
document title/ titre du document

SCIAMACHY BI-MONTHLY REPORT: SEPTEMBER - OCTOBER 2005

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Checked by	Gareth Davies
reference/ <i>référence</i>	ENVI-SPPA-EOPG-TN-06-0001
issue/ <i>édition</i>	1
revision/ <i>révision</i>	0
date of issue/ <i>date d'édition</i>	11 Jan 2006
status/ <i>état</i>	
Document type/ <i>type de document</i>	Technical Note
Distribution/ <i>distribution</i>	

APPROVAL

Title <i>titre</i>	SCIAMACHY Bi-Monthly Report: September - October 2005	issue 1 <i>issue</i>	revision 0 <i>revision</i>
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approved by <i>approuvé by</i>	T. Fehr ESA/ESRIN, D/EOP-GOQ	date 19/01/2006 <i>date</i>
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CHANGE LOG

reason for change /raison du changement	issue/issue	revision/revision	date/date

CHANGE RECORD

Issue: 1 Revision: 0

reason for change/raison du changement	page(s)/page(s)	paragraph(s)/paragraph(s)

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SCIAMACHY BI-MONTHLY REPORT SEPTEMBER - OCTOBER 2005

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 Product Control Facility, 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 and SOST-IFE.

The remainder of the report is dedicated to Level 1 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: J, Alberto Pellegrini

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
D-PAC	Processing and Archiving Centre in Germany
DPQC	Data Processing Quality Control
ESM	Elevation Scan Mechanism
FPN	Fixed Pattern Noise
HK	Housekeeping
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)
LOS	Line of Sight
MCMD	Macro Command
MR	Monthly Report
NCWM	Nadir Calibration Window Mechanism
NDFM	Neutral Density Filter Mechanism
NNDEC	Non-nominal Decontamination
NRT	Near Real Time
OBM	Optical Bench Module
OCR	Operations Change Request
OSDF	Orbit Sequence Definition File
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
SAA	South Atlantic Anomaly

SCIAMACHY	Scanning Imaging Absorption Spectrometer for Atmospheric Chartography
SEU	Single Event Upset
SLS	Spectral Line Source
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

2 SUMMARY

- During the reported period SCIAMACHY measurements were nominal with respect to planning.
- Monthly Calibration was executed during Orbits
 - 18561-18565 (17/18-Sep-2005)
 - 18976-18980 (16/17-Oct-2005)
- Moon occultations were not executed as the moon was rising on the dayside.
- No OCR has been implemented during September - October 2005.
- No TC adjustment was required.
- Due to a planned Orbit Control Manoeuvre, SCIAMACHY was in measurement/idle mode during Orbits
 - 18409 – 18415 (07-Sep-2005)
- Light Path monitoring:
 - Small degradation in UV continues (channel 1 – 2%, channel 2 – 1%); sun over ESM diffuser degradation smaller than for other light paths – indication that ESM diffuser degrades less than ESM mirror
 - Overall degradation in channel 3 continues, but is smaller than for channels 1 and 2
 - Channels 4-5 radiometricly stable
 - Channel 6 throughput loss due to icing
 - Channel 7 throughput rather stable over time interval
 - Channel 8 throughput is reduced by about 20%, the transmission is stable at this level
- 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 which is currently unexplained.
 - PMD 6 results still under investigation

- Spectral light path monitoring:
 - UV degradation decreases with increasing wavelength
 - Degradation is wavelength dependent (especially at channel edges)
 - Solar activity variation visible (e.g Mg II Fraunhofer line)
 - Channel degradation results generally are confirmed with spectral light path monitoring
- Downlink/acquisition problems resulted in corrupted L0 and L1b data products:
 - Orbits 18682-18687, 18697
- ADF generation was impacted by hardware failures during September
- SCIAMACHY Level 2 NRT ozone and AMF values are impacted by a wrong handling of the seasonal index 3, corresponding to the period 15 October – 31 December 2005. This season index is handled correctly in the L2 offline product.

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 18322 (ANX = 01-September-2005, 01:17:48.633) to 19194 (ANX = 31-October-2005, 23:19:57.974). One OSDF specified the planning baseline.

Orbit		ANX		OSDF
Start	Stop	Start	Stop	
18322	19194	01-Sep-2004 01:17:48.633	31-Oct-2005 23:19:57.974	MPL_OSD_SHVSH_20050714_010101_00000000_33110001_20050901_011750_20051101_010031

Table 3-1: SCIAMACHY OSDF planning files from September – October 2005

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

- 18561-18565 (17/18-Sep-2005)
- 18976-18980 (16/17-Oct-2005)

The moon was in the limb TCFoV between orbits 18498-18578 (13-Sep-2005 until 18-Sep-2005) and 18916-19001 (12-Oct-2005 until 18-Oct-2005) but no occultations were executed since the moon was rising on the dayside.

No OCR has been implemented between September and October.

3.1.2 *Instrument Measurement Status (SOST-DLR)*

Final flight status for mission scenarios, states and timelines remained unchanged throughout the reporting period.

3.1.3 *Executed Operations and Measurements (SOST-DLR)*

Measurements

The OSDF planning files have been scheduled as requested. A short planned deviation occurred between orbits 18409-18415 (07-Sep-2005) when an orbit control manoeuvre was performed (see below).

Detector thermal adjustment

No TC adjustment was required. TC settings throughout the reporting period were

- DAC1 = 0.53 W
- DAC2 = 0.70 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
18711	28-SEP-2005 06:59:11	ok	18712	28-SEP-2005 08:35:42
n.a.	n.a.	n.a.	19112	26-OCT-2005 07:18:17

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

Anomalies

No anomalies had occurred.

Instrument unavailability

The instrument was available throughout the reporting period except for the short period with an orbit control manoeuvre on 07-Sep-2005 when a planned activity transferred SCIAMACHY to MEASUREMENT/IDLE for about 6 orbits.

Unavailability					
Orbit		UTC		Event	Remark
Start	Stop	Start	Stop		
18409	18415	07-Sep-2005 03:24:52	07-Sep-2005 14:37:25	transfer to MEASUREMENT/IDLE	OCM

Table 3-3: Instrument unavailabilities

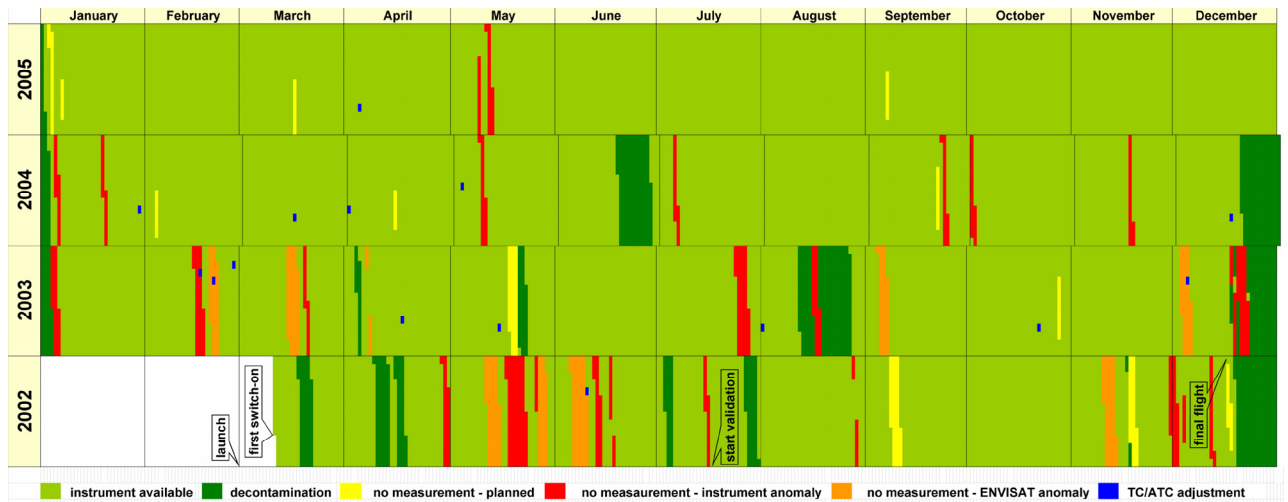


Fig. 3-1: Current instrument availability status including the reporting period

3.1.4 Performance Monitoring - System (SOST-DLR)

Detector temperatures

Detector 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. 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.

No temperature violations occurred.

OBM temperatures

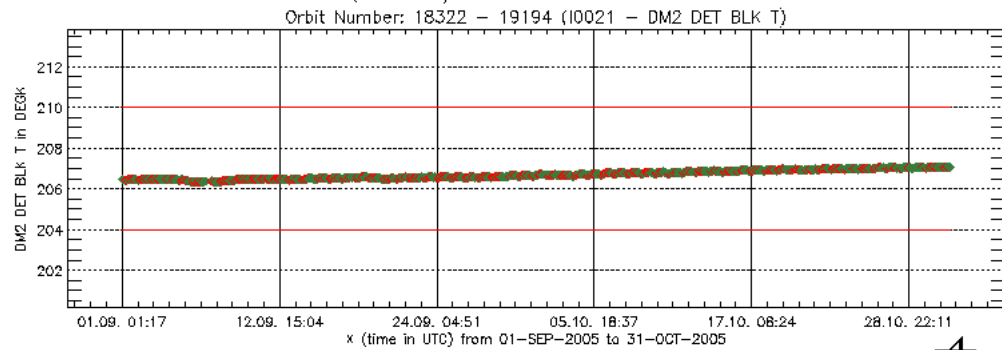
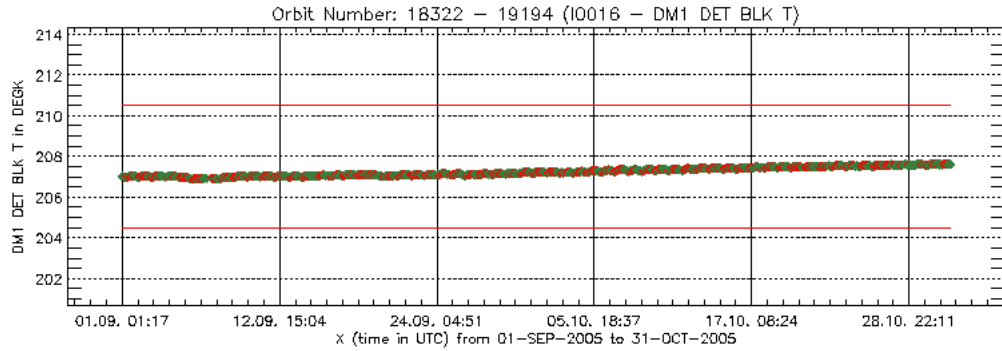
OBM temperatures are monitored according to the requirements of the IOM [1]. It requests to ensure that the average temperature per orbit remains within the specified limits. The average OBM temperature per orbit is determined from specific HK telemetry parameters. In addition power readings for the 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.

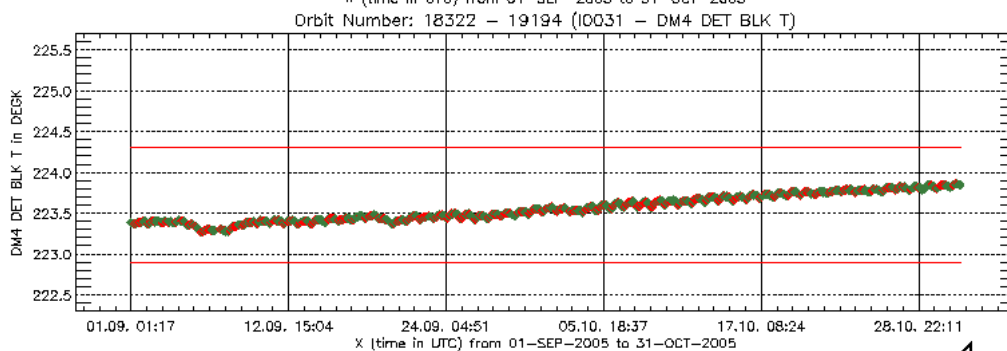
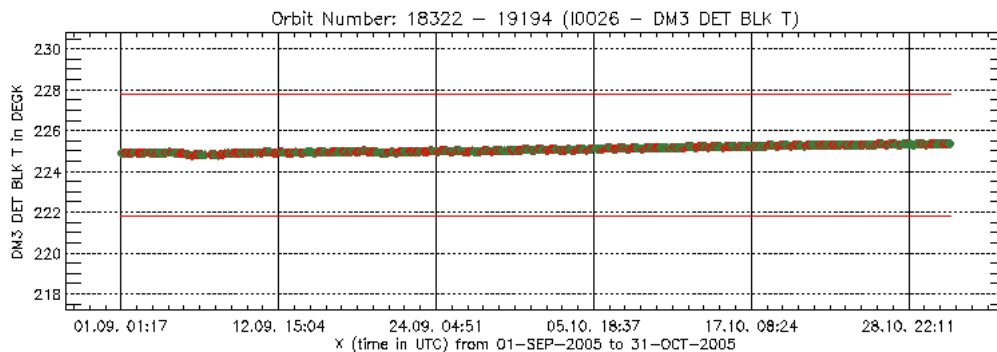
PMD ADC status

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.



Filename: PIN_401_18322_19194_
Date : 21-12-2005 Page : 7



Filename: PIN_401_18322_19194_
Date : 21-12-2005 Page : 7





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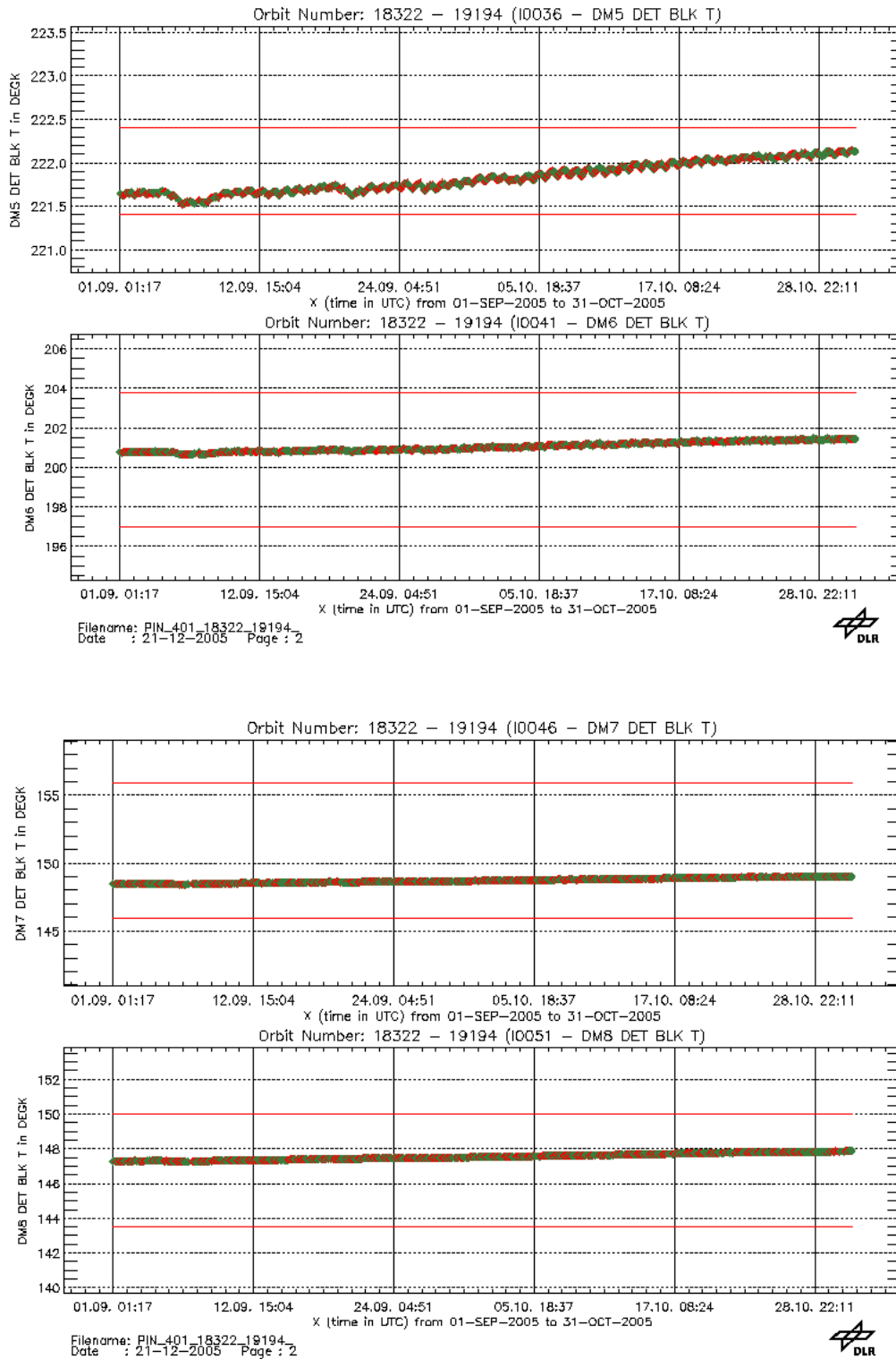


Fig. 3-2: Detector temperatures

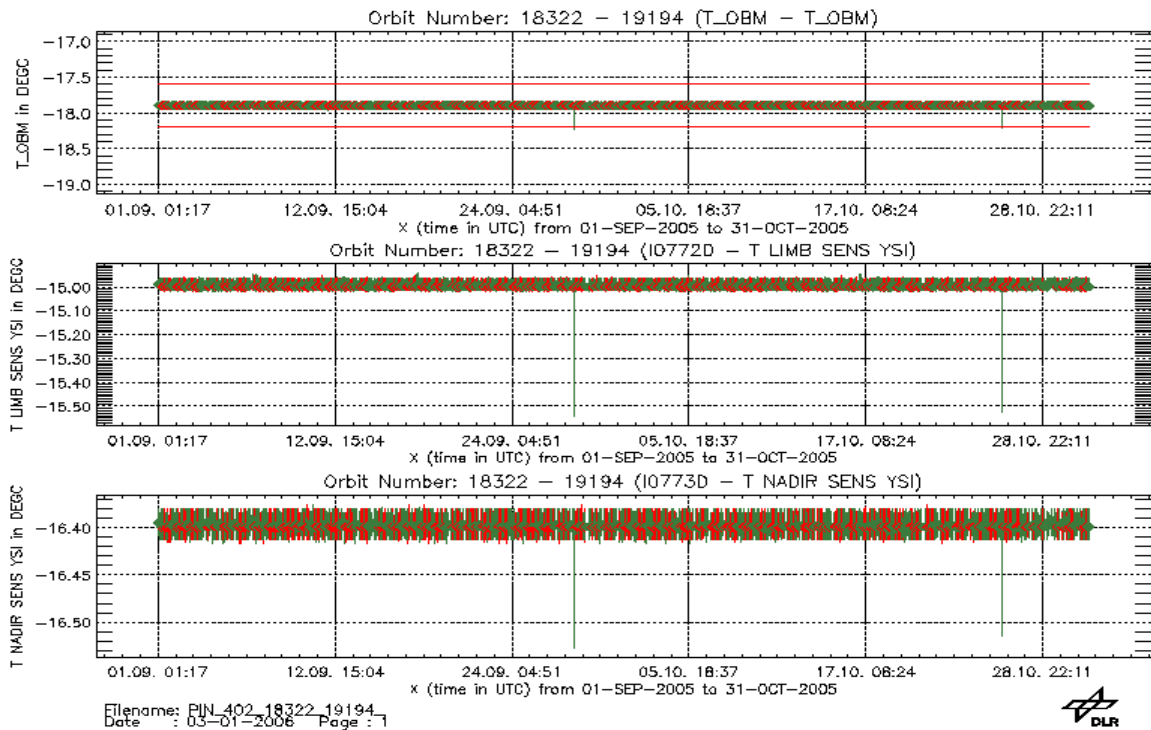


Fig. 3-3: OBM temperatures (top: derived OBM, middle: limb sensor, bottom: nadir sensor)

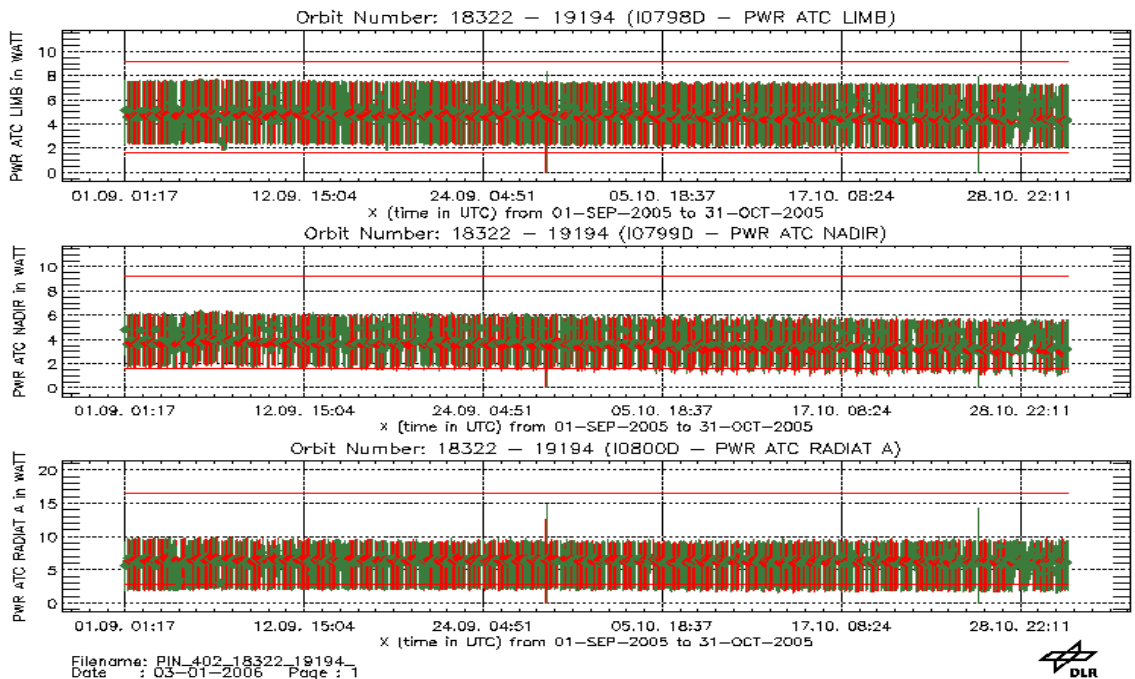


Fig. 3-4: ATC heater power (top: ATC limb, middle: ATC nadir, bottom: ATC Rad A)

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

- NDFM: 0.50
- APSM: 0.46
- NCWM (sub-solar port): 0.53
- WLS (switches): 0.11
- WLS (burning time): 0.21
- SLS (switches): 0.03
- SLS (burning time): 0.01

How the relative LLI usage has accumulated since launch can be seen in fig. 3-5. 'EOL' assumes a total mission lifetime of 0.5 years of Commissioning Phase and 4.5 years of routine operations.

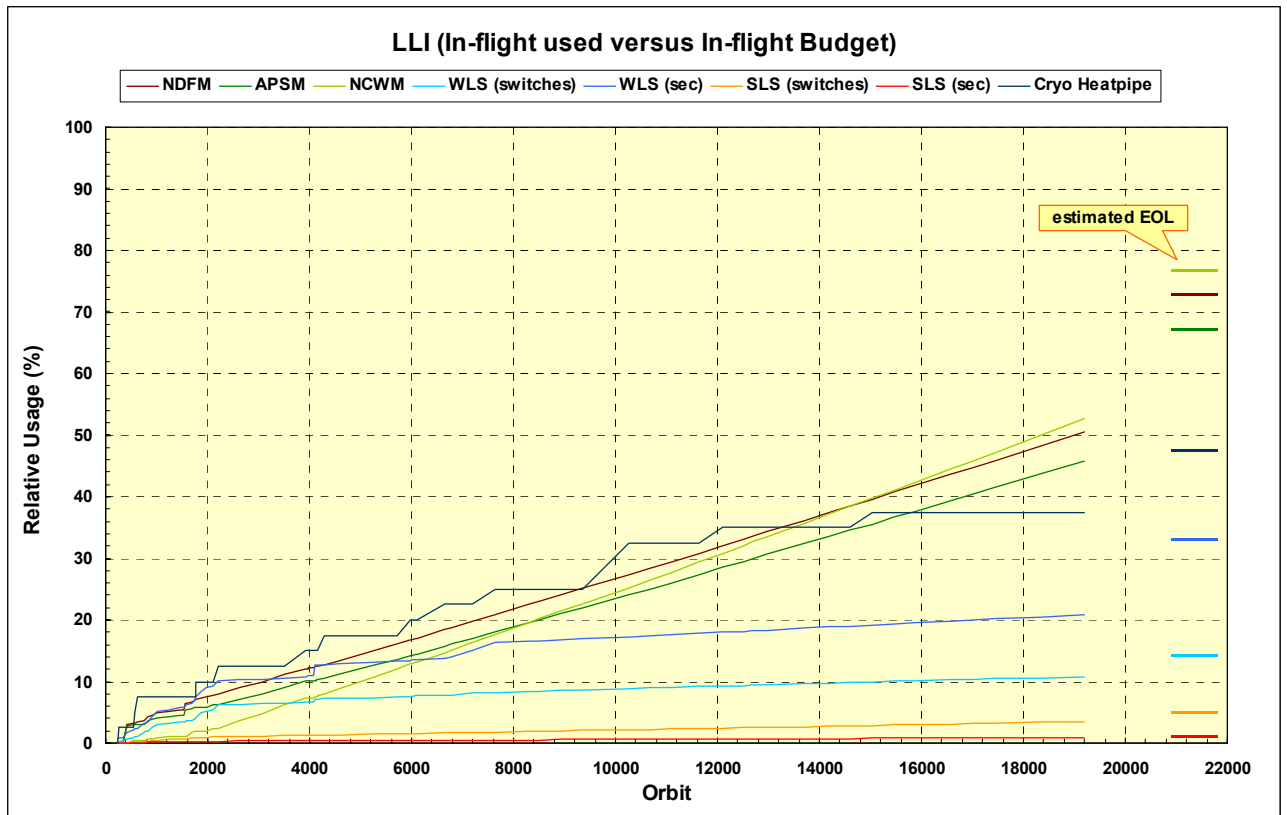


Fig. 3-5: Relative usage of LLIs. 'EOL' is derived for the currently specified mission lifetime.

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 $< \pm 10$ 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 manoeuvres cause distinct discontinuities.

Time reference is not a critical issue with respect to quality monitoring.

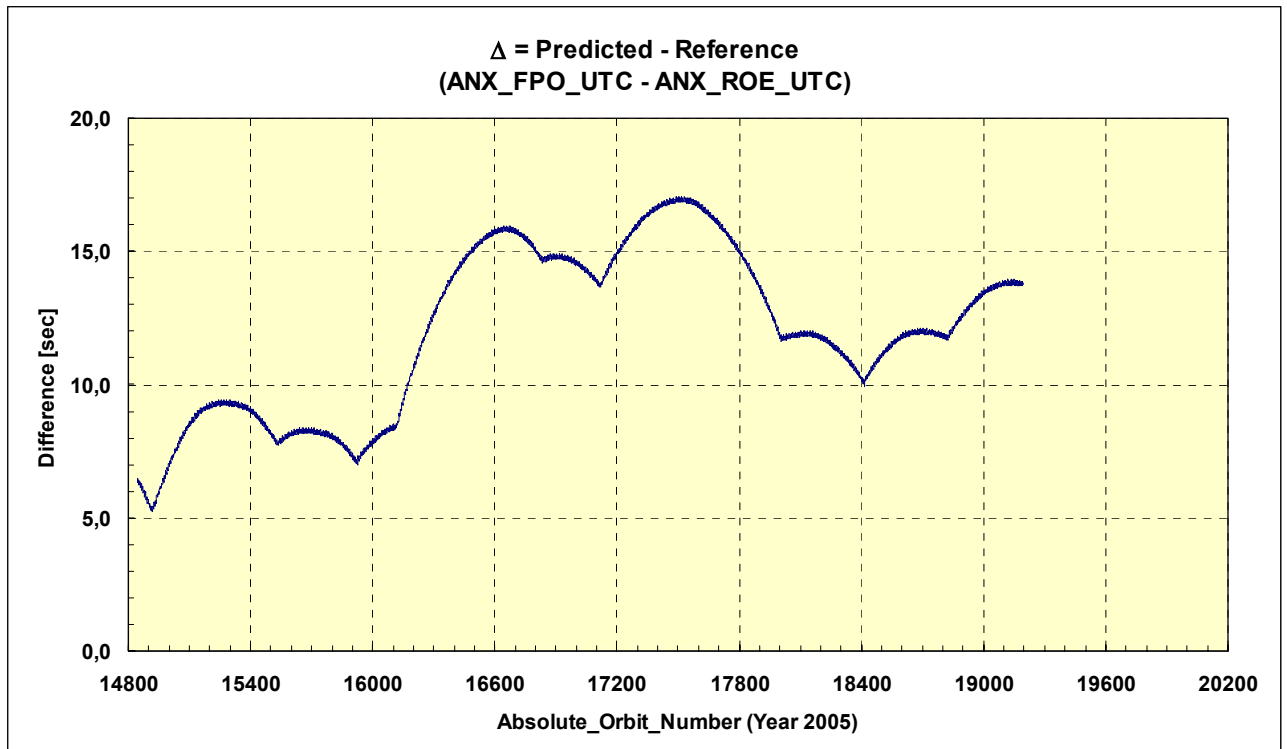


Fig. 3-6: Time difference between predicted and reference time.

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 September to October 2005.

All measured signals have been averaged over the entire channel and then divided by the corresponding measurement at a reference time (currently 2 August 2002, at about orbit 2200), yielding an effective instrument throughput for the different light paths.

The timing of subsolar measurements before 30 November 2002 (about orbit 3922) did not consider the known yaw misalignment of SCIAMACHY on ENVISAT. Therefore all subsolar measurements after 30 November 2002 have been referred to orbit 4519 (10 January 2003, just after a long decontamination phase).

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 investigation.

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 Level 1b data.

Daily updated light path monitoring results can be found on the SOST or IUP web site (<http://www.iup.physik.uni-bremen.de/sciamachy/LTM/LTM.html>).

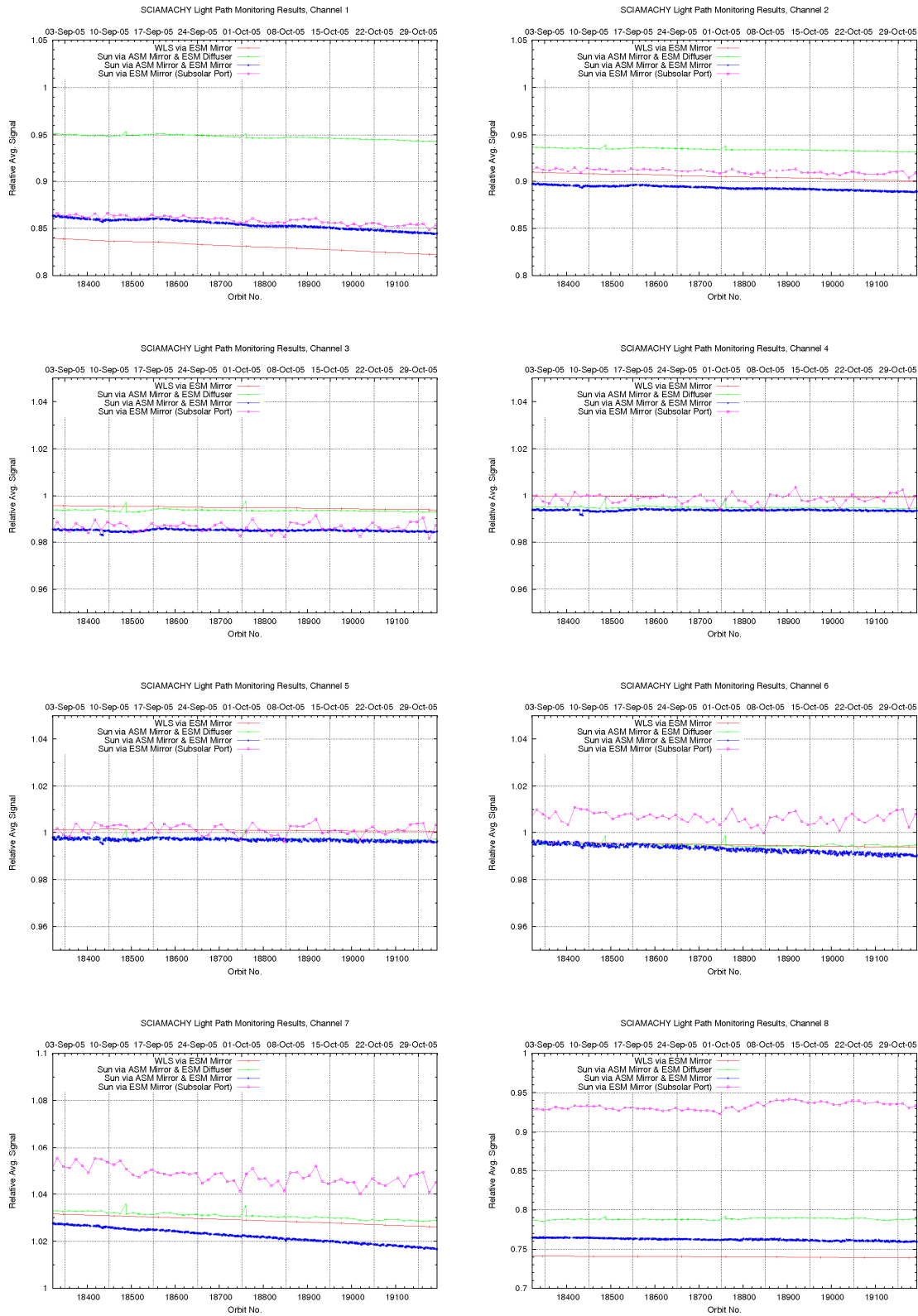


Fig. 3.7: Light path monitoring results September 2005 to October 2005.

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

- The degradation in the UV (channels 1 & 2) increases. Currently, the throughput loss for all light paths involving the ESM mirror is about 2% (for channel 1), now reaching levels below 80%, and almost 1% (for channel 2) within the shown two months. The degradation of the calibration light path which involves the ESM diffuser instead of the ESM mirror is still smaller than for the other light paths, indicating that the ESM diffuser degrades less than the ESM mirror.
- The overall degradation of channel 3 also continues, but it is still much less than in channels 1 and 2.
- Channels 4 and 5 remain stable.
- The throughput loss in channel 6 is not easily accessible from the bi-monthly plot because of the overlaid seasonal variation of the signal which has not been completely corrected out.

However, the long-term plots (accessible via the SOST web site) indicated that some of the observed throughput loss may be attributed to degradation, possibly caused by icing.

Note that there has not been a decontamination since January 2005, therefore even small icing effects may now become visible.

- The throughput of channel 7 still decreases, but this is almost negligible compared to the formerly observed throughput losses. Seasonal effects may also not be excluded here.
- Channel 8 transmission remains stable at about 75-80% (depending on light path). The higher throughput for the subsolar light path is most likely caused by the specific scan mode (fast sweep) analysed which causes a systematic offset.

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 month, Fig. 3.8 – 3.11 show the complete time series from 2 August 2002 to the end of October 2005.

Notes:

- Dates in the graphs refer to UTC noon (12:00).
- The data 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.

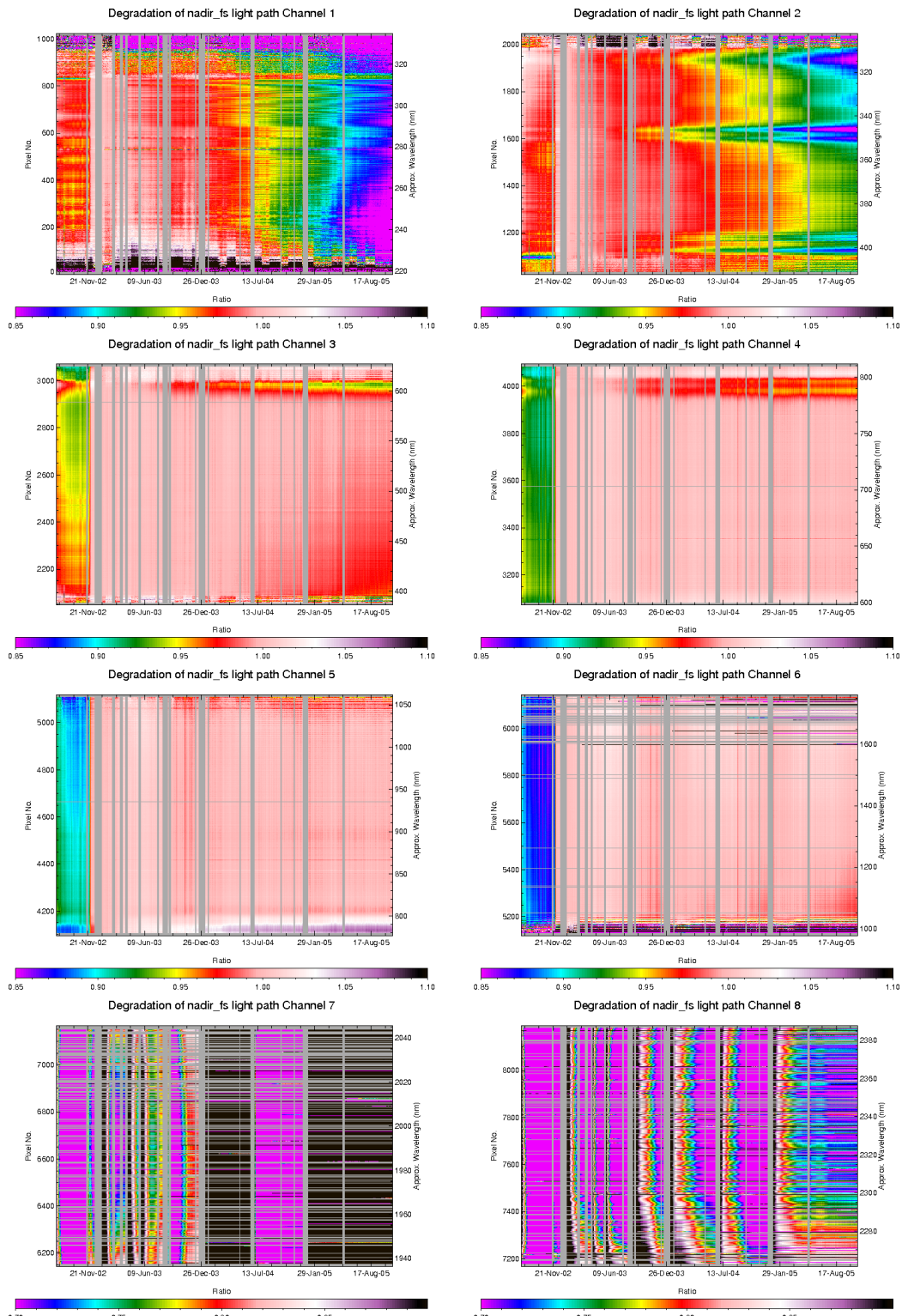


Fig. 3.8: Spectral light path monitoring results August 2002 to October 2005 (nadir light path)

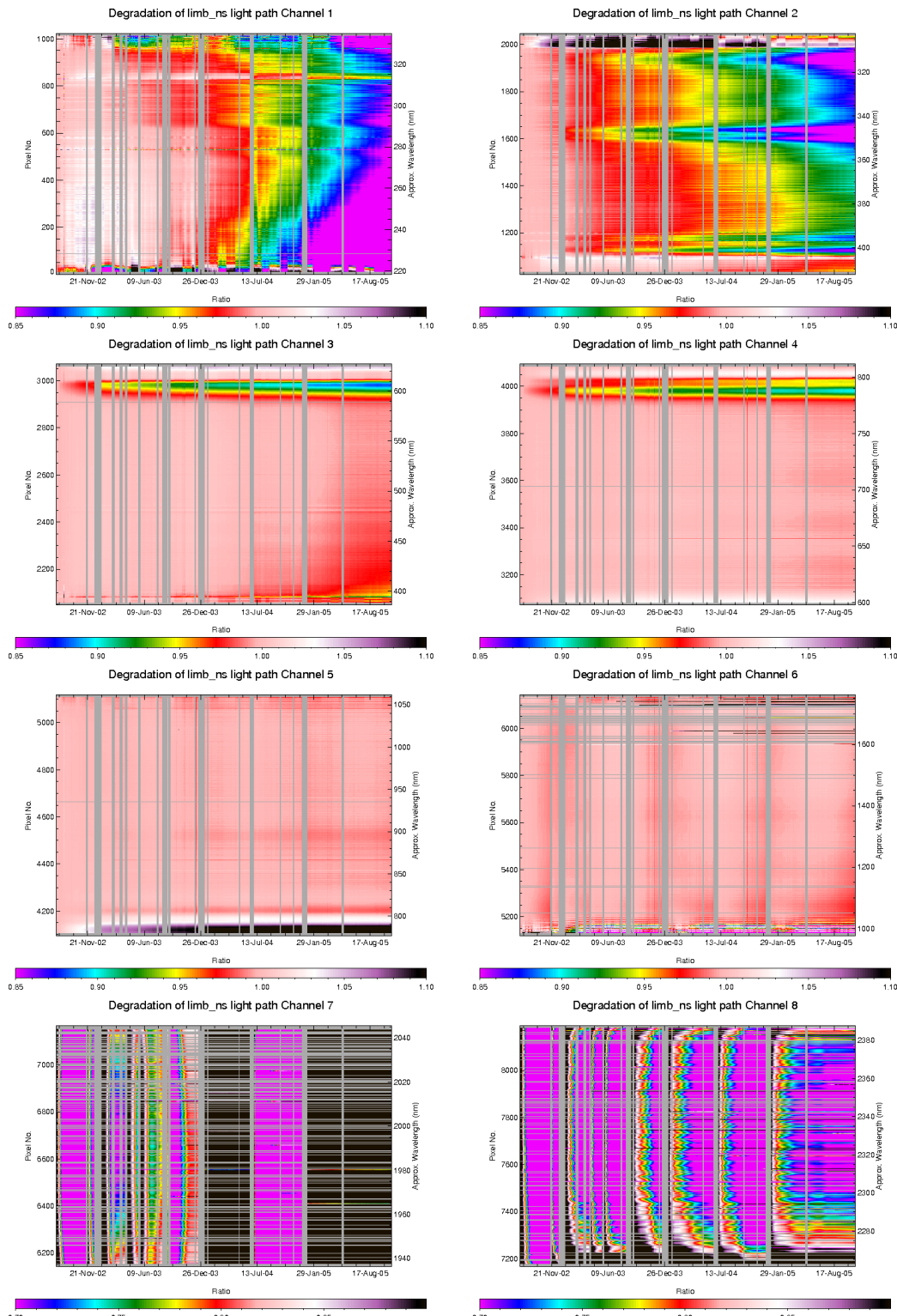


Fig. 3.9: Spectral light path monitoring results August 2002 to October 2005 (limb light path)

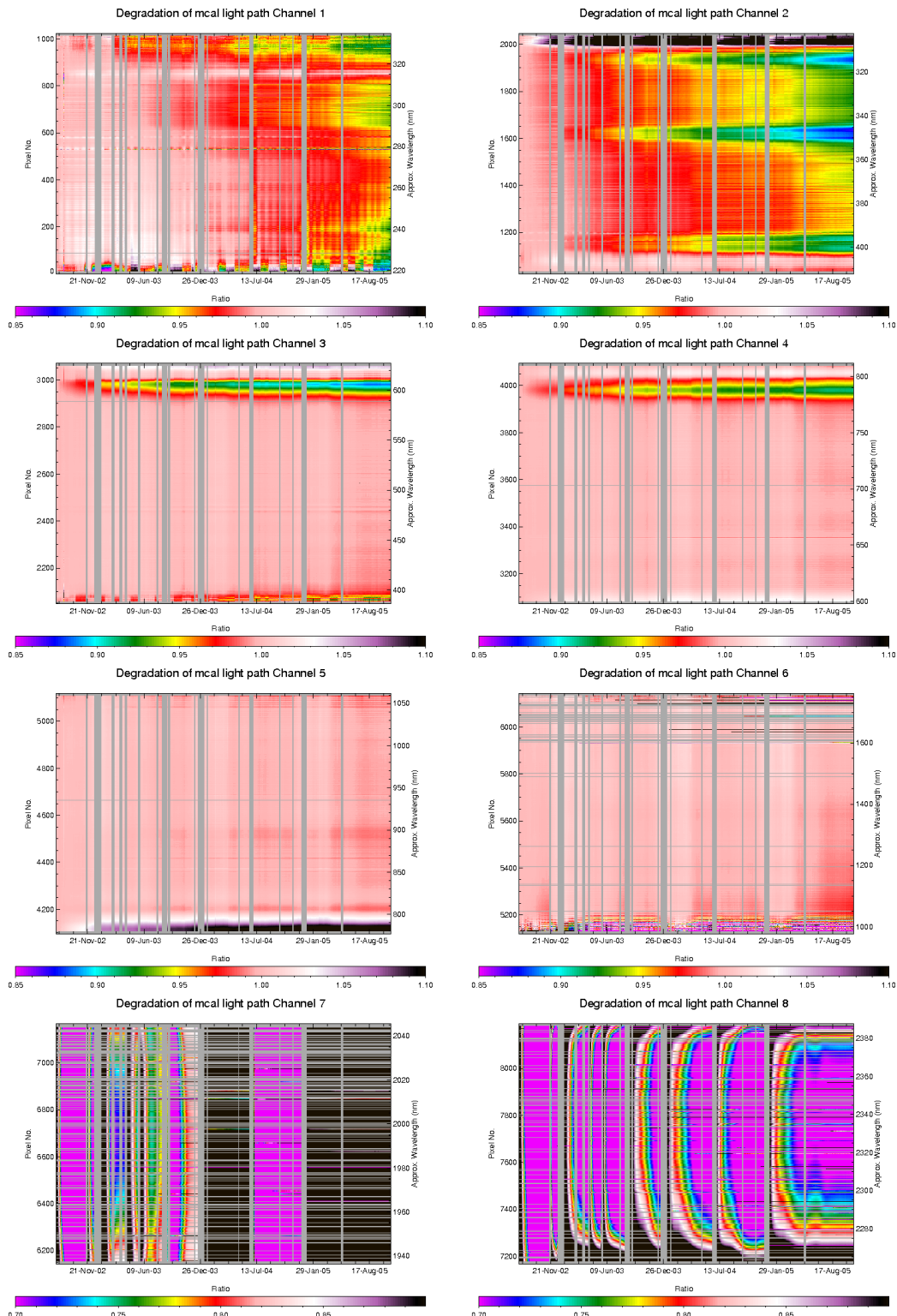


Fig. 3.10: Spectral light path monitoring results August 2002 to October 2005 (calibration light path)

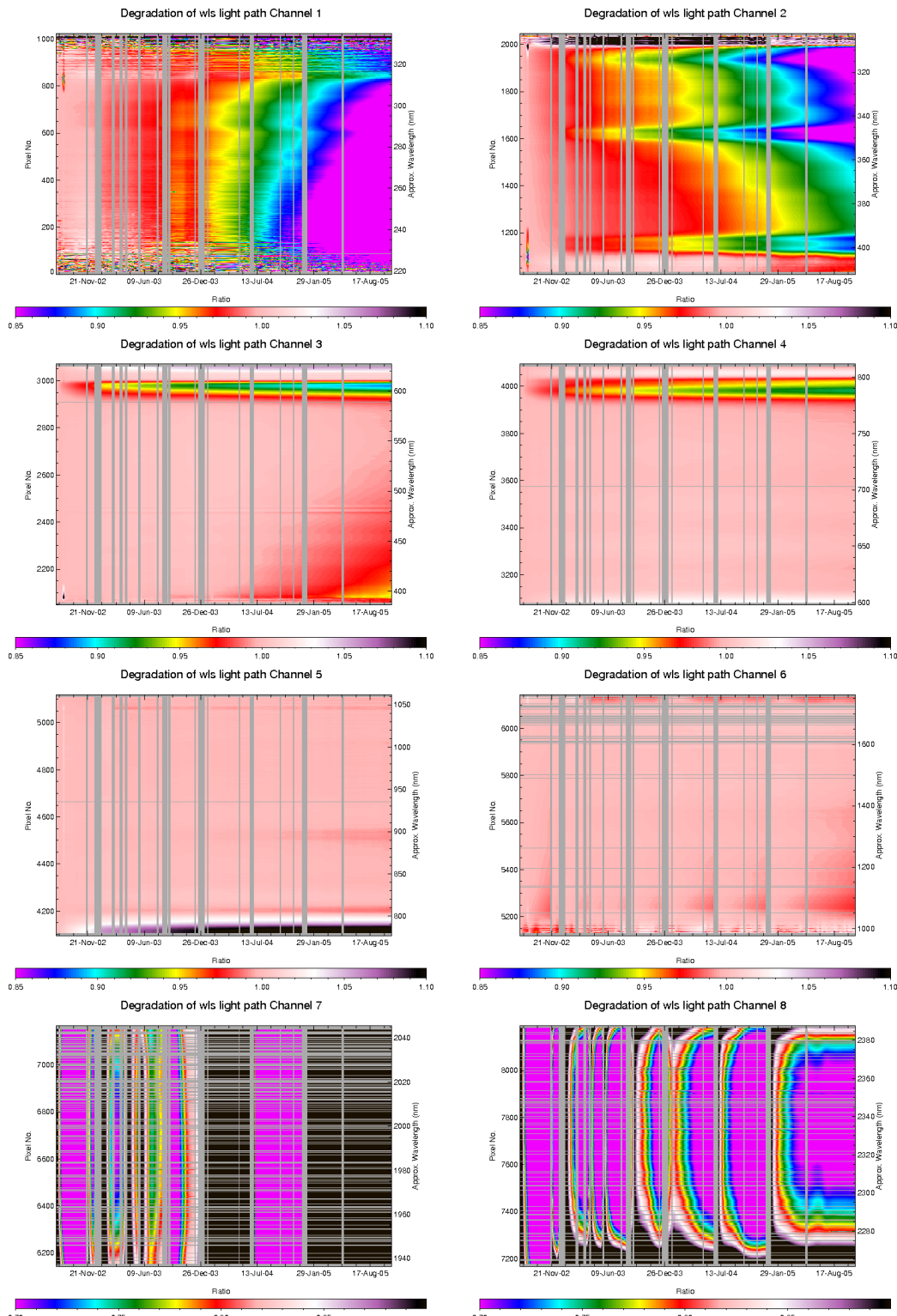


Fig. 3.11: Spectral light path monitoring results August 2002 to October 2005 (WLS light path)

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

- As expected, the UV degradation generally decreases with increasing wavelength.
- The SCIAMACHY degradation strongly depends on wavelength and is largest at the channel edges and at spectral regions of high polarisation sensitivity (especially visible in channel 2, e.g. the peak around 350 nm).
- 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 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.
- Channel 6 spectral results confirm the assumption of a slight degradation in this channel which is concentrated at the lower wavelength edge and independent of the overlaid remaining seasonal cycle.
- 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.

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.

For the nadir light path it is not possible to use subsolar fast sweep measurements for PMD monitoring, because these show a 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. Unfortunately, subsolar pointing measurements are only

performed once per month, therefore the temporal sampling is much less than for the other light paths.

This reduced temporal sampling is also the reason that Fig. 3.12 shows the PMD throughput variation for the whole time period between 2 August 2002 and 31 October 2005 (instead of only the two month time interval of this report). 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 with the following features:

- 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.

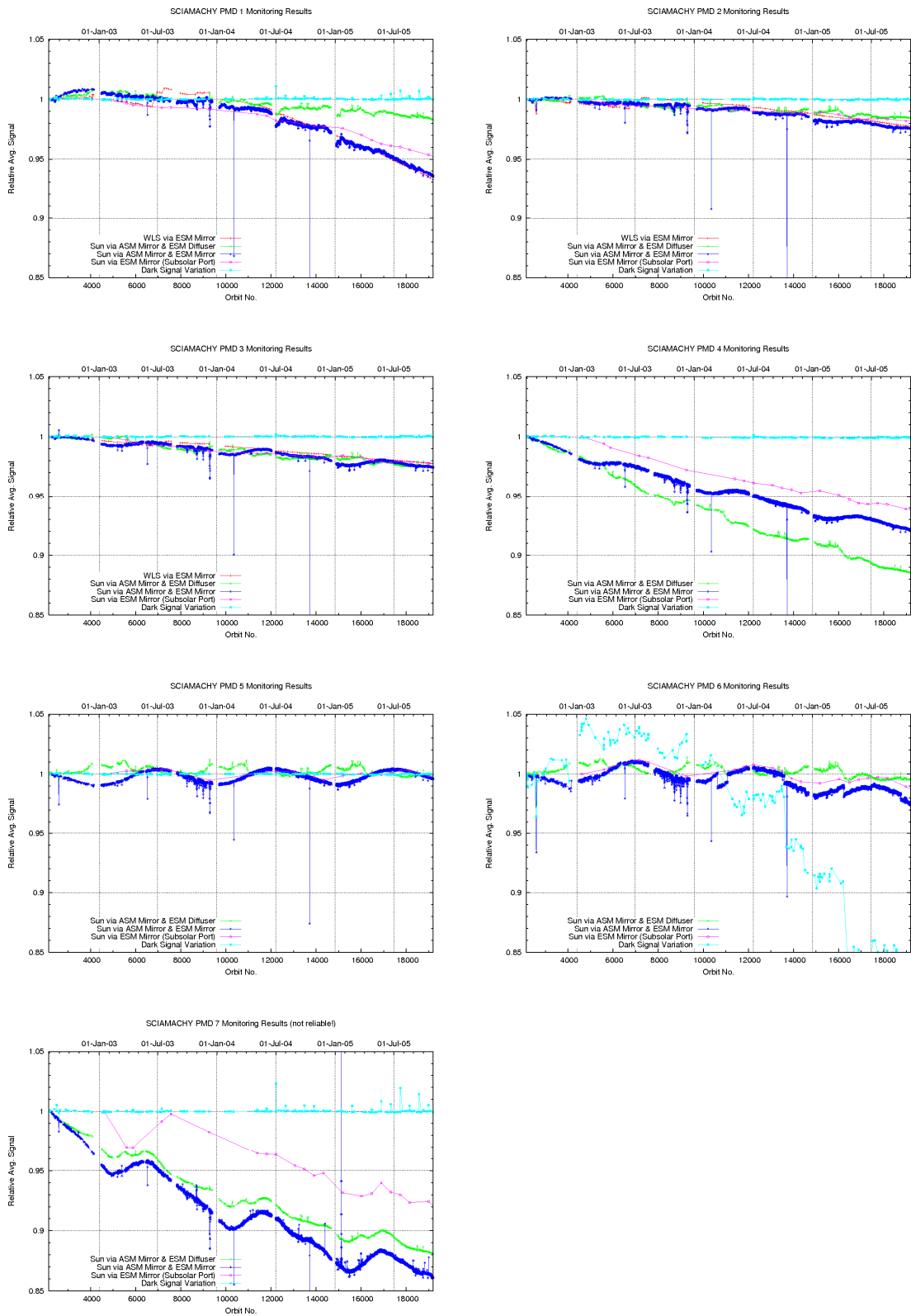


Fig. 3.12: PMD monitoring results August 2002 to October 2005

3.1.6 Problem Report Status (DLR-BO)

The problem report statistics is as follows (same status as during period July-August 2005):

- Total number of problem reports: 43
- Open problem reports: 5
- New problem reports during the reporting period: 0

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	26-Sep-2005	SCI_NL__0PNPDK20050926_055311_000041702041_00091_18682_0642.N1 SCI_NL__0PNPDK20050926_070145_000061482041_00092_18683_0643.N1 SCI_NL__0PNPDK20050926_084318_000060362041_00093_18684_0644.N1 SCI_NL__0PNPDK20050926_102258_000060232041_00094_18685_0645.N1 SCI_NL__0PNPDK20050926_120117_000059802041_00095_18686_0646.N1 SCI_NL__0PNPDK20050926_134002_000058992041_00096_18687_0647.N1	All products have a high number of ISP Errors; the data format is not correct
SCI_NL__0P	27-Sep-2005	SCI_NL__0PNPDK20050927_070327_000041012041_00106_18697_0651.N1	Incorrect data format
SCI_NL__1P	27-Sep-2005	SCI_NL__1PNPDK20050927_074150_000012402041_00150_18741_3838.N1	SENSING_START="30-SEP-2005 08:29:10.326292" SENSING_STOP="27-SEP-2005 08:02:31.397707" correct orbit should be 18697, start stop are wrong too
SCI_NL__1P	27-Sep-2005	SCI_NL__1PNPDK20050927_080235_000005622041_00150_18741_3768.N1	SENSING_START="30-SEP-2005 08:29:10.326292" SENSING_STOP="27-SEP-2005 08:11:57.921115"

Tab. 4-1: Products with data 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.

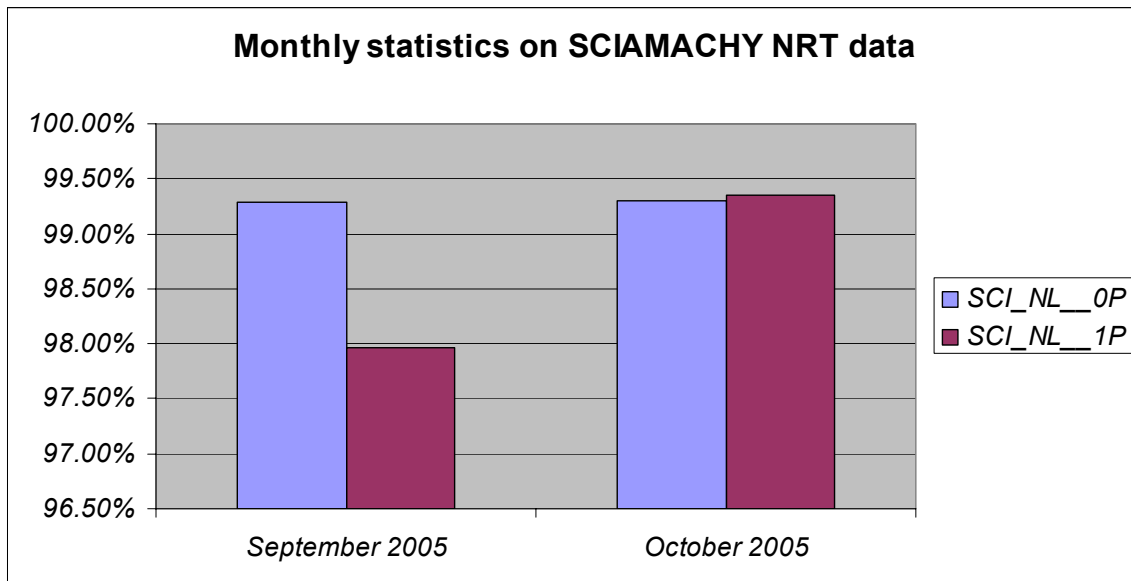


Fig. 4-1: Statistics on available unconsolidated Level 0 and Level 1 products

4.3 Statistics on consolidated data

In this paragraph statistics on consolidated data products L0 and L1 are presented.

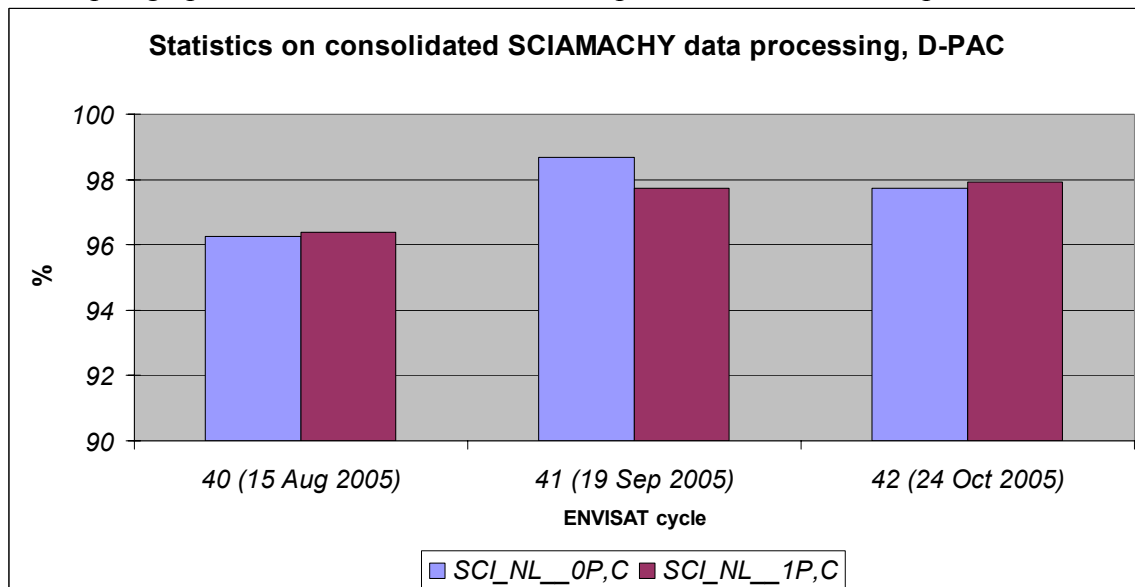


Fig. 4-2: Statistics on consolidated Level 0 and Level 1 products

4.4 Statistics on reprocessed data

Information about statistics on SCIAMACHY reprocessed data is made available by D-PAC.

Products from the time interval July 2002 to May 2004 (corresponding to cycles 7 -26, each cycle consisting of 501 orbits) are being reprocessed with IPF version 5.04 on consolidated L0/L1 data using the re-processed Auxiliary files (LK1, SU1, SP1, PE1). Data after that time interval have already been processed operationally with IPF 5.04 version and Auxiliary files had been processed operationally since then (the last status for the statistics in Fig. 4-3 is from 10/01/2006).

Data sets that lie in non-nominal decontamination periods are not re-processed to L2 products as the science data are not reliable.

It may occur that the availability of L1b products is slightly higher than L0 (e.g. cycle 17). This could be due to a multiple processing for some orbits. An anomaly report was opened to investigate the reason. As the analysis is ongoing, the statistics shown in Fig. 4-3 are not yet updated respectively to the last BMR. The reprocessing in general, however, has been finished.

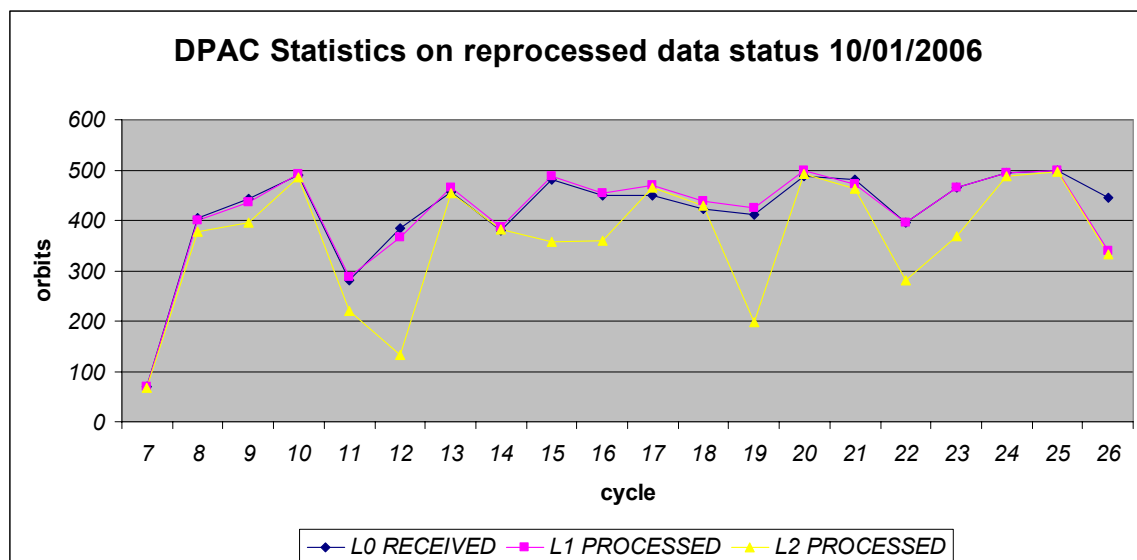


Fig. 4-3: DPAC statistics on reprocessed data

5 LEVEL 1 PRODUCT QUALITY MONITORING

5.1 Processor Configuration

5.1.1 Version

The current IPF version used for processing (and re-processing) of SCIAMACHY level 1 data is 5.04. The corresponding product specification is [2]. The disclaimer at http://envisat.esa.int/dataproducts/availability/disclaimers/SCI_NL_1P_Disclaimers.pdf describes known artefacts.

Table 5.1 gives an overview of changes implemented with processor versions IPF 5.04 and 5.01.

In addition here is a summary on the definition of the SZA used in previous and actual IPFs.

For IPF versions 4.02, 5.00, 5.01, 5.04 the SZA is defined with respect to Top of Atmosphere (TOA).

Instead for IPF versions 4.03, 4.01 and earlier versions the SZA is defined with respect to Tangent Height. IPF versions 4.02 and 5.00 however were not used operationally but to generate the validation dataset for the ACVT workshop in 2004.

A new upgrade on the IPF to version 6.00 is currently in progress.

IPF Version	Description	Proc Centre	Date	Start Orbit
5.04	<p>No algorithm specification changes were implemented, but two algorithm implementation errors have been corrected. In addition, code adaptations have been performed to resolve performance problems encountered during reprocessing. The list of modifications is as follows:</p> <ul style="list-style-type: none"> • An incorrect polarisation-ratio calculation has been corrected, to remove radiance discrepancies up to 1% between prototype and operational processor. • Memory leaks have been detected and eliminated • Two modifications have been performed to avoid level 1B processing crashes 	PDHS-K	21-AUG-2004	12942
		LRAC	20-AUG-2004	12750
		PDHS-E	16-AUG-2004	12823
		DPAC	12-AUG-2004	12879
5.01		DPAC	31-MAR-2004	
		PDHS-E	24-MAR-2004	
		PDHS-K LRAC		

Tab. 5-1: Processor Version and main changes

5.1.2 Auxiliary Data Files

For operation of the SCIAMACHY level 1 processor a set of Auxiliary files as input is required.

These Auxiliary files consist of a subset that 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 are 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 monthly basis)
- Pixel-to-Pixel Gain and Etalon Parameters (SCI_PE1_AX - updated on a monthly basis)

Since 04 May 2004 LK1 Auxiliary Files (Leakage Current Calibration) were processed operationally by the IECF. A SCI_LK1_AX is generated about every orbit (if measurements do not lie in the SAA area or orbit phase constraints occur).

SU1 Auxiliary Files were operationally processed starting from day 08 May 2004, a new SCI_SU1_AX file is generated every day with a validity time of two weeks.

PE1 and SP1 Auxiliary files are generated once per month with measurements of the monthly calibration orbits.

The table in Appendix A gives an overview about the Auxiliary files for the reporting period September - October 2005.

Fig. 5.1 shows statistics of the SU1 and LK1 ADFs generated operationally with the IECF. It has to be noted that unavailability periods are excluded from statistics. Generation of SU1 ADFs for September and October 2005 was 100%.

The LK1 ADF statistic is calculated by dividing the number of all LK1 ADFs by number of all available (to IECF) level 1 orbits. The statistics on available LK1 ADFs during September (41.9%) and October 2005 (53.2%) is lower than during previous months. In average ADFs used to be available about 58% per month. The statistic does not take into account SAA and orbit phase constraints. Special analysis showed that only 6-8 orbits per day can be used for LK1 ADF processing, and therefore the performance is at 80-100%.

During the reported period hardware failures at ESRIN caused a delay of the generation of in flight ADFs. Especially during September most ADFs were generated with a time delay of average 1 week. This had an impact for processing L1b Near Realtime products being processed with ADFs older than 1 week and the low availability of LK1 ADFs.

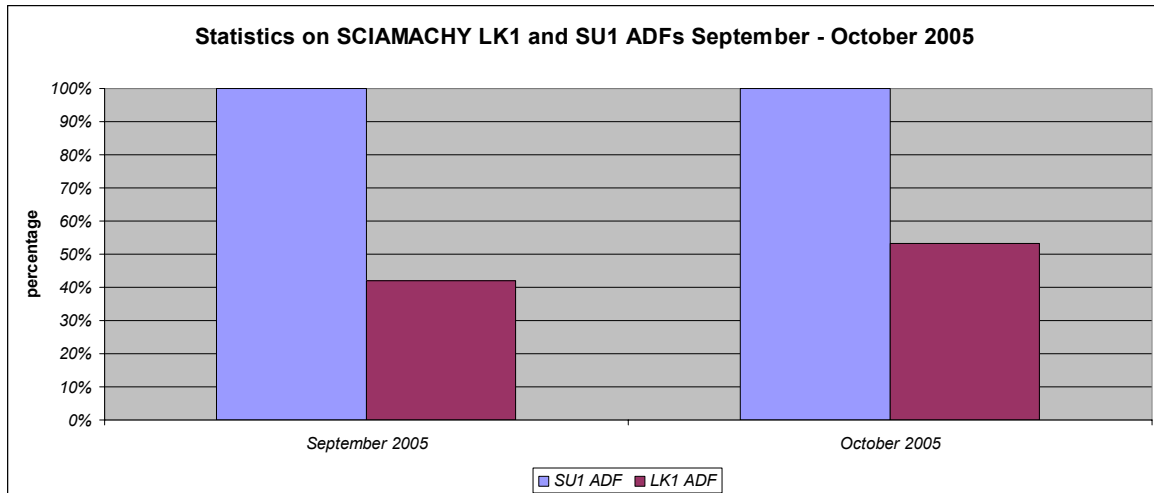


Fig. 5-1: Statistics on LK1 and SU1 processing

5.1.3 Spectral Performance

Future reports will contain analyses of spectral performance.

5.1.4 Radiometric Performance

Future reports will contain analyses of spectral performance.

5.1.5 Other Calibration Results

5.1.5.1 SMR analysis

The IECF generates daily SU1 Auxiliary Files, that contain new sun mean reference spectra for the different possible modes (e.g., subsolar, ESM diffuser, occultation).

Fig. 5-2 to Fig. 5-5 show the ratios of SMR spectra derived from calibrated SMR/ESM during the months September – October 2005. The ratios were determined by dividing the spectra of the beginning of each month to a set of days during each month. All ratios are not corrected for variation of distance earth/sun.

In detail the spectra used for the ratios of each month are the following:

- **September 2005**
Reference SMR - 01 September 2005
SMR used for ratios: 02, 03, 04, 05, 06, 07, 14, 21, 28 September 2005
- **October 2005**
Reference SMR - 01 October 2005
SMR used for ratios: 02, 03, 04, 05, 06, 07, 14, 21, 28 October 2005

The overall changes lie between 1 - 2 % during one month. In channel 1 around pixel 550 some features can be noticed as well as in channel 2 at pixel 840. The reason for these features need to be investigated. A possible explanation could be a solar variability causing Fraunhofer lines with different intensities. Generally a spectral feature could have significant impact on the product quality, especially when the affected spectral parts are used for DOAS retrieval.

The IR channels are impacted by more noise than the UV-visible channels.

Fig. 5-6 and Fig. 5-7 show SMR ratios on a long term trend dividing the ESM spectra from days 30-Sep-2002 and 30-Sep-2005, respectively 31-Oct-2002 and 31-Oct-2005. 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. What can be concluded is that for channels 1-2 an average degradation of about 5% is observed, channels 3-6 degrade by less than 1%. The signal in channels 7 and 8 has increased with respect to the SMR of year 2002. This is consistent with the Light Path monitoring at SOST-IFE. The effect is due to ice contamination for the last two channels.

ratio of smrs as a function of pixel, September 2005

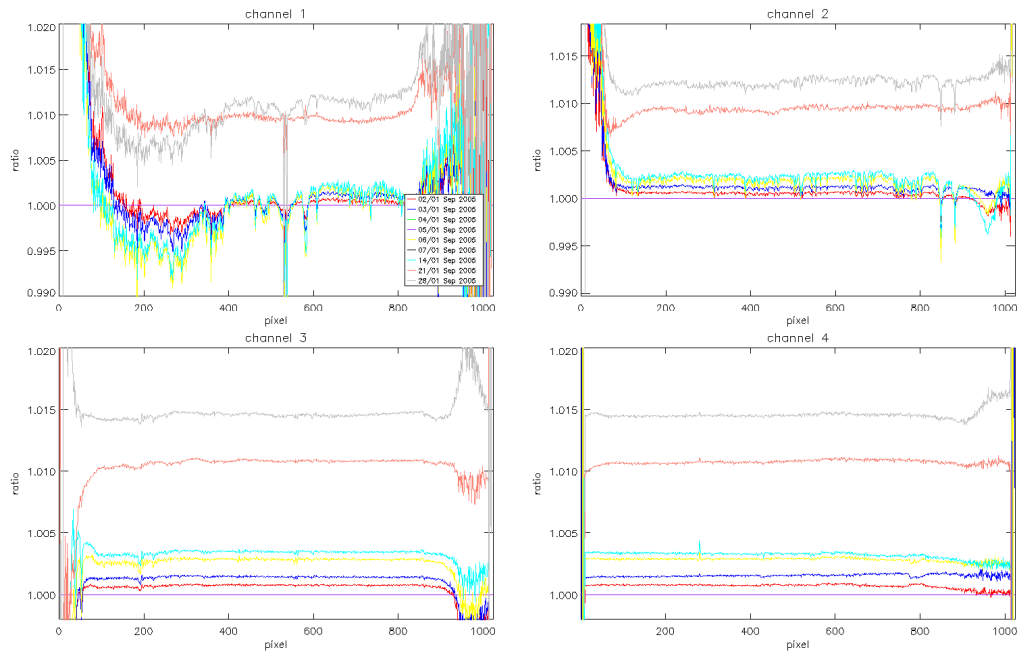


Fig. 5-2: SMR ratios per detector channel 1-4 (changes during September 2005)

ratio of smrs as a function of pixel, September 2005

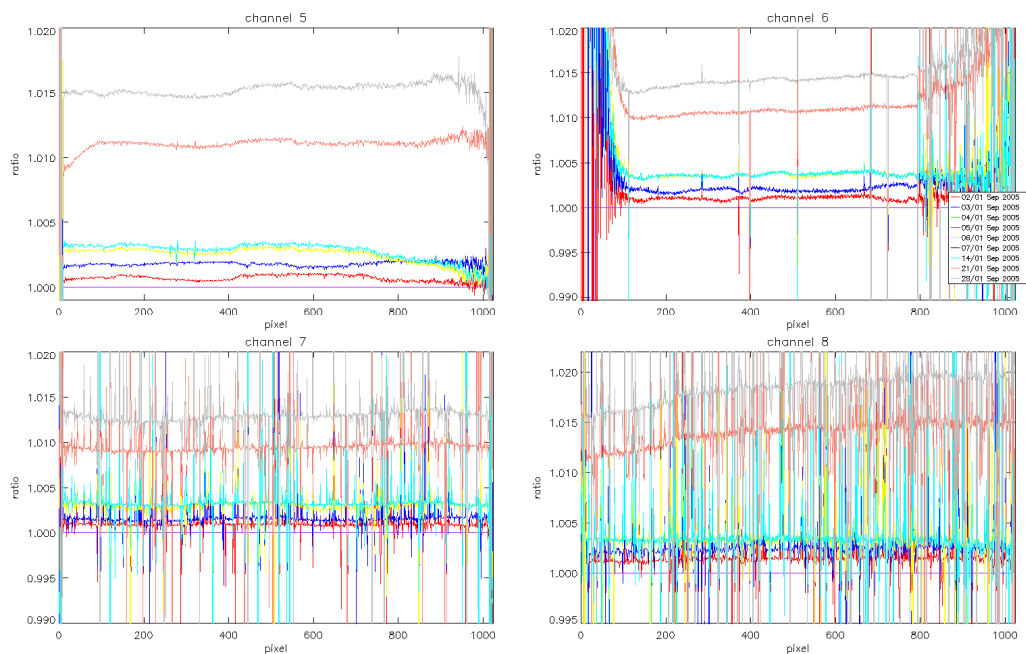


Fig. 5-3: SMR ratios per detector channel 5-8 (changes during September 2005)

ratio of smrs as a function of pixel, October 2005

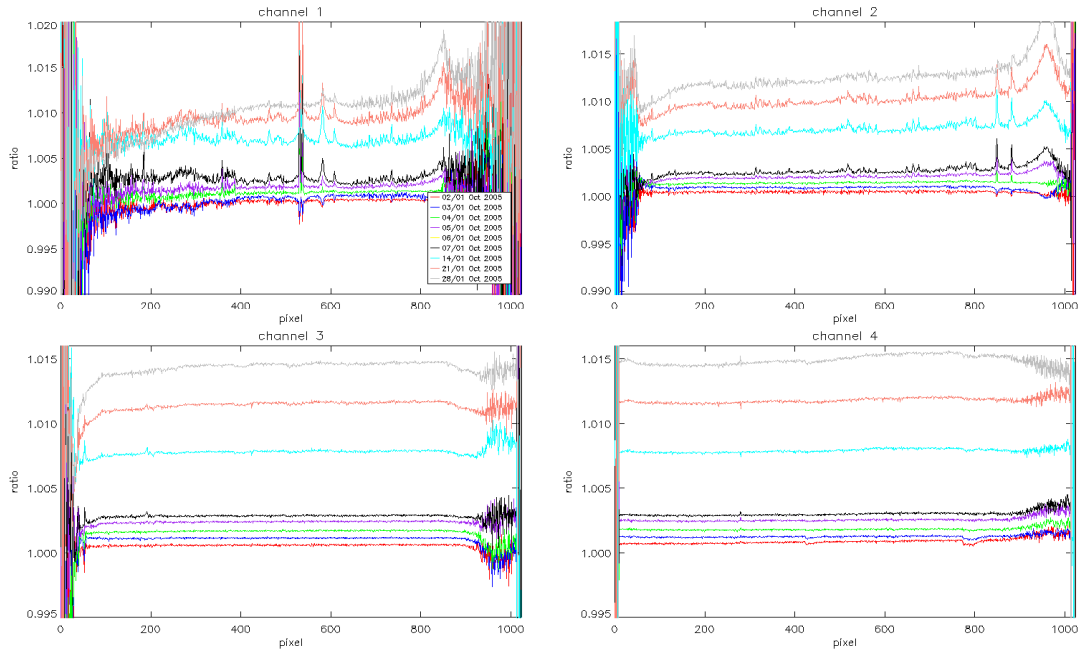


Fig. 5-4: SMR ratios per detector channel 1-4 (changes during October 2005)

ratio of smrs as a function of pixel, October 2005

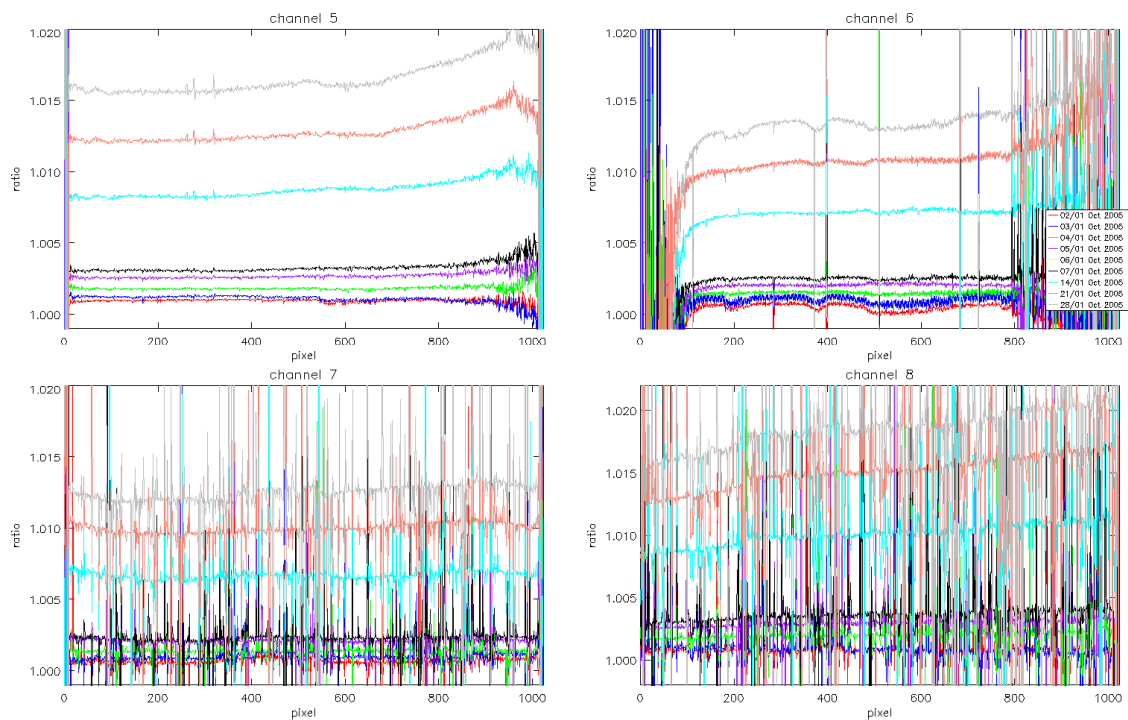


Fig. 5-5: SMR ratios per detector channel 5-8 (changes during October 2005)

smr ratio, DO 30/09/2005 divided by 30/09/2002

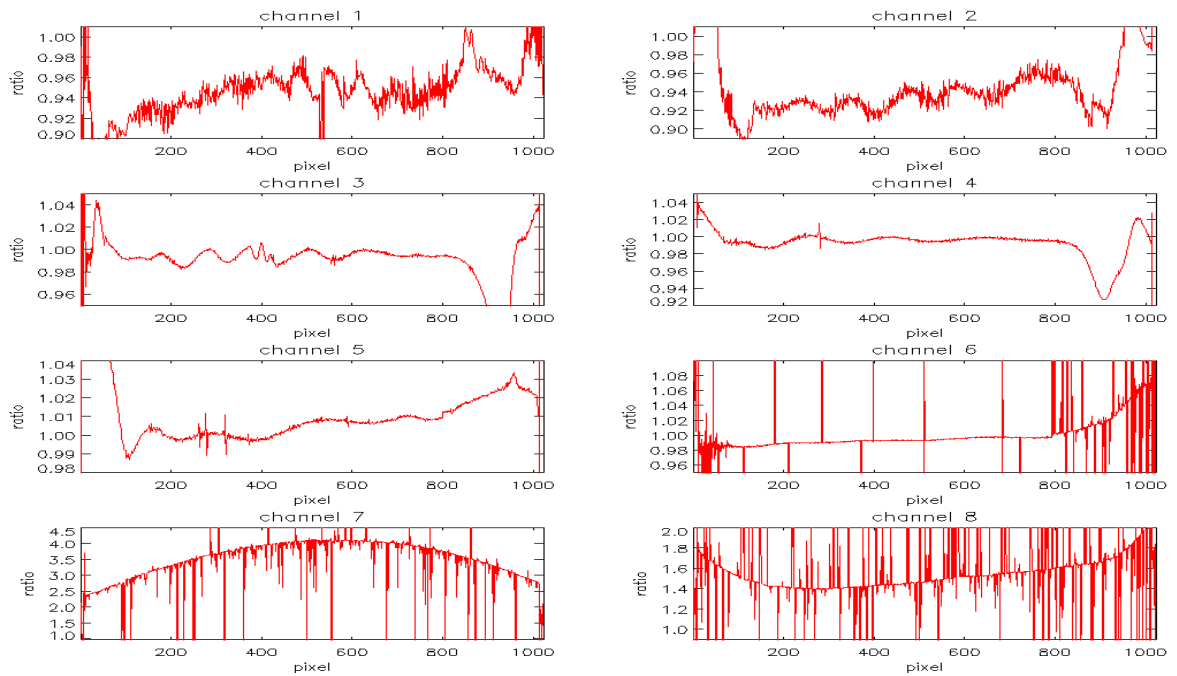


Fig. 5-6: SMR ratios per detector channel on Long Term Trend

smr ratio, DO 31/10/2005 divided by 31/10/2002

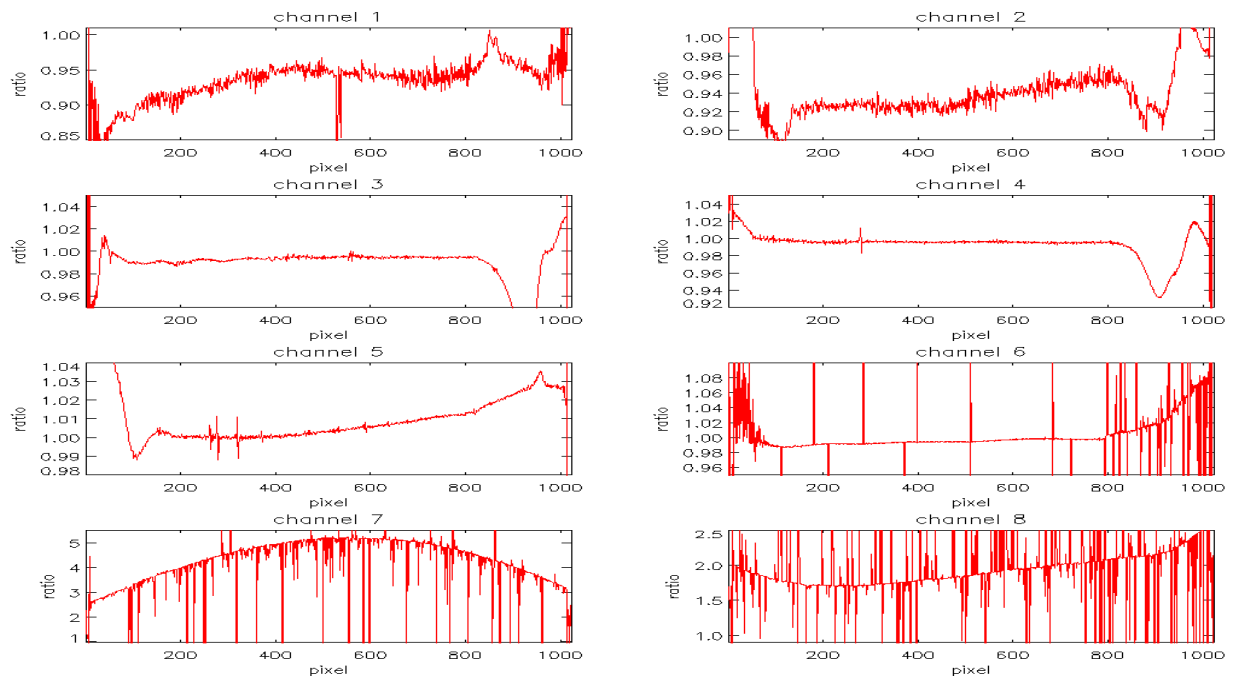


Fig. 5-7: SMR ratios per detector channel on Long Term Trend

5.1.5.2 LK1 analysis

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 2 and 3 weeks. They are very small but above the noise level.

The IR channels show a lot of noise. Here an improvement is foreseen with the new processor version IPF 6.00, where the time dependent part of the leakage current will be considered.

LK1 ADF analysis, ratios of fpn const, September 2005

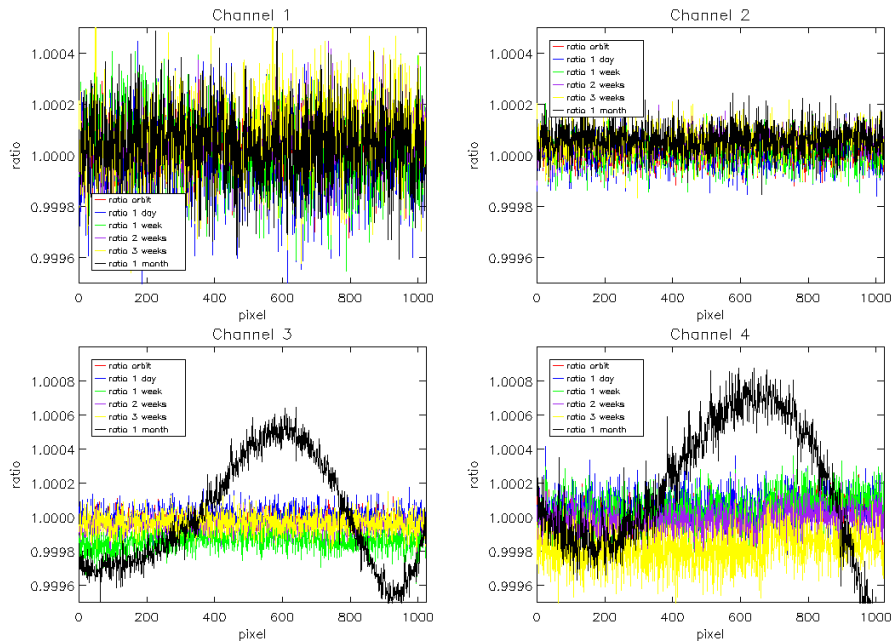


Fig. 5-7: dark current ratios (constant part) channel 1-4 during September 2005, Reference Spectrum used: Orbit 18325, 01-September-2005

LK1 ADF analysis, ratios of fpn const, September 2005

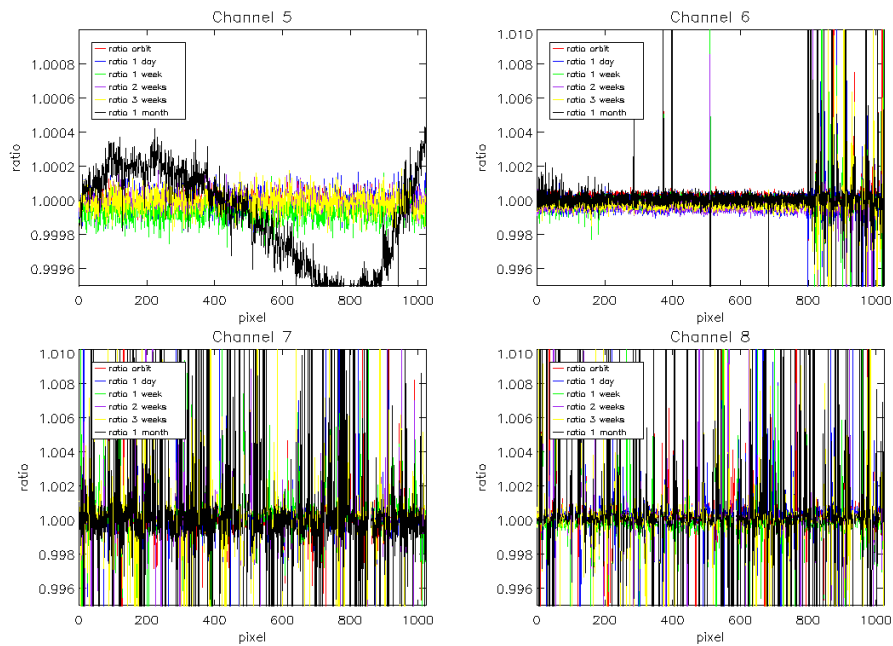


Fig. 5-8: dark current ratios (constant part) channel 5-8 during September 2005, Reference Spectrum used: Orbit 18325, 01-September-2005

LK1 ADF analysis, ratios of fpn const, October 2005

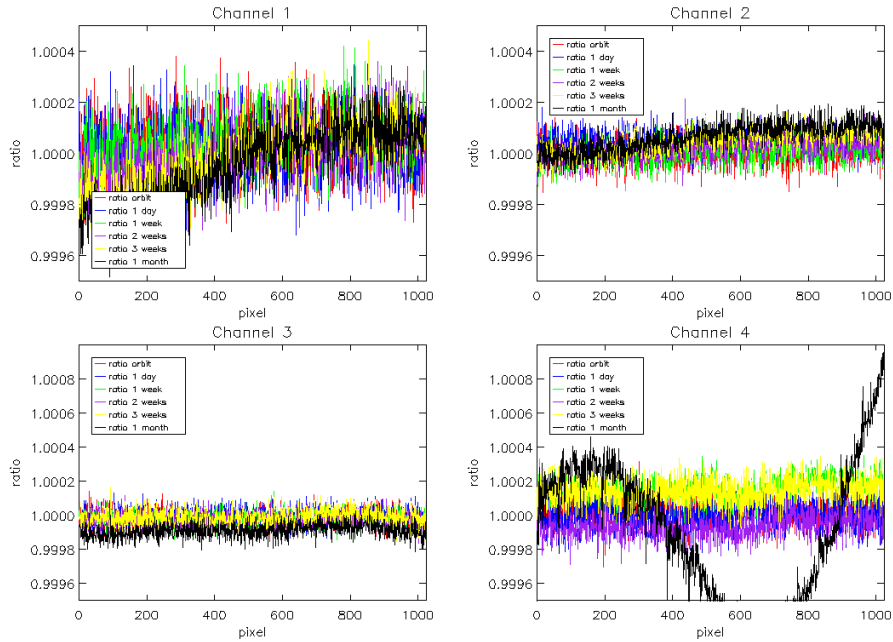


Fig. 5-9: dark current ratios (constant part) channel 1-4 during October 2005, Reference Spectrum used: Orbit 18755, 01-Oct-2005

LK1 ADF analysis, ratios of fpn const, October 2005

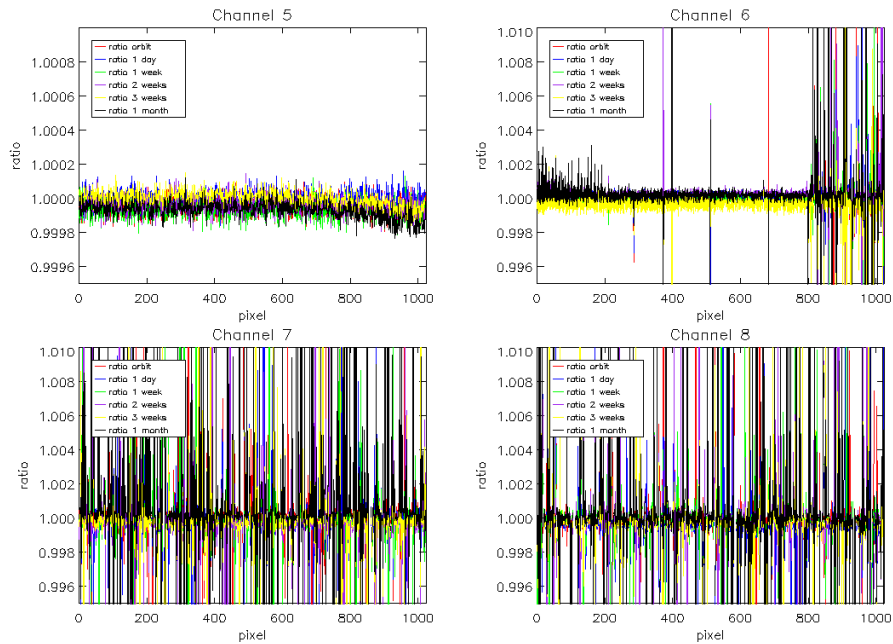


Fig. 5-10: dark current ratios (constant part) channel 5-8 during October 2005, Reference Spectrum used: Orbit 18755, 01-Oct-2005

5.1.6 Pointing Performance

The results on the analysis with respect to the Pointing Performance were presented in previous BMR.

The results of this study are being implemented in the new SCIAMACHY processor IPF 6.0.

6 LEVEL 2 NRT PRODUCT QUALITY MONITORING

6.1 Processor Configuration

6.1.1 Version

The current IPF version used for processing (and re-processing) of SCIAMACHY level 2 data is 5.04. The according product specification is [2]. The disclaimer at http://envisat.esa.int/dataproducts/availability/disclaimers/SCI_NL_2P_Disclaimers.pdf describes known artefacts. SCIAMACHY NRT products generated with IPF 5.04 contain wrong ozone and AMF values due to a wrong handling of the seasonal index 3. This occurs to data starting from day 15 October 2005 until 31 December 2005 (as well as for previous years).

Table 6.1 shows the implementation dates of the IPF at the different PDS processing centres and the main modifications implemented.

IPF Version	Description	Proc Centre	Date	Start Orbit
5.04	<p>No algorithm specification changes were implemented, but two algorithm implementation errors have been corrected. In addition, code adaptations have been performed to resolve performance problems encountered during reprocessing. The list of modifications is as follows:</p> <ul style="list-style-type: none"> • The incorrect handling of the season index 4 has been corrected. • An incorrect polarisation-ratio calculation has been corrected, to remove radiance discrepancies up to 1% between prototype and operational processor. • Memory leaks have been detected and eliminated • An adaptation has been implemented to allow co-existence with the initialisation file used by the Off-Line processor 	PDHS-K	21-AUG-2004	12942
		LRAC	20-AUG-2004	12750
		PDHS-E	16-AUG-2004	12823
		DPAC	12-AUG-2004	12879
5.01	<ul style="list-style-type: none"> • description for cloud MDS updated • minor changes in MPI and USA climatology description • latitude grids fixed • list of surface types fixed, note about vegetation index added • O₃ FM formula fixed sizes of SCIA FM spectra fixed latitude zones fixed • solar zenith angle grid fixed 	DPAC	31-MAR-2004	
		PDHS-E PDHS-K LRAC	24-MAR-2004	

Tab. 6-1: Level 2 Processor Configuration

6.1.2 Auxiliary Data Files

Auxiliary Files being used as input for SCI_NL__2P products are listed in table 6-2. These ADF files are generally not changed.

SCI FM2	AXVIEC20040309	092553	19990101	000000	20991231	235959
SCI BL2	AXVIEC20020220	093709	20020101	000000	20200101	000000
SCI CC2	AXVIEC20020220	094004	20020101	000000	20200101	000000
SCI CL2	AXVIEC20020220	094214	20020101	000000	20200101	000000
SCI CS2	AXVIEC20020220	094417	20020101	000000	20200101	000000
SCI MF2	AXVIEC20040309	093236	19990101	000000	20991231	235959
SCI PF2	AXVIEC20020220	100450	20020101	000000	20200101	000000
SCI PR2	AXVIEC20020220	100642	20020101	000000	20200101	000000
SCI RC2	AXVIEC20020220	100912	20020101	000000	20200101	000000
SCI UC2	AXVIEC20040309	092027	19990101	000000	20991231	235959
SCI SF2	AXVIEC20020220	101039	20020101	000000	20200101	000000
SCI LI2	AXVIEC20040308	170000	20020101	000000	20200101	000000

Tab. 6-2: Level 2 Auxiliary Files

6.2 O_3 consistency checking

Future reports will contain information on this issue.

6.3 NO_2 consistency checking

NO_2 vertical column density (VCD) values of one month were averaged using QUADAS, filtering those data where the VCD flags are 0. Diurnal variations have not been corrected (no model applied). Fig. 6-1 and Fig. 6-2 are aimed at processing consistency checking and are not intended for geophysical interpretation.

Generally, 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.

6.3.1 NO_2 VCD map September 2005

High NO_2 VCD values can be seen over industrial regions.

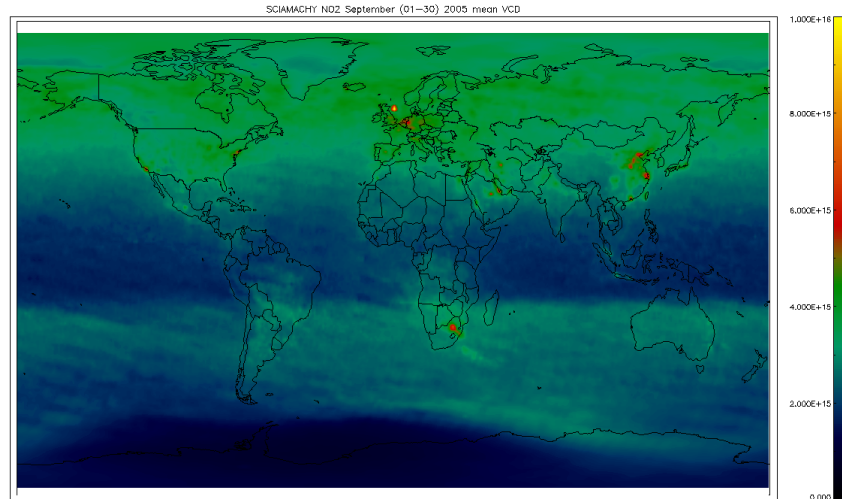


Fig. 6-1: NO₂ VCD world map 01-30 September 2005 – monthly average

6.3.2 NO₂ VCD map October 2005

The world map showing the distribution of mean values of NO₂ VCD values of October 2005 contains unphysical values at high latitudes which need to be investigated.

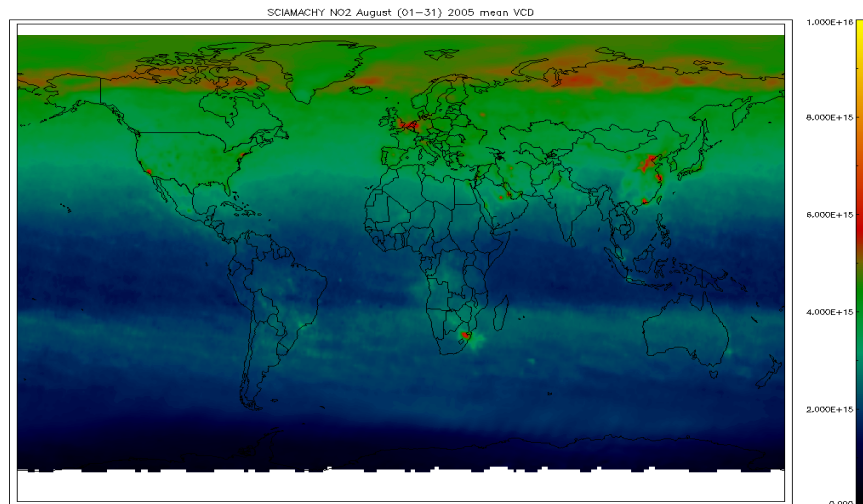


Fig. 6-2: NO₂ VCD world map 01-31 October 2005 – monthly average

7 LEVEL 2 OFFLINE PRODUCT QUALITY MONITORING

7.1 *Processor Configuration*

7.1.1 *Version*

In January 2005 the SCIAMACHY Level 2 Offline product SCI_OL__2P was released, data are generated with processor version 2.5.

The according product specification is PO-RS-MDA-GS-2009_15_3H. The disclaimer at http://envisat.esa.int/dataproducts/availability/disclaimers/SCI_OL_2P_Disclaimers.pdf describes known artefacts.

SCI_OL__2P products contain geolocated vertical column amounts of O₃, NO₂ Nadir measurements, as well as stratospheric Limb profiles of O₃, NO₂.

7.1.2 *Auxiliary Data Files*

Input for Level 2 Offline processing is the Initialization File SCI_IN_AXNPDE20041221_112322_000000000000_000000_000000_0000.N1, that usually is changed only in case of a processor upgrade.

7.1.3 *Monitoring results*

In future reports results on Limb and Nadir products will be presented here.

8 VALIDATION ACTIVITIES AND RESULTS

8.1 *SCIAMACHY-ECMWF Comparisons using SCI_RV__2P*

8.1.1 *Summary of the ECMWF SCIAMACHY monthly report for September 2005*

- SCIAMACHY data quality stable.
- SCIAMACHY data about 5 DU lower in the global mean than ECMWF ozone values
- Increase of SCIAMACHY data standard deviations in the global mean
- Relatively large biases south of 50S along 90W, 0 (and 90E) meridians
- The operational ECMWF model version used was CY29R2.

The full report is available at http://earth.esa.int/pcs/envisat/tmp_calval_res/

Below see the ECMWF plot on SCIAMACHY mean observation in DU.

STATISTICS FOR OZONE FROM ENVISAT / SCIAMACHY
 MEAN OBSERVATION [DU] (ALL)
 DATA PERIOD = 2005090100 - 2005093018
 EXP = 0001, LAYER = 01, 0.10 - 1013.25 HPA
 Min: 111.6 Max: 437.14 Mean: 268.63

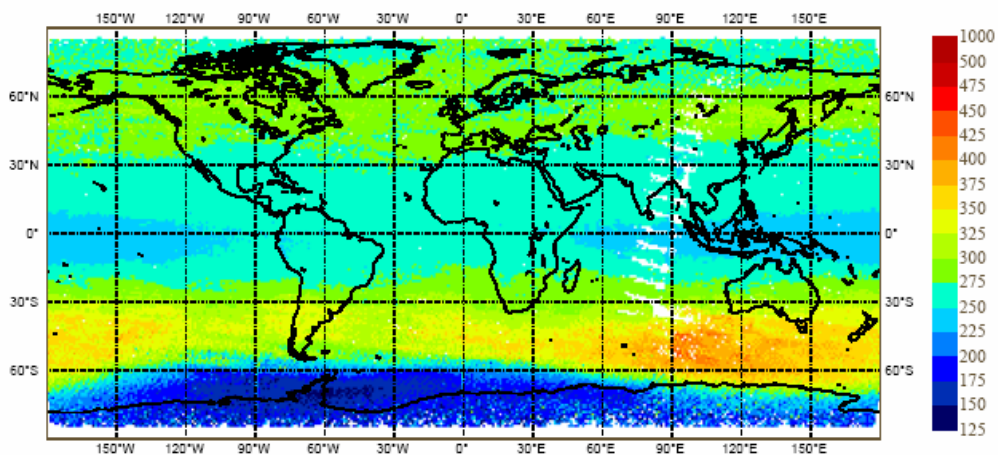


Fig. 8-1: Ozone Mean ECMWF September 2005

8.1.2 Summary of the ECMWF SCIAMACHY monthly report for October 2005

- SCIAMACHY data quality not stable.
- Change in SCIAMACHY SCI RV 2P data on 15 October
- SCIAMACHY data about 16 DU higher in the global mean than ECMWF ozone values after 15 October
- Unrealistically large ozone values south of 75S
- Still relatively large biases south of 50S along about 90W, 0 and 90E meridians
- The operational ECMWF model version used was CY29R2.

The full report is available at http://earth.esa.int/pcs/envisat/tmp_calval_res/

Below see the ECMWF plot on SCIAMACHY mean observation in DU.

STATISTICS FOR OZONE FROM ENVISAT / SCIAMACHY
 MEAN OBSERVATION [DU] (ALL)
 DATA PERIOD = 2005100100 - 2005103118
 EXP = 0001, LAYER = 01, 0.10 - 1013.25 HPA
 Min: 114.13 Max: 707.18 Mean: 278.92

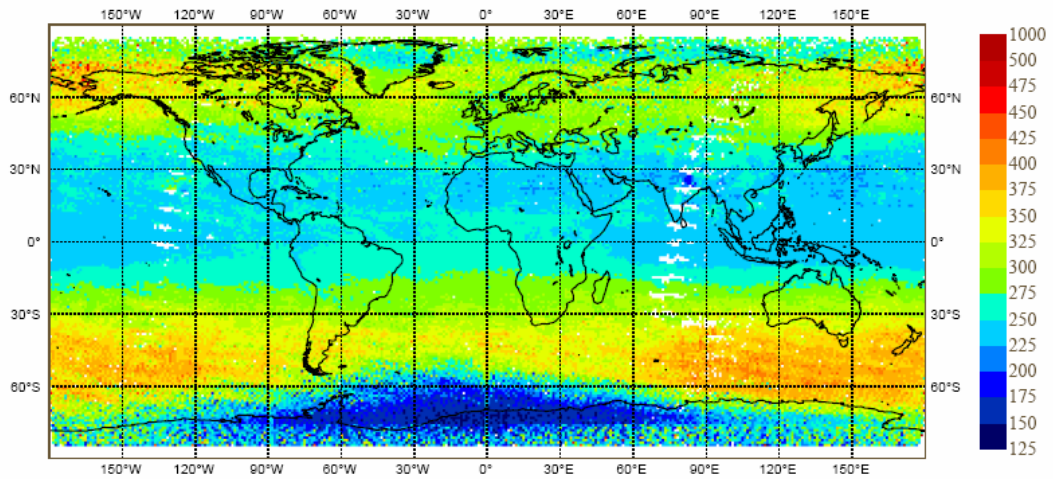


Fig. 8-2: Ozone Mean ECMWF October 2005

8.2 *Statistics from Inter comparison with External Data*

Future reports will contain information on this issue.

APPENDIX A

Type	ADF Name
PE1_AX	SCI PE1_AXVIEC20050627_154704_20050621_000000_20900101_000000
SP1_AX	SCI_SP1_AXVIEC20050901_074503_20050819_000000_20060201_000000 SCI_SP1_AXVIEC20050920_104957_20050917_000000_20060301_000000 SCI_SP1_AXVIEC20051024_172837_20051016_000000_20060401_000000
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