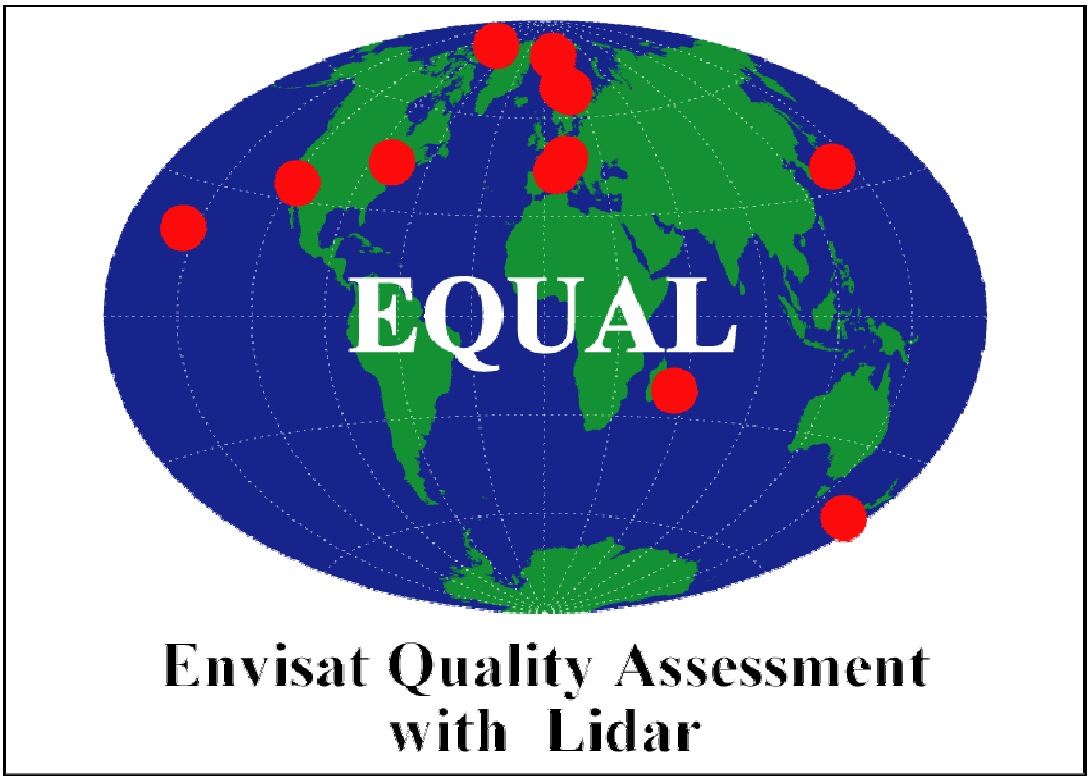
Annual Report

2005



Prepared by: Yasjka Meijer and Daan Swart (RIVM)
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Summary

This is the 2005 annual report of the EQUAL project. This project supports and performs the quality assessment of ozone and temperature profiles retrieved from ENVISAT data using lidar data. In total eleven lidar stations are part of the EQUAL network and they have submitted in HDF-format over 4100 profiles to the correlative database, which is maintained by NILU in Norway.

The availability of ENVISAT data suitable for validation has improved in 2005. For MIPAS, we had data available in version 4.61/4.62. For SCIAMACHY, we had the ESA offline data product starting from November 2004, but no reprocessing of earlier data is available as this product will be revised. For SCIAMACHY, we also resided to 'scientific' data from IFE in Bremen, which have been extensively analyzed. For GOMOS, we received the official ESA data via CD-rom in the period that GOMOS was operational, however this service ceased (data up to 6 August 2005) in view of the mission reprocessing effort by ACRI-ST. Preliminary data processed with ESA's prototype processor at ACRI were available using several different processor settings. These data sets have been extensively validated in order to support the selection of the new level 1-to-2 settings for the mission reprocessing. The results were presented in an EQUAL report and at a dedicated meeting at ACRI-ST in June 2005.

In 2005 we have furthermore focussed on setting up a robust validation approach. For all three instruments we have generated lists of collocated measurements within 800-km radius and 20 hours time difference with a lidar observation. These lists are the basis of all validation activities. RIVM has set up a database with collocated ENVISAT measurements. A tool has been developed to generate HDF files from ENVISAT data, which contain one profile, collocated within 800 km of one of the lidar stations. These data have been distributed among the project partners, facilitating validation activities and easier access to the required data (easier format and smaller data volume). Up to now all available (full-resolution) MIPAS data have been downloaded (2002-2004), and have been converted to HDF. Initial validation of these MIPAS data were presented at the 'MIPAS Validation Papers' meeting in Karlsruhe, Germany from 29-30 November, and will lead to contributions in two joint validation papers which will be part of an ACP, online journal, special issue. SCIAMACHY data of version 2.5 are of insufficient quality to perform in depth analysis, and we have contributed to pre-validation exercises for different new retrieval schemes to be implemented in 2006 in the offline processor. Results were presented in Bremen during a dedicated workshop. In addition, we examined scientific retrievals of SCIAMACHY ozone profiles from IFE. These results revealed two different attitude problems; observed as an altitude shift compared to lidar profiles.

1 Introduction

This is the annual report of the EQUAL project led by RIVM. The objective of this project is to ensure that adequate support is available to the Agency to assess and report on the product quality of ozone and temperature profiles retrieved from ENVISAT data. The project activities will ensure that sufficient expertise and resources are available to acquire and analyze collocated datasets and investigate discrepancies. This includes ensuring availability of adequate tools for data handling and analysis.

The two Work Packages (WPs) in this project involve lidar data submission to the NILU database and validation activities of ENVISAT data with these data. In section 2 the availability of lidar data is presented. The satellite instruments involved are GOMOS, MIPAS and SCIAMACHY, and in particular we are investigating their results regarding ozone and temperature profiles. In section 3 the availability of the ENVISAT data is presented. In section 4 the analysis approach is outlined. In section 5 the validation activities performed in the year 2005 are described. An overview of the EQUAL activities and the project plan has also been presented on the internet and can be accessed at the following URL:

http://www.esa.int/esaLP/SEMPP23AR2E_LPcampaigns_0.html.

2 LIDAR Data

2.1 Overview of Data Submission - Figures

The statistics of the lidar data that have been measured, processed, converted (to HDF) and submitted to the NILU database are shown in **Figure 1** for the ozone profiles and in **Figure 2** for the temperature profiles. Each figure presents per month the number of days with lidar measurements. Note that multiple profiles per day are counted as one in this representation. The first set of panels regard the ozone measurements, while the second part concerns the temperature measurements. In each panel title we have indicated with an acronym the station location (see **Table 1**) and the system name which corresponds to the filename in the NILU database (e.g., files with MSC003 in their name contain ozone profile information and MSC004 temperature profile information, and both for Eureka, Canada).

Table 1. Overview of LIDAR systems: acronyms, locations and parameters

Groundstation	**Acro**	**Lat.**	**Long.**	**Parameter**	**System name**
Eureka	EUR	80.05	-86.42	Ozone, temperature	MSC003, MSC004
Ny Ålesund	NYA	78.92	11.93	Ozone, (temperature)	AWI001, AWI002[#]
Alomar	ALO	69.30	16.00	Ozone, (temperature)	NILU001, NILU002[#]
Esrange	ESR	67.88	21.10	Temperature	UBONN003
Hohenpeissenberg	HOH	47.80	11.02	Ozone, temperature	DWD001, DWD002
Obs. Haute Provence	OHP	43.94	5.71	Ozone, temperature	DIAL_CNRS.SA001, RMR_CNRS.SA001
Toronto	TOR	43.66	-79.40	Ozone	MSC001
Tsukuba	TSU	36.05	140.13	Ozone, temperature	NIES001, NIES002
Table Mountain	TMF	34.40	-117.70	Ozone, temperature	NASA.JPL003 (was CNRS.SA003), NASA.JPL004 (was CNRS.SA002)
Mauna Loa	MLO	19.54	-155.58	Ozone, temperature	NASA.JPL001 (was CNRS.SA004), NASA.JPL002 (was CNRS.SA005)
La Reunion	LAR	-20.80	55.50	Ozone, temperature	LPA001, LPA002
Lauder	LAU	-45.04	169.68	Ozone, (temperature)	RIVM002, RIVM003[#]

[#] Data of these systems are currently not available in the Cal/val database.

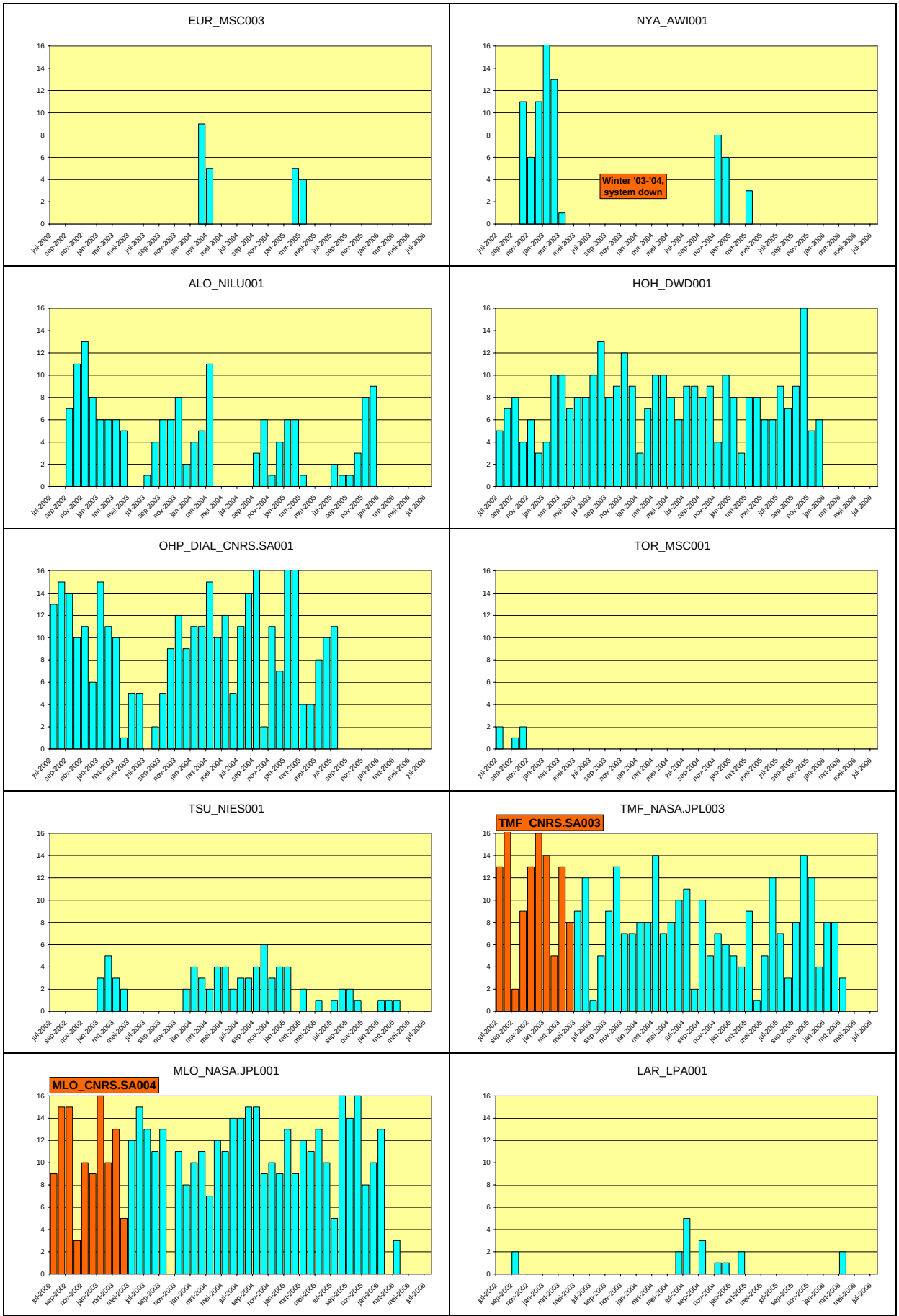


Figure 1. Statistics of available OZONE lidar data in the NILU database. Numbers indicate the number of days per month with lidar measurements. Note that the maximum range for the numbers is fixed to 16 and larger numbers are not displayed (see Table for these values).

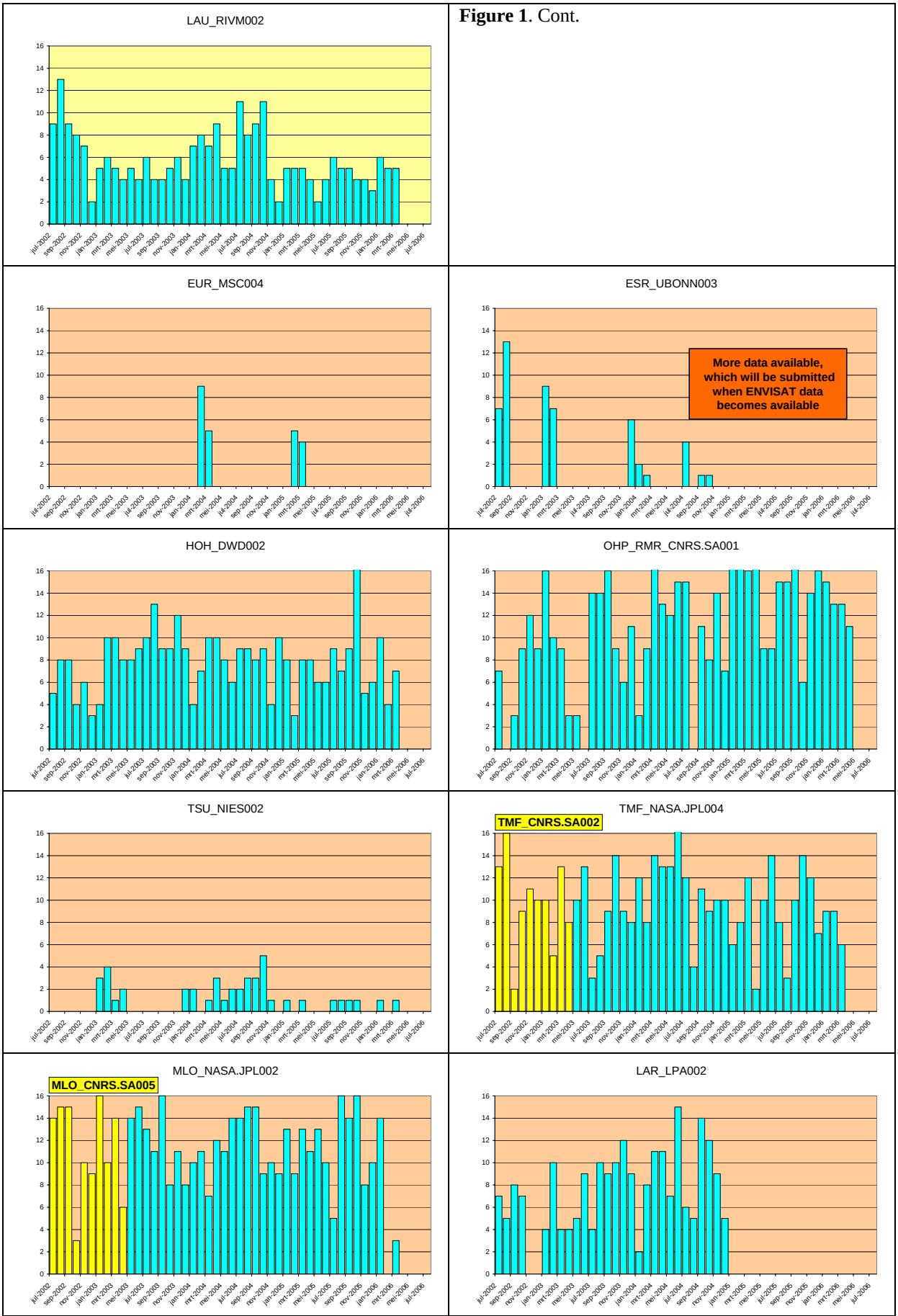


Figure 1. Cont.

Figure 2. Statistics of available TEMPERATURE lidar data in the NILU database. Numbers indicate the number of days per month with lidar measurements. Note that the maximum range for the numbers is fixed to 16 and larger numbers are not displayed (see Table for these values).

2.2 Overview of Data Submission – Tables

In this section we give an overview of the lidar data submitted to the ENVISAT Cal/Val database at NILU in Table form. In **Table 2** we present the number of days (603) with measurements during the Commissioning Phase of ENVISAT, and most of these data have been submitted prior to the EQUAL project. In **Table 3** we present the statistics for the data measured in 2003. Although the EQUAL project formally started in January 2004, the project partners additionally contributed data of 2003 and hence filled the gap between the end of the Commissioning Phase and the start of the project, which is a bonus for the project and amounts in total an extra 1175 days with measurements. In **Table 4** we present the data measured in 2004, which come to a total of 1294 days, and in **Table 5** we present the data measured in 2005, which now come to a total of 1057 days with measurements submitted to the database.

Table 2. Data submission statistics, Commissioning Phase (2002) (in gray temperature lidar systems)

Station	System	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Total
ALO	NILU001	0	0	7	11	13	8	39
ALO	NILU002	0	0	0	0	0	0	0
ESR	UBONN003	7	13	0	0	0	0	20
HOH	DWD001	5	7	8	4	6	3	33
HOH	DWD002	5	8	8	4	6	3	34
LAR	LPA001	0	0	2	0	0	0	2
LAR	LPA002	7	5	8	7	0	0	27
LAU	RIVM002	9	13	9	8	7	2	48
LAU	RIVM003	0	0	0	0	0	0	0
MLO	CNRS.SA004	9	15	15	3	10	9	61
MLO	CNRS.SA005	14	15	15	3	10	9	66
NYA	AWI001	0	0	0	11	6	11	28
NYA	AWI002	0	0	0	0	0	0	0
OHP	l_CNRS.SA001	13	15	14	10	11	6	69
OHP	r_CNRS.SA001	7	0	3	9	12	9	40
TMF	CNRS.SA003	13	16	2	9	11	10	61
TMF	CNRS.SA002	13	17	2	9	13	16	70
TOR	MSC001	2	0	1	2	0	0	5
TOTAL all systems		104	124	94	90	105	86	603

Table 3. Data submission statistics, 2003 (in gray temperature lidar systems)														
Station	**System**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**Jun.**	**Jul.**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Dec.**	**Total**
ALO	NILU001	4	5	11	0	0	0	0	0	3	6	1	4	50
ALO	NILU002	0	0	0	0	0	0	0	0	0	0	0	0	0
ESR	UBONN003	2	1	0	0	0	0	4	0	1	1	0	0	22
HOH	DWD001	3	7	10	10	8	6	9	9	8	9	4	10	108
HOH	DWD002	4	7	10	10	8	6	9	9	8	9	4	10	111
LAR	LPA001	0	0	0	0	0	0	0	0	0	0	0	0	0
LAR	LPA002	2	8	11	11	7	15	6	5	14	12	9	5	90
LAU	RIVM002	7	8	7	9	5	5	11	8	9	11	4	2	58
LAU	RIVM003	0	0	0	0	0	0	0	0	0	0	0	0	0
MLO	CNRS.SA004	16	10	13	5	End	-	-	-	-	-	-	-	44
MLO	NASA.JPL001	-	-	-	Start	12	15	13	11	13	0	11	8	83
MLO	CNRS.SA005	16	10	14	5	End	-	-	-	-	-	-	-	45
MLO	NASA.JPL002	-	-	Start	1	14	15	13	11	16	8	11	8	97
NYA	AWI001	0	0	0	0	0	0	0	0	0	0	0	0	35
NYA	AWI002	0	0	0	0	0	0	0	0	0	0	0	0	0
OHP	l_CNRS.SA001	11	11	15	10	12	5	11	14	18	2	11	7	84
OHP	r_CNRS.SA001	3	9	17	13	12	15	0	0	0	0	0	0	111
TMF	CNRS.SA003	10	5	13	7	End	-	-	-	-	-	-	-	35
TMF	NASA.JPL003	-	-	-	Start	9	12	1	5	9	13	7	7	63
TMF	CNRS.SA002	14	5	13	8	End	-	-	-	-	-	-	-	40
TMF	NASA.JPL004	-	-	Start	1	10	13	3	5	9	14	9	8	72
TSU	NIES001	3	5	3	2	0	0	0	0	0	0	0	2	15
TSU	NIES002	3	4	1	2	0	0	0	0	0	0	0	2	12
TOTAL all systems		146	122	112	63	79	90	75	92	104	92	106	94	1175

Table 4. Data submission statistics, 2004 (in gray temperature lidar systems)														
Station	**System**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**Jun.**	**Jul.**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Dec.**	**Total**
ALO	NILU001	4	5	11	0	0	0	0	0	3	6	1	4	34
ALO	NILU002	0	0	0	0	0	0	0	0	0	0	0	0	0
ESR	UBONN003	2	1	0	0	0	0	4	0	1	1	0	0	9
EUR	MSC003	0	9	5	0	0	0	0	0	0	0	0	0	14
EUR	MSC004	0	9	5	0	0	0	0	0	0	0	0	0	14
HOH	DWD001	3	7	10	10	8	6	9	9	8	9	4	10	93
HOH	DWD002	4	7	10	10	8	6	9	9	8	9	4	10	94
LAR	LPA001	0	0	0	0	0	2	5	0	3	0	1	1	12
LAR	LPA002	2	8	11	11	7	15	6	5	14	12	9	5	105
LAU	RIVM002	7	8	7	9	5	5	11	8	9	11	4	2	86
LAU	RIVM003	0	0	0	0	0	0	0	0	0	0	0	0	0
MLO	NASA.JPL001	10	11	7	12	11	14	14	15	15	9	10	9	137
MLO	NASA.JPL002	10	11	7	12	11	14	14	15	15	9	10	9	137
NYA	AWI001	0	0	0	0	0	0	0	0	0	0	8	6	14
NYA	AWI002	0	0	0	0	0	0	0	0	0	0	0	0	0
OHP	l_CNRS.SA001	11	11	15	10	12	5	11	14	18	2	11	7	127
OHP	r_CNRS.SA001	3	9	17	13	12	15	15	0	11	8	14	7	124
TMF	NASA.JPL003	8	8	14	7	8	10	11	2	10	5	7	6	96
TMF	NASA.JPL004	12	8	14	13	13	17	12	4	11	9	10	10	133
TSU	NIES001	4	3	2	4	4	2	3	3	4	6	3	4	42
TSU	NIES002	2	0	1	3	1	2	2	3	3	5	1	0	23
TOTAL all systems		82	115	136	114	100	113	126	87	133	101	97	90	1294

Table 5. Data submission statistics, 2005 (in gray temperature lidar systems)														
Station	**System**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**Jun.**	**Jul.**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Dec.**	**Total**
ALO	NILU001	6	6	1	0	0	0	2	1	1	3	8	9	37
ALO	NILU002	6	6	1	2	0	0	0	0	1	3	7	8	34
DDU	x?x	0	0	0	0	0	0	0	0	0	0	0	0	0
ESR	UBONN003	0	0	0	0	0	0	0	0	0	0	0	0	0
EUR	MSC003	0	5	4	0	0	0	0	0	0	0	0	0	9
EUR	MSC004	0	5	4	0	0	0	0	0	0	0	0	0	9
HOH	DWD001	8	3	8	8	6	6	9	7	9	16	5	6	91
HOH	DWD002	8	3	8	8	6	6	9	7	9	17	5	6	92
LAR	LPA001	0	2	0	0	0	0	0	0	0	0	0	0	2
LAR	LPA002	0	0	0	0	0	0	0	0	0	0	0	0	0
LAU	RIVM002	5	5	5	4	2	4	6	5	5	4	4	3	52
LAU	RIVM003	0	0	0	0	0	0	0	0	0	0	0	0	0
MLO	NASA.JPL001	13	9	12	11	13	10	5	16	14	16	8	10	137
MLO	NASA.JPL002	13	9	13	11	13	10	5	16	14	16	8	10	138
NYA	AWI001	0	0	3	0	0	0	0	0	0	0	0	0	3
NYA	AWI002	0	0	0	0	0	0	0	0	0	0	0	0	0
OHP	l_CNRS.SA001	17	17	4	4	8	10	11	0	0	0	0	0	71
OHP	r_CNRS.SA001	18	18	16	17	9	9	15	15	20	6	14	16	173
TMF	NASA.JPL003	5	4	9	1	5	12	7	3	8	14	12	4	84
TMF	NASA.JPL004	6	8	12	2	10	14	8	3	10	14	12	7	106
TSU	NIES001	4	0	2	0	1	0	1	2	2	1	0	0	13
TSU	NIES002	1	0	1	0	0	0	1	1	1	1	0	0	6
TOTAL all systems		110	100	103	68	73	81	79	76	94	111	83	79	1057

3 ENVISAT data

In this section we give an overview of the available ENVISAT data for the EQUAL project during 2005 (see **Table 6a, 6b, and 6c**). Note that data might have been (temporarily) available but not acquired within the EQUAL project.

Table 6a. Available ENVISAT Data from IPF Processor

Legend: ..... = potential data, ... = available data, ... = available data at end of 2005.

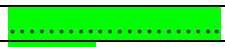
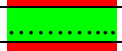
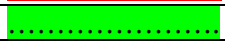
Instrument	2002	2003	2004	2005
GOMOS				
MIPAS				
SCIAMACHY				

Table 6b. Available ENVISAT Data from Prototype Processor

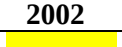
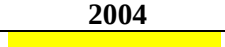
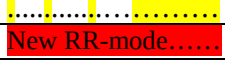
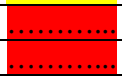
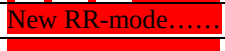
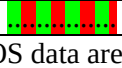
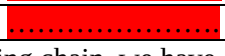
Instrument	2002	2003	2004	2005
GOMOS				
MIPAS				
SCIAMACHY				

Table 6c. Available ENVISAT Data from Scientific Institutes

Instrument	2002	2003	2004	2005
GOMOS*				
MIPAS				
SCIAMACHY				

* As enough GOMOS data are available through the nominal ESA processing chain, we have not tried to get access to 'scientific' data products.

3.1 GOMOS Data

The prototype processor of ESA at ACRI has been used to generate GOMOS data for the year 2003 (GOPR_lv2_6.0a). In addition, we received GOMOS data via CD-rom from D-PAC in Wessling, Germany. These data have been processed with the operational ESA processor version 4.02. We have data over the period 30 May 2004 until 22 January 2005, and from 30 July until 6 August 2005. After August 2005 this service was ceased and waits for a processor upgrade before continuing.

The prototype processor has been used to generate several small data sets in order to verify certain settings on the retrieval outcome. The final settings were determined in June 2005 and ACRI-ST performed the GOMOS mission reprocessing using GOPR 6.0f, equivalent to the future IPF 5.0. These data became available at the end of 2005 containing over 300,000 profiles.

3.2 MIPAS Data

The data from the operational ESA processor have been made available though the D-PAC ftp-site. These data are from MIPAS measurements using the full resolution mode and were processed either with version IPF 4.61 or IPF 4.62. Data are available up to March 2004 when the instrument encountered an anomaly.

MIPAS resumed its operations in January 2005. The measurement strategy has been altered (reduced resolution mode (RR-mode) and as a consequence also the data processing will have to change. This change is expected to be implemented in 2006.

3.3 SCIAMACHY Data

The data from the operational ESA processor are available through the D-PAC ftp-site. These data cover observations since November 2004. As the processor will be upgraded there has been no effort to reprocess archived data and only newly measured data are processed. Some test data for pre-validation were made available from the prototype processor. These data have been evaluated and this will lead to a new retrieval scheme to be implemented in 2006 in the operational processor.

Temperature profiles in the files are climatological values and they are not retrieved. Originally it was foreseen to retrieve temperature information from the infrared channels, but these measurements suffer from ice on the detectors, which makes it impossible to retrieve temperature. The current status

for alternative algorithms using measurements from the other channels is unclear for the operational processor.

In addition, we have contacted the IFE group in Bremen (Germany) for non-operational products (C. von Savigny). These products concern ozone profiles retrieved from limb data covering in total 3121orbits with 1031, 1904 and 186 orbits in 2002, 2003 and 2004, respectively.

4 Validation Approach

4.1 Introduction

The validation approach used in this project has been outlined in 'EQUAL Annual Report 2004' [*Meijer and Swart*, 2005], which as a final preparation result provides lists containing direct pointers to two collocated profiles (i.e., filenames and other directional information). The validation approach and target level 2 data quality have also been mentioned in 'EQUAL Annual Report 2004' [*Meijer and Swart*, 2005]. In this section we only provide an update of the status per instrument.

4.2 Status per Instrument

For GOMOS data coincident with the measurements of the lidar stations in the EQUAL network, the overpass tables and collocation lists have been generated for the complete period between July 2002 and January 2006. The lists are based on planned measurements (RGT files) and they do not take into account instrument unavailability. New lists will be generated in early 2006 using the available reprocessed GOMS data. In order to support the algorithm development of the high-resolution temperature product, we have generated special lists focusing on some near-perfect collocated observations.

For MIPAS data coincident with the measurements of the lidar stations in the EQUAL network, the overpass tables and collocation lists have been generated for the period between July 2002 and April 2004. These lists have been generated using available (and downloaded) MIPAS data that were successfully converted to HDF files.

For SCIAMACHY data coincident with the measurements of the lidar stations in the EQUAL network, the overpass tables and collocation lists have been generated for the complete period between July 2002 and December 2005. We have anticipated receiving data from both the nadir and limb observations of SCIAMACHY. The lists are based on planned measurements available on the SOST website and they do not take into account instrument unavailability. Lists have also been generated based on the available (OL_2P) SCIAMACHY data covering the period after November 2004.

5 Validation Activities

This section describes per instrument the validation activities performed during the year 2005 using lidar data of one of the EQUAL partners. During the EGU general assembly in Vienna, 24-29 April 2005 and at the Aura Science meeting in Den Haag, 8-10 November, we presented general posters [*Meijer et al.*, 2005a] about the EQUAL project and some of the major validation results. A similar overview on ENVISAT validation by lidar was presented during a Latin American lidar conference in Columbia [*Snoeij et al.*, 2005]. In addition, Y.J. Meijer obtained his PhD in January 2005 on his thesis named "Characterization of ozone profiles retrieved from satellite measurements", which contains validation results of GOMOS ozone profiles [*Meijer*, 2005].

5.1 GOMOS Ozone and Temperature Profile Validation

In June 2005 we made a significant contribution to the choice of the processor settings used for the mission reprocessing of GOMOS [*Meijer et al.*, 2005b]. At ACRI (Sophia-Antipolis, France) the complete mission data set has been processed by the end of 2005. The settings for the applied aerosol model would potentially lead to better results for most other species than ozone. Though, as ozone is the main product of GOMOS, these new settings should not have a negative effect on the retrieved ozone product. With a joint effort between members of the GOMOS Quality Working Group (QWG) and RIVM, ESA was presented with the recommendation that the new settings have negligible effects on the ozone profile validation results. In **Appendix 1** we show some of the comparison results using different aerosol models and different cross-section databases. The overall conclusion is that the previously observed minor (2.5%) negative bias has now disappeared and nearly no bias remains.

The validation of the high-resolution temperature profile of GOMOS will start in 2006 when this product is assumed to have improved following some major changes in the new processing algorithm used for the mission reprocessing data set.

5.2 MIPAS Ozone and Temperature Profile Validation

Significant amount of work has gone in the comparison of MIPAS ozone and temperature profiles for the joint validation papers that will be part of a special issue of the Atmospheric Chemistry and Physics (ACP) online journal. Preliminary results were presented and discussed during a dedicated meeting in Karlsruhe, Germany on 29-30 November. The lidar data measured at the Esrange and Alomar stations have been used in more dedicated temperature profile validation and altitude registration studies of MIPAS data. Results are now being finalized and combined in two separate joint papers which will be submitted to ACP in 2006.

5.3 SCIAMACHY Ozone and Temperature Profile Validation

Validation of SCIAMACHY ozone profiles has been quite extensive but also still affected by lack of the operational L2 data. In January we contributed to a paper in ACPD [*Brinksma et al.*, 2005] which was later adapted and accepted for ACP [*Brinksma et al.*, 2006]. In the comparison, results are shown for lidar with SCIAMACHY IPF 2.5. In addition, we have shown results of lidar compared to data retrieved by IFE (Bremen).

The quality of the data from the IPF version 2.5 is still insufficient. ESA decided to develop a complete new algorithm. Several different retrieval schemes were proposed and their results were subjected to a pre-validation. We performed an pre-validation by comparing the results with lidar data. During a dedicated meeting in June at IFE, Bremen the results were presented [*Lolkema*, 2005] and a new processor algorithm was chosen. This algorithm should become operational in 2006.

At the Aura Science meeting in Den Haag, 8-10 November 2005 we presented validation results of the IPF version 2.5 and IFE algorithm version 1.62 data compared to lidar data [*Lolkema et al.*, 2005]. One of the remarkable outcomes, which were presented at this meeting, was that there is an altitude shift varying from the most easterly to the most westerly profile in one state, for both algorithms. A complete overview of these results and other findings will be published in a RIVM report by *Lolkema et al.* in 2006. This will be a report based on the validation efforts for SCIAMACHY ozone profiles which took place as part of an NIVR project led by KNMI and conducted at RIVM by D.E. Lolkema.

6 Conclusions

The aim of this project is to assess the quality of ENVISAT's ozone and temperature profiles with lidar data, and check for possible dependencies on certain parameters. One of the main objectives is to make lidar ozone and temperature profiles available for validation activities. Currently over 4100 profiles are stored in HDF-format in the correlative database at NILU. These profiles are quite evenly spread over the period July 2002 until the end of 2005, and cover several different global regions.

The current status of the validation activities is that all preparations are made for extensive analysis of ENVISAT data. From data of the planned measurements for GOMOS, MIPAS and SCIAMACHY coincidences have been derived with the lidar stations and from the currently available lidar data we have derived listings of collocated measurements. Compared to 2004 there is a significant improvement in the ENVISAT data availability, which resulted in several assessment studies and algorithm development support. In 2006 we will finalize MIPAS and GOMOS ozone profile studies, and for SCIAMACHY a start will be made when the validation reference set is generated with the new processor version. A complete overview of the validation status of each instrument is provided in **Table 7**. In 2005 we have reached all the planned milestones. We will contribute to the next ACVE meeting which is intended to take place at the end of 2006.

Table 7. Validation status of ENVISAT Data from IPF Processor

Legend: ..... = complete assessment, ... = initial assessment, ... = no assessment.

Instrument	Ozone version	Temperature version
GOMOS	GOPR 6.0cf, several intermediate	HRTP from GOPR 6.0cf
MIPAS	IPF 4.61/4.62	IPF 4.61/4.62
SCIAMACHY	IPF 2.5, IPF2.8, IFE 1.62	not applicable

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8 Appendix 1

In this section we present some of the analysis results obtained during the verification of the new prototype processing algorithm which would finally be used for the complete GOMOS mission reprocessing. In **Figure 3** we show the comparison results of GOMOS ozone profiles compared to groundbased observations from ozonesonde, lidar system and microwave radiometers. The data set is exactly the same as the one used in the paper of *Meijer et al.* [2004]. In **Figure 3** we show in the upper panels the results when applying an aerosol law of 1/λ and in the bottom panels for a second order polynomial.

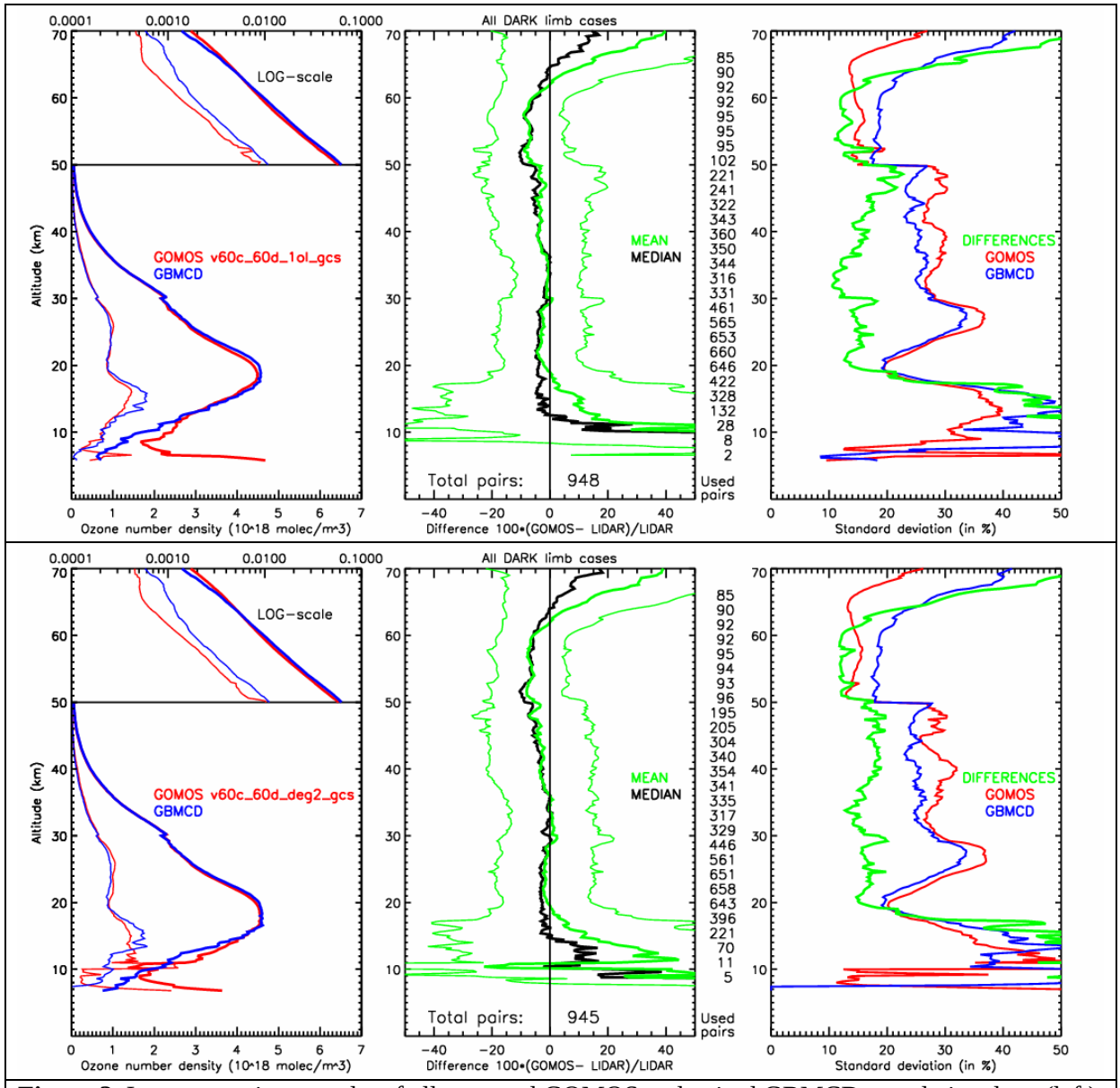

Figure 3. Intercomparison results of all accepted GOMOS and paired GBMCD correlative data. (left). Mean GOMOS (bold red line) and GBMCD (bold blue line) ozone profiles and their standard deviations (thin lines in corresponding colors). Note the logarithmic, instead of linear, scale for the ozone values above 50-km altitude. (middle) Mean (bold green line) and median (black line) differences between all the paired GOMOS and GBMCD data as a percentage of the latter. For the mean profile, we also plotted the (1s) standard deviation of the differences (thin green line). Numbers at the right of the middle panel indicate, for some altitude levels, the number of pairs used at that level. (right) A comparison between the standard deviation of the differences (green line) and the standard deviation of all GOMOS (red line) and GBMCD (blue line) ozone profiles. Upper panels show results for GOMOS when assuming 1/λ and in the bottom panels for a second order polynomial.

In **Figure 4** we show validation results in which two different ozone cross section databases were used in the GOMOS retrieval. The former GOMOS database (bottom panels) was established and based on a database from GOME, and the other database is the latest database provided by IFE Bremen (top panels).

In order to see the effect of using air fixed to ECMWF values or as a retrieval parameter, one should compare the bottom panels of **Figure 3** with the bottom panels of **Figure 4**. Apart from some minor bug fixes, the final algorithm settings for the GOMOS mission reprocessing included air fixed to ECMWF, second order polynomial aerosol model and the new Bremen cross section database for ozone, and hence the results closely related to those presented in the top panels of **Figure 4**.

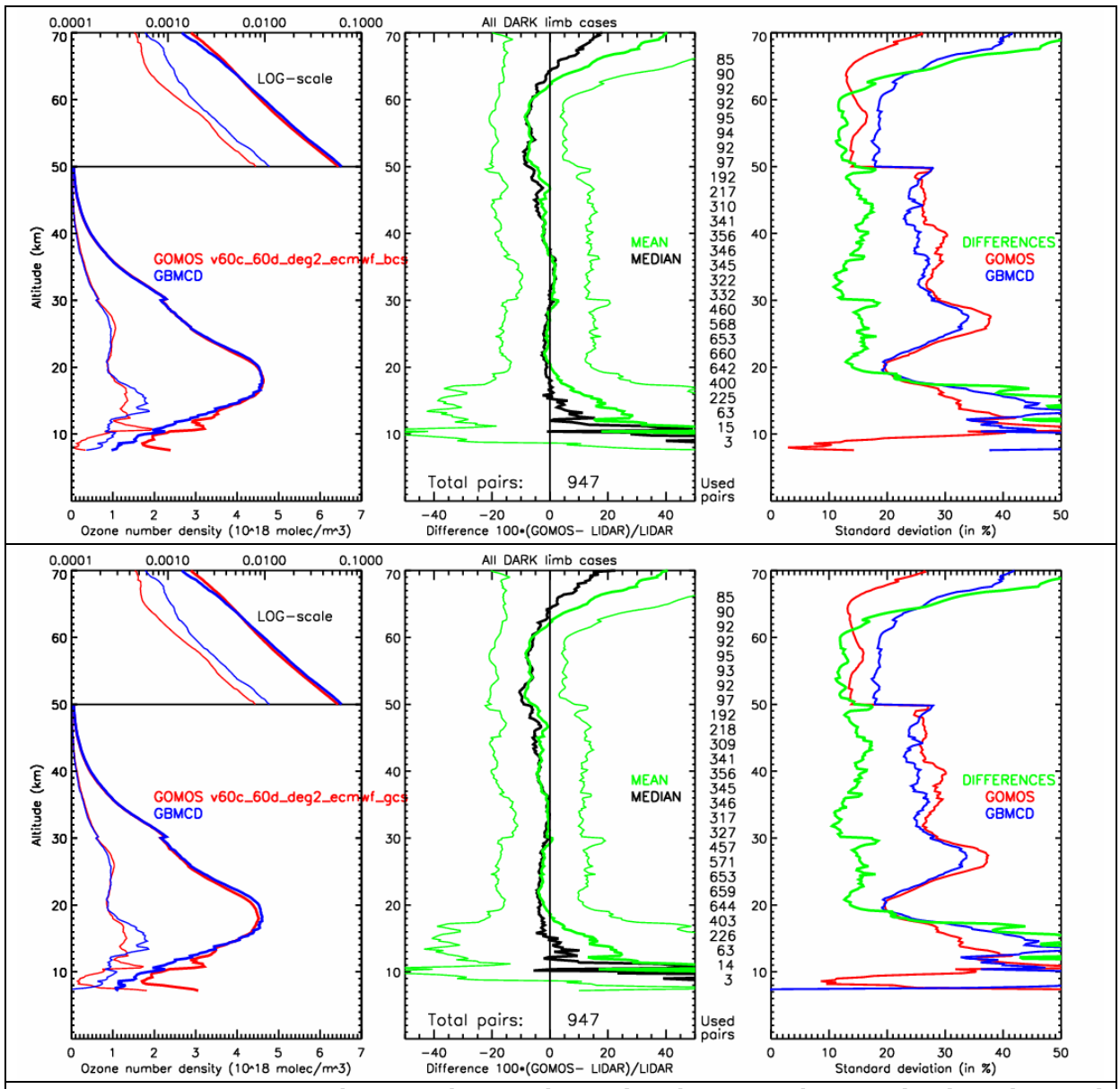

Figure 4. Same as Figure 3, but now showing the results when using the second order polynomial (deg2) wavelength dependence in the aerosol model, air density fixed to the values of ECMWF, and either using the new ozone cross sections of the Bremen (BCS) database (top panels) or the former 'GOMOS' (GCS) database (bottom panels).