_20021002t110400z_001.hdf	02-OCT-2002/12:00	OK			Pa3075_84
Ozonesoundings						
Filename	Filename_HDF	Launchtime(utc)	Flag	Note	Plots	Filename
sc021004.t12	balloon_sonde.o3_dmi001_scoresbysund_s2_20021004t113758z_001.hdf	04-OCT-2002/12:00	OK			Sc3061_52
sc021004.t12	balloon_sonde.o3_dmi001_scoresbysund_s2_20021004t113758z_001.hdf	04-OCT-2002/12:00	OK			Sc3090_52
sc021004.t12	balloon_sonde.o3_dmi001_scoresbysund_s2_20021004t113758z_001.hdf	04-OCT-2002/12:00	OK			Sc3091_52
sc021004.t12	balloon_sonde.o3_dmi001_scoresbysund_s2_20021004t113758z_001.hdf	04-OCT-2002/12:00	OK			
Ozonesoundings						
Filename	Filename_HDF	Launchtime(utc)	Flag	Note	Plots	Filename
so021002.p12	balloon_sonde.o3_dmi001_scoresbysund_s2_20021004t113758z_001.hdf	02-OCT-2002/12:00	OK			So3060_52
so021002.p12	balloon_sonde.o3_dmi001_scoresbysund_s2_20021004t113758z_001.hdf	02-OCT-2002/12:00	OK			So3061_52
so021002.p12	balloon_sonde.o3_dmi001_scoresbysund_s2_20021004t113758z_001.hdf	02-OCT-2002/12:00	OK			So3074_52
so021002.p12	balloon_sonde.o3_dmi001_scoresbysund_s2_20021004t113758z_001.hdf	02-OCT-2002/12:00	OK			So3075_52
so021002.p12	balloon_sonde.o3_dmi001_scoresbysund_s2_20021004t113758z_001.hdf	02-OCT-2002/12:00	OK			So3088_52
so021002.p12	balloon_sonde.o3_dmi001_scoresbysund_s2_20021004t113758z_001.hdf	02-OCT-2002/12:00	OK			So3089_52
so021002.p12	balloon_sonde.o3_dmi001_scoresbysund_s2_20021004t113758z_001.hdf	02-OCT-2002/12:00	OK			So3103_52

The analysis for the selected set of data was made inside the height interval from 15 km to 35 km. The limiting height on the top of the layer is the burst level of ozone sonde balloons and the lower boundary is set by the end of GOMOS observation. Because the resolution of compared products is rather different and the number of observations is limited, the standard deviation, STD, (eq. 1.) and the relative difference (eq. 2.) are calculated in 3 km thick height categories. Tabulated values of the analysis is shown in the table 6. and visualised in the panel of figure 3.

$$STD = \sqrt{\frac{\sum (ozone_{sonde} - ozone_{GOMOS})^2}{N}} \quad (1)$$

$$relative_difference = 100 * \sqrt{\frac{\sum \left(\frac{ozone_{sonde} - ozone_{GOMOS}}{ozone_{sonde}} \right)^2}{N}} \quad (2)$$

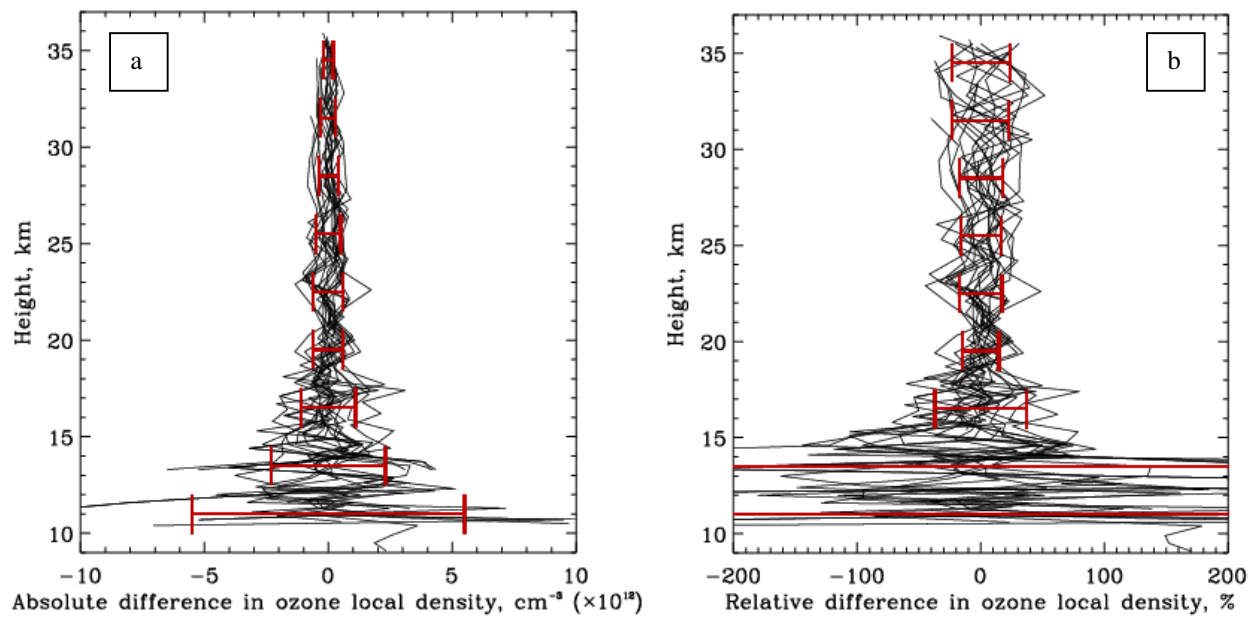


Fig 3. Validation results for reference dataset v.4. a) The absolute difference in ozone local density between GOMOS and sonde measurements ($O^3_{sonde} - O^3_{gomos}$), is plotted as a function of height for each of the 19 comparison (black profiles). STD (eq 1.) is plotted in red for each layer. b) The relative difference in ozone local density is plotted as a function of height for each of the 19 comparison (black profiles). Relative difference (eq.2.) is plotted in red for each layer.

Table 6. Validation results for reference dataset v.4

Layer [km]	Number of samples [N]	Standard deviation, $(mol \times cm^{-3}) \times 10^{-12}$	Relative difference [%]
...-12	49	5.50	687
12-15	89	2.30	224
15-18	91	1.07	37
18-21	67	0.57	15
21-24	57	0.56	17
24-27	51	0.46	16
27-30	42	0.40	17
30-33	40	0.33	23
33-...	28	0.23	24

5.4 Conclusions from the Statistical analysis

Generally, the first indications under the individual profile comparisons are that ozone data acquired in dark limb is reasonable (in particular low bias), and under other circumstances (bright limb) the data quality is poor. The error analysis of bright limb data is not presented here, since the lack of collocated measurements in bright limb and the unrealistic nature of the current results.

Under these circumstances, only the statistical analysis of the dark limb measurements of reference dataset (v. 5.3) is presented here. These GOMOS measurements have been validated against ozone soundings, which have been stored in the NILU Cal/Val database. The total amount of collocated measurements was 19.

From the statistical analysis one can draw the following conclusions for dark limb measurements:

- No observable bias for GOMOS O₃
- At 18–30 km height, GOMOS O₃ has best quality, relative differences between 15–17%
- Above 30 km height, relative differences increase slightly to 24%
- Under 18 km height large deviations, when relative differences up to several hundred%