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SCIAMACHY Bi-MONTHLY REPORT: MAY - JUNE 2008

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SCIAMACHY Bi-monthly Report May – June 2008

1 INTRODUCTION

The SCIAMACHY Bi-Monthly report documents the current status and recent changes to the SCIAMACHY instrument, its data processing chain, and its data products.
The Bi-Monthly Report (hereafter BMR) is composed of analysis results obtained by the DPQC, combined with inputs received from the different groups working on SCIAMACHY operation, calibration, product validation and data quality.
The first part of the report is dedicated to Instrument Configuration and Performance. It is composed of contributions from SOST-DLR, SOST-IFE and SRON.
The remainder of the report is dedicated to level 1b and level 2 performance assessment and is generated by ESA/ESRIN DPQC with contributions from ESA/ESTEC PLSO and DLR-IMF.

The structure of the report will be in constant evolution through the ENVISAT mission, as experience with SCIAMACHY data and quality control grows.

1.1 Scope

The main objective of the BMR is to give, on a regular basis, the status of SCIAMACHY instrument performance, data acquisition, results of anomaly investigations, calibration activities and validation campaigns. The BMR is composed of the following six sections:

- Summary;
- Instrument Configuration and Performance;
- Data Availability Statistics;
- Level 1 Product Quality Monitoring;
- Level 2 Product Quality Monitoring;
- Validation Activities and Results.

1.2 References

[1] ‘Instrument Operation Manual’, MA-SCIA-0000DO/01, Issue F R2, 16 Dec. 2004
[2] ‘ENVISAT-1 Products Specifications Volume 15: SCIAMACHY Products Specifications’, PO-RS-MDA-GS-2009, Issue 3, Rev: K, Gianni Sotis, 06 May 2006
[3] ‘SCIAMACHY cL0 Statistics, PO-TN-DLR-SH-0012, Issue 1, Rev. 1 14 April 2005’
[4] SCIAMACHY cL0 Statistics 2003, PO-TN-DLR-SH-0013, Issue 1, Rev. 0 14 April 2005

[5] ‘SCIAMACHY Consolidated Level 0: Statistics for the Year 2005’, PO-TN-DLR-SH-0014, Issue 1, Rev. 0 11 July 2006
[6] ‘Summary of the Atmospheric Chemistry Instrument Validation results as presented at the ACVE-3 Workshop’, Paul Snoeij, Ankie Piters, Herbert Fischer, Yasjka Meijer, Jean-Christopher Lambert, Thorsten Fehr
[7] ‘SCIAMACHY Extra Misalignment Model’, PO-TN-DLR-SH-0016 Issue 1, M. Gottwald, E. Krieg, DLR-IMF, C. von Savigny, S. Noël, K. Bramstedt IUP-IFE, 07 March 2007
[8] ‘Verification of the extra misalignment correction in the SCIAMACHY IPF 6.03 processor’, TN-IUP/IFE-2007-cvs-02, C. von Savigny, A. Dehn, H. Bovensmann, J. Steinwagner IUP-IFE, 05 July 2007
[9] ‘SCIAMACHY SciCal Tool Change of Leakage ADF generation’ ENV-TN-DLR-SCIA-0094, Issue 1.0, Bernd Aberle, Günter Lichtenberg, 08 November 2007

1.3 Acronyms and Abbreviations

ADC	Analogue to Digital Converter
ADF	Auxiliary Data File
ANX	Ascending Node Crossing
AOCS	Attitude and Orbit Control System
APSM	Aperture Stop Mechanism
ASM	Azimuth Scan Mechanism
ATC	Active Thermal Control
BMR	Bi-Monthly Report
CA	Corrective Action
CCA	Communication Area
CTI	Configurable Transfer Item
DAC	Digital Analogue Converter
DLR-IMF	Deutsches Zentrum fuer Luft- und Raumfahrt
DPQC	Data Processing Quality Control
EOL	End of Life
ESM	Elevation Scan Mechanism
FPN	Fixed Pattern Noise
HK	Housekeeping
HSM	High Speed Multiplexer
ICE	Instrument Control Electronics
ICU	Instrument Control Unit
IECF	Instrument Engineering and Calibration Facilities
IOM	Instrument Operation Manual
LK1	Leakage Current Auxiliary File (SCI_LK1_AX)
LLI	Life Limited Item
LOS	Line of Sight
MCMD	Macro Command
MPH	Main Product Header
MPS	Mission Planning Schedule
MR	Monthly Report
NCWM	Nadir Calibration Window Mechanism
NDFM	Neutral Density Filter Mechanism
NIVR	Netherlands Agency for Aerospace Programmes
NNDEC	Non-nominal Decontamination
NRT	Near Real Time
OAR	Observation Anomaly Report
OBM	Optical Bench Module
OCR	Operations Change Request
OSDF	Orbit Sequence Definition File
OSV	Orbit State Vector
PCF	Product Control Facility
PDHS	Payload Data Handling Station (PDS)

PDHS-E	Payload Data Handling Station – ESRIN
PDHS-K	Payload Data Handling Station – Kiruna
PDS	Payload Data Segment
PE1	Pixel to Pixel/ Etalon Auxiliary File (SCI_PE1_AX)
PLSO	Payload Switch OFF
PMD	Polarization Measurement Device
QUADAS	Quality Analysis of Data from Atmospheric Sounders
QWG	Quality Working Group
SAA	South Atlantic Anomaly
SCIAMACHY	Scanning Imaging Absorption Spectrometer for Atmospheric Chartography
SCICAL	SCIAMACHY Calibration tool
SEU	Single Event Upset
SLS	Spectral Line Source
SM	Service Module
SMR	Sun Mean Reference
SOST	SCIAMACHY Operations Support Team
SP1	Spectral Calibration Auxiliary File (SCI_SP1_AX)
SU1	Sun Reference Auxiliary File (SCI_SU1_AX)
SZA	Sun Zenith Angle
TC	Thermal Control
TCFoV	Total Clear Field of View
TOA	Top of Atmosphere
TRUE	Tangent height Retrieval by UV-B Exploitation
VCD	Vertical Column Density
WLS	White Light Source
WUR	Wageningen University and Research
YSM	Yaw Steering Mode

2 SUMMARY

- During the reported period SCIAMACHY measurements were nominal with respect to planning, besides one unavailability period during following orbits starting at the end of the reporting period:

  - 33121 - 33129 (30 June - 01 July 2008) ENVISAT planned OCM manoeuvre

- During analysis of the reprocessed data set Level 1b version IPF 6.03, it was found that for limited data sets The D1 solar reference spectra were not updated D1 spectra are not used for operational Level 1b – level 2 offline processing but D0. (see details chapter 5.1.2)

- Monthly Calibration was executed during Orbits:

  - 32517-32521 (19/20-May-2008)
  - 32947-32951 (18/19-Jun-2008)

- Following occultation measurements with the moon rising on nightside were executed:

  - 32432-32504 (13-May-2008 until 18-May-2008)
  - 32883-32918 (14-Jun-2008 until 16-Jun-2008)

- Three OCRs were implemented:

  - 32092 - 32493 (20 April – 18 May 2008)
  (OCR_035: Cluster 16 and 18 short integration times)
  - 33108 - 33309 (30 June – 13 July 2008)
  (OCR_33: Improved limb coverage during ECOMA4 campaign)
  - 32607 - 33122 (26 May – 30 June 2008)
  (OCR_34: Improved limb coverage for the Teresina balloon campaign)

- No TC adjustments was required

- Light Path monitoring:

  - Channel 1&2: degradation in UV for all light paths involving ESM increases with a rate of about 1 % per month. The average throughput loss in channel 1 is currently ca. 46%.

- Channel 3 small throughput loss (about 4%)
- Channels 4-7 small throughput loss (sub percent level)
- Channel 8 throughput remains stable at about 66-67%

- PMD monitoring:

  - UV degradation visible in science channels is also visible in PMD 1 to 3
  - PMD 4 and 7 show a large decrease in throughput
  - PMD 6 results still under investigation

- LIMB monitoring:
  In this BMR the monthly monitoring of NO_2 limb profiles is introduced

3 INSTRUMENT CONFIGURATION AND PERFORMANCE

3.1 In-Flight Status and Performance

Detailed operations, planning and instrument status information can be found on the website of the *SCIAMACHY Operations Support (SOST)* under http://atmos.caf.dlr.de/projects/scops/. These pages are maintained on a daily basis and show the history and actual progress of the SCIAMACHY mission.

3.1.1 Planned Operations and Measurements (SOST-DLR)

The reporting period covers the orbits 32250 (ANX = 01-May-2008, 01:37:55.819) to 33122 (ANX = 30-Jun-2008, 23:40:05.160). Two OSDFs specified the planning baseline.

Orbit		ANX		OSDF
Start	Stop	Start	Stop	
32250	32692	01-May-2008 01:37:55.819	31-May-2008 22:42:36.058	MPL_OSD_SHVSH_20080312_010101_00000000_34190001_20080501_013758_20080601_002310.N1
32693	33122	01-Jun-2008 00:23:11.986	30-Jun-2008 23:40:05.160	MPL_OSD_SHVSH_20080318_010101_00000000_34210001_20080601_002314_20080701_012039.N1

Table 3-1: SCIAMACHY OSDF planning file from May – June 2008

Measurements were nominal, i.e. timelines executed limb/nadir sequences with wide swath settings on the dayside of the orbit. In-flight calibration and monitoring measurements occurred on daily, weekly and monthly timescales according to the mission scenarios. Regular monthly calibration was scheduled between orbits

- 32517-32521 (19/20-May-2008)
- 32947-32951 (18/19-Jun-2008)

The moon was in the limb TCFoV between orbits

- 32432-32554 (13-Mar-2008 until 22-May-2008)
- 32865-32972 (13-Jun-2008 until 20-Jun-2008)

Occultation measurements with the moon rising on the nightside could be executed between orbits

- 32432-32504 (13-May-2008 until 18-May-2008)
- 32883-32918 (14-Jun-2008 until 16-Jun-2008)

Three OCRs were successfully implemented. These were

- OCR_033 *(Improved limb coverage during ECOMA4 campaign)*: Starting in orbit 33108 (30-Jun-2008) – and ending in orbit 33309 (13-Jul-2008) – the planning

optimized limb coverage over Andoya. In addition selected PET and co-adding parameters were changed to improve the spatial resolution.

- OCR_034 *(Improved limb coverage for the Teresina balloon campaign)*: Between orbit 32607 (26-May-2008) and 33122 (30-Jun-2008) the planning optimized limb coverage over Teresina.
- OCR_035 *(Cluster 16 and 18 short integration timese)*: Execution started in orbit 32092 (20-Apr-2008) and ended in orbit 32493 (18-May-2008). Co-adding factors in channel 3 were modified as required. Some channel 6 and 7 co-adding factors needed modifications to compensate for the increased data rate.

3.1.2 Instrument Measurement Status (SOST-DLR)

The final flight status for states and timelines remained unchanged.

3.1.3 Executed Operations and Measurements (SOST-DLR)

Measurements and instrument availability

The OSDF planning files have been scheduled as requested except for the last two orbits in June (orbit 33121/33122) when due to an orbit control manoeuvre (OCM) a transfer to MEASUREMENT IDLE had occurred.

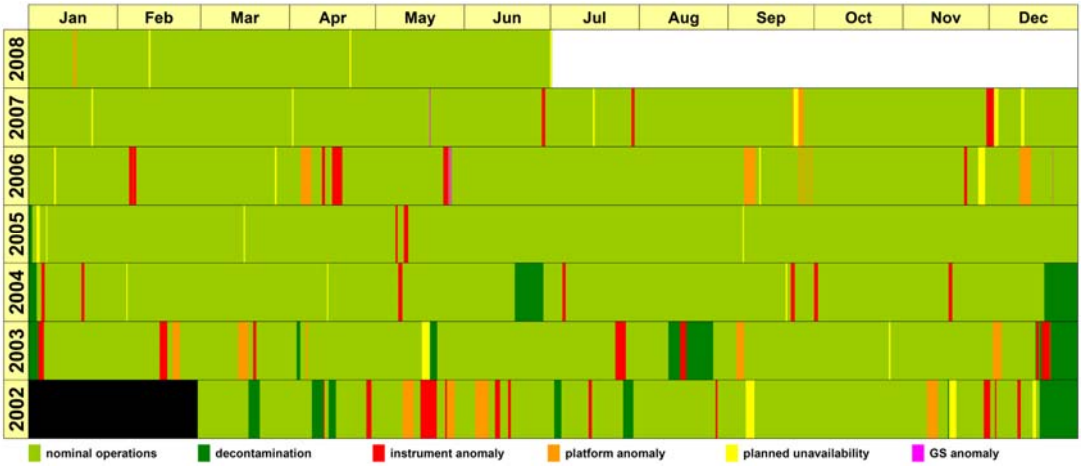


Fig. 3-1: Current instrument availability status including the reporting period

Detector thermal adjustment

No TC adjustment was required. The TC settings remained at

- DAC1 = 0.53 W
- DAC2 = 0.50 W
- DAC3 = 0.00 W

APSM/NDFM health checks & PMD ADC cal

In the reporting period 1 APSM/NDFM health check and 2 PMD ADC calibrations were executed. All showed nominal results.

APSM/NDFM			PMD ADC	
Orbit	**ANX**	**Result**	**Orbit**	**ANX**
n.a.	n.a.	n.a.	32625	27-May-2008 07:39:05
33055	29-Jun-2008 08:40:01	ok	33056	29-Jun-2008 10:16:31

Table 3-2: APSM/NDFM health check and PMD ADC calibration

Anomalies

Four minor instrument anomalies had occurred. In orbit 32517 (19-May-2008, 18:17:45 UTC) the known occasional error when switching the Sun Follower from lunar acquisition to lunar pointing was recorded. Measurements were not interrupted and continued as scheduled.

Orbit	Date	Entry - UTC	Level	Entry Type	ID Content/Transition	Mode	Remark
32517	19-MAY-2008	2008.140.18.17.45.587	Instrument	HK PARAMETER LIMIT EXCEEDING	86 (I0107)	MEASUREMENT	State 57 (mop02)
32517	19-MAY-2008	2008.140.18.17.46.610	Instrument	HK PARAMETER LIMIT EXCEEDING	94 (I0119)	MEASUREMENT	ASM control difference due to state 57 w arning
32517	19-MAY-2008	2008.140.18.17.46.614	Instrument	HK PARAMETER LIMIT EXCEEDING	100 (I0129)	MEASUREMENT	ESM control difference due to state 57 w arning
32517	19-MAY-2008	2008.140.18.18.01.607	Instrument	HK PARAMETER LIMIT EXCEEDING	100 (I0129)	MEASUREMENT	ESM control difference due to state 57 w arning

Table 3-3: Instrument & platform anomalies between May and June 2008

3.1.4 Performance Monitoring - System (SOST-DLR)

Detector and OBM temperatures are monitored according to the requirements of the IOM *[1]*. It requests to ensure that the average temperature per orbit remains within the specified limits.

Detector temperatures

For each detector the average temperatures per orbit are determined from HK telemetry parameters. Fig. 3-2 displays the temperatures of all 8 detectors. Colour coding is as on the operational monitoring website, i.e. data from orbits with HK telemetry coverage > 90% are shown in red, for < 90% in green. Minimum/maximum values per orbit are indicated as vertical bars. The temperature limits of each detector are shown as horizontal lines.

In late May/early June the detector temperatures reach their seasonal maximum. During this period detector 5 was slightly above its upper limit. This had already occurred in the past and is considered uncritical.

It has to be noted that the detector temperature curves since 2002 clearly indicate a degrading TC system with constantly rising temperatures (0.2-0.3 K/year for detectors 1-6 and 1 K/year for detectors 7 & 8). This is however a predicted behaviour.

OBM temperatures

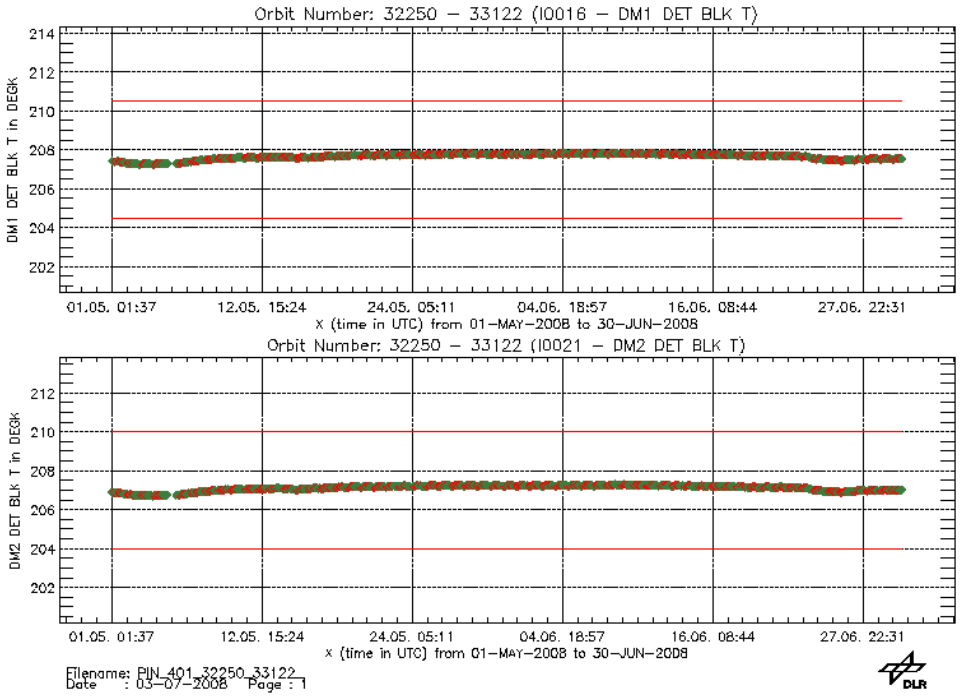
The average OBM temperature per orbit is determined from specific HK telemetry parameters. In addition power readings for the ATC heaters are monitored. Temperatures and ATC heater powers are given in Fig. 3-3 and 3-4. Colour coding is as in Fig. 3-2.

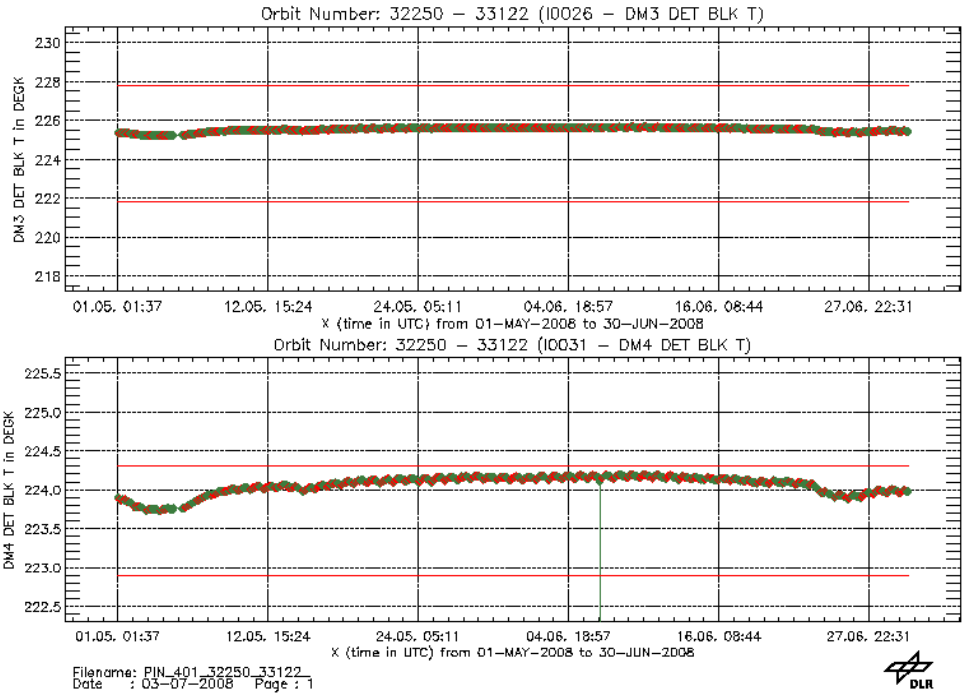
OBM temperatures and ATC heater powers remained within limits.

PMD ADC status

The status of the PMD ADC is monitored according to the requirements of the IOM *[1]*. It requests to ensure that no glitches occur caused by an SEU.

No PMD ADC glitches have been detected.


Orbit Number: 32250 – 33122 (I0016 – DM1 DET BLK T)
DM1 DET BLK T in DEGK
214
212
210
208
206
204
202
01.05. 01:37
12.05. 15:24
24.05. 05:11
04.06. 18:57
16.06. 08:44
27.06. 22:31
X (time in UTC) from 01–MAY–2008 to 30–JUN–2008
Orbit Number: 32250 – 33122 (I0021 – DM2 DET BLK T)
DM2 DET BLK T in DEGK
212
210
208
206
204
202
01.05. 01:37
12.05. 15:24
24.05. 05:11
04.06. 18:57
16.06. 08:44
27.06. 22:31
X (time in UTC) from 01–MAY–2008 to 30–JUN–2008
Filename: PIN_401_32250_33122
Date : 03–07–2008 Page : 1
DLR


Orbit Number: 32250 – 33122 (I0026 – DM3 DET BLK T)
DM3 DET BLK T in DEGK
230
228
226
224
222
220
218
01.05. 01:37
12.05. 15:24
24.05. 05:11
04.06. 18:57
16.06. 08:44
27.06. 22:31
X (time in UTC) from 01–MAY–2008 to 30–JUN–2008
Orbit Number: 32250 – 33122 (I0031 – DM4 DET BLK T)
DM4 DET BLK T in DEGK
225.5
225.0
224.5
224.0
223.5
223.0
222.5
01.05. 01:37
12.05. 15:24
24.05. 05:11
04.06. 18:57
16.06. 08:44
27.06. 22:31
X (time in UTC) from 01–MAY–2008 to 30–JUN–2008
Filename: PIN_401_32250_33122
Date : 03–07–2008 Page : 1
DLR

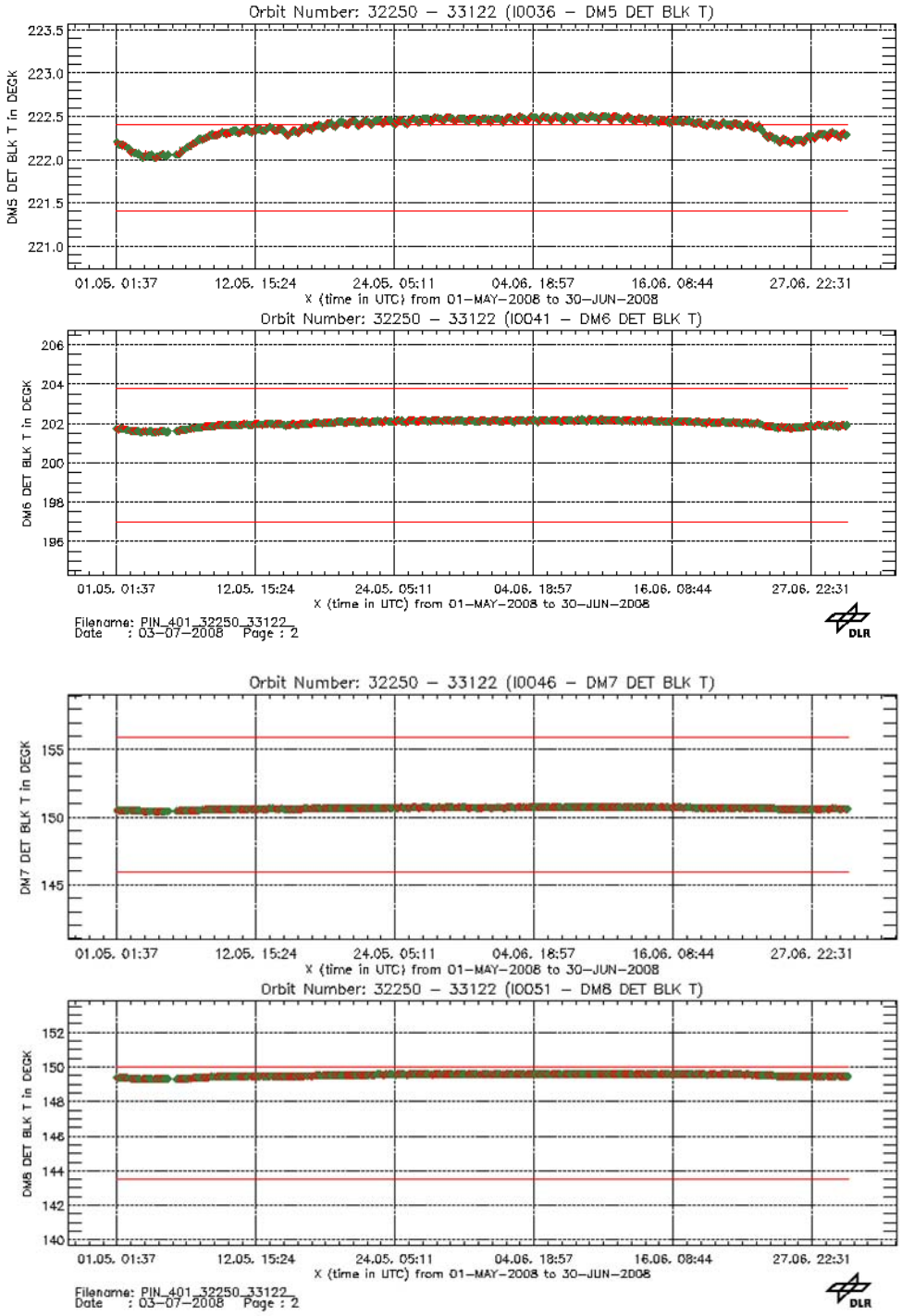


Fig. 3-2: Detector temperatures

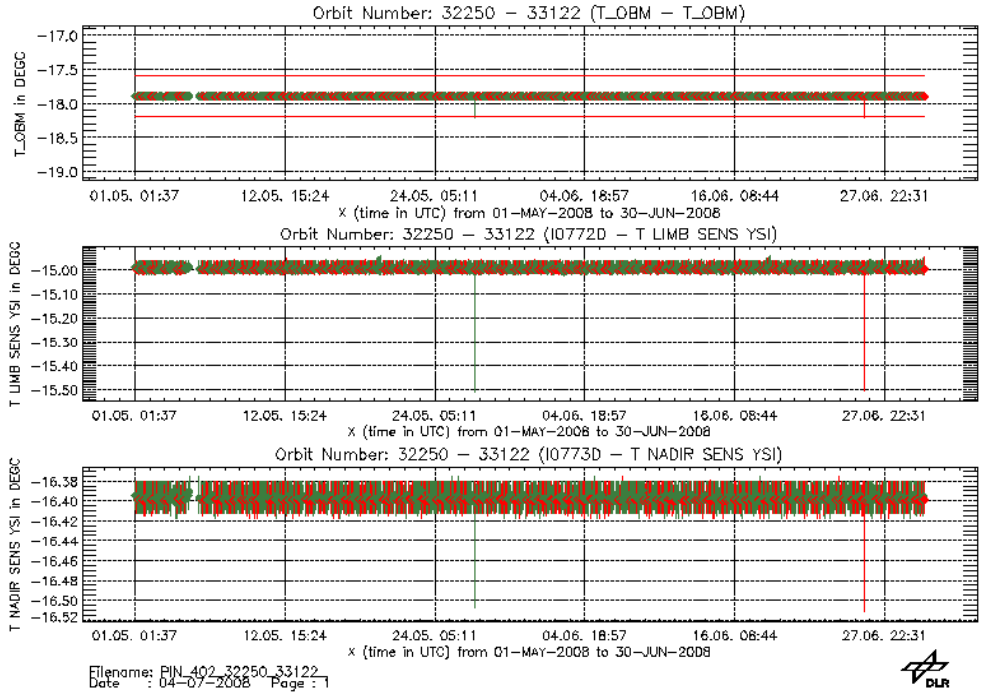


Fig. 3-3: OBM temperatures (top: derived OBM, middle: limb sensor, bottom: nadir sensor)

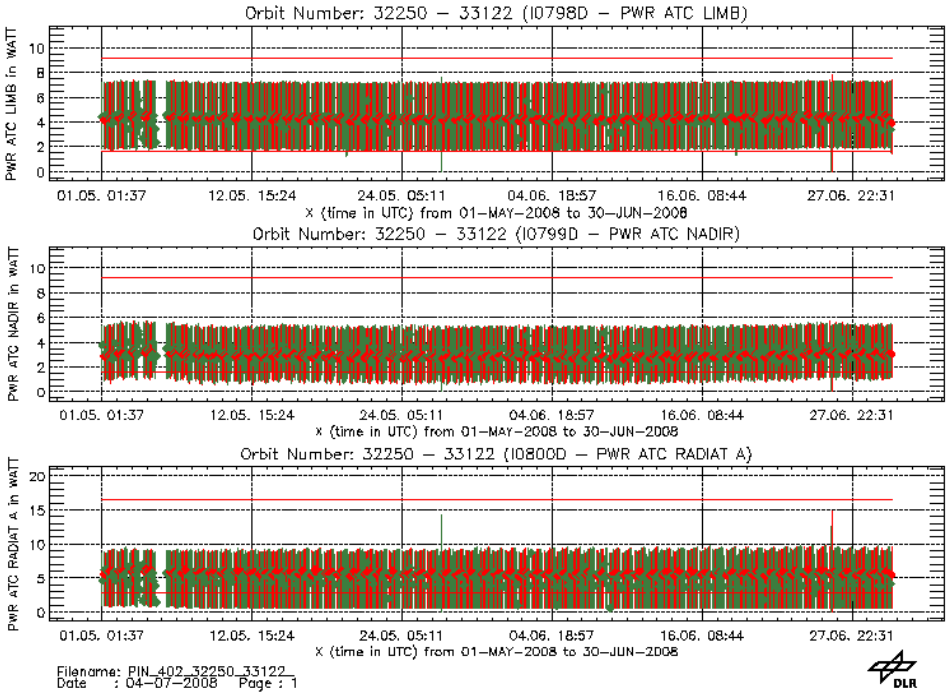


Fig. 3-4: ATC heater power (top: ATC limb, middle: ATC nadir, bottom: ATC Rad A)

LLI status

Life Limited Items are monitored based on analysis of the

- OSDF: This yields a predicted LLI usage.
- Report format: This counts the actual LLI switches or used LLI cycles. No WLS/SLS burning times can be derived thereof.

In addition, the in-flight usage of the cryogenic heat pipe is recorded. This subsystem has a limited number of cycles. Each decontamination increases the accumulated number of cycles by 1.

At the end of the reporting period the fractional usage of the LLI relative to the allowed in-flight budget was (based on OSDF prediction)

- NDFM: 0.43
- APSM: 0.39
- NCWM (sub-solar port): 0.76
- WLS (switches): 0.14
- WLS (burning time): 0.27
- SLS (switches): 0.05
- SLS (burning time): 0.01

For the NDFM and APSM the safety margin factor of 2 was no longer applied in the calculation of the fractional usage since it was found acceptable to stay below the figures of the lifetests. How the relative LLI usage has accumulated since launch can be seen in fig. 3-5. 'EOL' assumes a total mission lifetime until end of 2010.

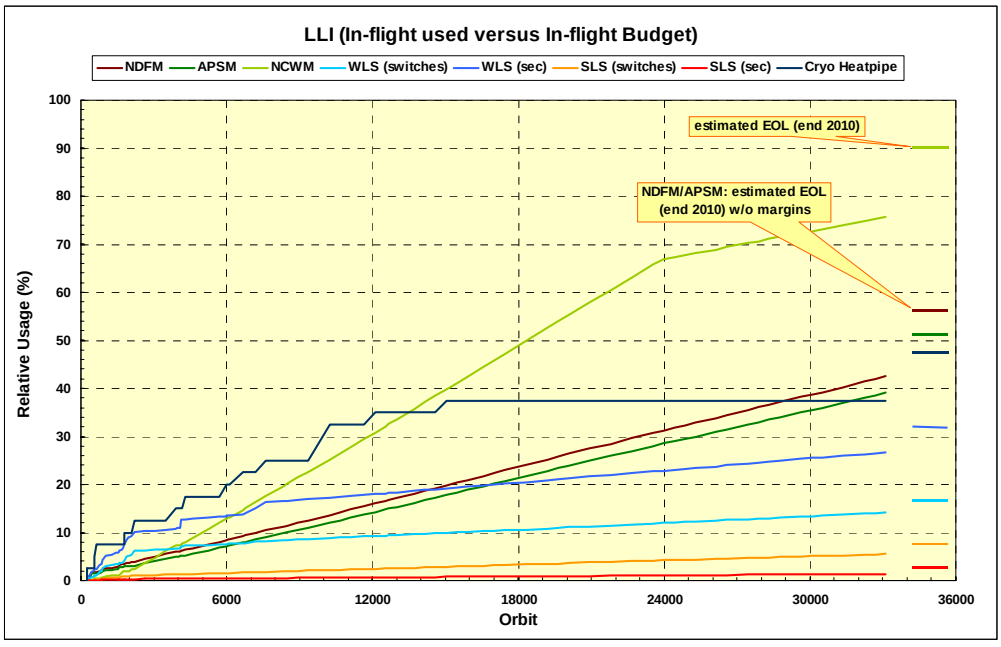


Fig. 3-5: Relative usage of LLIs. 'EOL' is derived for a mission lifetime until 2010. For the NDFM and APSM no margin factors have been applied to derive the EOL relative usage.

The number of cryogenic heatpipe cycles did not increase (no decontamination). The budget used remained at 38% of the allowed in-flight budget.

Time reference

The times quoted in all planning files refer to the reference orbit. Since the actual orbit differs from the reference orbit (e.g. orbit drift), the times given w.r.t. the reference orbit also do not reflect exactly the actual absolute times of events along the orbit (e.g. ANX, sunrise, sub-solar, moonrise, eclipse). The requirements for orbit maintenance may result in time differences of usually < ±10 sec. In some cases this value may even reach ±1 min, however.
SOST monitors how the reference time deviates from the actual time. This is done by using the predicted time which comes very close to the actual = restituted time. If the predicted times are delayed w.r.t. the reference orbit, then the difference *predicted – reference time* is > 0 sec; in the other case it is < 0 sec.

Fig. 3-6 displays the time difference *predicted – reference*. Orbit manouevres cause distinct discontinuities.

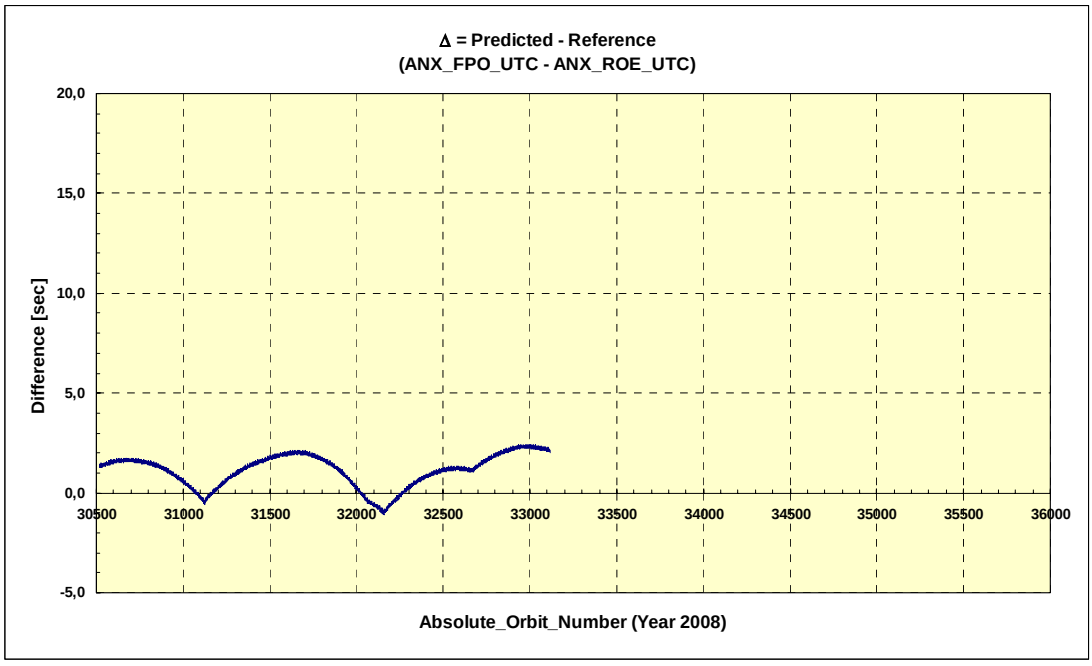


Fig. 3-6: Time difference between predicted and reference time.

3.1.5 Performance Monitoring - Light Path (SOST-IFE)

3.1.5.1 Science Channel Averages

One part of the SOST long-term monitoring activities is the trend analysis of measurements with the internal White Light Source (WLS) and of observations of the unobscured Sun above the atmosphere. In order to monitor the different SCIAMACHY light paths solar measurements are taken in various viewing geometries: In limb/occultation geometry (via ASM and ESM mirrors), in nadir geometry (via the ESM mirror through the subsolar port), and via the so-called calibration light path involving the ASM mirror and the ESM diffuser. SCIAMACHY long-term monitoring comprises a regular analysis of these measurements. The plots displayed in Fig. 3.7 show results of these monitoring activities for the time interval May to June 2008.
Note that the reported arithmetical channel averages are medians.

The displayed data have been produced in the following way:
All measured spectra have been divided by the corresponding measurement at a reference time; then for each channel a median of the ratio is computed, yielding an effective instrument throughput for the different light paths.
The reference spectra for all light paths are derived from measurements on 16 January 2003 (the time of the first monthly calibration performed with final flight settings). The resulting medians are then scaled to be 1 just after the first decontamination under (quasi-) nominal measurement conditions in August 2002. Therefore, the reference date for all data is in fact 2 August 2002.
Subsolar measurements before 30 November 2002 (about orbit 3922) did not consider the known yaw misalignment of SCIAMACHY on ENVISAT and thus may not be used for monitoring purposes. Therefore there are no subsolar data shown before December 2002. Since no valid subsolar measurements are available for August 2002 the subsolar throughput data have been scaled to 2 August 2002 by using the same factor as for the limb light path.
Note that measurements performed during times of reduced instrument performance (e.g. switch-offs or decontamination periods) have been omitted.
The results presented in Fig. 3.7 are based on the analysis of Level 0 data, which have been corrected for dead/bad pixels, dark current (fixed value from August 2002), scan angle dependencies, quantum efficiency changes, and the seasonally varying distance to the Sun. Additional calibration steps have not been performed, like for example a straylight correction. Therefore, variations smaller than about 1% require careful interpretation. Especially, small variations of the throughput signal may be caused by remaining seasonal effects due to the limited calibration of the data.
Until October 2006 the nadir/subsolar light path was monitored based mainly on fast sweep measurements. However, subsolar pointing measurements are considered to have a better quality for monitoring purposes (especially for PMD monitoring) and thus have become the new baseline.
Since 1 October 2006 subsolar measurements in fast sweep scan mode are only executed once per month (before that time: daily) whereas subsolar measurements in pointing mode are executed twice per week (before: once per month).

The channel average plots in Fig. 3.7 show both data sets for the subsolar light path.
Note that the reference time for the subsolar pointing data is 16 January 2003 (instead of 10 January 2003 for subsolar fast sweep).

The WLS throughput is considered to be not representative for the UV degradation because a degradation of the lamp may not be excluded.
In channel 2, the contribution of the spectral features in the degradation (see spectral plots) may result in an larger average degradation rate than in channel 1.
The calibration light path shows some seasonal variation probably related to an insufficient scan angle correction in the calibration. This variation is usually in the order of magnitude of the degradation, such that no clear quantitative statements about the degradation rate for this light path can be given.

The light path monitoring results presented in this section may be regarded as a first step towards spectrally resolved monitoring factors (m-factors) which will be produced based on fully calibrated data.
Daily updated light path monitoring results can be found on the SOST or IUP web site (http://www.iup.uni-bremen.de/sciamachy/LTM/LTM.html).

The following specific features can be identified from the light path monitoring results during the time interval of this report:

- Overall, the instrument throughput changes were close to expectation.
- For all light paths involving the ESM mirror the degradation in the UV (channels 1 and 2) increases with a rate of about 1% per month. The maximum average throughput loss in channel 1 lies currently around 46% (for the limb light path). The throughput of the calibration light path is currently still at about 88% in channel 1 and 87% in channel 2, showing no significant decrease over the two months of this report.
- The overall degradation of channel 3 is very small (still about 4%) compared to channels 1 and 2. A small decrease in throughput of much less than 0.5% is observed for the limb and nadir/WLS light paths within the two months of this report.
- Channel 4 remains stable on a sub-percent level, although a slight decrease of throughput is visible in the limb light path.
- Channels 5 and 6 are also stable on a sub-percent level.
- The throughput in channel 7 slightly increases by about 0.5%/month, similar as observed during the last reporting period.
- The Channel 8 transmission remains rather stable and lies for all light paths at around 66-67%.

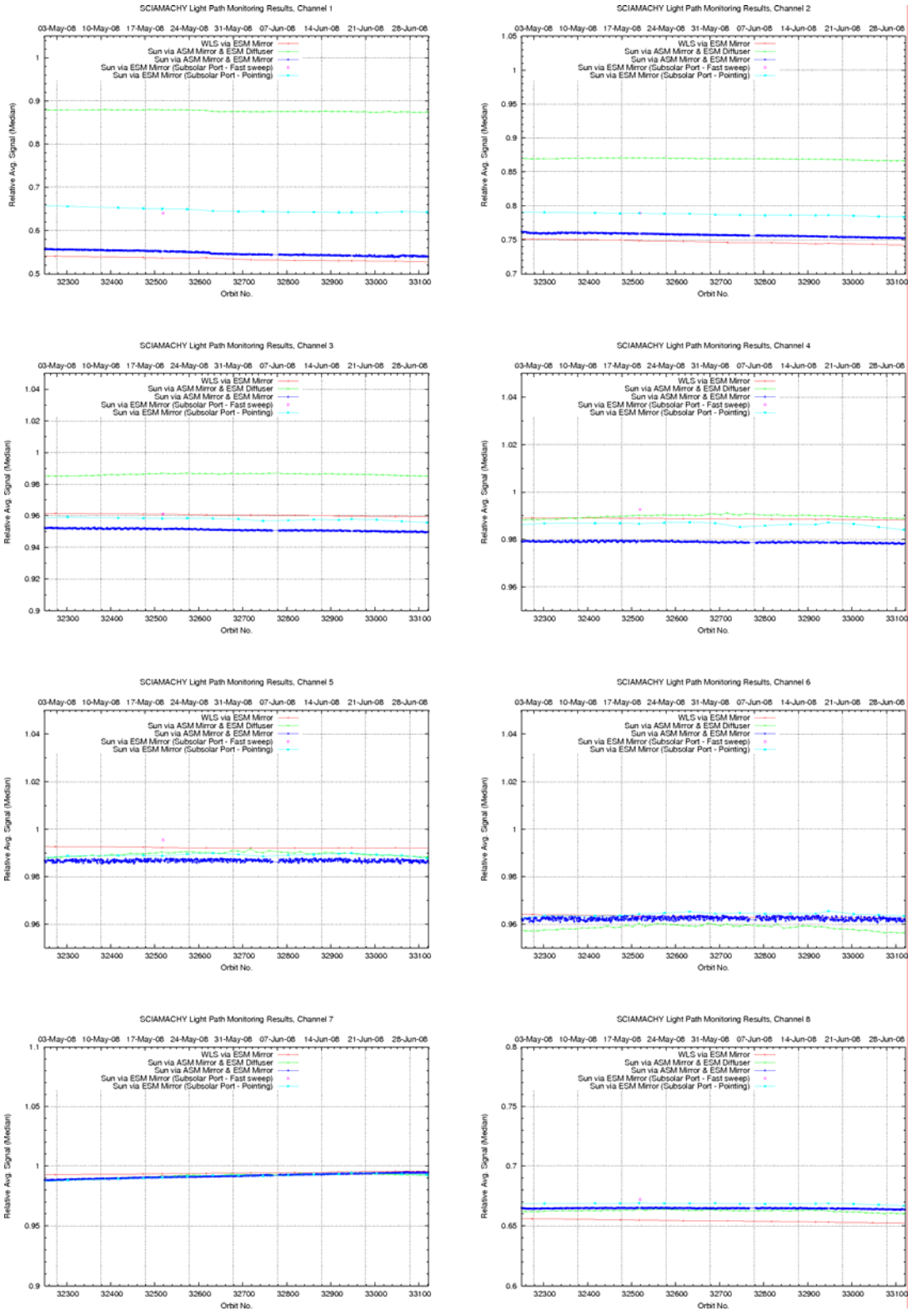


Fig. 3.7: Light path monitoring results May to June 2008 (medians).

3.1.5.2 Spectral light path monitoring results

Fig. 3.8 – 3.11 show results of spectral throughput monitoring performed by SOST-IFE for the different light paths (nadir, limb, calibration, and WLS). These results have been derived from Level 0 data analysed in a similar way as for the channel averaged throughput data (but of course without spectral averaging). Because the variation in spectral direction is very small within two months, Fig. 3.8 – 3.11 show the complete time series from 2 August 2002 to the end of June 2008.

Notes:

- The data (12:00 UTC reference time) have been interpolated over dead/bad pixels (using the on-ground list).
- Data from times of reduced instrument performance (like decontaminations or instrument switch-offs) have not been considered. These times are masked out by grey vertical bars.
- All data have been transformed to a daily grid, involving averaging and interpolation.
- Ratios have been performed on a pixel axis without any spectral interpolations. The wavelength axis is just for illustration and gives only approximate values, assuming a linear relation between pixel number and wavelength.
- Depending on the availability of measurement data, features close to large data gaps (especially before and after a decontamination) may be caused by interpolation.
- WLS data have not been corrected for a potential degradation of the lamp. Only the intensity jump after the extended WLS usage in June 2003 has been removed.
- As mentioned before, the timing of subsolar measurements before 30 November 2002 did not consider the known yaw misalignment of SCIAMACHY on ENVISAT. The timing has been corrected in the final flight settings. To take this change into account, all subsolar measurements have been referred to orbit 4519 (10 January 2003).
  Therefore, subsolar results before 30 November 2002 are not reliable.
- Subsolar pointing data are not considered here yet because of their low measurement frequency before October 2006. Activities to generate a joined consistent subsolar fast sweep/pointing data set are ongoing.
- Subsolar data affected by blocking of the subsolar port (May/June 2007) have been excluded.

The underlying data for the spectral monitoring are available via the SOST-IFE web site (see http://www.iup.uni-bremen.de/sciamachy/LTM/LTM_spectral/LTM_spectral.html). As for the plotted results, these data are regularly updated one to two times per month.

The following general features can be identified in the spectral monitoring plots:

- The UV degradation generally decreases with increasing wavelength.
- The SCIAMACHY degradation strongly depends on wavelength and is largest at the channel edges. The prominent degradation peak around 350 nm in channel 2

coincides with a region of high polarisation sensitivity, although this is probably not directly related.

- Also solar activity variation can be seen in the plots, e.g. the intensity change of the solar Mg II Fraunhofer line at about 280 nm.
- The degradation in channel 3 which was already indicated by the channel integrated results is much better visible in the spectrally resolved plots, where the propagation of this effect in time to higher wavelengths can be clearly identified.
- The difference in degradation between the diffuser light path and the other light paths is also visible in the plots; however, the spectral regions where degradation is strongest coincide quite well.
- The spectral plots also show that the relative stability for channels 4 and 5 observed in the integrated data is not present over the whole spectral range; also these channels show variations, but these are restricted to the overlap regions close to the channel edges.
- The channel 6 degradation is concentrated at the lower wavelength edge.
- For channels 7 and 8 the spectral behaviour of the throughput loss is consistent with (broadband) ice absorption features. The effect of the decontaminations is of course also clearly visible in these channels.
- Especially channel 8 shows a large pixel dependence of the throughput variation caused by the different sensitivity of the pixels. This variation is much higher for light paths where the small aperture is involved (i.e. nadir (subsolar) and limb), indicating that the small aperture causes additional effects which need to be considered when applying these results to Earthshine data.
- In general, the WLS data are much smoother than the solar data.

The current status of the degradation is as follows:

- The minimum throughput is below 50% for the limb and WLS (nadir) light paths at the short wavelength edge of channel 1 (i.e. below about 255-265 nm).
- The minimum throughput at the degradation peak around 350 nm in channel 2 is currently about 60%.
- The minimum throughput at the lower wavelength edge of channel 3 is currently at 90% (not considering the overlaps).
- Channel 4 and 5 are still stable over the whole spectral range (except for the overlaps).
- The channel 6 degradation at the lower wavelength edge is still below 10%.
- Degradation in channels 7 and 8 is as expected.

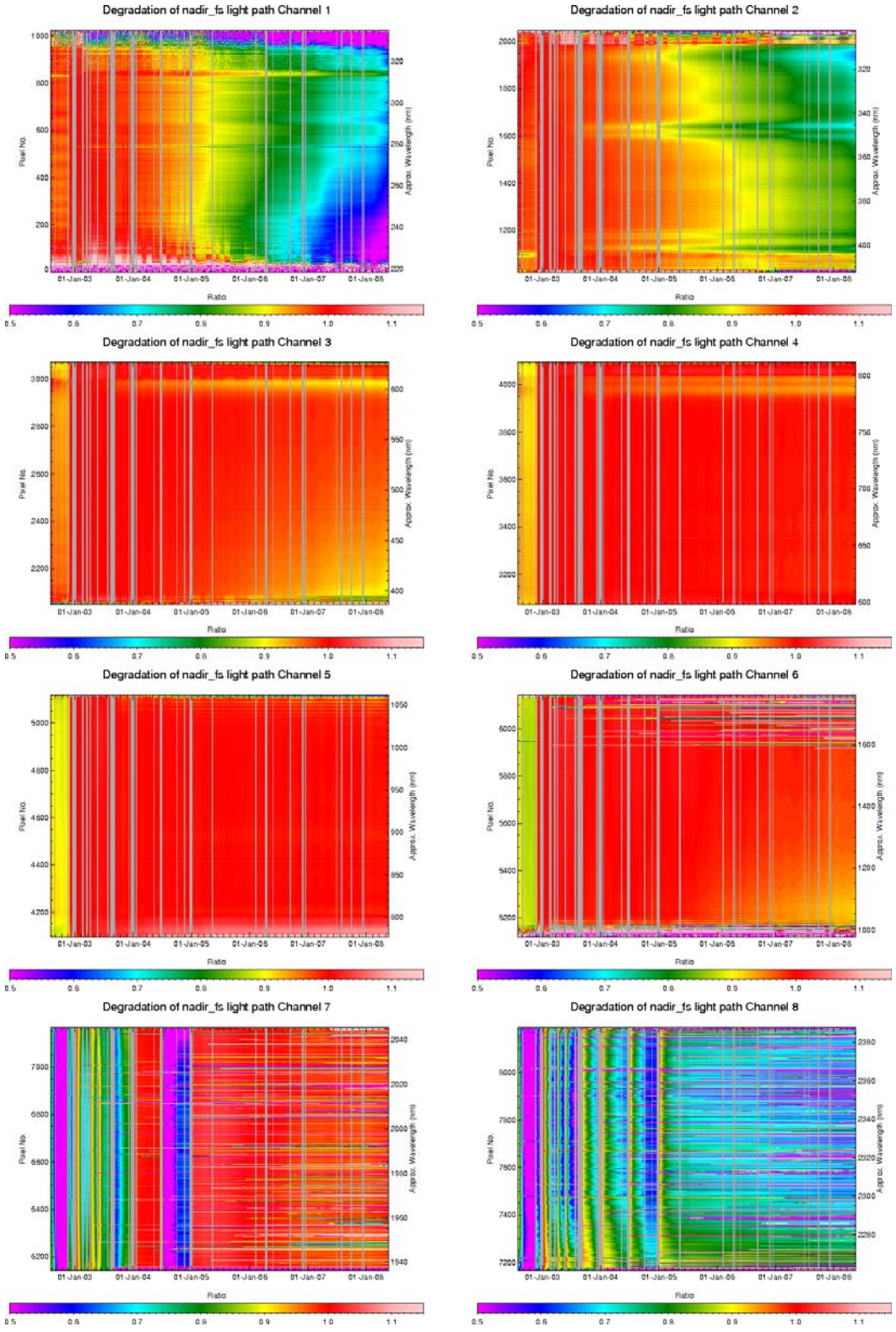


Fig. 3.8: Spectral light path monitoring results August 2002 to June 2008 (nadir light path)

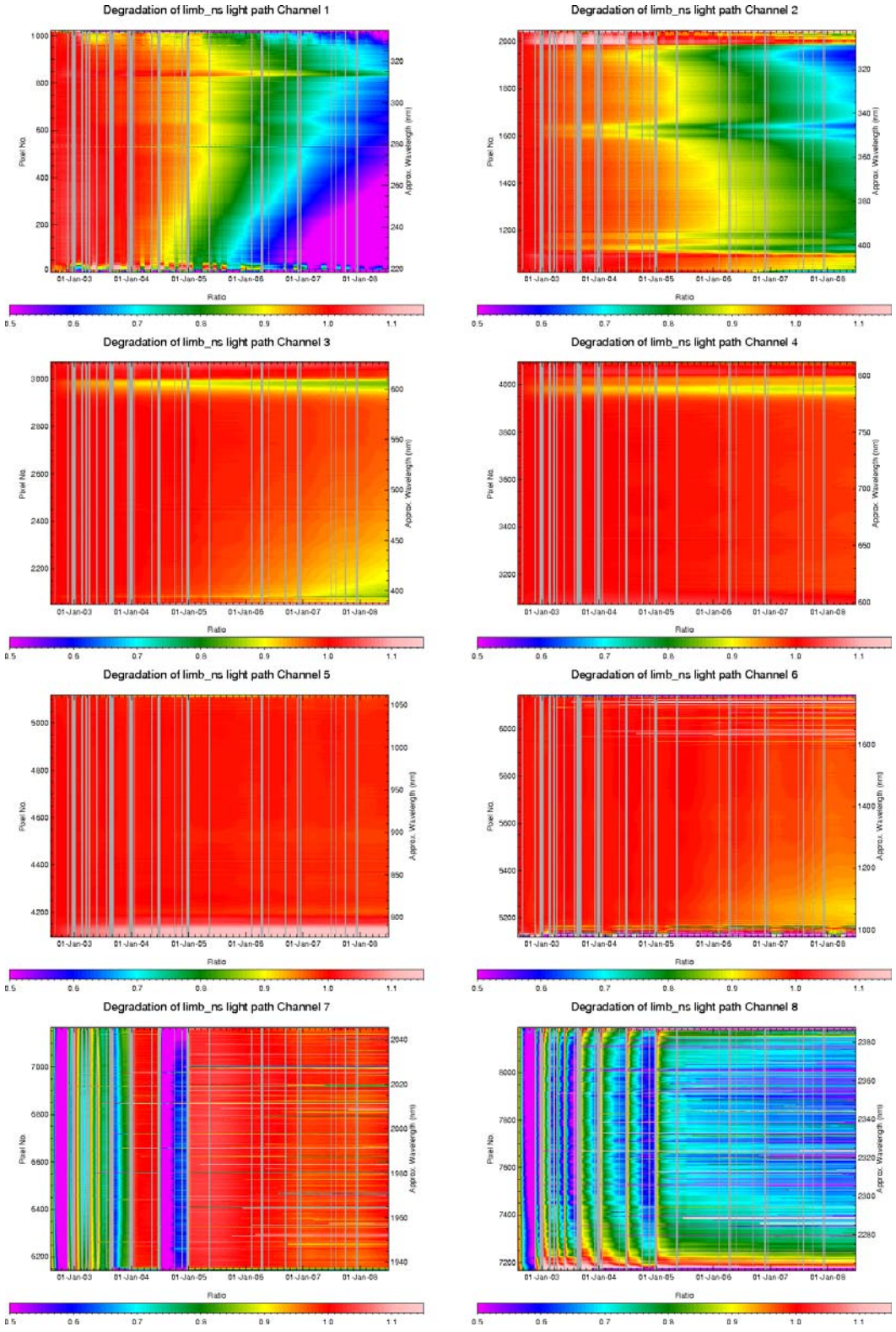


Fig. 3.9: Spectral light path monitoring results August 2002 to June 2008 (limb light path)

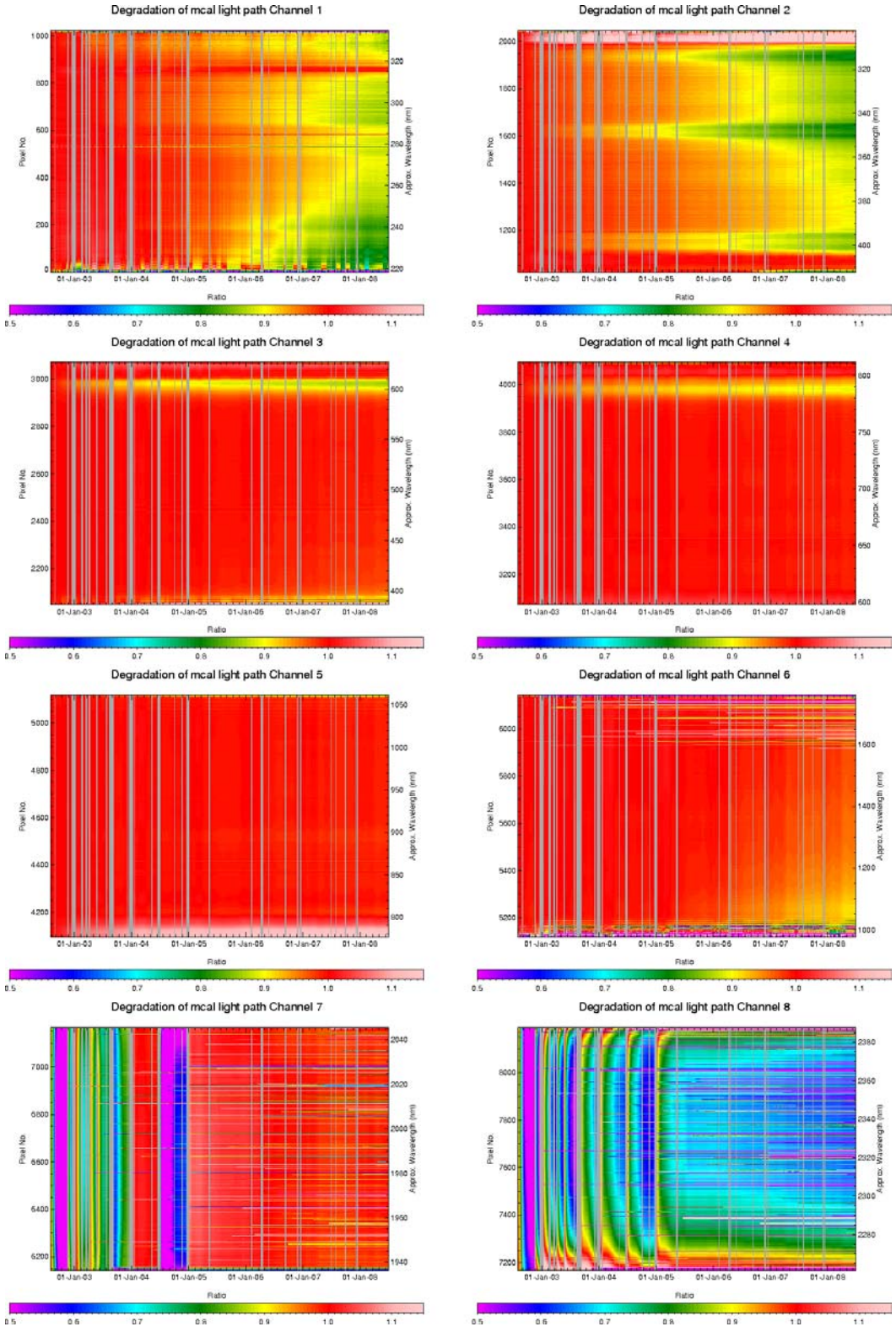


Fig. 3.10: Spectral light path monitoring results August 2002 to June 2008 (calibration light path)

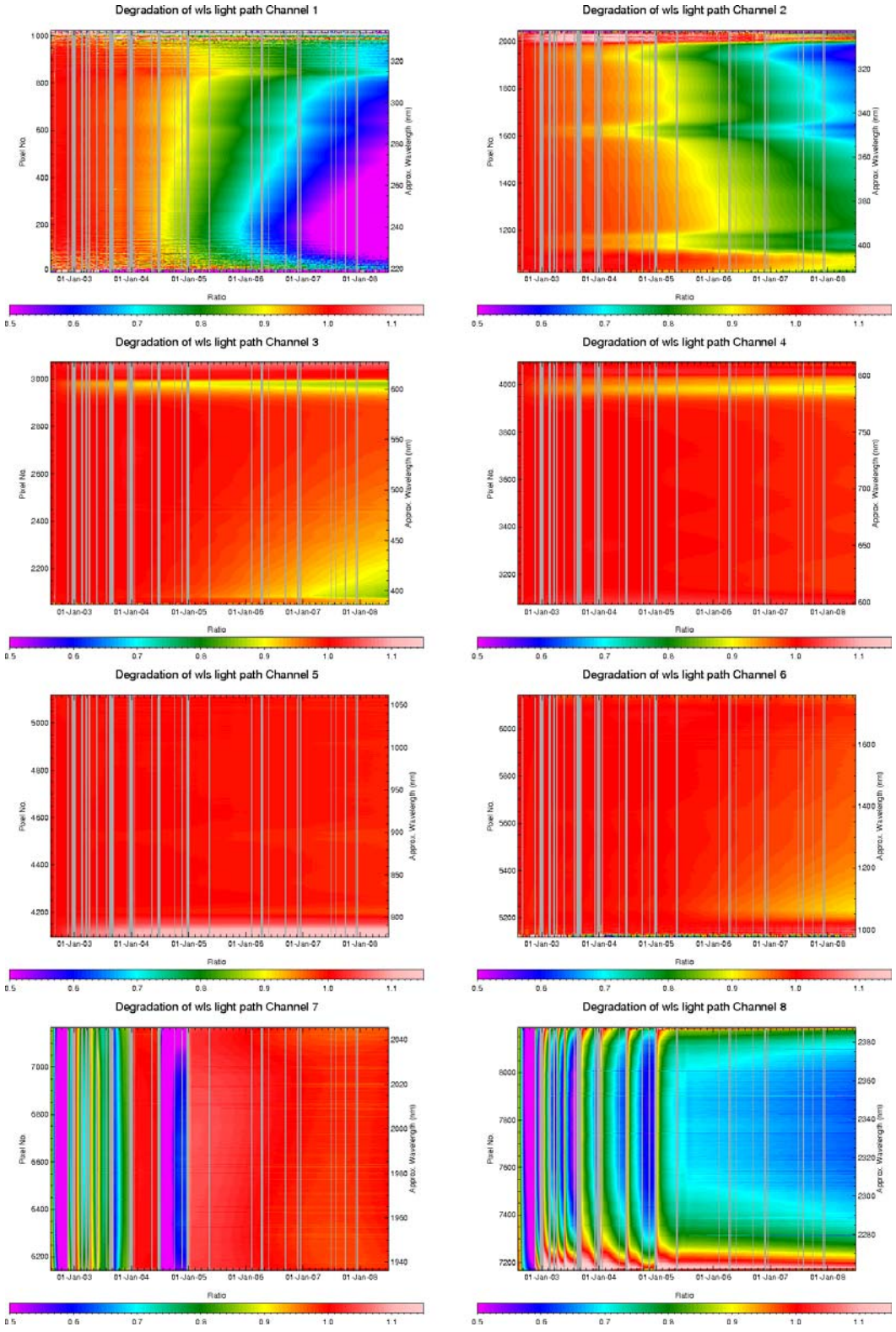


Fig. 3.11: Spectral light path monitoring results August 2002 to June 2008 (WLS light path)

3.1.5.3 PMD monitoring results

The SCIAMACHY PMDs are monitored in a similar way as the science channels, but of course no channel averaging is performed. However, the results presented here are based on the same measurements as the science channel results (but using the PMD low gain signal), and they have been normalized to the same reference times as the spectral results. Thus, the reference time for the subsolar data is January 2003, whereas it is August 2002 for the other data sets.
For the nadir light path it is not possible to use subsolar fast sweep measurements for PMD monitoring, because these show too large scatter. This is probably caused by a combination of the very time-sensitive measurement type and scan mode and the fact that the PMDs measure a sampled signal, not an integrated one. Therefore, subsolar pointing measurements are used for monitoring of the PMD nadir light path, because the pointing signal is much more stable. Until October 2006 subsolar pointing measurements were only performed once per month, therefore the temporal sampling is much less than for the other light paths. Since 1 October 2006 the number of subsolar pointing measurements has been increased (on the cost of subsolar fast sweep data).
Fig. 3.12 shows the PMD throughput variation for the whole time period between 2 August 2002 and 30 June 2008. Note that a constant dark signal for each of the PMDs has been assumed. To verify this assumption, Fig. 3.12 also shows the variation of the PMD dark signal over time, which is usually quite low.
Note that PMD 7 results are most likely dominated by straylight and not reliable. They are only shown for completeness. Furthermore, WLS data are only available for PMD 1 to 3 because of saturation in the other PMD channels.

Considering the broadband character of the PMDs, the observed PMD throughput changes are (except for PMD 4 and 7) very similar to those of the science channels.

The following general features are observed:

- The UV degradation apparent in the science channels is also visible in PMD 1 to 3.
- PMD 4 and 7 (which cover the same wavelength interval) show a considerably large decrease in throughput which is still unexplained (but may be related to the specific detector material).
- There are remaining seasonal variations in the data which could up to now not be corrected out. The amplitude of these seasonal variations increases with the wavelength range covered by the PMD. This issue is still unresolved.
- The PMD 6 dark signal shows a strange variation over time which is still under investigation.

A more detailed investigation of the open issues listed above requires a better calibration of the monitoring data which is currently (in the context of m-factor generation) under development, but will probably take some time.

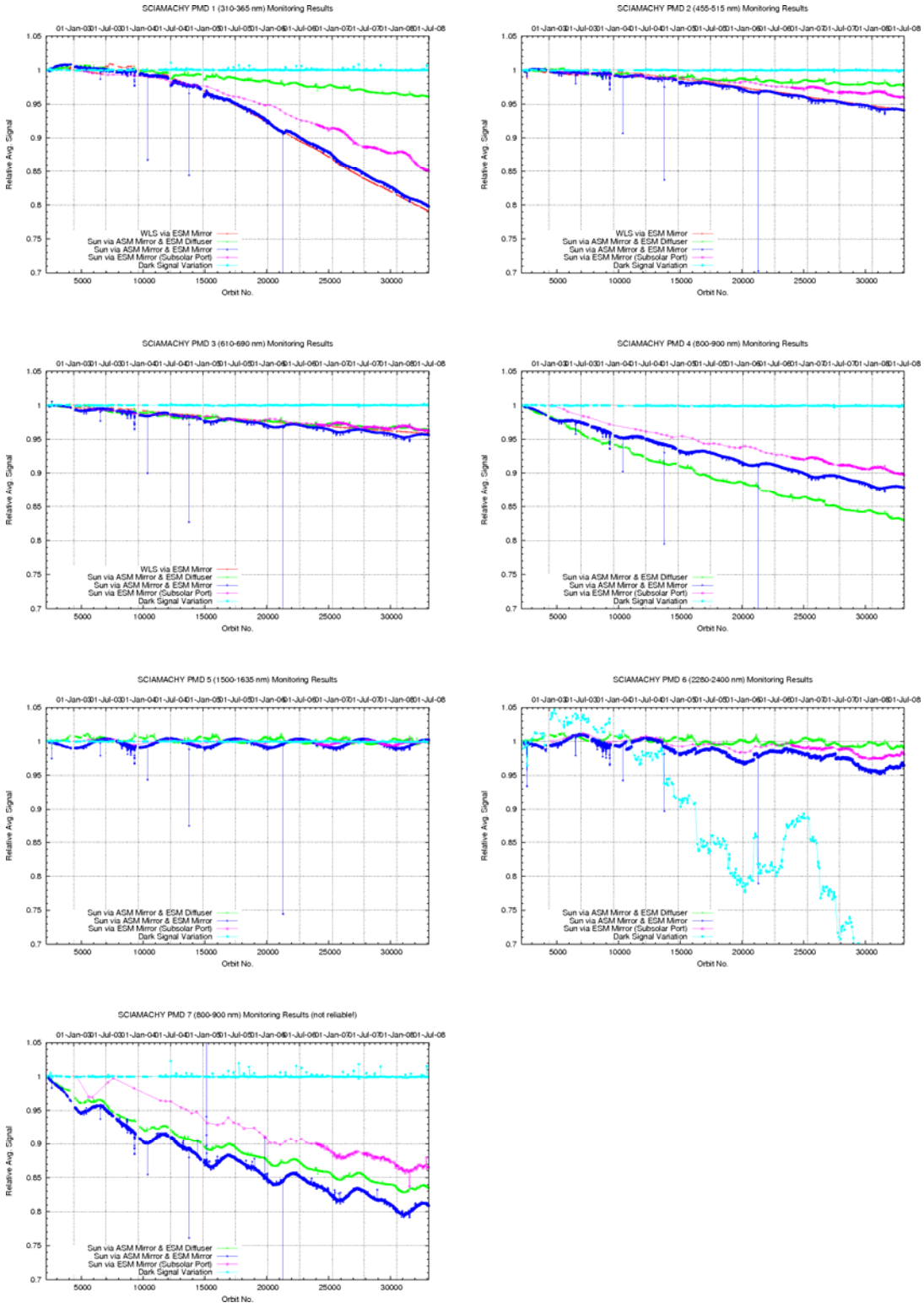


Fig. 3.12: PMD monitoring results August 2002 to June 2008

4 DATA AVAILABILITY STATISTICS

4.1 Downlink/Acquisition Performance

Problems are known for the products listed in Tab. 4.1:

Product	Day	Filename	description
SCI_NL__0P	10-MAY-2008	SCI_NL__0PNPDK20080510_171733_000059672068_00270_32388_8181.N1	sciamachy_source_packets ERROR: incorrect file size
SCI_NL__0P	22-MAY-2008	SCI_NL__0PNPDK20080522_110841_000060362068_00438_32556_8282.N1	sciamachy_source_packets ERROR: incorrect file size
SCI_NL__0P	24-MAY-2008	SCI_NL__0PNPDE20080524_195739_000001932068_00472_32590_6758.N1 SCI_NL__0PNPDE20080524_200148_000000002068_00472_32590_6771.N1 SCI_NL__0PNPDE20080524_200148_000000002068_00472_32590_6770.N1 SCI_NL__0PNPDE20080524_200257_000000272068_00472_32590_6772.N1 SCI_NL__0PNPDE20080524_200353_000000002068_00472_32590_6804.N1 SCI_NL__0PNPDE20080524_200353_000000002068_00472_32590_6811.N1 SCI_NL__0PNPDE20080524_200353_000000472068_00472_32590_6801.N1 SCI_NL__0PNPDE20080524_200353_000000582068_00472_32590_6813.N1 SCI_NL__0PNPDE20080524_200353_000000002068_00472_32590_6795.N1 SCI_NL__0PNPDE20080524_200417_000000002068_00472_32590_6787.N1 SCI_NL__0PNPDE20080524_200418_000000002068_00472_32590_6788.N1	Quality of Orbit affected for all envisat instruments
SCI_NL__0P	01-JUN-2008	SCI_NL__0PNPDK20080601_172758_000059802069_00084_32703_8374.N1	sciamachy_source_packets ERROR: incorrect file size
SCI_NL__0P	22-JUN-2008	SCI_NL__0PNPDK20080622_081224_000062162069_00379_32998_8569.N1	sciamachy_source_packets ERROR: incorrect file size

Table 4-1 Products containing format errors

These occurrences of data corruptions are currently under investigation.

4.2 Statistics on unconsolidated data (SCI_NL__0P, SCI_NL__1P)

This paragraph reports the availability of NRT data on a monthly basis. The statistics are based on level 0 data and level 1 data inventoried in the ground segment. Unavailability periods due to instrument anomalies or Satellite switch-offs are excluded. The gaps considered are only interfile gaps.

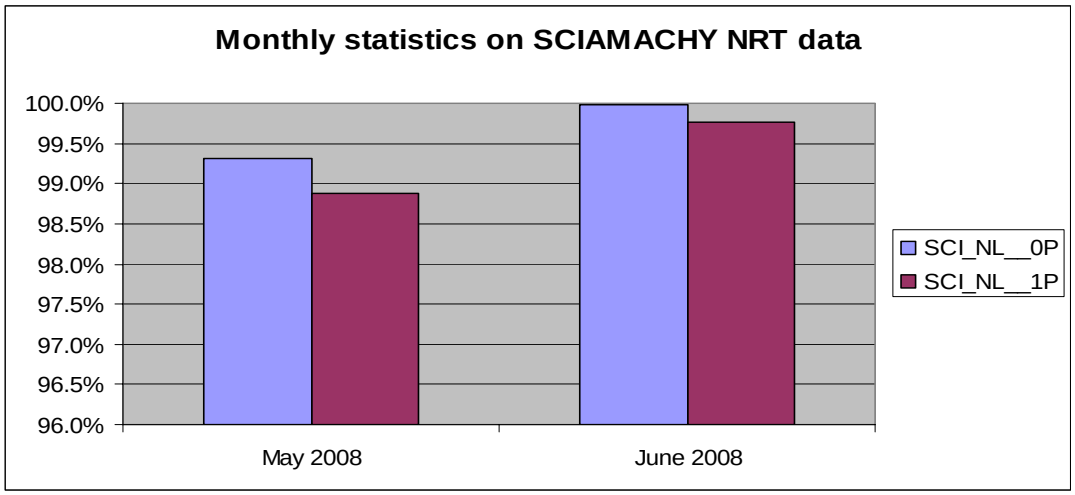


Fig. 4-1: Statistics on available unconsolidated level 0 and level 1b products

4.3 Statistics on consolidated data

In this chapter an overview about operational off-line data (consolidated data) is provided.

4.3.1 Anomalies on level 0 consolidated data products

In the past it had been reported by SOST-DLR that the SCIAMACHY consolidated level 0 data contain errors and are not complete. Following specific problems have been identified and are reported in detail in the technical notes *[3]*, *[4]* for years 2003 and 2004 as well as for products of 2005 *[5]*:

- For one orbit there can be more than one consolidated level 0 product. These products may be identical or different in content (disregarding the product type file counter).
- Some orbits are not covered by consolidated level 0 products although SCIAMACHY was operational.
- Some orbits are covered by consolidated level 0 products but the product duration does not comply with the actually planned and executed instrument operations in that particular orbit.
- Some consolidated level 0 products exceed the Reed Solomon correction threshold and are flagged accordingly. The occurrence of Reed Solomon errors is non-uniform.
- Until late October / early November 2003 consolidated level 0 data are hampered by an incorrect orbit number.

More details on consolidated level 0 anomalies can be found on the SOST web page, which contains a catalogue of available level 0 consolidated data and description of errors.

http://atmos.caf.dlr.de/projects/scops/data_availability/availability.html

A recovery plan was initiated in order to reprocess erroneous data 2002 - 2006. This activity has been completed. For the year 2007 the recovery is currently being performed.

The overall goal is to achieve a level 0 consolidated data 'master set' that allows data reprocessing of improved data quality.

4.3.2 Availability of consolidated SCI_NL__1P products

SCIAMACHY level 1b consolidated data are generated at D-PAC using the consolidated level 0 products as input for processing. The available level 1b off-line products on the D-PAC ftp-server are checked for completeness and an overview for the months May to June 2008 is summarised here, considering flight segment and ground segment anomalies. Note that also interfile gaps are considered, but no data gaps inside the products. The missing data from period 14-19 April, orbits 32009 – 32090 reported in the previous report need to be recovered still.

The FTP address accessing the data server at D-PAC is 195.37.183.37.

Month/Year	Planned orbit range	Number of orbits unavailable due to anomalies	Number of unique orbits available at D-PAC	Expected number of orbits (considering anomalies)	Availability in percentage during month
05/2008	32250 - 32692	0	442	442	99.5%
06/2008	32693 - 33122	1	428	429	99.7%

Table 4-2 Consolidated level 1b statistics

4.4 Statistics on reprocessed data

4.4.1 Level 1b re-processing IPF 6.03

The second reprocessing cycle had been completed between September and December 2007 using the level 1b IPF version 6.03 at D-PAC.
A new reprocessing flag was introduced in the filename and MPH, which is the letter "R" replacing the Processing Stage flag "P" for off-line level 1b products that was valid for IPF 5.04 and IPF 6.02 products.

Data is available at the D-PAC server (FTP address 195.37.183.37, ftp-ops-dp.eo.esa.int). Monthly mean availability lies at about 94% and progress on the missing data to be processed is still on-going as well as the quality check on the whole dataset.

More details see previous BMR (January - February 2008).

Detailed statistics will be provided in the next BMR considering the reprocessing round filling the data gaps.

In a second step the data contents will be monitored. Preparations for this major monitoring activity are ongoing.

4.4.2 Level 2 re-processing processor version 3.01

Level 2 off-line re-processing has been performed at D-PAC with processor version 3.01.
As for the level 1b, the level 2 off-line reprocessed data set contains the new processing flag “R” in the filename and MPH.
The level 2 off-line products have been successfully validated by the SCIAVALIG team and results have been presented during a validation workshop at the end of March 2008 (see chapter 8). Data are now available to the users at the D-PAC server (FTP address 195.37.183.37, ftp-ops-dp.eo.esa.int).

The first round of reprocessing for level 2 data for the period 02 August 2002 – September 2007 had been completed in January 2008.
As well as for the level 1b, consolidation of the data set is on-going with respect to completeness and duplicates. In a second step the data contents will be monitored.

Besides a few exceptions the mean monthly availability lies at about 91%.

Detailed statistics will be provided in the next BMR.

5 LEVEL 1 PRODUCT QUALITY MONITORING

5.1 Processor Configuration

5.1.1 Version

The operational IPF version used for processing of near real-time SCIAMACHY level 1b data is 6.03 at Kiruna and ESRIN. The same IPF is used for level 1b off-line processing at D-PAC for forward processing and the second SCIAMACHY full mission re-processing cycle.

The corresponding product specification is Volume 15 issue 3/k *[2]*. It is available at http://earth.esa.int/pub/ESA_DOC/ENVISAT/Vol15_Sciamachy_3k.pdf

The disclaimer at
http://envisat.esa.int/dataproducts/availability/disclaimers/SCI_NL__1P_Disclaimers.pdf
describes known artefacts as well as major improvements with respect to the previous IPF version.

Currently the new baseline 7.00 is prepared for industrial implementation.
Table 5.1 gives a brief overview of changes implemented with processor versions IPF 6.03, 6.02, 6.01 and 5.04/5.01.

IPF Version	Description	Proc Centre	Date	Start Orbit
6.03	Following changes are implemented with IPF 6.03 • New pointing correction (new SCI_LI1_AX) • Updated of the ESA CFI (5.6) software • Correction of a non compliancy report, impacting the Leakage GADS in the consolidated data processing chain (channels 6-8)	D-PAC	04-JUL-2007	27937
		PDHS-E	19-JUL-2007	28153
		PDHS-K	19-JUL-2007	28145
6.02	No algorithm specification changes were implemented, but following non compliances of version 6.01 have been corrected, to get • Polarisation correction factors different from 0 • Correct order of SMR spectra in Sun Reference ADS	D-PAC	05-MAY-2006	21843
		PDHS-E	07-JUN-2006	22327
		PDHS-K	07-JUN-2006	22318

	• Solar mean reference spectra in New Sun Reference Data set with positive sign (was negative in IPF 6.01)			
6.01	• Improved parameterization of the Memory effect for channels 1 to 5 • New correction for the Non-Linearity effect in the infrared channels • Usage of improved key data for the radiometric calibration of all channels • Each solar spectrum is provided in a calibrated and un-calibrated manner for all channels • Orbital dependency of channel 6 to 8 leakage calculated; currently applied only to channel 8 • Improvement of the pointing accuracy through the usage of the ENVISAT Restituted Attitude auxiliary files for the off-line processing • decontamination flag added to the SPH	D-PAC	No operations activated	-
		PDHS-E	22-MAY-2006	22098
		PDHS-K	22-MAY-2006	22090
		PDHS-E PDHS-K LRAC	24-MAR-2004	

Tab. 5-1: Processor Version and main changes

5.1.2 Anomalies

During analysis of the reprocessed data set Level 1b version IPF 6.03, it was found that for limited data sets

January 2005, orbits15154 – 15166
December 2005, orbits 19752-19762
January 2006, orbits 20224-20235, 20352-20363
April 2006, orbits 21356-21512

The D1 solar reference spectra were not updated by the operational calibration tool SCICAL in the SCI_SU1_AX files and within in the Level 1b products. Analysis of this problem could confirm that the spectra were measured, though. Detailed analysis of this processing problem is still on-going. Please note, that for operational Level 1b – level 2 offline processing the D0 spectrum is used and not the D1. The outcome of further analysis will be reported in the next BMR.

5.2 Auxiliary Data Files

For operation of the SCIAMACHY level 1 processor, a set of auxiliary files as input is required.
One subset of these auxiliary files usually changes only in correspondence with a new IPF version, namely the Initialisation file (SCI_LI1_AX), the Key Data File (SCI_KD1_AX).
In addition there is the m-factor file (SCI_MF1_AX), which shall describe the degradation of the instrument during its stay in orbit. Note that the m-factor file has not been changed so far.

Another subset of auxiliary files is the In-flight calibration data files, which are generated when calibration measurements are included in the set of level 0 data to be processed. Four types of In-flight calibration auxiliary files exist:

- Leakage Current Calibration (SCI_LK1_AX - updated on orbital basis)
- Solar Reference Spectrum (SCI_SU1_AX - updated on daily basis)
- Spectral Calibration Parameters (SCI_SP1_AX - updated on a weekly basis)
- Pixel-to-Pixel Gain and Etalon Parameters (SCI_PE1_AX - updated on a weekly basis)

Table 5-2 lists the actual Key Data File and Initialisation File used with IPF 6.02 and IPF 6.03. The SCI_LI1_AX was updated with IPF 6.03 in order to improve the instrument pointing correction.

Table 5-2 Key data and Initialisation configuration

SCI_LI1_AXVIEC20060523_182643_20020701_000000_20991231_235959 (until 18/07/2007)
SCI_LI1_AXVIEC20070628_134108_20020701_000000_20991231_235959 (from 18/07/2007)
SCI_KD1_AXVIEC20060523_182626_20020301_000000_20991231_235959

Fig. 5.1 shows statistics of the SU1 and LK1 ADFs generated operationally with SCICAL. It has to be noted that unavailability periods are excluded from statistics. Generation of SU1 ADFs for May 2008 was 100% and for June 2008 it was 96.7%. The SU1 ADF for 06 June was not generated.
The LK1 ADF statistic is calculated by dividing the number of all LK1 ADFs by number of all available (to SCICAL) level 0 products. The statistics on available LK1 ADFs during May 2008 (77.4%) and June 2008 (92%) are on a nominal level.
The statistic does not exclude dark measurements that cannot be used for ADF generation due to SAA and orbit phase constraints leading to an over-estimation of missing files.

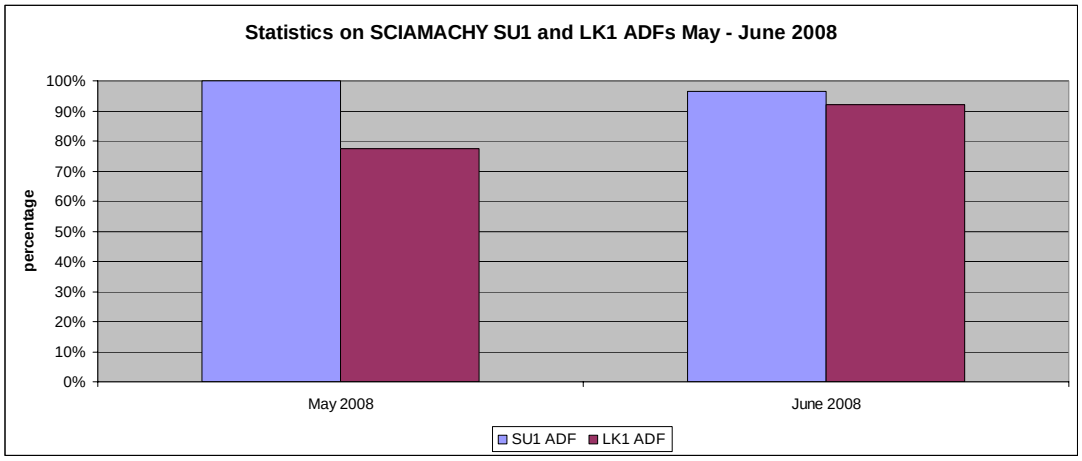


Fig. 5-1: Statistics on SU1 and LK1 processing

5.2.1 Auxiliary Data File quality analysis

5.2.1.1 SMR analysis

SCICAL generates daily SU1 Auxiliary Files. Solar spectra obtained from ESM and ASM calibration measurements are provided in two ways:

- fully calibrated
- not radiometrically calibrated.

The different types of spectra can be recognized by the so called identifier in the solar reference global annotation data set record.

Note the following recommendation:

- Use a not radiometrically calibrated ASM diffuser spectrum (A0) for DOAS type applications.
- All retrieval methods requiring absolute calibrated radiance and irradiance are obliged to use the calibrated ESM diffuser spectrum (D0) (see also disclaimer).

Fig. 5-2 to Fig. 5-5 show the ratios of SMR spectra derived from calibrated SMR/ESM (D0) during the months May - June 2008. The ratios were determined by dividing the spectra of the beginning of each month to a set of days during each month. Ratios are not corrected for variation of distance earth/sun.
In detail the spectra used for the ratios of each month are the following:

- **May 2008**
  Reference SMR - 01 May 2008
  SMR used for ratios: 02, 03, 04, 05, 06, 07, 08, 09, 10, 14, 21, 31 May 2008
- **June 2008**
  Reference SMR - 01 June 2008

SMR used for ratios: 02, 03, 04, 05, 07, 08, 09, 10, 11, 14, 21, 30 June 2008

The overall changes lie at about 1-2 % during one month for all channels, which is at least partially caused by the decreasing distance between sun and earth. In channel 1 around pixel 550 (at 282 nm) some strong features can be noticed, as well as in channel 2 near pixel 840 (near 393 nm). These strong features coincide with the Mg II and Ca Fraunhofer lines respectively. These lines are partially formed in the solar chromosphere and are known to change with solar variability.
The weaker spectral features in channel 2 (e.g. near pixels 550, 650,750), on the other hand, correlate with strong Fraunhofer lines, which are not chromospheric. These features probably arise from small wavelength shifts (order of 1/100 of a pixel).
Generally a spectral feature could have significant impact on the product quality, especially when the affected spectral parts are used for DOAS retrieval.

The large features in the end of channel 6 (channel 6+) and channels 7 and 8 are due to bad pixels.
Note that the bad pixel mask used is still from the on ground calibration.
A regular update of the bad pixel mask is implemented starting with IPF 6.02. However a bad pixel correction will not be applied to the SMR spectra, but only to PMD out-of-band factors, in order to enable the user to apply a different mask from the one provided by the ADF.

Fig. 5-6 and Fig. 5-7 show SMR ratios on a long term trend dividing the ESM spectra from days 31 May 2003 and 31 May 2008, respectively 30 June 2003 and 30 June 2008.
The first spectrum available exists for 18-Jul-2002. However to consider sun/earth distance, the ratio was performed with spectra from same calendar days. All SCI_SU1_AX files used were generated with SCICAL.

What can be concluded is that for channels 1-2 an average degradation in 5 years of about 7-10% is observed, channels 3 degrades by about 2% and channels 4-5 degrade by less than 1%, channel 6 by about 4-5%. The signal in channel 7 has increased with respect to the SMR of year 2003. This is due to the impact of the icing of the IR detectors.
This is consistent with the Light Path monitoring at SOST-IFE.

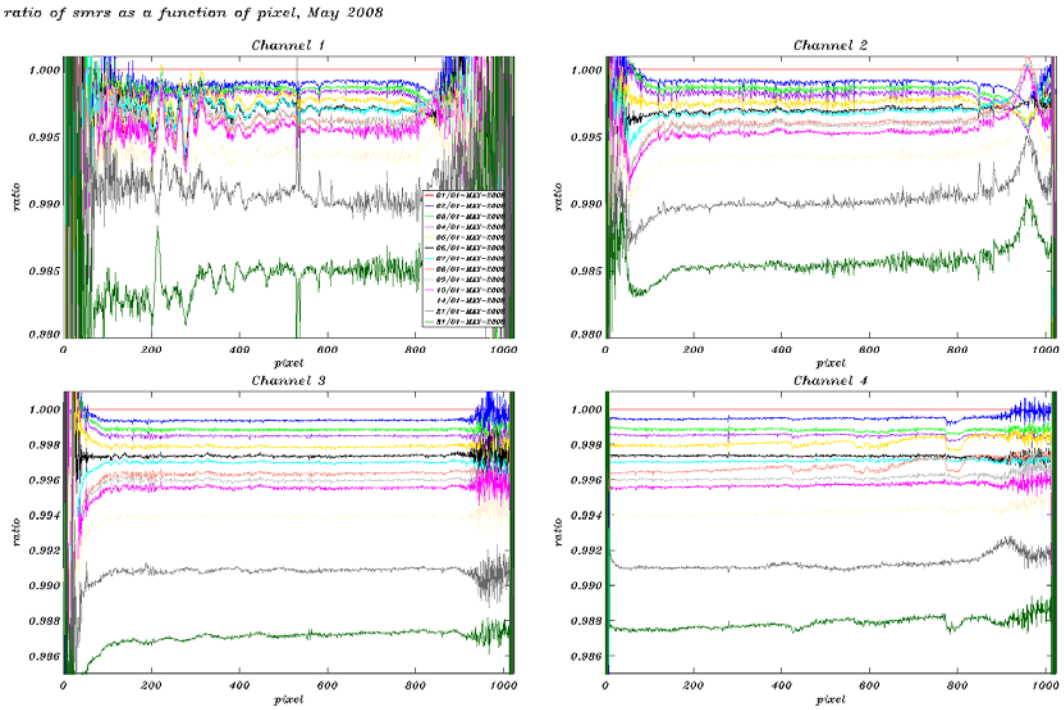


Fig. 5-2: SMR ratios per detector channel 1-4 (changes during May 2008)

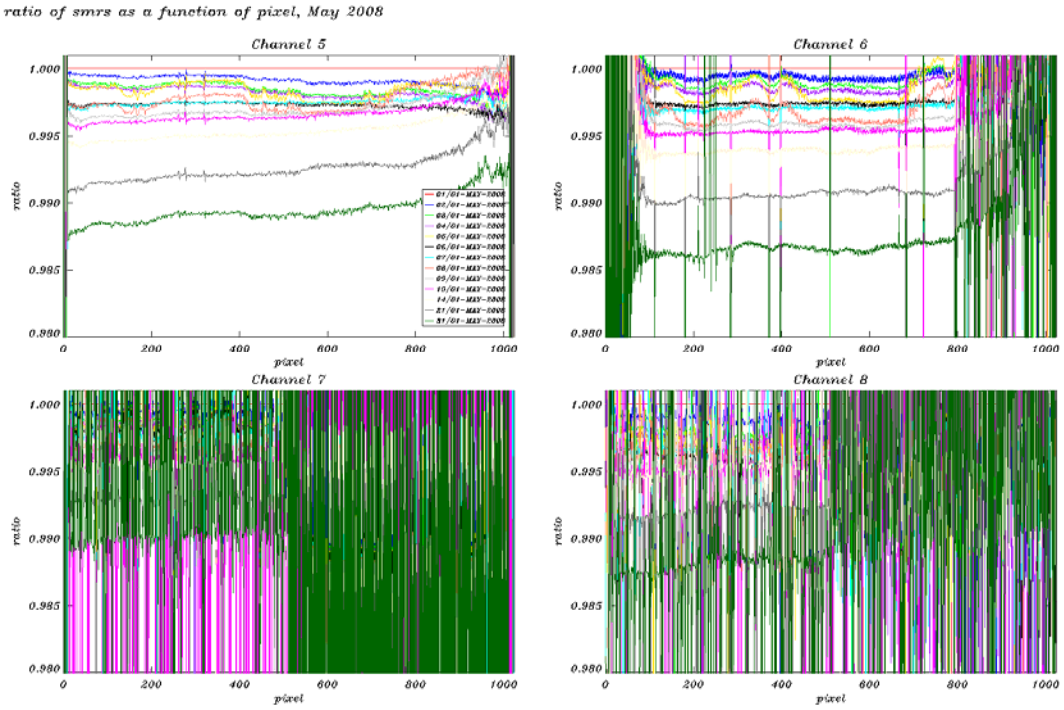


Fig. 5-3: SMR ratios per detector channel 5-8 (changes during May 2008)

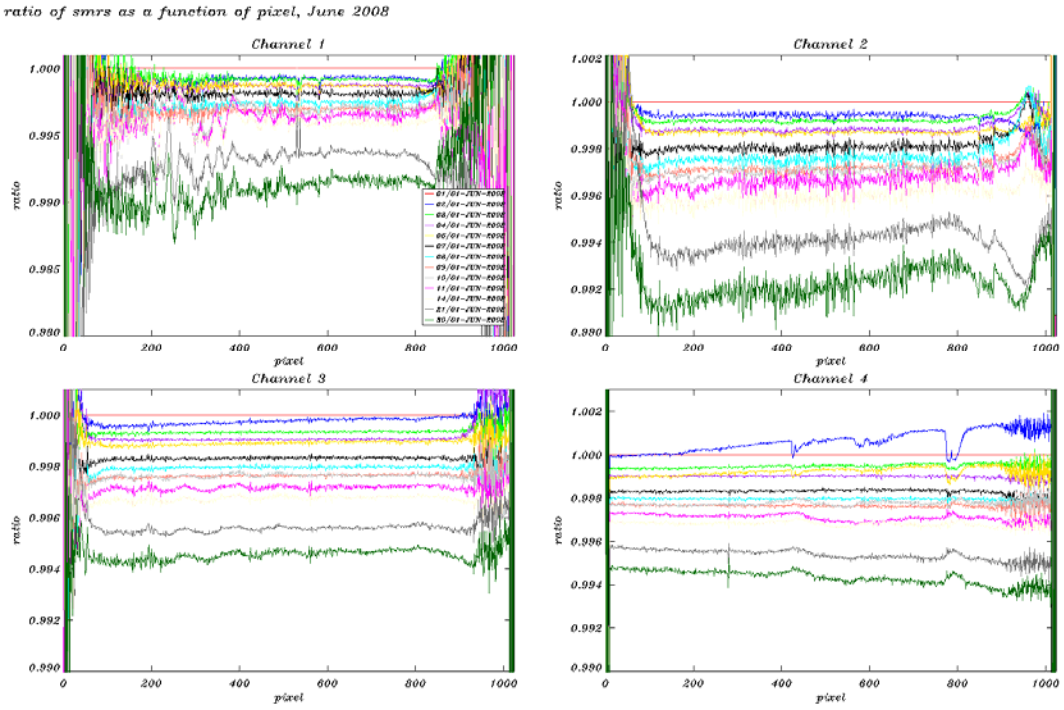


Fig. 5-4: SMR ratios per detector channel 1-4 (changes during June 2008)

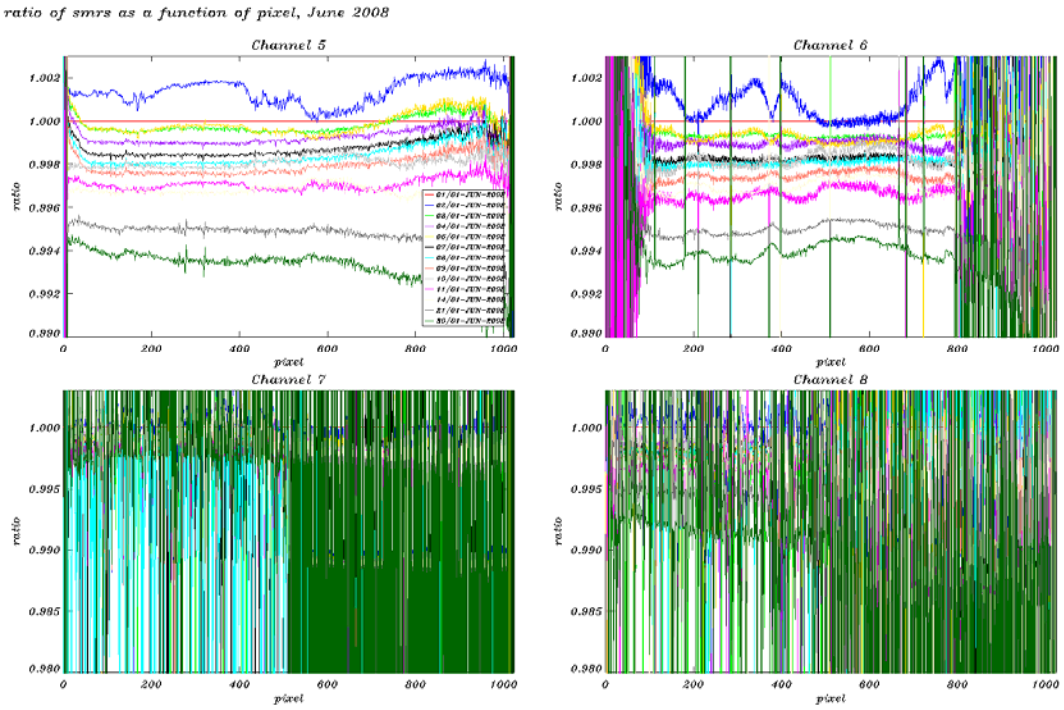


Fig. 5-5: SMR ratios per detector channel 5-8 (changes during June 2008)

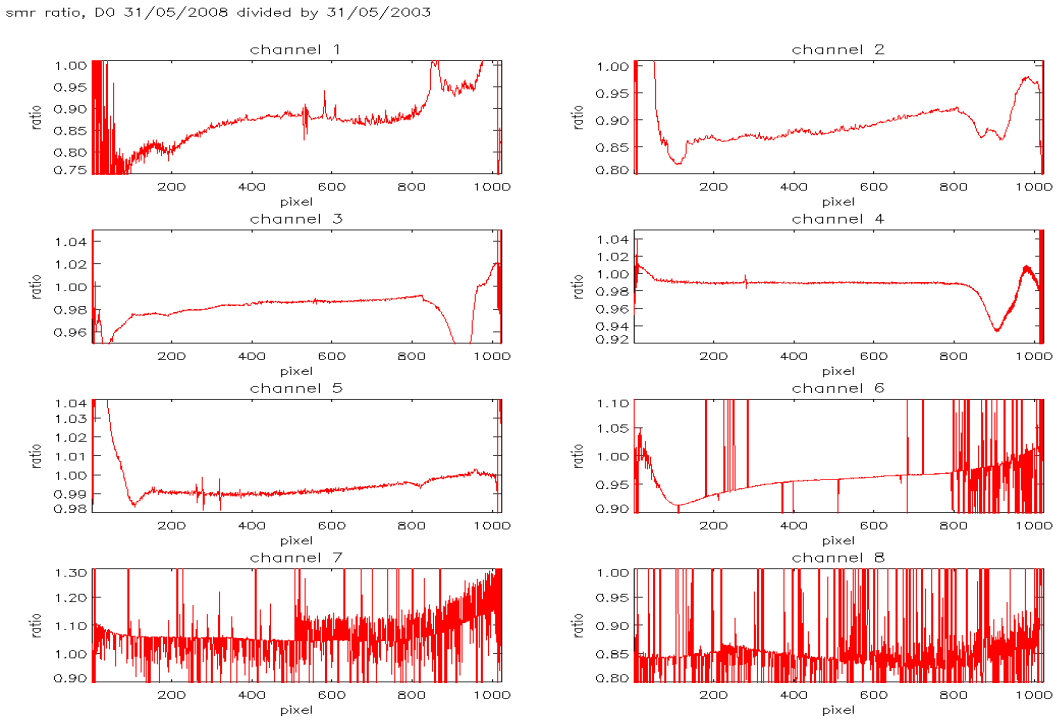


Fig. 5-6: SMR ratios per detector channel on Long Term Trend

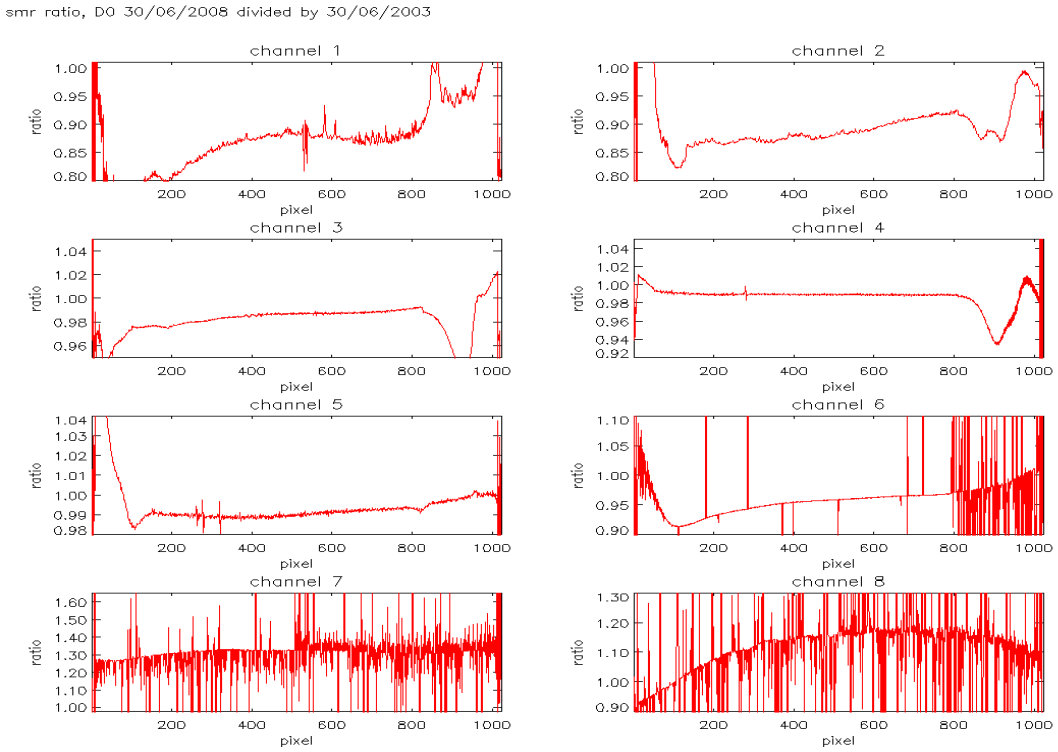


Fig. 5-7: SMR ratios per detector channel on Long Term Trend

5.2.1.2 LK1 analysis

5.2.1.2.1 Leakage Constant part

On an orbital basis a leakage current calibration is performed, if measurement data do not lie in the South Atlantic Anomaly region.
In Fig. 5-8 to Fig. 5-11 the leakage constant part FPN (fixed pattern noise) of the LK1 ADFs are analysed by determining the ratios of the FPN of each month with a time distance of one orbit, one day, one week, two weeks, three weeks and a month.
For channels 1-5 and the first part of channel 6, during up to three weeks nearly no changes can be noticed. Sudden jumps however between the different dark current ratios can be seen for channels 1, 2, 4 and 5 between 4 weeks. They are very small but above the noise level.
The IR channels show a lot of noise. Note that since the processor version IPF 6.02, the time dependent part of the leakage current is considered (see 5.2.3.2.2).

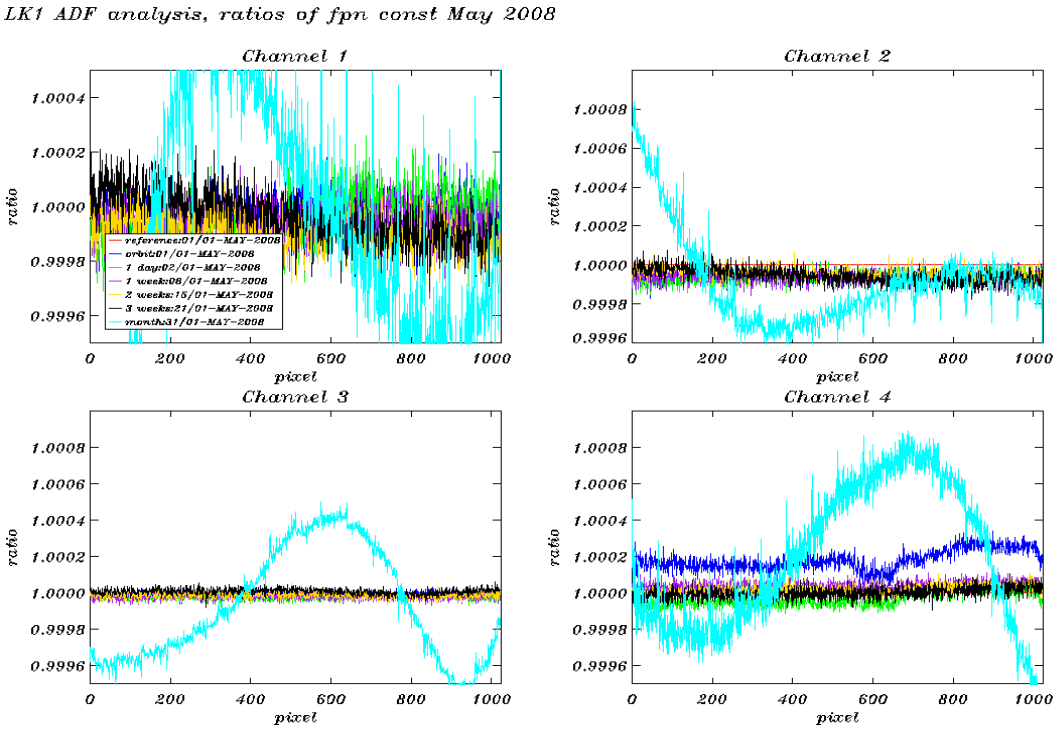


Fig. 5-8: dark current ratios (constant part) channel 1-4 during May 2008, Reference Spectrum used: Orbit 32253, 01-May-2008

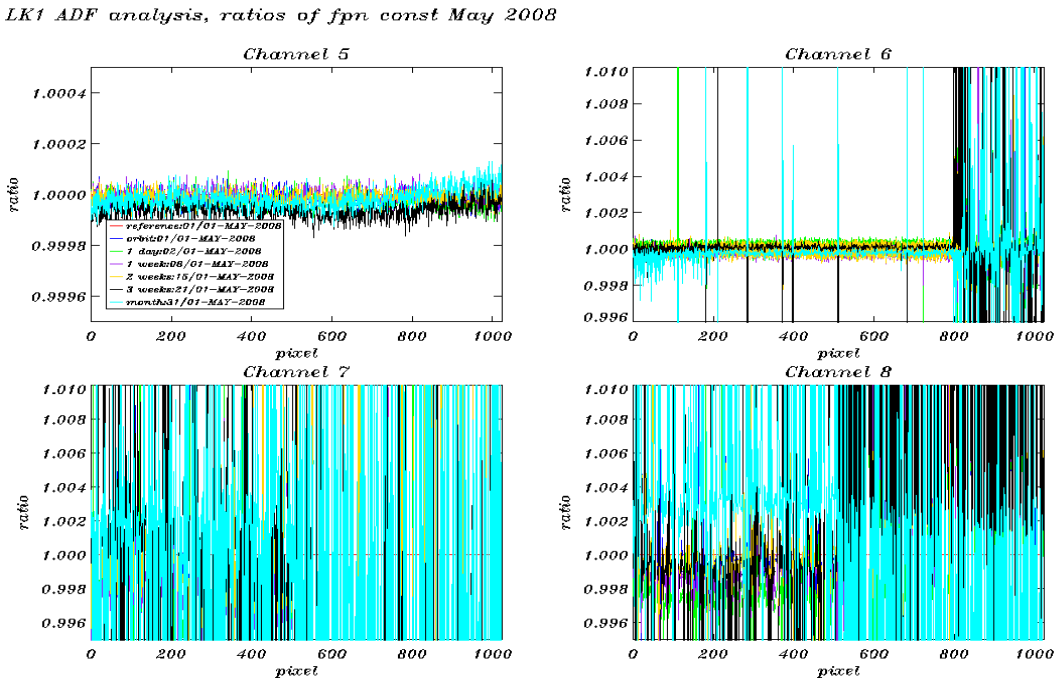


Fig. 5-9: dark current ratios (constant part) channel 5-8 during May 2008, Reference Spectrum used: Orbit 32253, 01-May-2008

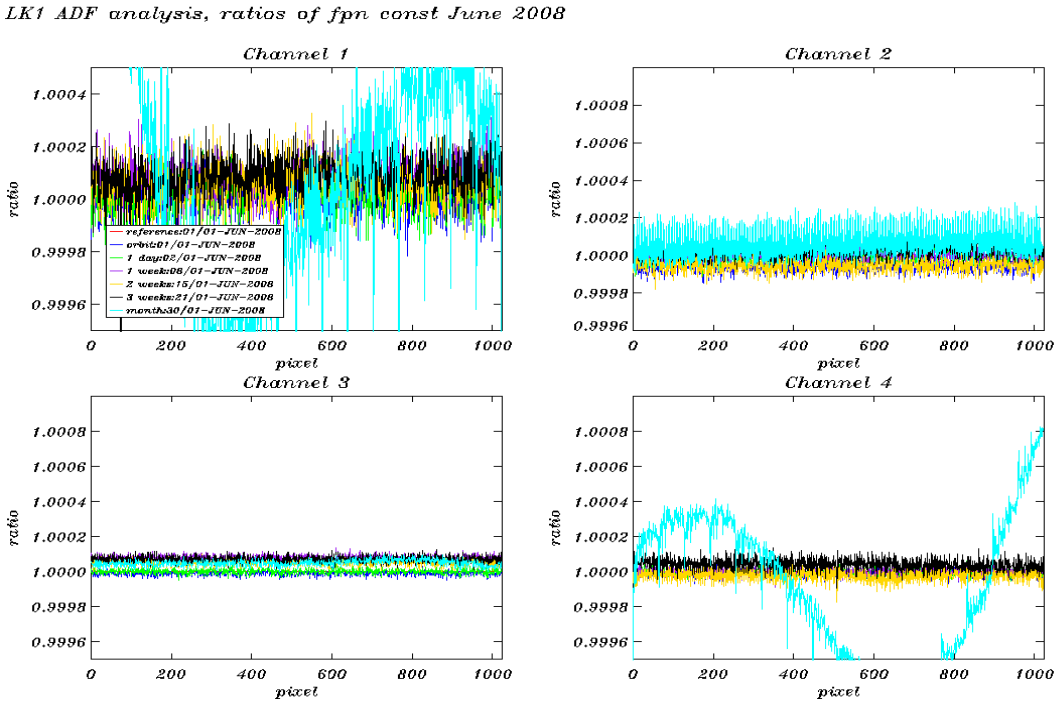


Fig. 5-10: dark current ratios (constant part) channel 1-4 during June 2008, Reference Spectrum used: Orbit 32697, 01-June 2008

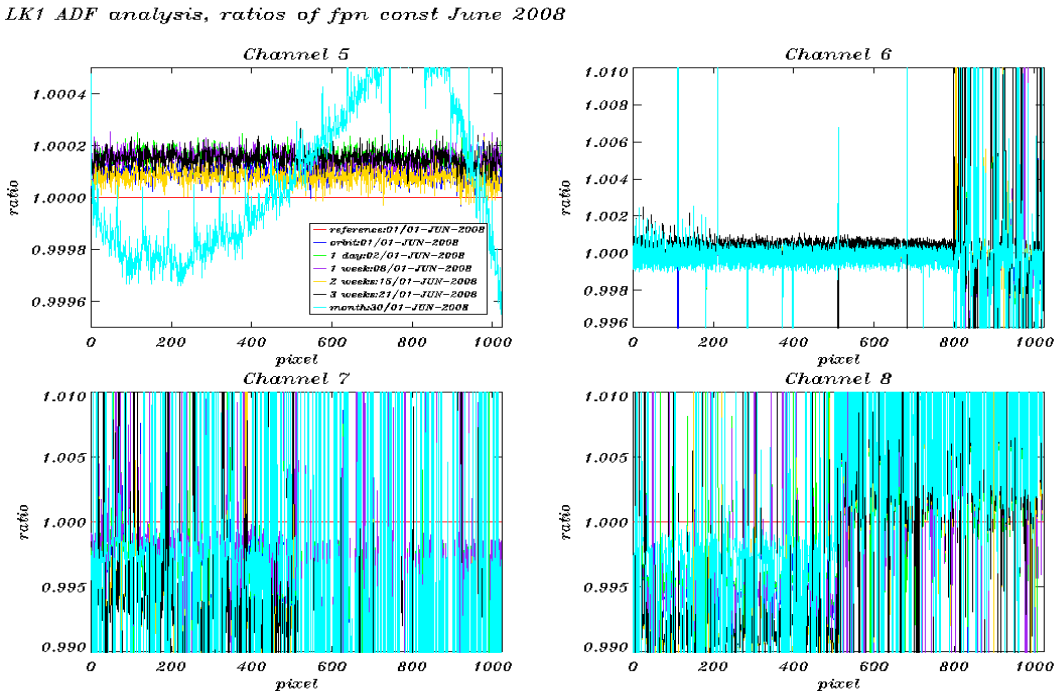


Fig. 5-11: dark current ratios (constant part) channel 5-8 during June 2008, Reference Spectrum used: Orbit 32697, 01-June-2008

5.2.1.2.2 Leakage Variable part

With IPF 6.03 the orbital dependency of channel 6 to 8 leakage current is considered.
SCIAMACHY detector channels 6 – 8 have a time dependent leakage dark signal that consists of two components, the leakage current of the detector pixel and second a component due to thermal background that varies along the orbit.
The implementation of the orbital variation of the leakage current is expected to improve retrieval especially in detector channel 8 for infrared products.

Figure 5-12 shows the evolution of the leakage variable part of the SCI_LK1_ADF during the time span 01 May 2008 to 30 June 2008. The leakage variation for a selected pixel (222) in channel 7 corresponding to orbit phase 5 is shown.
Updates of the leakage variable are expected after the processing of the monthly calibration orbits, i.e. once per month. During this period Monthly Calibration sequences were scheduled for:

- 19 May 2008
- 18 June 2008

For both dates the change of the Leakage Variable value can be clearly seen, demonstrating that the calibration was performed successfully.

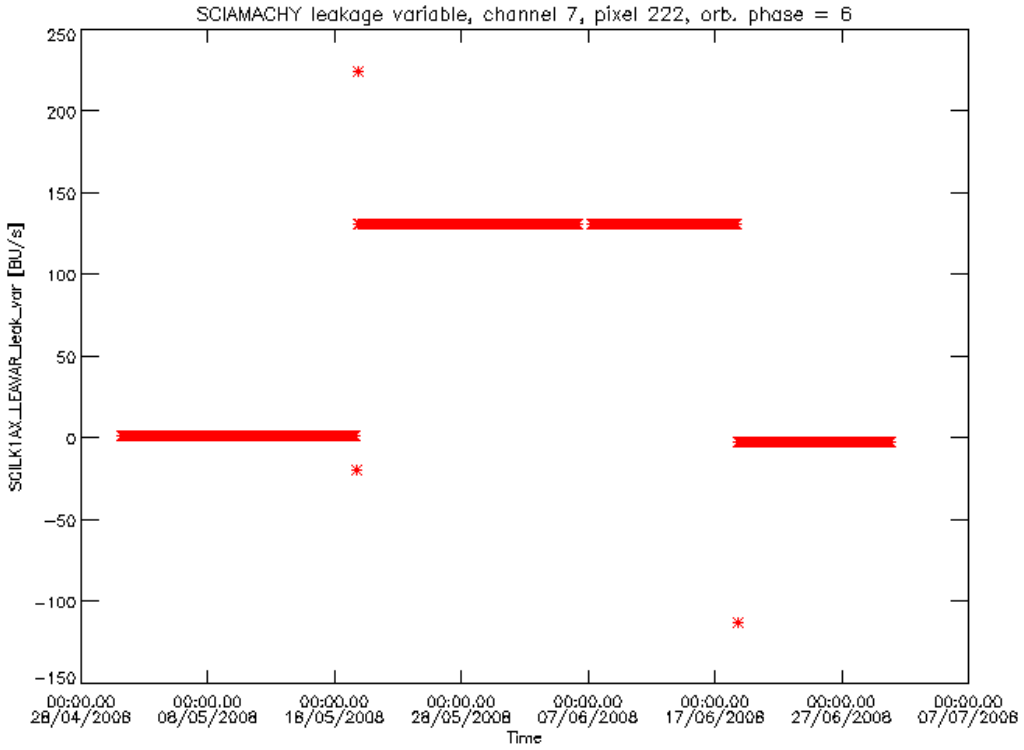


Figure 5-12: Leakage VARIABLE, SCI_LK1_AX, 01 May – 30 June 2008, channel 7, Orbit phase=6 pixel 222

5.3 Bad and Dead Pixel Mask

SRON performs routinely analysis on the SCIAMACHY Bad and Dead Pixel Mask. Within this analysis bad pixels of the detector arrays are identified by the SCIAMACHY Detector Monitoring Facility (SDMF) using 11 flagging criteria. These criteria are based on the dark signal model, transmission, gain and noise of a pixel. Bad pixel masks are calculated on an orbital basis and combined into a "smoothmask" that combines the masks of about 50 orbits. In Fig. 5.13 we show the number/fraction of pixels that is flagged as bad for channels 6, 6+, 7 and 8. Note that channel 6 consists of two parts employing different detector materials. Channel 6+ starts at pixel 794. The rate at which the number of pixels that is flagged is increasing is similar for the IR channels 6+, 7 and 8. The fraction of flagged pixels in channel 6 is much lower and almost constant over the mission, because of the different detector materials used in this part of the channel. The mask currently provided in the level 1b product must be regarded experimental. It uses a different algorithm and is not identical to the mask provided by SRON. It is planned to align the two masks in future processor versions.

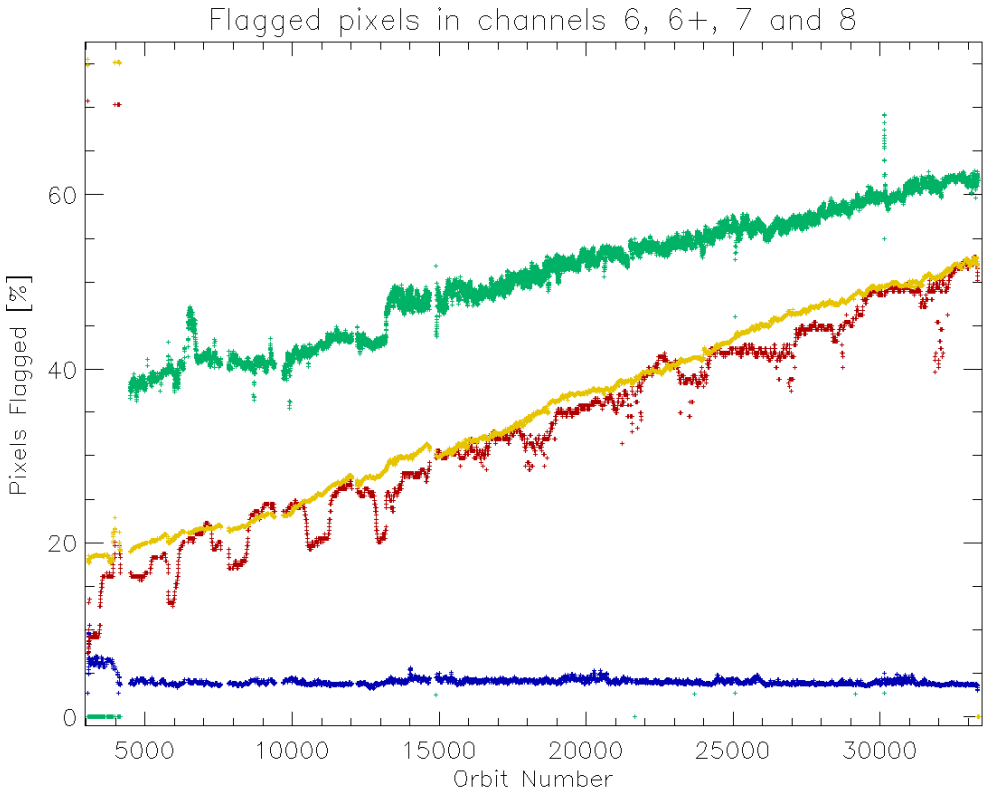


Figure 5-13: Number/Fraction of pixels that is flagged as bad by the SDMF smoothmask for channels 6 (blue), 6+ (red), 7 (green) and 8 (dark yellow). Orbits during SODAP or decontaminations have been removed.

5.4 Pointing Performance

No upgrade with respect to the pointing performance during this reporting period. See BMR September-October 2007 for the last status.

5.5 SciaL1c tool

The SciaL1c tool is an application provided to the users of SCIAMACHY Level 1b products. This application allows selecting specific calibrations to apply to Level 1b data, which are in case of SCIAMACHY defined as not fully calibrated Level 0 channel information in combination with calculated calibration data. The generated Level 1c products are suitable for the user's particular applications.
The SciaL1C Calibration and Extraction Software was upgraded to be compatible with IPF 6.02 data. It is downward compatible, i.e. it can also be used with data from older IPF versions.
SciaL1c can be downloaded at:

http://envisat.esa.int/scial1c

LINUX, Sun Solaris, LINUX on DEC-Alpha and HP-UX on IA64 versions are available.

6 LEVEL 2 NRT PRODUCT QUALITY MONITORING

6.1 Processor Configuration

6.1.1 Version

Since 08 May 2006 the near real time processing of SCIAMACHY level 2 data has been suspended, evolution is currently restricted to the level 2 Off-line processor (see chapter 7).
The last IPF version used was 5.04. The corresponding product specification is *[2]*. The disclaimer at
http://envisat.esa.int/dataproducts/availability/disclaimers/SCI_NL__2P_Disclaimers.pdf
describes known artefacts.

An overview on the implementation dates of the IPF at the different PDS processing centres and the main modifications implemented can be found in previous BMR (June-May 2007).

6.1.2 Auxiliary Data Files

An overview of Auxiliary Files being used as input for SCI_NL__2P products can be found in BMR May-June 2007.

7 LEVEL 2 OFF-LINE PRODUCT QUALITY MONITORING

7.1 Processor Configuration

7.1.1 Version

The Level 2 Off-line processing version is 3.01.
The product specification corresponding to the level 2 off-line processor 3.01 is Volume 15, issue 3/k *[2]* and can be found at
http://earth.esa.int/pub/ESA_DOC/ENVISAT/Vol15_Sciamachy_3k.pdf

The disclaimer at
http://envisat.esa.int/dataproducts/availability/disclaimers/SCI_OL__2P_Disclaimers.pdf
describes known artefacts.

SCI_OL__2P products contain geo-located vertical column amounts of O_3 and NO_2 Nadir measurements, as well as stratospheric Limb profiles of O_3 and NO_2. Additionally the fractional cloud coverage, the cloud-top height, and the cloud optical thickness are derived and provided as product to the user. The major upgrades are summarised in table 7.1.
Currently the new baseline leading to the operational processor 4.00 is under acceptance review by the agencies.

Processor Version	Description	Proc Centre	Date	Start Orbit
3.01	Main processor changes: • Updated SACURA cloud algorithm • Offset applied in NO_2 slant column processing was removed • Number of retrieved profiles per state was set from one to four (4) • Cloud and Aerosol MDS are filled with the next valid value instead of being set to zero • Molecular Ring correction applied on NADIR O3 slant column density Non-compliance corrections: • Inter change of Pressure and Temperature values in LIMB MDS • Erroneous Cloud and Aerosol	D-PAC	23-SEP-2007	29092

	Quality Flags • AAI erroneously set to zero in Cloud and Aerosol MDS • Scaling of too large NO_2 error estimate			
3.00	• Nadir UV/Visible algorithm for ozone and NO2 is based on the GDP (GOME Data Processor) Version 4.0 • Nadir UV/Visible algorithm for cloud-top height and cloud optical thickness based on the SACURA algorithm • Limb UV/Visible products: Stratospheric Ozone and NO2 profiles • Improved pointing performance through the use of the ENVISAT Restituted Attitude information in the consolidated Level 1b product	D-PAC	03-MAY-2006	21824

Table 7-1: Level 2 off-line Processor Configuration

7.1.2 Anomalies

During this reporting period no anomalies in level 2 offline processing were identified.

7.1.3 Auxiliary Data Files

Input for level 2 Off-line processing is the so-called Initialization File. For processor version 3.01 a new Initialization file became active which is
SCI_IN__AXNPDE20070629_092400_20070720_000000_20991231_235959
This ADF is usually changed only in case of a processor upgrade.

7.2 Monitoring results

7.2.1 Nadir: NO_2 consistency checking

The world map plots of nadir NO_2 vertical column density (VCD) values averaged over one month are generated from the SCI_OL__2P nadir products. Fig 7.1 and 7.3 show the monthly world map plots for May and June 2008.
Figures 7.2 and 7.4 show the VCD errors for the monthly average plots. The errors are given in relative fraction. Generally the equator region has NO_2 values with higher errors.

High concentration of NO_2 is expected over industrial regions, as over North America, especially the East coast, over central Europe, China and South Africa, which is reflected in the world maps.

7.2.1.1 Nadir: VCD NO2 map May 2008

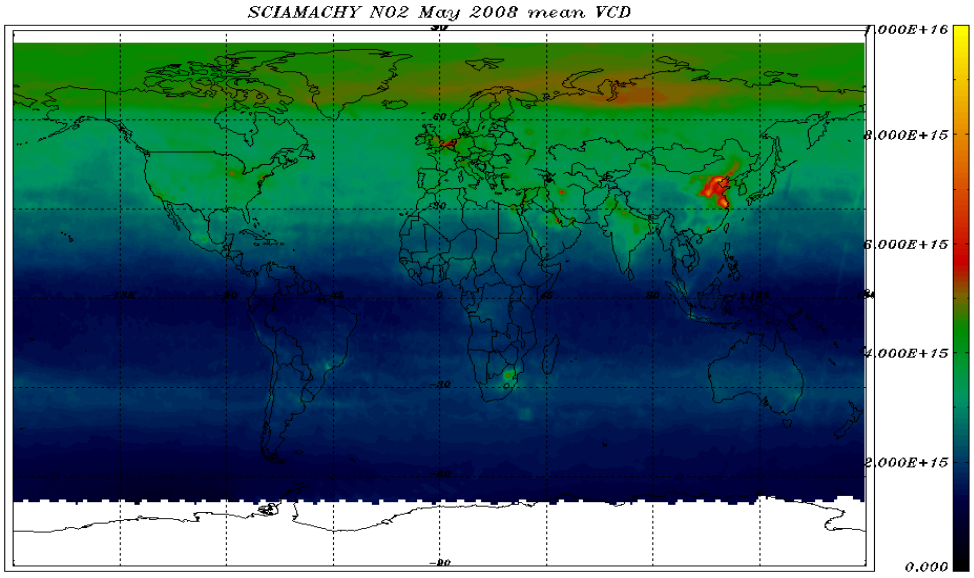


Figure 7-1: NO2 VCD world map 01 - 31 May 2008 – monthly average

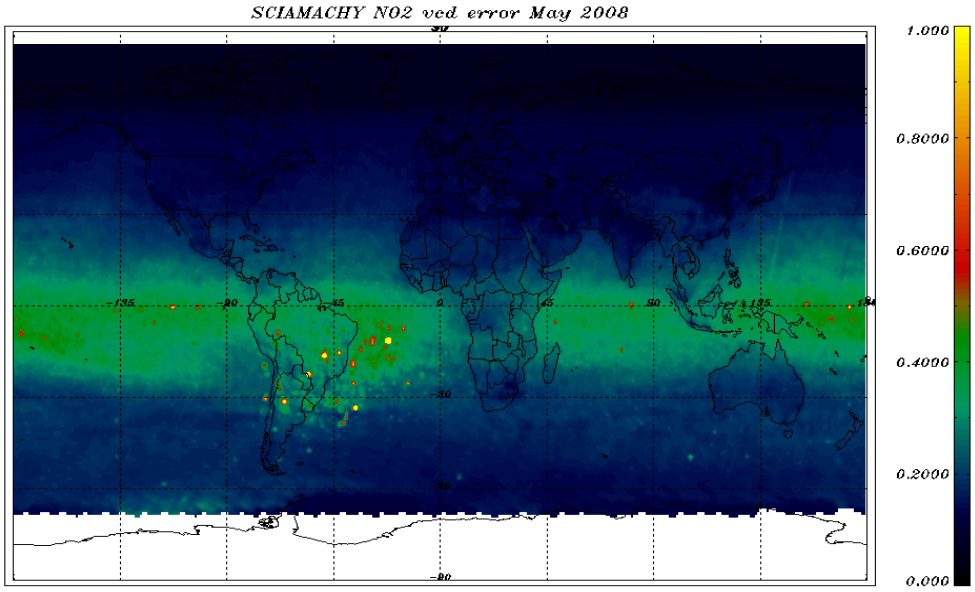


Figure 7-2: NO2 VCD error 01-31 May 2008

7.2.1.2 Nadir: VCD NO2 map June 2008

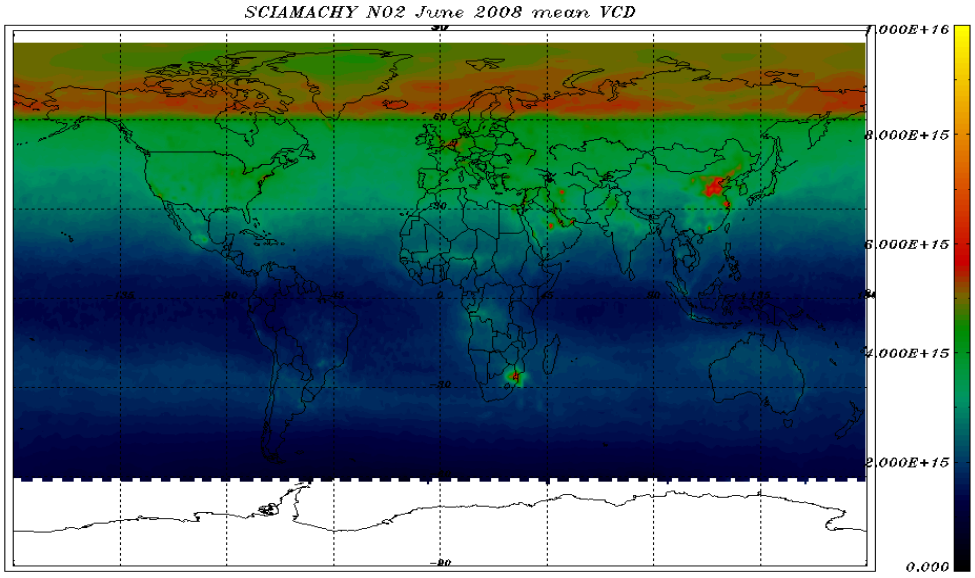


Figure 7-3: NO2 VCD world map 01 – 30 June 2008 – monthly average

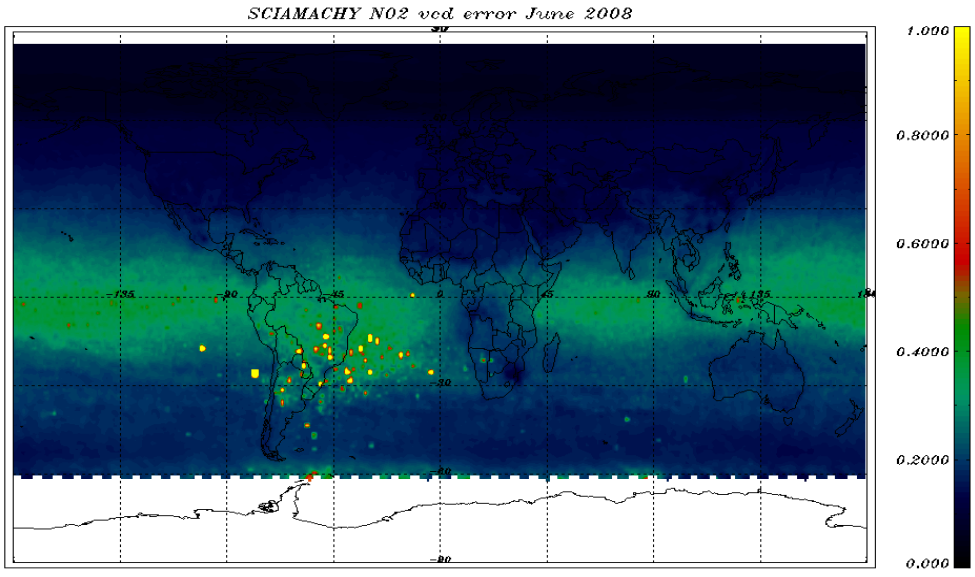


Figure 7-4: NO2 VCD error 01 – 30 June 2008

7.2.2 Nadir: O3 consistency checking

Analogous to the NO_2 world maps, O_3 vertical column density (VCD) values averaged over one month are generated from the SCI_OL__2P nadir products and plotted on a world map. Fig 7.5 and 7.7 show the ozone distribution converted in Dobson units for May and June 2008. Corresponding to the seasonal evolution the Ozone Hole over the Antarctica is not visible during these two months.
The VCD errors as monthly average plots are shown in Figures 7.6 and 7.8. The errors are given in relative fraction. Systematically higher error values at the North Pole area are visible.

7.2.2.1 Nadir: VCD O3 map May 2008

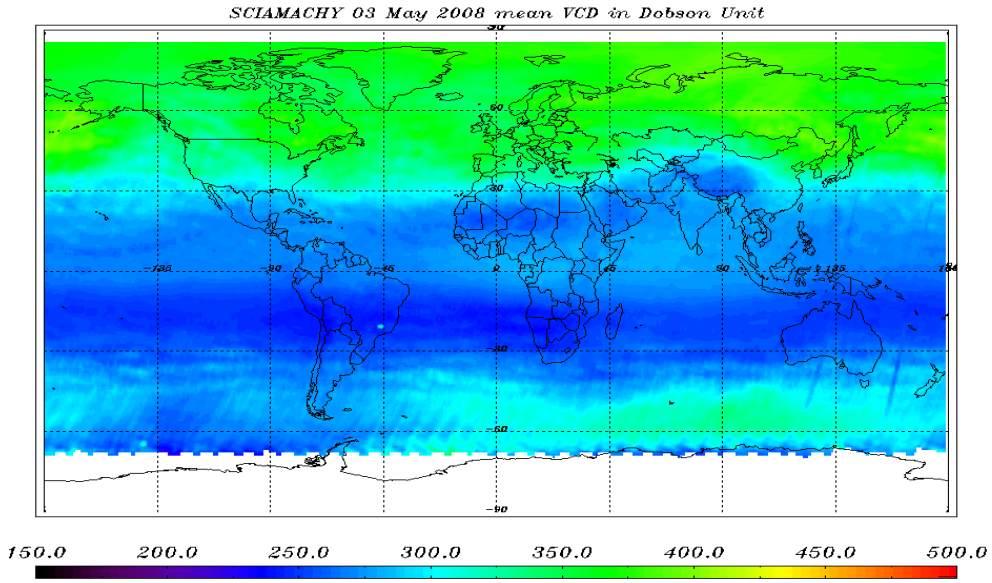


Figure 7-5: O_3 VCD world map 01-31 May 2008 – monthly average

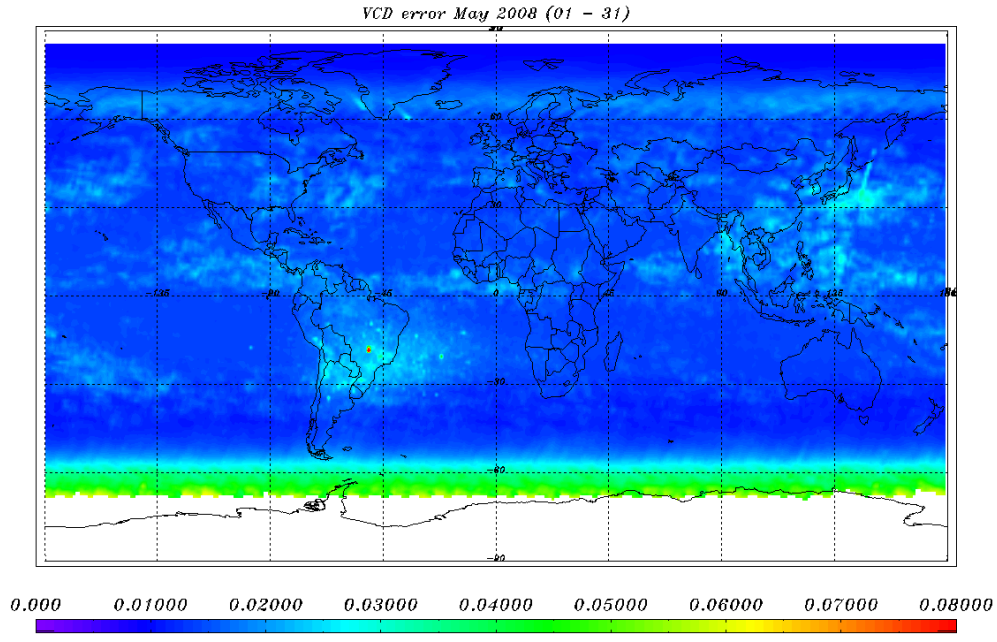


Figure 7-6: O_3 VCD error 01-31May 2008

7.2.2.2 Nadir: VCD O3 map June 2008

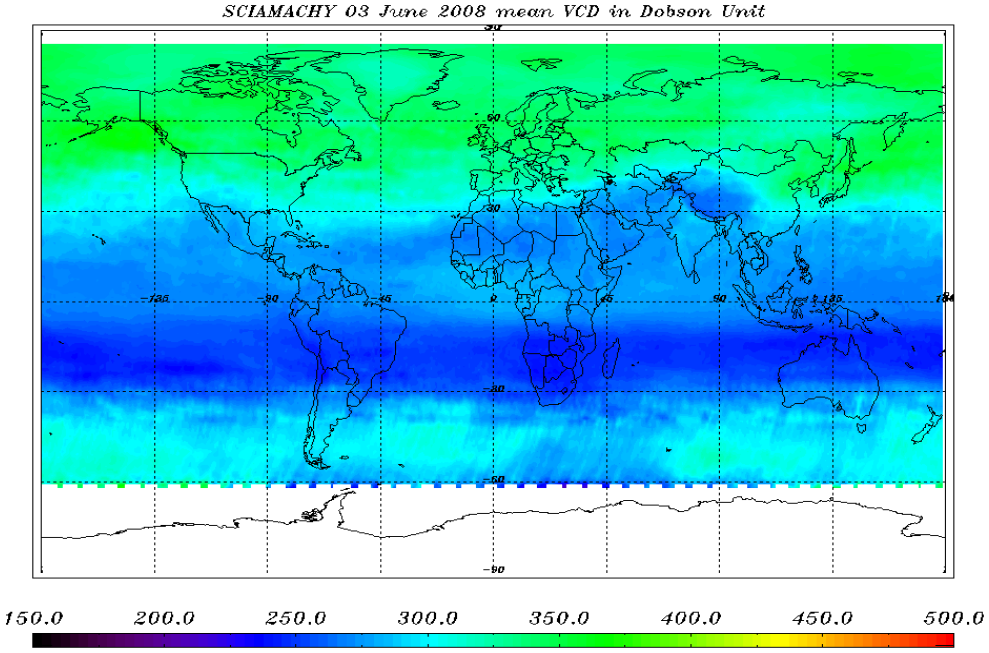


Figure 7-7: O_3 VCD world map 01 - 30 June 2008 – monthly average

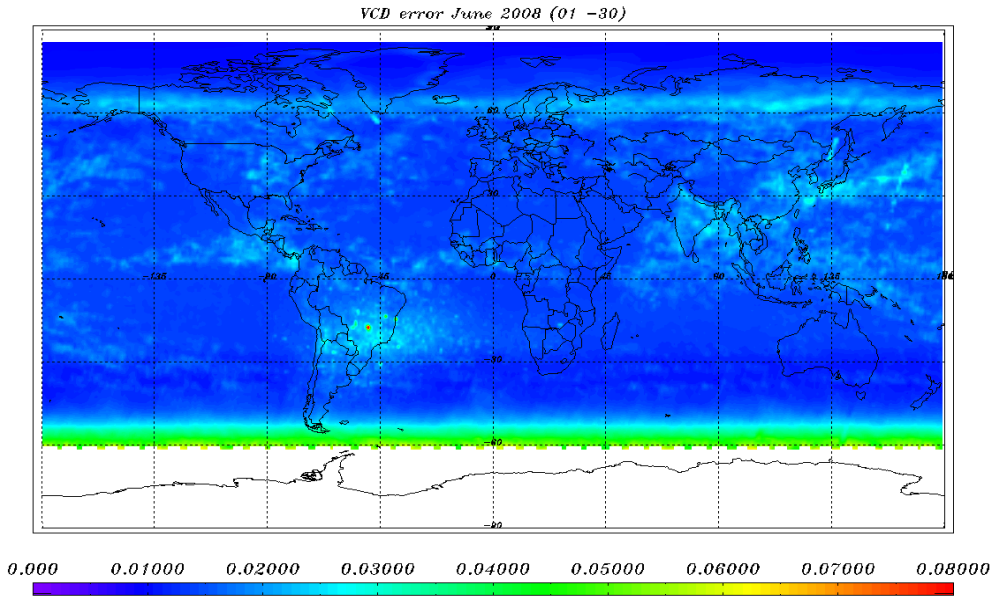


Figure 7-8: O_3 VCD error 01-30 June 2008

7.2.3 Limb: Ozone profile averages

This paragraph reports on the quality check of SCIAMACHY limb profiles on a monthly basis, showing the results for Ozone limb profiles binned for two tangent height regions bins:

- 21.0 – 24.5 km (17th bin, bin index=16).
- 35.0 – 38.5 km (13th bin, bin index=12).

The data of the first half of each month (calendar days 1 - 15) and the second half (calendar days 16 - 31) are averaged for selected tangent heights into geolocation bins of 10 degrees longitude and 5 degrees latitude. The binning algorithm uses a single longitude and latitude value for the entire profile, being the value for the middle of the integration time as reported in the Geolocation Limb Dataset. The corresponding error is averaged as well.
The world maps of the averaged Ozone values show comparably low errors over the SAA region, which is not as expected. Investigation showed that the low SAA errors result from irregular conditions of the LIMB retrieval in that region. This issue will be included into the level 2 off-line disclaimer.
Figures 7.9 – 7.12 show the results for the months of May and June 2008 and for the two different tangent height regions.

7.2.3.1 Ozone limb profiles May 2008

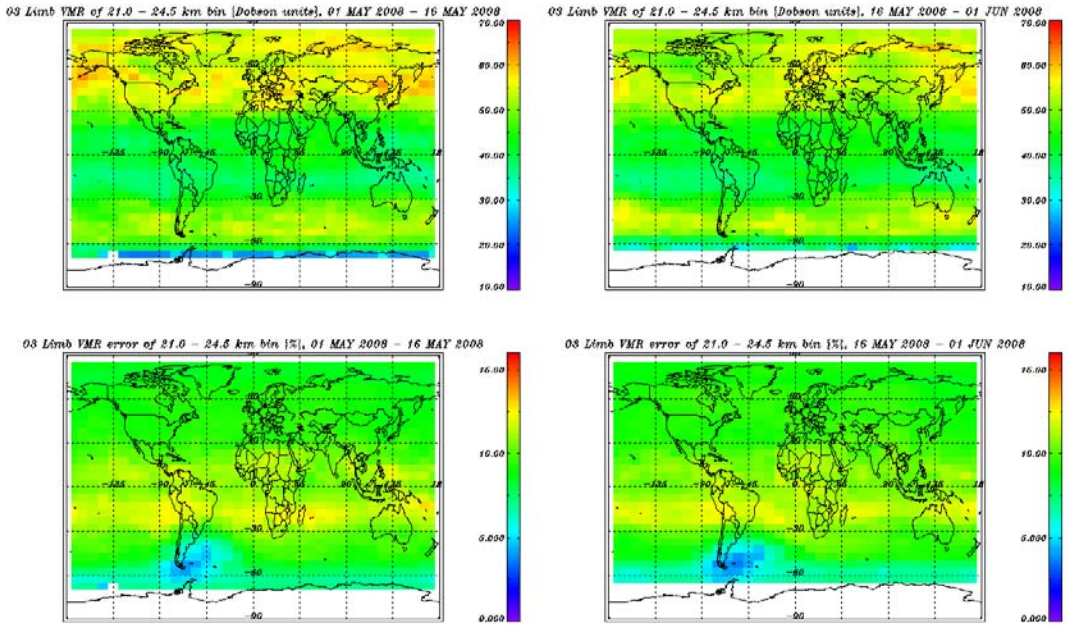


Figure 7-9 Limb Ozone profiles, binned over 21.0 – 24.5 km

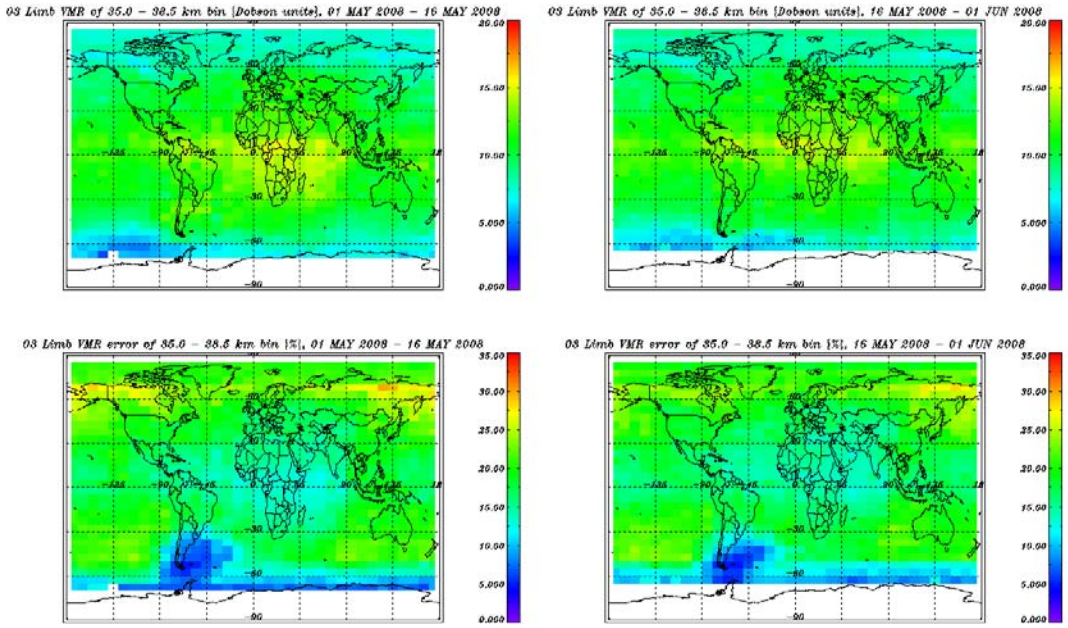


Figure 7-10 Limb Ozone profiles, binned over 35.0 – 38.5 km

7.2.3.2 Ozone limb profiles June 2008

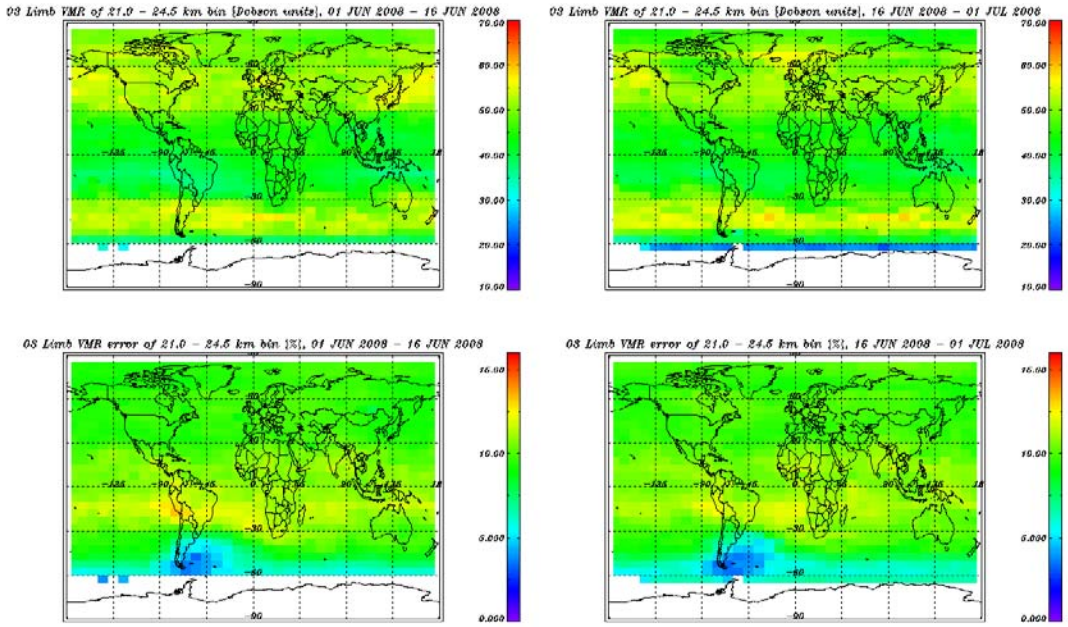


Figure 7-11: Limb Ozone profiles binned over 21.0 – 24.5 km

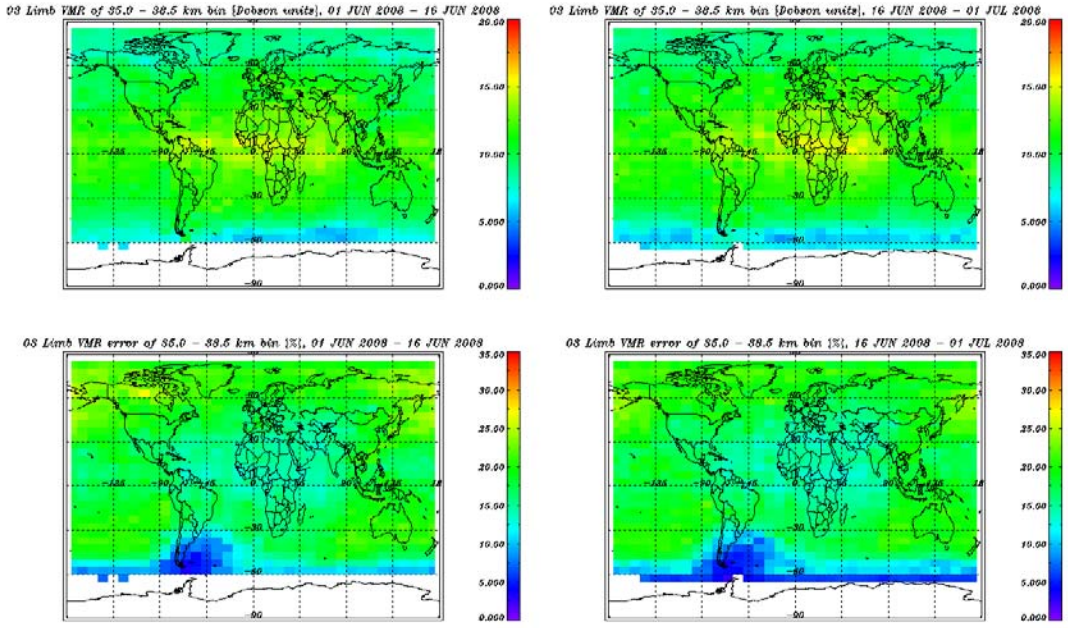


Figure 7-12: Limb Ozone profiles binned over 35.0 – 38.5 km

7.2.4 Limb: NO_2 profile averages

Analogous as for the limb Ozone profiles monthly averages for NO_2 limb averages were generated. The tangent height region chosen is:

- 24.5 – 28.0 km (15th bin, bin index=14).

As for the ozone averages the data of the first half of each month (calendar days 1 - 15) and the second half (calendar days 16 - 31) are averaged for selected tangent heights into geolocation bins of 10 degrees longitude and 5 degrees latitude. The binning algorithm used is the same as the described in 7.2.3. The corresponding error is averaged as well. Figures 7.13 – 7.14 show the results for the months of May and June 2008.

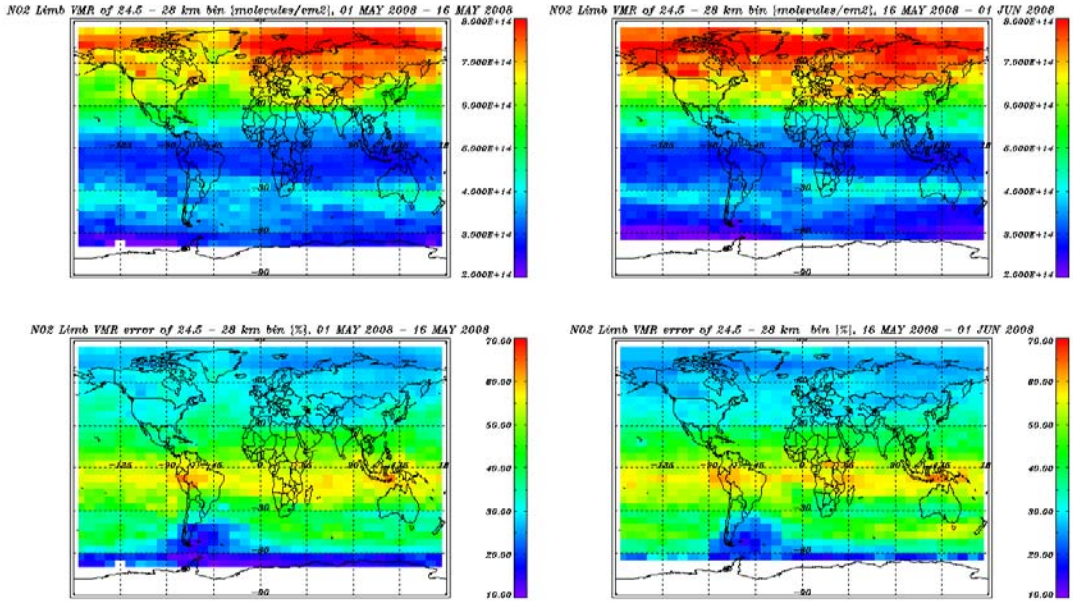


Figure 7-13 Limb NO2 profiles binned over 24.5 – 28 km, May 2008

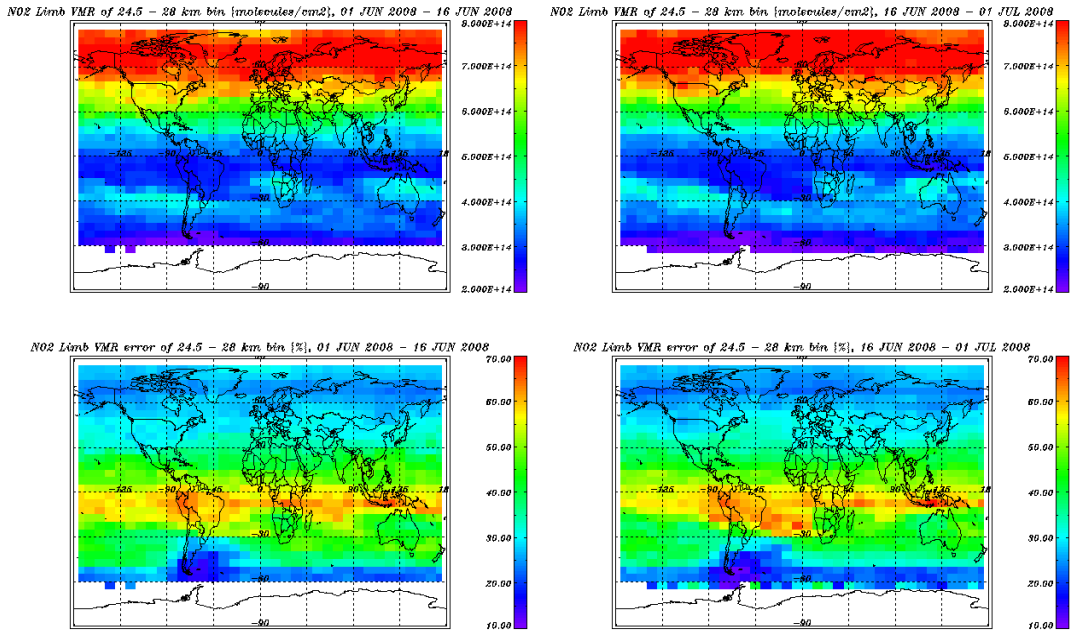


Figure 7-14 Limb NO2 profiles binned over 24.5 – 28 km, June 2008

8 VALIDATION ACTIVITIES AND RESULTS

Validation activities of products from re-processing, level 1 IPF 6.03 and level 2 off-line processor 3.01 have been performed. A preliminary validation meeting took place on 22 January 2008 at SRON and a second meeting at 26th March 2008 in Bremen.

The SCIAVALIG group has published the results of the Product Quality at

http://www.sciamachy.org/validation/documentation/technotes/SCIAVALIG/Summary_operational_product_quality_20080326.pdf

The results of the validation activity on the level 2 column products and level 2 profile products were also summarized in the last BMR of March-April 2008.