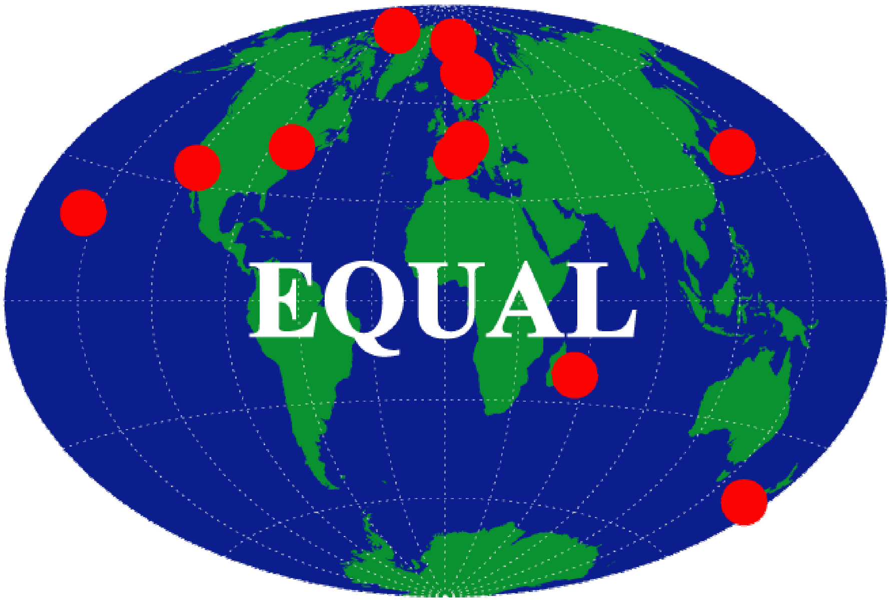
Annual Report

2004



Envisat Quality Assessment with Lidar

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Summary

This is the 2004 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 2000 profiles to the correlative database, which is maintained by NILU in Norway.

The availability of ENVISAT data suitable for validation has been quite limited. For MIPAS, we had no data available but this situation will improve in 2005 as data can now be downloaded by ftp and data are processed by IMK in Karlsruhe. For SCIAMACHY, there was no official data product and we resided to data from IFE in Bremen, but these data reached us at the end of 2004 and have not yet been analyzed. In 2005 the situation will improve, as official ESA offline data products are now becoming available through ftp. For GOMOS, we now regularly receive official ESA data via CD-rom. From these data we could use data generated after September 2004 which reached us at the end of 2004. Data processed with ESA's prototype processor at ACRI were available covering the period July 2002 until April 2003. These data have been extensively validated and results were presented at several conferences and in scientific journals. In dark limb the GOMOS data agree very well with the correlative data, and between 14- and 64-km altitude their differences only show a small (2.5–7.5%) insignificant negative bias with a standard deviation of 11–16% (19–63 km). This conclusion was demonstrated to be independent of the star temperature and magnitude and the latitudinal region of the GOMOS observation, with the exception of a slightly larger bias in the polar regions at altitudes between 35 and 45 km.

In 2004 we have furthermore focussed on setting up a robust validation approach. For all three instruments we have generated lists of all collocated measurements within 1000-km radius and 20 hours time difference with a lidar observation. These lists are the basis of the validation activities concerning the data that will become (and are already becoming) available at the beginning of 2005.

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 are presented. In section 4 the analysis approach is outlined. In section 5 the validation activities performed in the year 2004 are described. An overview of the EQUAL activities and the project plan has also been presented on the internet and can be accessed by going to the URL:

http://www.esa.int/export/esaLP/SEMPP23AR2E_campaigns_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	AWI001
Alomar	ALO	69.30	16.00	Ozone	NILU001
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)	CNRS.SA001, unknown #
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	-21.80	55.50	(Ozone, temperature)	unknown#, unknown #
Lauder	LAU	-45.04	169.68	Ozone, (temperature)	RIVM002, RIVM003#

The data of these systems are currently not available in the NILU database.

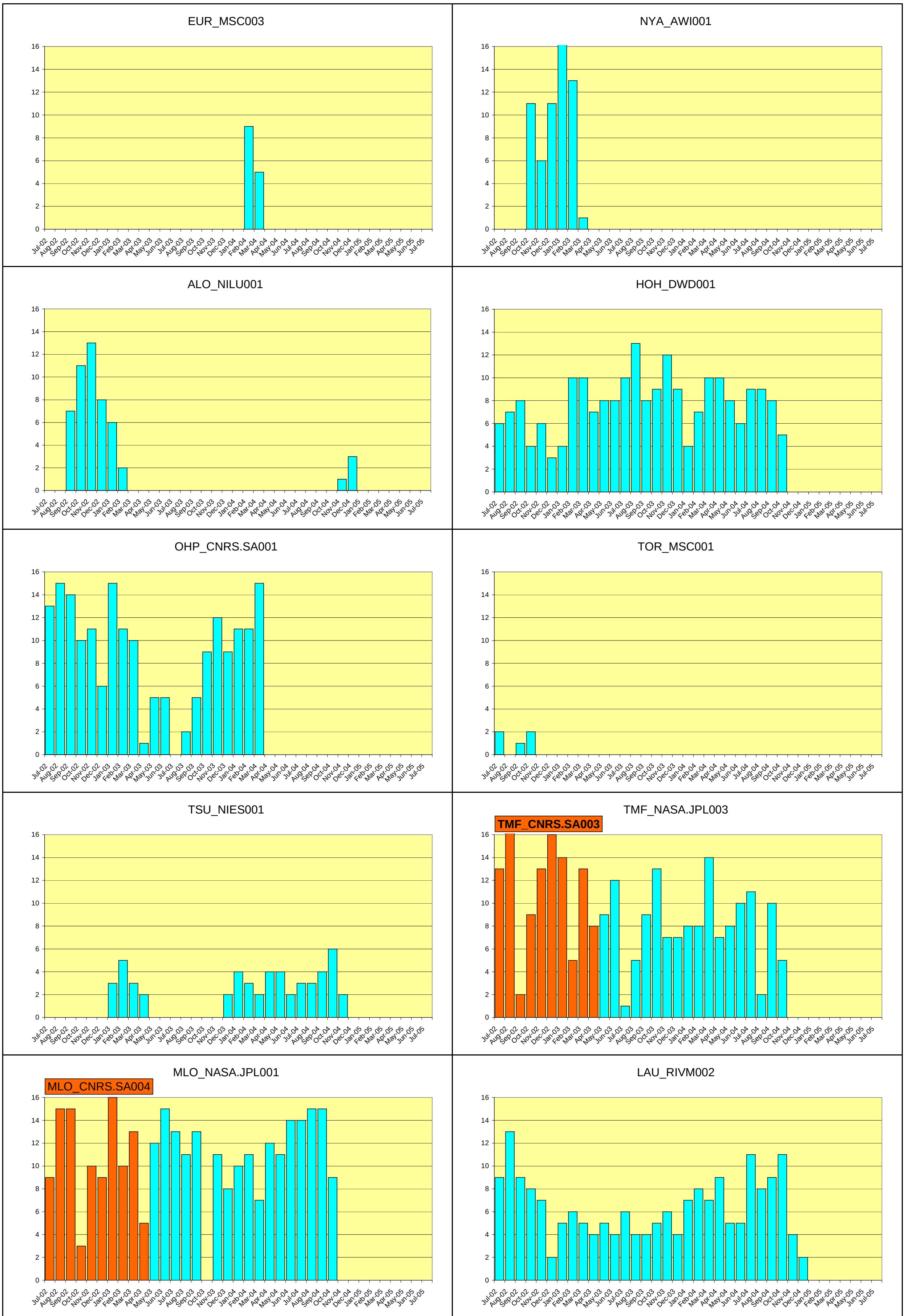

Figure 1. Statistics of available OZONE lidar data in the NILU database. Numbers indicate the number of days per month with lidar measurements. Note that the maximum range for the numbers is fixed to 16 and larger numbers are not displayed (see Table for these values).

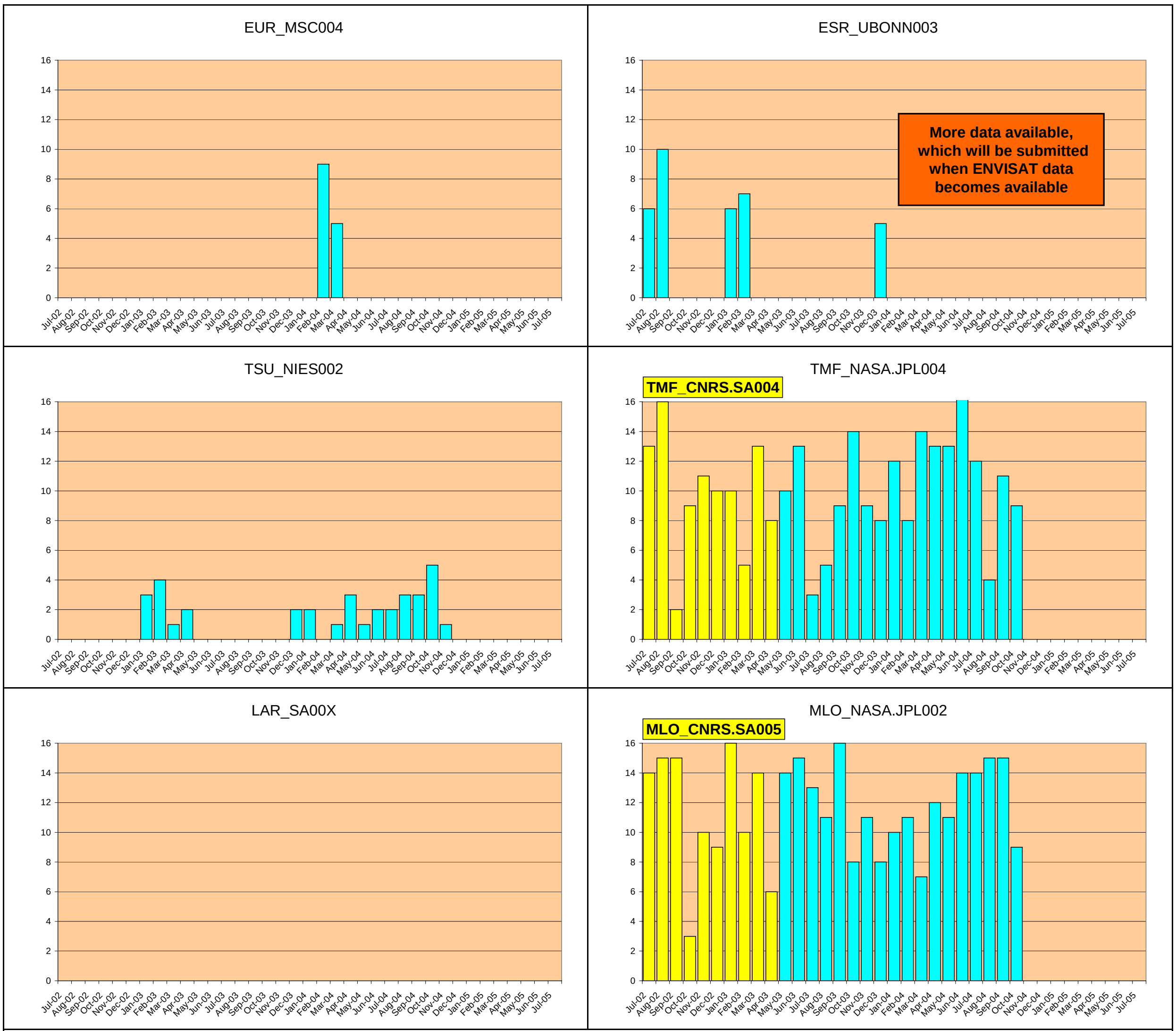

Figure 2. Statistics of available TEMPERATURE lidar data in the NILU database. Numbers indicate the number of days per month with lidar measurements. Note that the maximum range for the numbers is fixed to 16 and larger numbers are not displayed (see Table for these values).

2.2 Overview of Data Submission – Tables

In this section we give an overview of the lidar data submitted to NILU in Table form. In **Table 2** we present the number of days 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 817 days with measurements. In **Table 4** we present the data measured in 2004, which now come to a total of 723 days with measurements submitted to the NILU database.

Table 2. Data submission statistics, Commissioning Phase (2002)

Station	System	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Total
ALO	NILU001	0	0	7	11	13	8	39
ESR	UBONN003	6	10	0	0	0	0	16
HOH	DWD001	6	7	8	4	6	3	34
LAR	Unknown	0	0	0	0	0	0	0
LAR	Unknown	0	0	0	0	0	0	0
LAU	RIVM002	9	13	9	8	7	2	48
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
OHP	CNRS.SA001	13	15	14	10	11	6	69
TMF	CNRS.SA002	13	17	2	9	13	16	70
TMF	CNRS.SA003	13	16	2	9	11	10	61
TOR	MSC001	0	0	0	1	0	0	1
TOTAL all systems		83	108	72	69	87	74	493

Table 3. Data submission statistics, 2003														
Station	**System**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**Jun.**	**Jul.**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Dec.**	**Total**
ALO	NILU001	6	2	0	0	0	0	0	0	0	0	0	0	8
ESR	UBONN003	6	7	0	0	0	0	0	0	0	0	0	5	18
HOH	DWD001	4	10	10	7	8	8	10	13	8	9	12	9	108
LAR	Unknown	0	0	0	0	0	0	0	0	0	0	0	0	0
LAR	Unknown	0	0	0	0	0	0	0	0	0	0	0	0	0
LAU	RIVM002	5	6	5	4	5	4	6	4	4	5	6	4	58
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	21	13	1	0	0	0	0	0	0	0	0	0	35
OHP	CNRS.SA001	15	11	10	1	5	5	0	2	5	9	12	9	84
TMF	CNRS.SA002	14	5	13	8	End	-	-	-	-	-	-	-	40
TMF	NASA.JPL003	-	-	-	Start	9	12	1	5	9	13	7	7	63
TMF	CNRS.SA003	10	5	13	7	End	-	-	-	-	-	-	-	35
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		119	88	83	43	63	72	46	51	64	58	68	62	817

Table 4. Data submission statistics, 2004														
Station	**System**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**Jun.**	**Jul.**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Dec.**	**Total**
ALO	NILU001	0	0	0	0	0	0	0	0	0	0	1	3	4
DDU	XXX	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	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	4	7	10	10	8	6	9	9	8	5	0	0	76
HOH	DWD002	0	0	0	0	0	0	0	0	0	0	0	0	0
LAR	XXX	0	0	0	0	0	0	0	0	0	0	0	0	0
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	0	0	118
MLO	NASA.JPL002	10	11	7	12	11	14	14	15	15	9	0	0	118
NYA	AWI001	0	0	0	0	0	0	0	0	0	0	0	0	0
OHP	CNRS.SA001	11	11	15	0	0	0	0	0	0	0	0	0	37
TMF	NASA.JPL003	8	8	14	7	8	10	11	2	10	5	0	0	83
TMF	NASA.JPL004	12	8	14	13	13	17	12	4	11	9	0	0	113
TOR	MSC001	0	0	0	0	0	0	0	0	0	0	0	0	0
TSU	NIES001	4	3	2	4	4	2	3	3	4	6	2	0	37
TSU	NIES002	2	0	1	3	1	2	2	3	3	5	1	0	23
TOTAL all systems		68	85	87	70	61	70	76	59	75	59	8	5	723

3 ENVISAT data

In this section we give an overview of the available ENVISAT data for the EQUAL project during 2004 (see **Table 5a, 5b, and 5c**). Note that data might have been (temporarily) available but not acquired within the EQUAL project.

Table 5a. Available ENVISAT Data from IPF Processor

Legend: …… = potential data, …… = available data, …… = available data at end of 2004.

Instrument	2002	2003	2004
GOMOS			
MIPAS			
SCIAMACHY			

Table 5b. Available ENVISAT Data from Prototype Processor

Instrument	2002	2003	2004
GOMOS			
MIPAS			
SCIAMACHY			

Table 5c. Available ENVISAT Data from Scientific Institutes

Instrument	2002	2003	2004
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). These data have been made available later in 2004, but unfortunately these data can only be accessed by manually selecting small sets and the whole (level 2) data set was not available. Access to bulk data has been arranged through the DLR ftp-site, but these data were not available in the reporting period.

In addition, we are now regularly receiving GOMOS data via CD-rom from DLR in Wessling. These data have been processed with the official ESA processor with version 4.02. We have data over the period 30 May 2004 until 11 Dec. 2004. However, the analysis has been halted due to incompatibility of about half of the files with the most recent BEAT software version (3.0.0). Investigations revealed that the GOMOS IPF4.02 has been incorrectly configured at the FIN CoPAC at the start of the offline production. This same processor was correctly configured at PDHS-E and K. The incorrect configuration consisted of a wrong REF_DOC field, and the products are to be discarded. As reprocessing activities are underway with a strongly improved processor (GOPR 6.0, equivalent to the future IPF 5.0), the products affected will be reprocessed only with that version.

3.2 MIPAS Data

The official data from the ESA processor have been made available though a ftp site which only stores the most recent data. We have not kept up to date with these (temporarily) available data and hence did not have them available for the project. However, as is the case for the GOMOS data, the MIPAS data are now becoming available through the DLR ftp-site, but these data were not available in the reporting period. Currently MIPAS is slowly resuming its operations after problems that ceased its operations in March 2004. However, the measurement strategy has been altered and as a consequence also the data processing will have to change. This change is not expected to take place soon and for the future measurements only the off-line processing will be performed.

In addition, we have contacted the scientific group of IMK in Karlsruhe (Germany). This group will also process the MIPAS data with their processing algorithm and these data will become available in the near future.

3.3 SCIAMACHY Data

The official data from the ESA processor have only been recently made available though a ftp site, and they are the first offline data products that are available which include ozone and temperature profiles. However, the 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 offline processor.

In addition, we have contacted the IFE group in Bremen (Germany) for scientific 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. As these data reached us at the end of 2004, they will be analyzed in the coming period.

4 Validation Approach

In this section we briefly outline the approach for the validation of ENVISAT data.

4.1 Overpass Tables

The initial validation approach in the project is the generation of lists with performed ENVISAT measurements in the vicinity of the ground-based observations. As a start we have allowed all measurements within a 1000-km radius around the lidar stations. Required input for these tables are lists with metadata information of one specific product (e.g., pixel area for one limb profile). Desired output would be the relevant pointer to this product and the (expected) official filename. The advantage of creating these tables is that they only need to be generated once.

4.2 Collocation Lists

The overpass tables are used to compare these observations to correlative measurements. On the basis of available data in the NILU database we generate lists of collocated observations by allowing a maximum time difference between the two observations. The time criterion is set to 20 hours. The collocation lists can be generated each time when new or more data become available in the NILU database. The lists contain direct pointers to the two collocated profiles (i.e., filenames and other directional information).

4.3 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 December 2004. The lists are based on planned measurements (RGT files) and they do not take into account instrument unavailability.

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 level 1 data currently available at IMK in Karlsruhe and do not necessarily cover all the performed measurements.

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 2004. The lists are based on planned measurements available on the SOST website and they do not take into account instrument unavailability.

4.4 Aim and Use of Collocation Lists

The validation activities start with the ingestion of the collocation lists, which form the maximum number of collocated measurements depending on their availability. On the basis of the information in the available files, the exact differences in measurement location and time are calculated and at this point stricter collocation criteria can be applied. The main advantages are that not all the ENVISAT data have to be ingested to check for potential collocated measurements and that these past events can be finalized in a list rather than reevaluating potential coincidences during each validation exercise.

4.5 Analysis Approach

The comparison of different data sets raises several important issues about their comparability. The differences in retrieved measurement units are accounted for by transforming all data to values of ozone number density versus geometric altitude. To be able to compare both profile sets, we linearly interpolate all profiles to a common altitude grid with 200-m intervals.

Between the profiles there can also be differences in the altitude resolution, and per product we evaluate whether this needs to be taken into account, because this can become very complicated. For example, in the comparisons involving MIPAS data the most appropriate way of comparing these data to other data would be to multiply the lidar profiles with the MIPAS averaging kernels and to incorporate their *a priori* information. However, when comparing the data sets in this manner, then the lidar data has been degraded and moreover they are no longer independent from the MIPAS data. For the comparisons involving lidar and GOMOS ozone data the situation is different, the effects of ignoring the resolution differences are expected to be small, as these data have quite similar resolutions.

The systematic and random differences between the ESA delivered geophysical products and the correlative measurements are analyzed by quantification of absolute and random differences, and identification of error dependencies on certain parameters (e.g. altitude, illumination conditions, season, year, etc.). For example, the quality of GOMOS data is expected to be dependent on the differences in the brightness and temperature in the large ensemble of targeted stars. The analyses are done in a global fashion, and in addition per lidar station. Apart from this statistical approach, some analyses are also performed on a profile-by-profile basis.

In the statistical approach, the data, which are now on a common grid with common units, are now subjected to the quality assessment. From the set of collocated pairs, or any subset of them, we will calculate the mean and the standard deviation of the ENVISAT and lidar profiles. In addition, we calculate the mean, the standard deviation, and the median of their differences; calculated as GOMOS minus lidar data in percentage relative to the latter. Per altitude level the availability of valid data pairs is evaluated (i.e., is there overlap in altitude), and from these data points we derive all of the above quantities.

4.6 Quality Monitoring

The validation results are confronted with the prelaunch expectations of the data quality. Estimates for the precision and accuracy of ENVISAT's ozone and temperature profiles are given in **Table 6**. The data quality is continuously monitored focussing both on aging effects of the instruments and the impact of processor upgrades on the data.

Table 6. Prelaunch Estimates of ENVISAT Data Quality

Instrument	GOMOS[a]		MIPAS		SCIAMACHY	
Product	O_3 profile	T profile	O_3 profile	T profile	O_3 profile	T profile
Precision	0.2 – 1%	1 K	1%	1 K	10%	Unknown
Accuracy	1 – 2%	2K	5%	2K	Unknown	Unknown

a: Estimated precision and accuracy for GOMOS products depend strongly on the star that is observed in occultation, in particular on its intensity and temperature. Two values are therefore presented in Table 6, the first representing values related to Sirius, the second to a star with visual magnitude 2.0.
Source (GOMOS and MIPAS): ENVISAT Calibration and Validation Plan (doc: PO-PL-ESA-GS-1092).
Source (SCIAMACHY): Bovensmann, H., et al., SCIAMACHY: Mission objectives and measurement modes, *J. Atmos. Sci.*, *56*, 127–150, 1999.

5 Validation Activities

This section describes per instrument the validation activities performed during the year 2004 using lidar data of one of the EQUAL partners.

5.1 GOMOS Ozone and Temperature Profile Validation

In April of 2004 we made a significant contribution to the choice of the processor settings used for the reprocessing of the GOMOS mission. At ACRI (Sophia-Antipolis, France) the complete mission data set of 2003 had to be processed. 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 results of the currently operational processor settings (equivalent to GOPR_5.4b), the intermediate settings with the old aerosol model which was also used for the ACVE-2 analysis (indicated with 6.0a) and the new aerosol model (indicated with aer_1ol).

The aer_1ol stands for the model that assumes the aerosol scattering to be proportional to 1 over lambda. The aer_1ol settings are now used in the reprocessing effort performed with the ESA prototype processor at ACRI, which is already completed for the 2003 data set.

During the second Atmospheric Chemistry Validation of ENVISAT (ACVE-2) meeting held at ESA-ESRIN in Frascati, Italy from 3-7 May 2004, we coordinated the validation results of GOMOS ozone profiles **[1]**. In the presented analysis lidar data measured at the Ny Ålesund, Alomar, Hohenpeissenberg, OHP, Toronto, Table Mountain, Mauna Loa and Lauder stations were used. Additionally, lidar data of Lauder were used in the presentation regarding the validation of all three ENVISAT atmospheric instruments compared to data only measured in Lauder **[2]**.

The currently available data that are processed by ESA's processors have version 4.02 (equivalent to GOPR_lv2_5.4b). This version has been extensively validated and the analysis results were presented in an oral presentation at the Quadrennial Ozone Symposium in Kos, Greece, 1-8 June 2004 **[3]**. In addition, a slightly improved version of the analysis was performed on the same data, and this the extensive validation of GOMOS ozone profiles has been published in the Journal of Geophysical Research **[4]**. The same publication is part of the Ph D thesis of Y. J. Meijer that was recently published **[5].**

The lidar data measured at the Esrange station have been used in the validation of the high-resolution temperature profile of GOMOS, and results were presented during the ACVE-2 **[6]**.

5.2 MIPAS Ozone and Temperature Profile Validation

In the comparisons of MIPAS ozone profiles with ground-based measurements there was a contribution of lidar data to two different papers **[2,7]**. The first paper only involves the validation of data measured near Lauder and the second paper concerns on overview paper of MIPAS ozone profile validation using ground-based techniques.

The lidar data measured at the Esrange and Alomar stations have been used in the validation of temperature profiles and altitude registration of MIPAS data, and results were presented during the ACVE-2 **[8,9,10]**.

The general approach for each validation activity is to initially generate lists of collocated measurements. We have approached the MIPAS team and from the IMK-ASF group in Karlsruhe, we have obtained the necessary metadata information of the past MIPAS observations required for creating the collocation lists. These data have not yet been processed but should soon become available.

5.3 SCIAMACHY Ozone and Temperature Profile Validation

Validation of SCIAMACHY ozone profiles has been quite limited due to lack of data, but some analysis were performed and in these studies also lidar data were involved **[2,11]**.

Validation of SCIAMACHY ozone profiles has also started with the generation of collocation lists. We have anticipated receiving data from both the nadir and limb observations of SCIAMACHY. Lists of collocated lidar and SCIAMACHY measurements have been generated for the period between the launch of ENVISAT and the end of 2004. As we have not yet been able to retrieve official ESA data products, we have focussed on IFE data. We are currently setting up the analysis of these data.

An outline of the objectives **[12]** and the validation approach **[13]** have been presented at the SCIAMACHY Validation Workshop in Bremen (6-8 December 2004). At the same workshop equal partner K. H. Fricke presented the validation results of the University of Bonn whom are operating the lidar system at the Esrange in Sweden **[14]**.

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 2000 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 2004, 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.

In 2004 the availability of ENVISAT data has been limited especially for MIPAS and SCIAMACHY data. For GOMOS data the situation was different and a substantial amount of data was available for validation activities based on the July 2002 to March 2003 period, and we have performed an extensive validation of GOMOS ozone profiles. In dark limb these data agree very well with the correlative data, and between 14- and 64-km altitude their differences only show a small (2.5–7.5%) insignificant negative bias with a standard deviation of 11–16% (19–63 km). This conclusion was demonstrated to be independent of the star temperature and magnitude and the latitudinal region of the GOMOS observation, with the exception of a slightly larger bias in the polar regions at altitudes between 35 and 45 km.

In 2005 the situation will improve, as now more ENVISAT data will become and are already available. We will then be able to perform similar analysis on MIPAS and SCIAMACHY ozone profile data. For MIPAS data the analysis will be mainly focussed on data from before the anomaly, because the new measurement strategy results in a later availability of the data. The situation for ENVISAT's temperature profiles is expected to only slightly improve in 2005. For MIPAS we expect to receive temperature profiles from before the anomaly. For SCIAMACHY we do not expect any temperature profiles from the ESA products, but temperature profiles might be available from scientific institutes. For GOMOS there is a project which focuses on retrieving a high-resolution temperature profile (HRTP), but these data are not yet available.

In 2004 we have reached all the planned milestones, which includes the kick-off of the project, a substantial contribution to the ACVE-2 meeting and the publication of a web article on the ESA/ENVISAT website **[15]**. We will contribute to the next ACVE meeting which is intended to take place at the end of 2005. In April 2005 we will present either an oral or a poster presentation at the European Geophysical Union conference in Vienna, Austria.

7 References

[1] GOMOS ozone profile validation using data from ground-based and balloonsonde measurements, Y. J. Meijer, D. P. J. Swart, M. Allaart, S. B. Andersen, G. Bodeker, I. Boyd, G. Braathen, Y. Calisesi, H. Claude, V. Dorokhov, P. von der Gathen, M. Gil, S. Godin-Beekmann, F. Goutail, G. Hansen, A. Karpetchko, P. Keckhut, H. M. Kelder, R. Koelemeijer, B. Kois, R. M. Koopman, J.-C. Lambert, T. Leblanc, I. S. McDermid, S. Pal, G. Kopp, H. Schets, R. Stübi, T. Suortti, G. Visconti, and M. Yela, *Proceedings of the Second Workshop on the Atmospheric Chemistry Validation of ENVISAT (ACVE-2) (ESA-ESRIN, Frascati, Italy 3–7 May 2004)*, ESA SP-562, 2004.

[2] Contributions to ENVISAT data validation from NIWA, New Zealand, S. W. Wood, D. Smale, S. Petrie, I. S. Boyd, P. V. Johnston, K. Kreher & G. E. Bodeker, *Proceedings of the Second Workshop on the Atmospheric Chemistry Validation of ENVISAT (ACVE-2) (ESA-ESRIN, Frascati, Italy 3–7 May 2004)*, ESA SP-562, 2004.

[3] Pole-to-pole validation of GOMOS ozone profiles using data from ground-based and balloon-sonde measurements, Y. J. Meijer, D. P. J. Swart, M. Allaart, S. B. Andersen, G. Bodeker, I. Boyd, G. Braathen, Y. Calisesi, H. Claude, V. Dorokhov, P. von der Gathen, M. Gil, S. Godin-Beekmann, F. Goutail, G. Hansen, A. Karpetchko, P. Keckhut, H. M. Kelder, R. Koelemeijer, B. Kois, R. M. Koopman, J.-C. Lambert, T. Leblanc, I. S. McDermid, S. Pal, G. Kopp, H. Schets, R. Stubi, T. Suortti, G. Visconti, and M. Yela, *Proceedings of the Qudrennial Ozone Symposium 2004 (Kos, Greece 1–8 June 2004)*, p. 101–102 (abstract no. 252), 2004.

[4] Pole-to-pole validation of ENVISAT/GOMOS ozone profiles using data from ground-based and balloon-sonde measurements, Y. J. Meijer, D. P. J. Swart, M. Allaart, S. B. Andersen, G. Bodeker, I. Boyd, G. Braathen, Y. Calisesi, H. Claude, V. Dorokhov, P. von der Gathen, M. Gil, S. Godin-Beekmann, F. Goutail, G. Hansen, A. Karpetchko, P. Keckhut, H. M. Kelder, R. Koelemeijer, B. Kois, R. M. Koopman, G. Kopp, J.-C. Lambert, T. Leblanc, I. S. McDermid, S. Pal, H. Schets, R. Stubi, T. Suortti, G. Visconti, and M. Yela, *Journal of Geophysical Research*, *109*, D23305, doi:10.1029/2004JD004834, 2004.

[5] Characterization of ozone profiles retrieved from satellite measurements, Y. J. Meijer, Ph D Thesis, January 2005.

[6] Validation of GOMOS high resolution temperature data with the U. Bonn lidar at the Esrange during January and February 2003, U. Blum, and K. H. Fricke, *Proc. ACVE-2 (Frascati, Italy 3–7 May 2004)*, ESA SP-562, 2004.

[7] Comparisons of MIPAS O_3 profiles with ground-based measurements, T. Blumenstock, S. Mikuteit, F. Hase, I. Boyd, Y. Calisesi, C. DeClercq, J.-C. Lambert, R. Koopman, S. McDermid, S. Oltmans, D. Swart, U. Raffalski, H. Schets, D. De Muer, W. Steinbrecht, R. Stubi, and S. Wood, *Proc. ACVE-2 (Frascati, Italy 3–7 May 2004)*, ESA SP-562, 2004.

[8] MIPAS temperature validation by radiosonde and lidar, K. H. Fricke, U. Blum, G. Baumgarten, F. Congeduti, V. Cuomo, G. Hansen, L. Mona, H. Schets, K. Stebel, and R. Stübi, , *Proc. ACVE-2 (Frascati, Italy 3–7 May 2004)*, ESA SP-562, 2004.

[9] Validation of MIPAS temperature data with the U. Bonn lidar at the Esrange during July and August 2002, U. Blum, and K. H. Fricke, *Proc. ACVE-2 (Frascati, Italy 3–7 May 2004)*, ESA SP-562, 2004.

[10] Validation of MIPAS temperature data with Alomar RMR-lidar measurements from July 2002 to March 2004, G. Baumgarten, A. Schöch, U. Blum, and K. H. Fricke, *Proc. ACVE-2 (Frascati, Italy 3–7 May 2004)*, ESA SP-562, 2004.

[11] SCIAMACHY ozone profile validation, E. J. Brinksma, A. J. M. Piters, L. S. Boyd, A. Parrish, A. Bracher, C. von Savigny, K. Bramstedt, A.-M. Schmoltner, G. Taha, E. Hilsenrath, T. Blumenstock, G. Kopp, S. Mikuteit, A. Fix, Y. J. Meijer, D. P. J. Swart, G. E. Bodeker, I. S. McDermid, and T. Leblanc, *Proc. ACVE-2 (Frascati, Italy 3–7 May 2004)*, ESA SP-562, 2004.

[12] Envisat Quality Assessment with Lidar; a project to support the long-term validation of SCIAMACHY's ozone and temperature profiles, Y. J. Meijer, presentation at the SCIAMACHY Validation Workshop, Bremen, 6–8 December 2004.

[13] Validation of SCIAMACHY ozone profiles: an extensive approach, D. E. Lolkema, presentation at the SCIAMACHY Validation Workshop, Bremen, 6–8 December 2004.

[14] U. Bonn lidar at Esrange used for SCIAMACHY validation, K. H. Fricke, presentation at the SCIAMACHY Validation Workshop, Bremen, 6–8 December 2004.

[15] Envisat data validation set to continue, Y. J. Meijer and D. P. J. Swart for the EQUAL consortium, http://www.esa.int/export/esaLP/SEMPP23AR2E_campaigns_0.html, 21 December 2004.

Appendix 1.

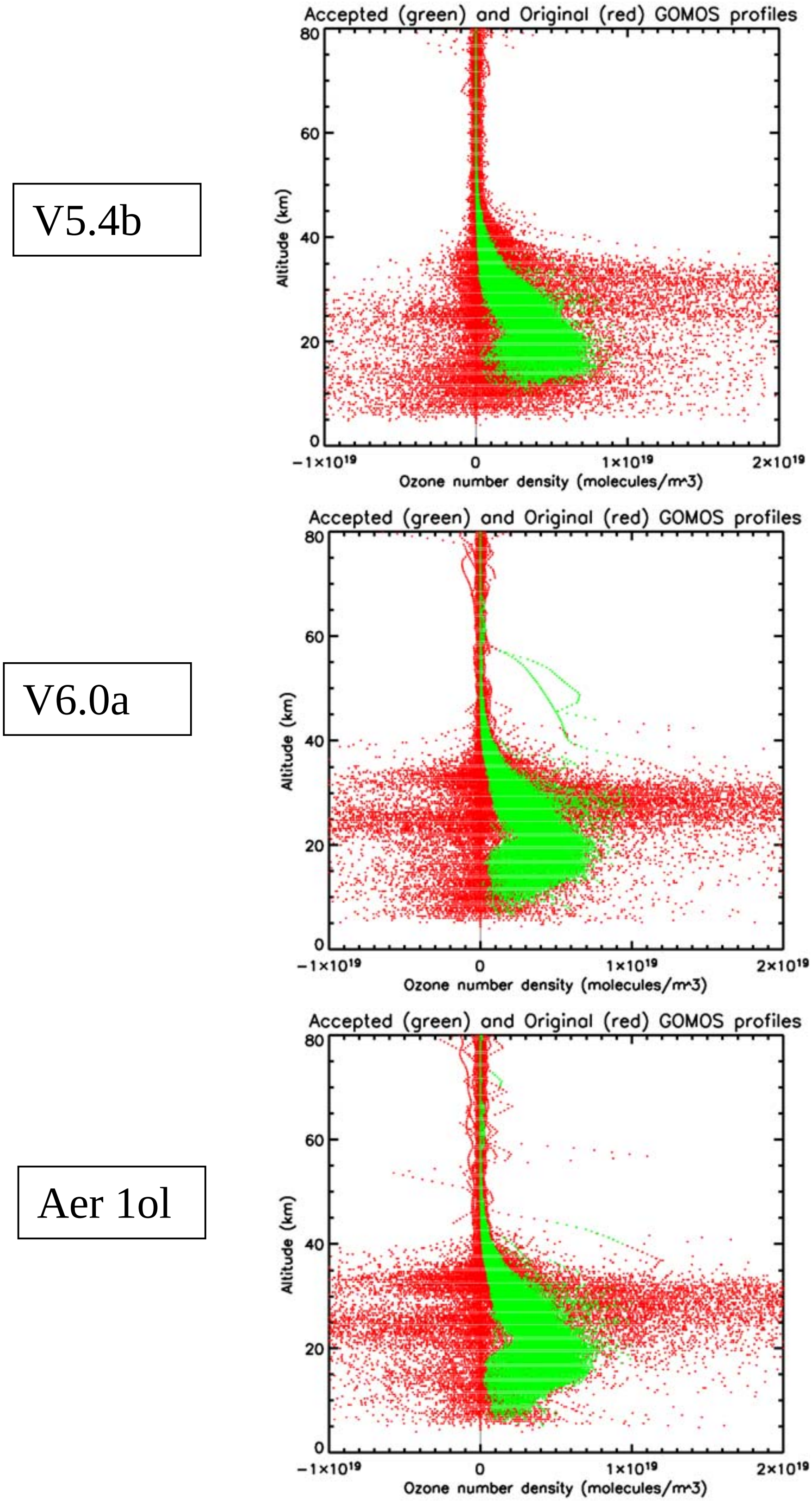

Figure 3. Comparison of the results of 3 types of processor settings (ACRI prototype processor). We have chosen to apply certain quality criteria on the data and in this figure we show the effect of these criteria on the data retrieved with the different processor settings.

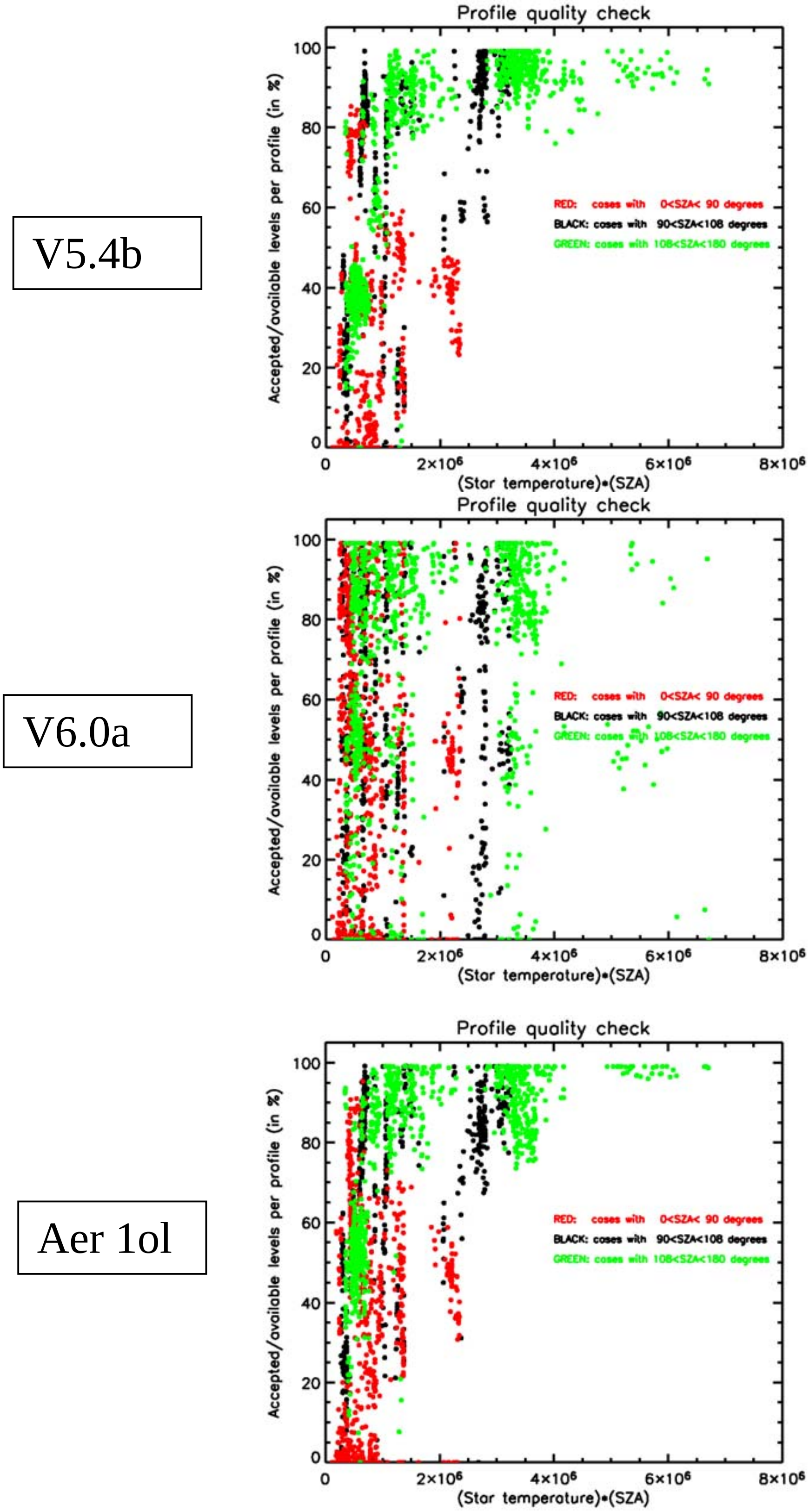

Figure 4. Comparison of the results of 3 types of processor settings (ACRI prototype processor). Analysis of the accepted and original data points as function of star temperature and atmospheric limb condition (expressed in Solar Zenith Angle (SZA)).

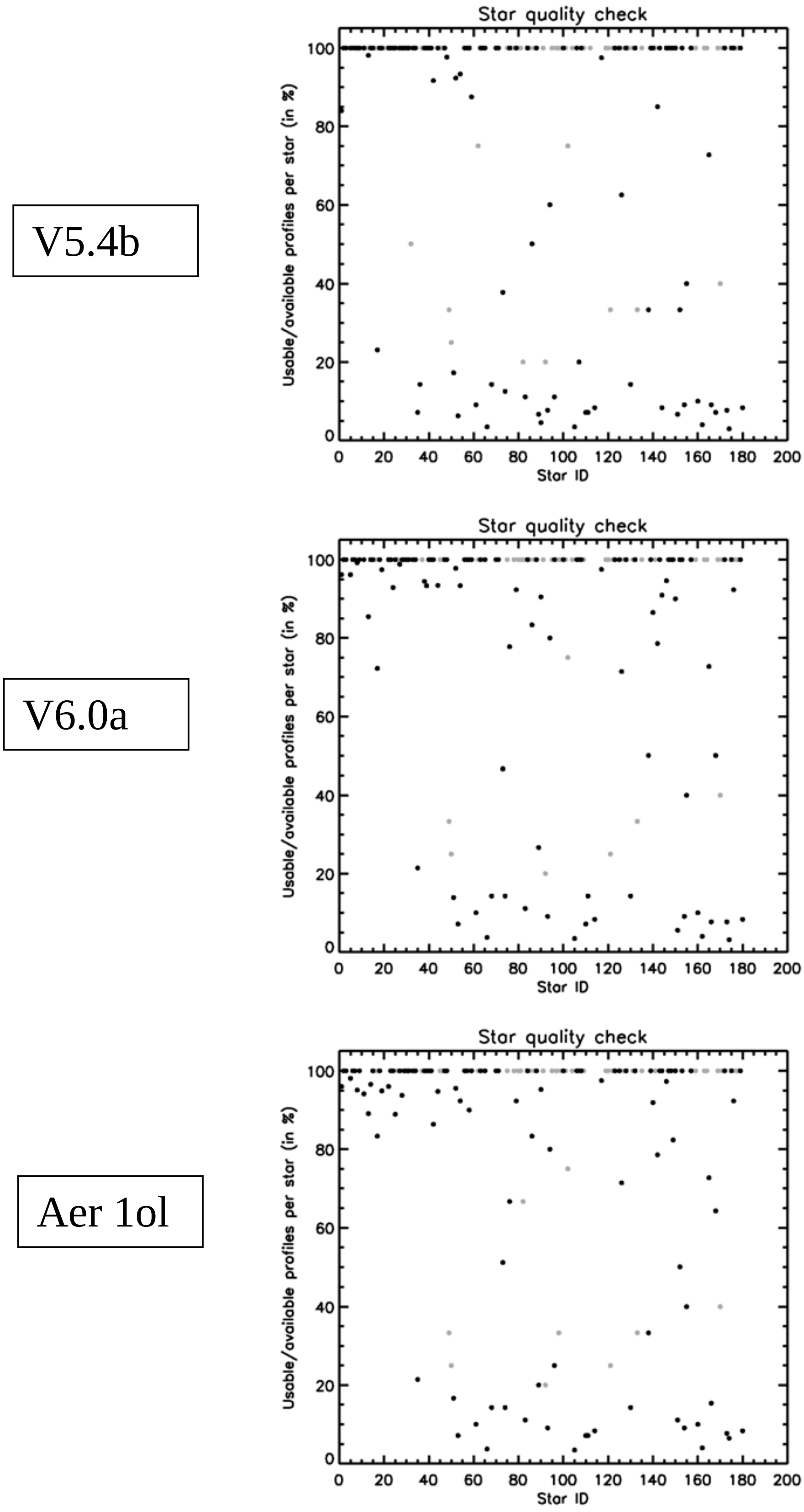

Figure 5. Comparison of the results of 3 types of processor settings (ACRI prototype processor). Analysis of the star quality as function of the star ID number, as some stars resulted in data that were completed rejected.

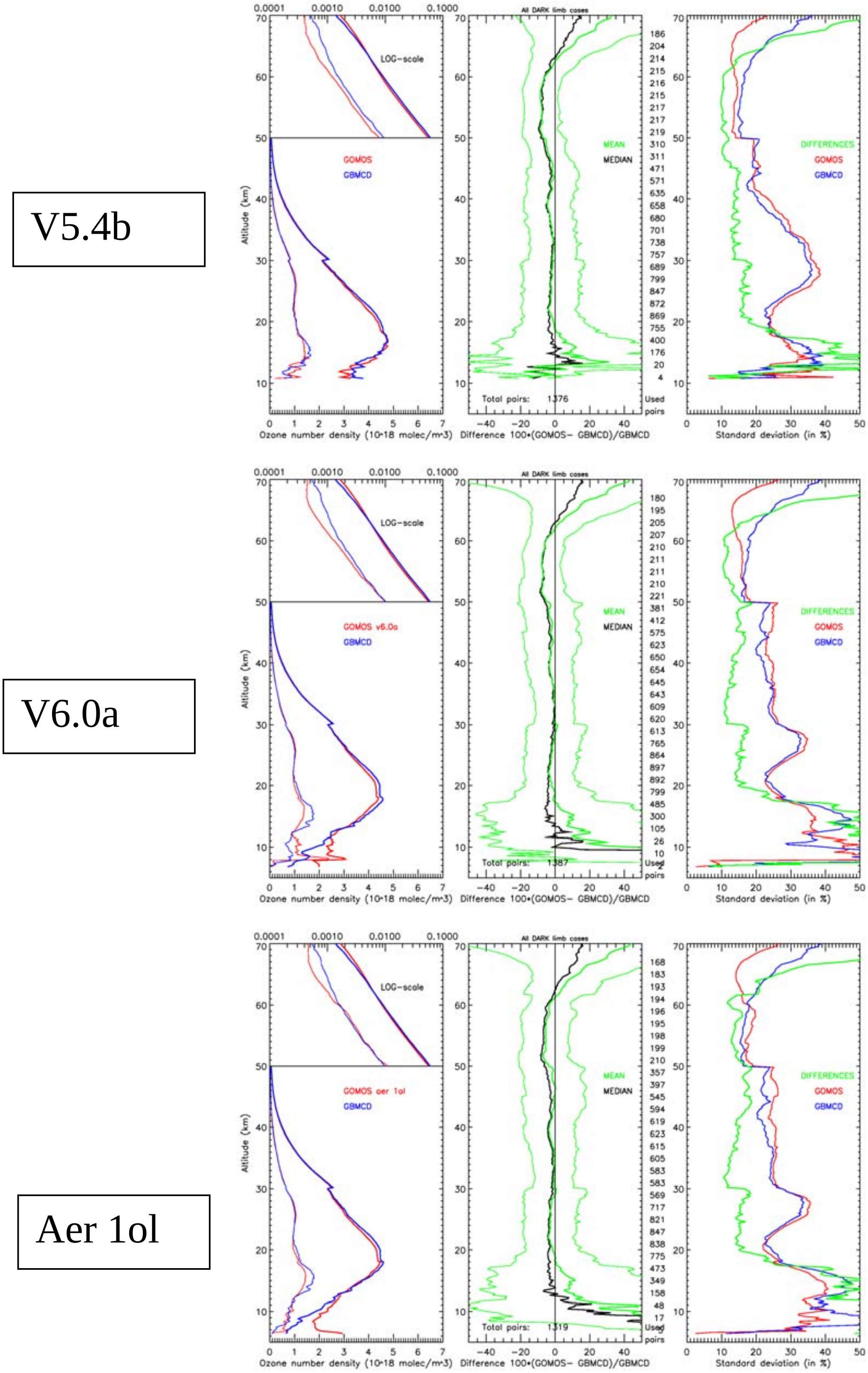

Figure 6. Main analysis results compared to ground-based data. Data shown were measured in a dark atmospheric limb and processed with the three different processor settings of the ACRI prototype processor.