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SCIAMACHY Bi-MONTHLY REPORT: MAY - JUNE 2005

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SCIAMACHY Bi-Monthly Report May – June 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] 'ENVISAT Restituted Pitch Assessment', ENVI-SPPA-EOPG-TN-05-0011, Issue 2, Technical Note, L. Saavedra (SERCO), R. Mantovani (VITROCISET), A. Dehn (SERCO), 17 May 2005
[2] 'Comparison of SCIAMACHY limb pointing retrievals with ESOC correction tables', Technical Note, Christian von Savigny, Stefan Noël, Heinrich Bovensmann, University of Bremen, 24 Feb. 2004
[3] 'Instrument Operation Manual', MA-SCIA-0000DO/01, Issue F R2, 16 Dec. 2004
[4] 'ENVISAT-1 Products Specifications Volume 15: SCIAMACHY Products Specifications', PO-RS-MDA-GS-2009, Issue 3, Rev: J, Alberto Pellegrini

[5] 'Comparison of ESOC pitch correction tables with TRUE retrievals – update June 2005', Christian von Savigny and Stefan Noel (IUP/IFE Bremen), 29 Jun. 2005.

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
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

Not complete

2 SUMMARY

- During the reported period SCIAMACHY measurements were nominal with respect to planning.

- Two SEUs, which transferred SCIAMACHY to a mode lower than MEASUREMENT, occurred in the reporting period during Orbits
  - 16675-16686 (09-May-2005)
  - 16716-16739 (11-13 –May-2005)

- Monthly Calibration was executed during Orbits
  - 16886-16890 (23-May-2005)
  - 17301-17305 (21-Jun-2005)

- Moon occultations were executed between orbits
  - 16802-16877 (17-May-2005 to 23-May-2005)
  - 17237-17296 (17-Jun-2005 to 21-Jun-2005)

- One OCR has been implemented during May – June 2005.
  - OCR_023: *Improve nadir coverage for the Cabauw campaign*

- No TC adjustment was required. The average temperature/orbit of detector 5 closely approached its upper limit but the seasonal maximum did not exceed this value.

- Light Path monitoring:
  - Small degradation in UV (channels 1, 2); sun over ESM diffuser degradation smaller than for other light paths – indication that ESM diffuser degrades less than ESM mirror
  - Channels 3-6 radiometricly stable besides slight throughput loss in channel 3
  - Channel 7 throughput rather stable over time interval
  - Channel 8 throughput is reduced by about 20%

- The Pointing Performance analysis was extended by
  - The data set used for comparison was extended from selected orbits on 32 days between November 2003 and January 2005 to all available TRUE and AOCS data.
  - The AOCS harmonic attitude functions were used instead of noisier AOCS estimator data
  - AOCS attitude correction values were taken at the same times as the tropical SCIAMACHY limb measurements and not when the ENVISAT is within the 20°N to 20°S latitude range.

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.af.op.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 16561 (ANX = 01-May-2005, 00:43:19.172) to 17433 (ANX = 30-Jun-2005, 22:45:28.513). Two OSDF specified the planning baseline.

Orbit		ANX		OSDF
Start	Stop	Start	Stop	
16561	17004	01-May-2004 00:43:19.531	31-May-2005 23:28:35.340	MPL_OSD_SHVSH_20050315_010101_00000000_33080001_20050501_004321_20050601_010909
17005	17433	01-Jun-2005 01:09:11.268	30-Jun-2005 22:45:28.513	MPL_OSD_SHVSH_20050421_010101_00000000_33090001_20050601_010913_20050701_002602

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

- 16886-16890 (23-May-2005)
- 17301-17305 (21-Jun-2005)

Moon occultations were executed between orbits

- 16802-16877 (17-May-2005 to 23-May-2005)
- 17237-17296 (17-Jun-2005 to 21-Jun-2005)

In all other orbits of the monthly lunar visibility periods the moon was rising on the dayside.

One OCR has been implemented between May and June.

- OCR_023: *Improve nadir coverage for the Cabauw campaign*
  With the start of a validation campaign in Cabauw/The Netherlands on 08-May-2005, SCIAMACHY mission planning improved the nadir coverage over Cabauw by optimizing the execution of limb/nadir sequence 1 & 2 timelines. This occurred until 30-Jun-2005 when the Cabauw campaign ended.

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 and were executed as requested except on

- 09-May-2005 (orbit 16675-16686)
- 11-May-2005 to 13-May-2005 (orbit 16716-16739)

when two Single Event Upsets (SEU) triggered a transfer to a mode lower than MEASUREMENT (details are found in the *Anomalies* section below).

Detector thermal adjustment

No TC adjustment was required. The average temperature/orbit of detector 5 closely approached its upper limit but the seasonal maximum did not exceed this value.

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
17022	02-Jun-2005 06:59:46	ok	17023	02-Jun-2005 08:36:16
n.a.	n.a.	n.a.	17394	28-Jun-2005 06:38:19

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

Anomalies

Two anomalies, which transferred SCIAMACHY to a mode lower than MEASUREMENT, occurred in the reporting period.

Orbit	Date	Entry - UTC	Level	Entry Type	ID Content/Transition	Mode	Remark
16675	09-MAY-2005	2005.129.00.25.56.797	Instrument	HK PARAMETER LIMIT EXCEEDING	84 (I0105)	HTR/RF	Single Event Upset (SEU)
16675	09-MAY-2005	2005.129.00.25.56.797	Instrument	AUTONOMOUS SWITCHING	goto HEATER/REFUSE	HTR/RF	Single Event Upset (SEU)
16675	09-MAY-2005	2005.129.01.12.02.582	Instrument	MACROCOMMAND EXECUTION ENTRY	START TIMELINE	HTR/RF	Complementary failure
16675	09-MAY-2005	2005.129.01.12.02.590	Instrument	COMPLEMENTARY FAILURES	---	HTR/RF	Complementary failure
16675	09-MAY-2005	2005.129.01.12.02.594	Instrument	MACROCOMMAND EXECUTION ENTRY	START TIMELINE	HTR/RF	Complementary failure
in total 4 Complementary Failures until 2005.129.01.44.20.504							
16676	09-MAY-2005	2005.129.01.44.20.492	Instrument	MACROCOMMAND EXECUTION ENTRY	START TIMELINE	HTR/RF	Complementary failure
16676	09-MAY-2005	2005.129.01.44.20.504	Instrument	MACROCOMMAND EXECUTION ENTRY	---	HTR/RF	Complementary failure
16676	09-MAY-2005	2005.129.01.44.20.504	Instrument	COMPLEMENTARY FAILURES	START TIMELINE	HTR/RF	Complementary failure
16716	11-MAY-2005	2005.131.22.11.17.000	Instrument	AUTONOMOUS SWITCHING	goto R/W-WAIT	R/W-WAIT	Single Event Upset (SEU) suspended ICU
16759	14-MAY-2005	2005.134.22.01.54.000	Instrument	COMPLEMENTARY FAILURES	---	Measurement	STATE_TRANS_OVERDUE (state 65 delayed by 12 counts, fault indication 886)
17110	08-JUN-2005	2005.159.09.24.33.068	Instrument	COMPLEMENTARY FAILURES	---	Measurement	PRIM_CMD_OVERDUE (RTCS STT_01 primitive cmd SET-UP MEASUREMENT

Table 3-3: Instrument anomalies

The first SEU occurred when ENVISAT was south of the equator in the West Pacific area. The anomaly detected by the onboard system is attributed to an SEU in the Instrument Operations Manual (IOM) *[3]*, i.e. FOCC was able to start the procedure driven recovery immediately. The second SEU occurred when ENVISAT was crossing the South Atlantic Anomaly (SAA). This time the error message was not conclusive since it was similar to the well-known CCA MCMD check error. Detailed analysis by FOCC, Astrium and SOST revealed that the transfer to R/W WAIT was in fact a Single Event Upset (SEU), disguised as a CCA MCMD check error. A SEU stopped the ICU about 12 msec prior to the error message. The ENVISAT PMC responded with what is usually attributed to the check error.

The two remaining anomalies were complementary failures leading to Corrective Actions (CA) 0 or 9, i.e. the instrument continued operations.

Instrument unavailability

The instrument was unable to execute measurements for a total of 32 orbits due to two SEU. In both cases the MPS driven schedule was resumed quickly.

Unavailability					
Orbit		UTC		Event	Remark
Start	Stop	Start	Stop		
16675	16686	09-May-2005 00:25:56	09-May-2005 18:37:20	transfer to HTR/RF	I0105 OOL latch-up detection thermal 2 board (SEU)
16716	16739	11-May-2005 22:11:17	13-May-2005 11:40:20	transfer to R/W WAIT	ICU suspended by SEU

Table 3-4: Instrument unavailabilities

3.1.4 Performance Monitoring - System (SOST-DLR)

Detector temperatures

Detector temperatures are monitored according to the requirements of defined procedures of the IOM *[3]*. 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 to check these limits.
Fig. 3-4 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 May, two SEUs interrupted measurements. These events are visible as short data gaps. When MPS driven operations resumed, detector temperatures were lower than nominal and took a few orbits to reach the operational level again. When detector temperature limits are reached, a TC adjustment is performed (see chapter 3.1.3).

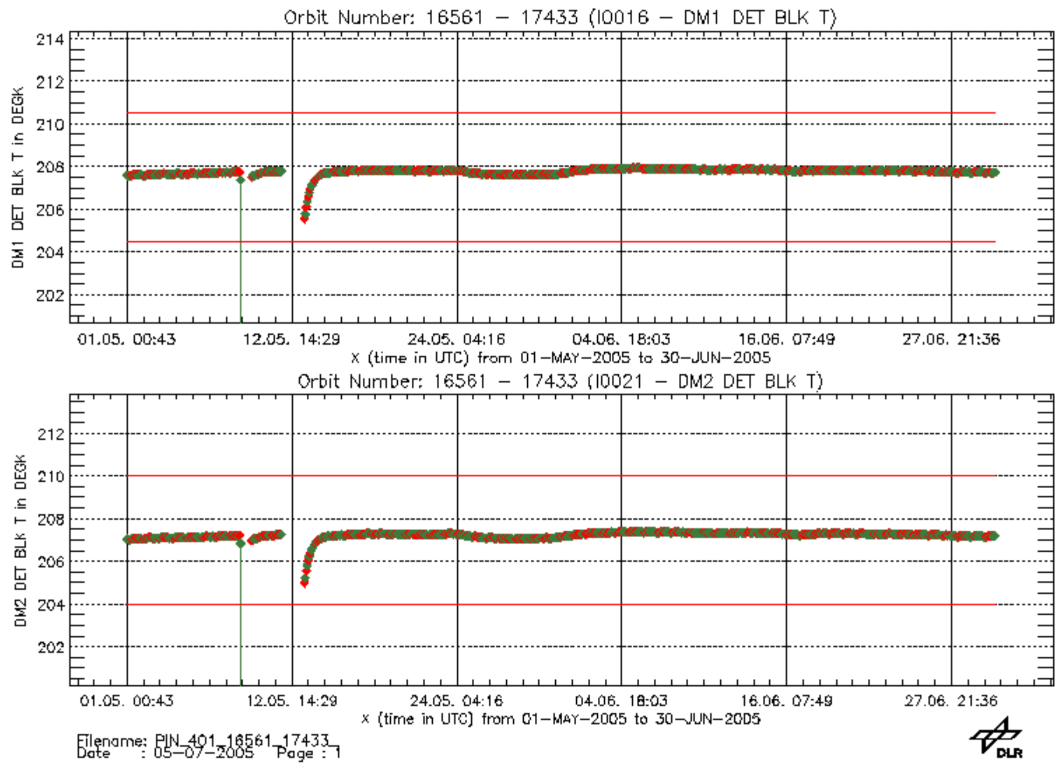
OBM temperatures

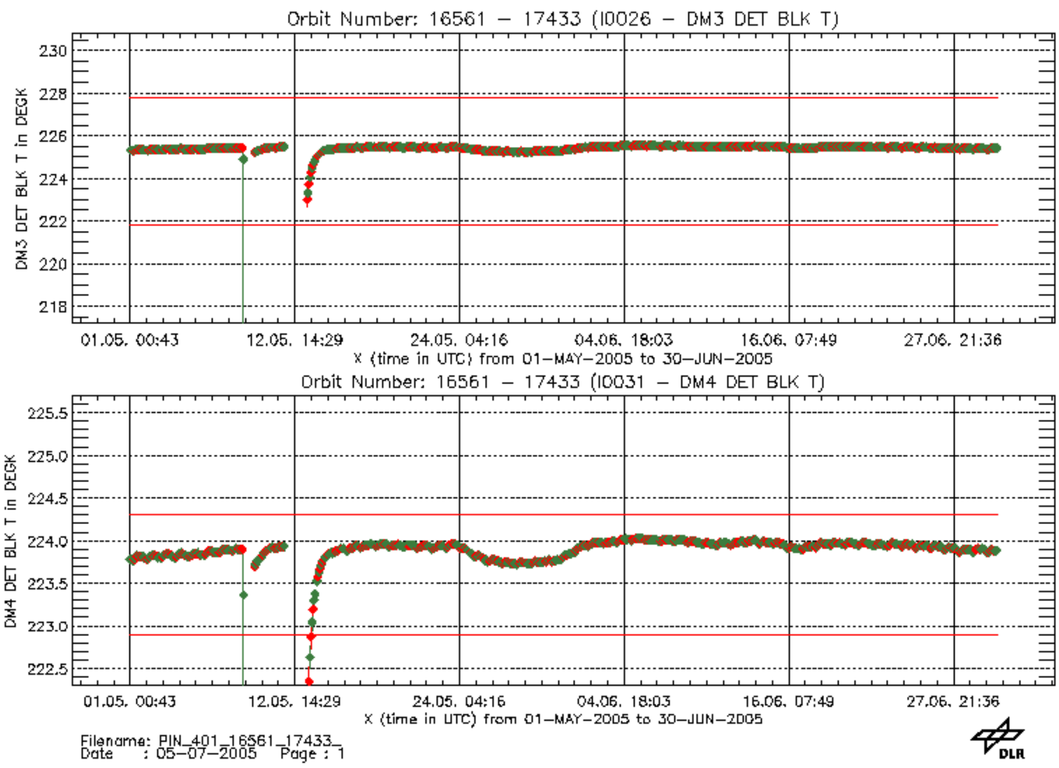
OBM temperatures are monitored according to specific requirements of the IOM *[3]*. It requests to ensure that the average temperature per orbit remains within the specified limits. The average OBM temperature is determined from specified HK parameters. In addition power readings for the Active Thermal Control heaters are monitored.
Temperatures and ATC heater powers are given in fig. 3-5 and 3-6. Colour coding is as in fig. 3-4.

The data gap in May is caused by the second SEU. Recovery from the first SEU was so fast that HK telemetry was interrupted only for a very short period.

PMD ADC status

The status of the PMD ADC is monitored according to the requirements of the IOM *[3]* using HK telemetry data. It requests to ensure that no glitches occur caused by an SEU.
No PMD ADC glitches have been detected for the reported period.


Orbit Number: 16561 – 17433 (I0016 – DM1 DET BLK T)
DM1 DET BLK T in DEGK
214
212
210
208
206
204
202
01.05. 00:43
12.05. 14:29
24.05. 04:16
04.06. 18:03
16.06. 07:49
27.06. 21:36
X (time in UTC) from 01–MAY–2005 to 30–JUN–2005
Orbit Number: 16561 – 17433 (I0021 – DM2 DET BLK T)
DM2 DET BLK T in DEGK
212
210
208
206
204
202
01.05. 00:43
12.05. 14:29
24.05. 04:16
04.06. 18:03
16.06. 07:49
27.06. 21:36
X (time in UTC) from 01–MAY–2005 to 30–JUN–2005
Filename: PIN_401_16561_17433_
Date : 05–07–2005 Page : 1
DLR


Orbit Number: 16561 – 17433 (I0026 – DM3 DET BLK T)
DM3 DET BLK T in DEGK
230
228
226
224
222
220
218
01.05. 00:43
12.05. 14:29
24.05. 04:16
04.06. 18:03
16.06. 07:49
27.06. 21:36
X (time in UTC) from 01–MAY–2005 to 30–JUN–2005
Orbit Number: 16561 – 17433 (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. 00:43
12.05. 14:29
24.05. 04:16
04.06. 18:03
16.06. 07:49
27.06. 21:36
X (time in UTC) from 01–MAY–2005 to 30–JUN–2005
Filename: PIN_401_16561_17433_
Date : 05–07–2005 Page : 1
DLR

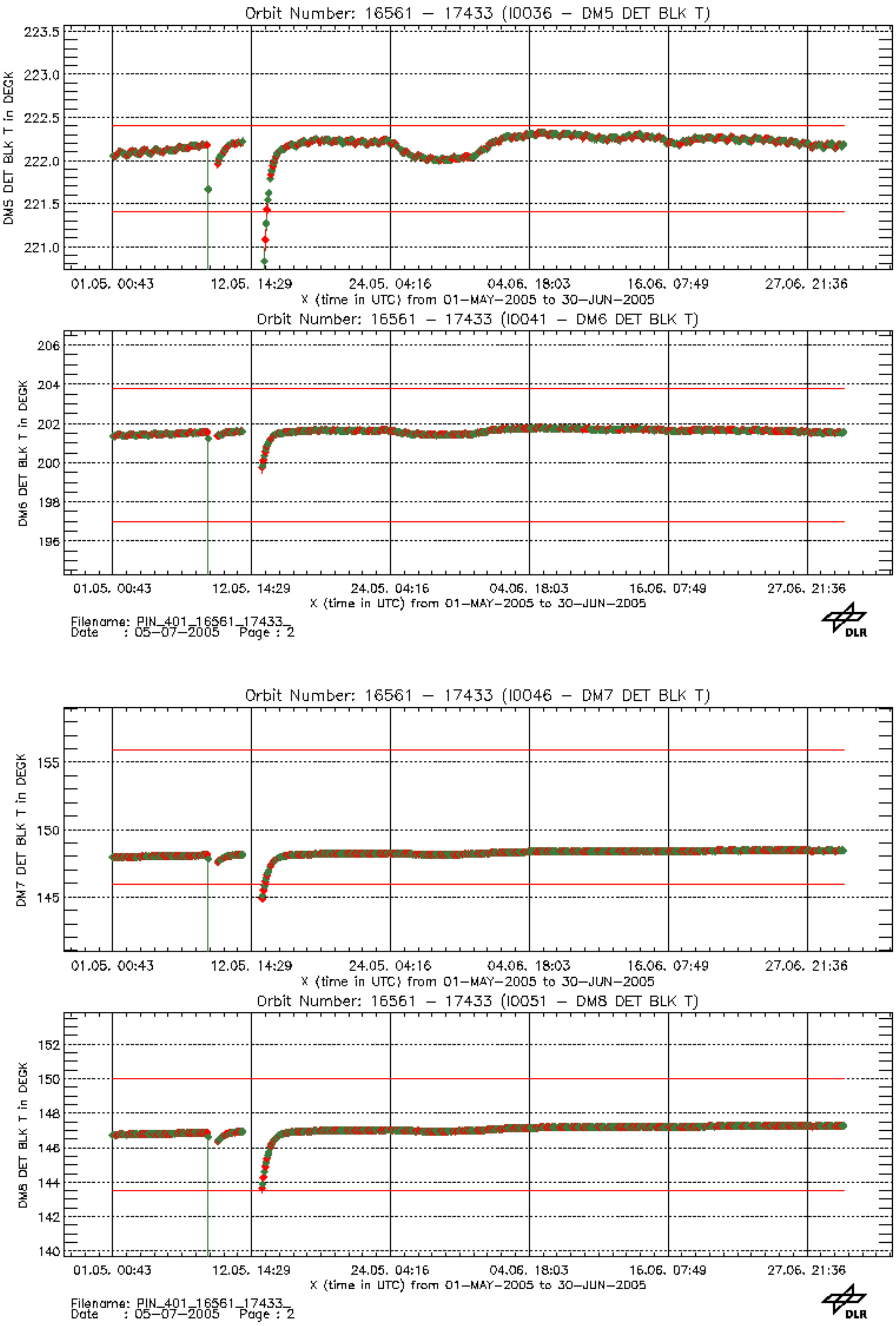


Fig. 3-4: Detector temperatures

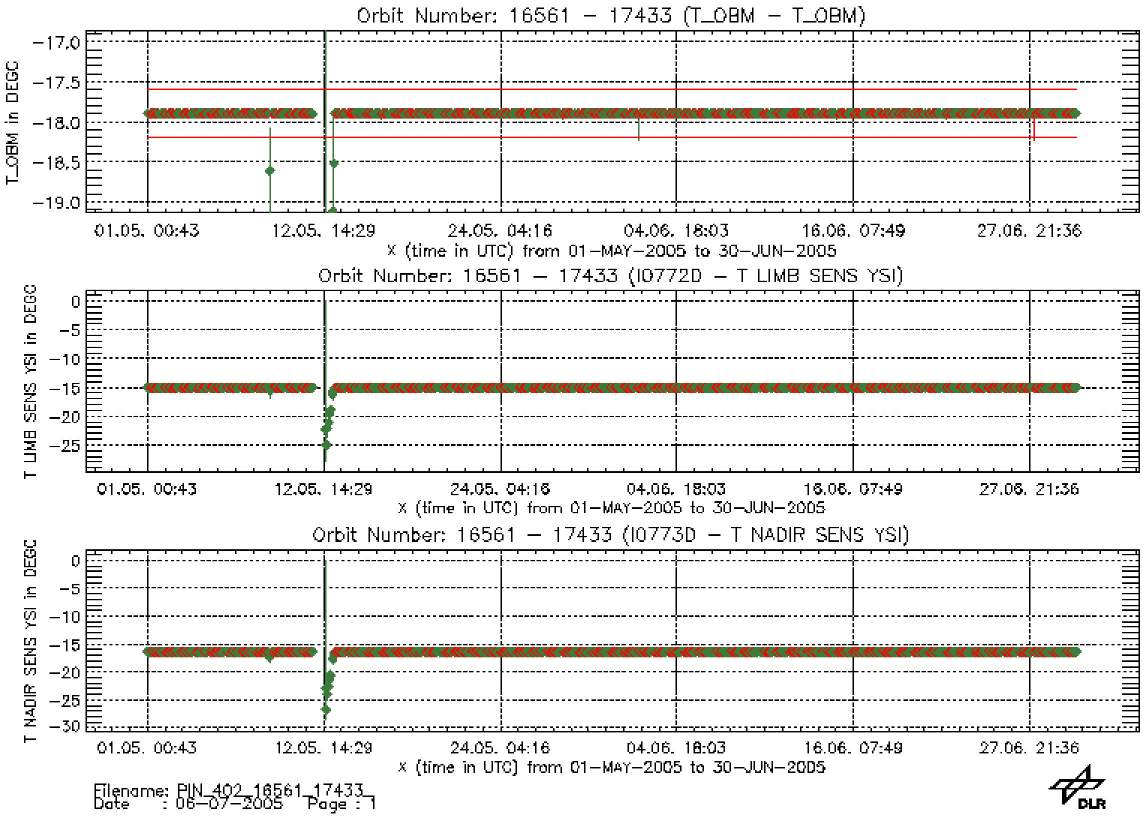


Fig. 3-5: OBM temperatures (top: derived OBM, middle: limb sensor, bottom: nadir sensor)

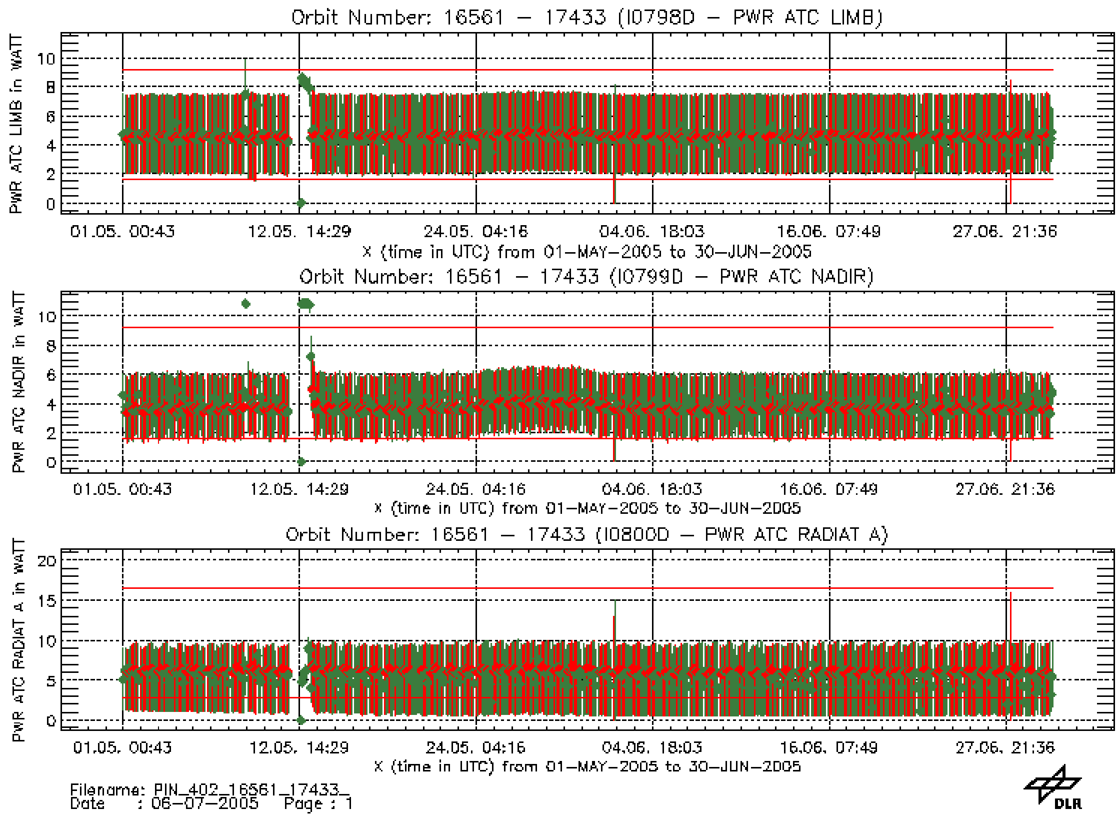


Fig. 3-6: ATC heater power (top: ATC limb, middle: ATC nadir, bottom: ATC Rad A)

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: 0.46
- APSM: 0.41
- NCWM (sub-solar port): 0.47
- WLS (switches): 0.10
- WLS (burning time): 0.20
- SLS (switches): 0.03

- SLS (burning time): 0.01

How the relative LLI usage has accumulated since launch can be seen in fig. 3-7. 'EOL' assumes a total mission lifetime of 0.5 years of Commissioning Phase and 4.5 years of routine operations.

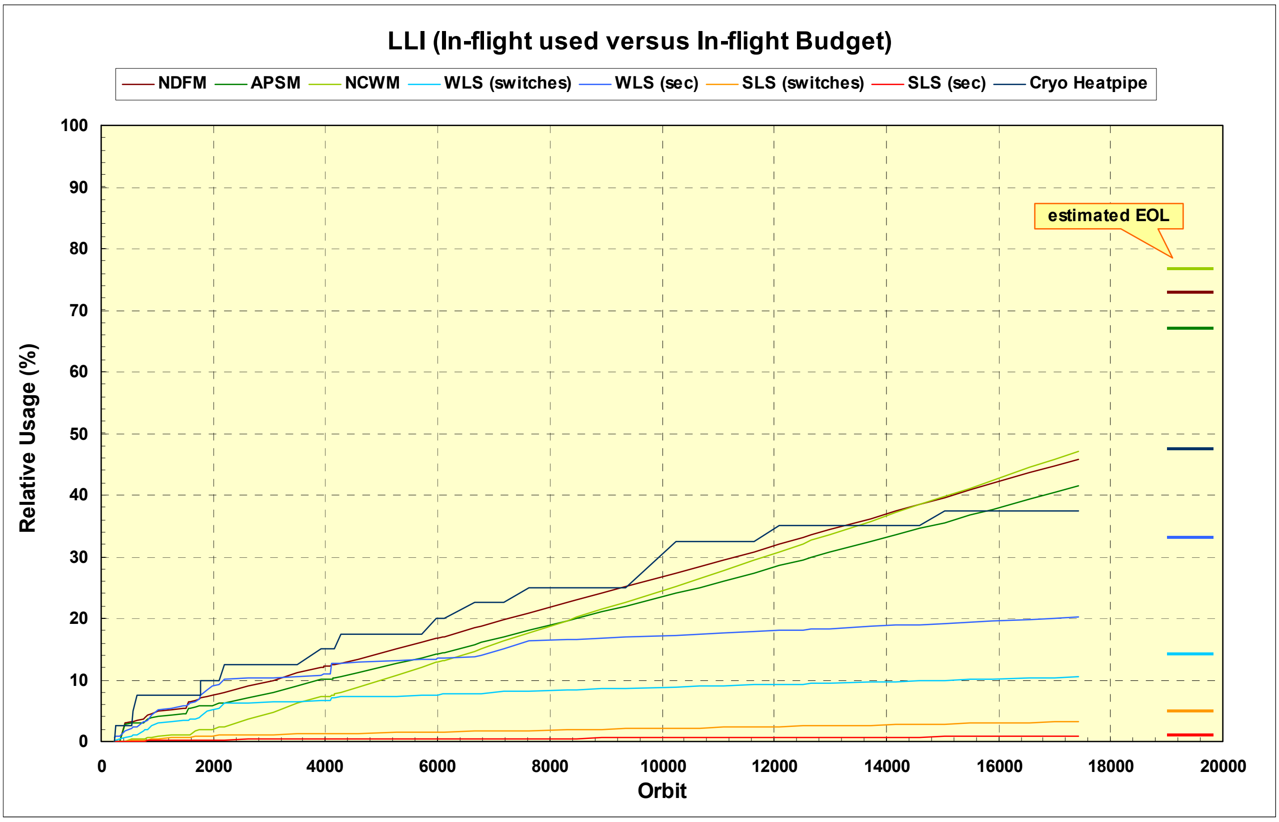


Fig. 3-7: Realtive usage of LLIs. 'EOL' is derived for the currently specified mission lifetime.

The number of cryogenic heatpipe cycles did not increased (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. 3-8 displays the time difference *predicted – reference*. Orbit manouevres cause distinct discontinuities.

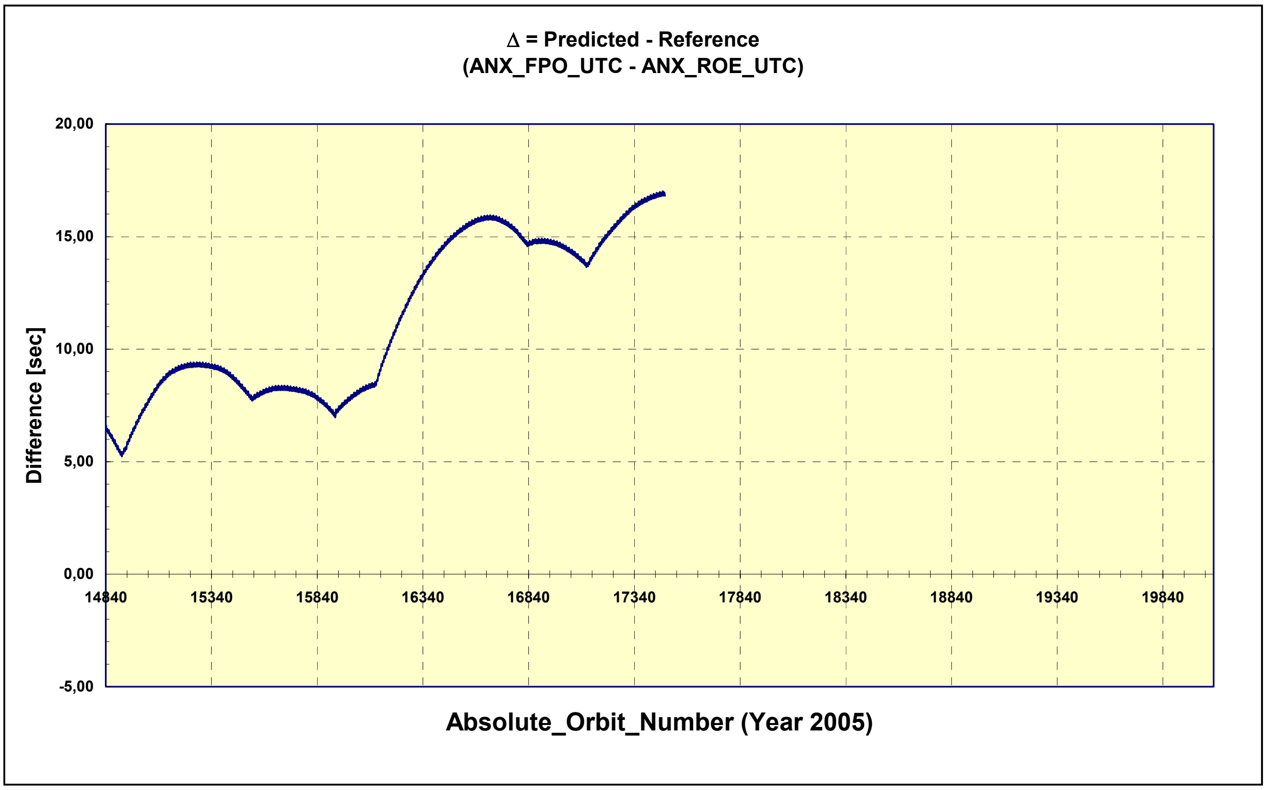


Fig. 3-8: Time difference between predicted and reference time.

3.1.5 Performance Monitoring - Light Path (SOST-IFE)

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 3-9 show results of these monitoring activities for the time interval May to June 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 3-9 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).

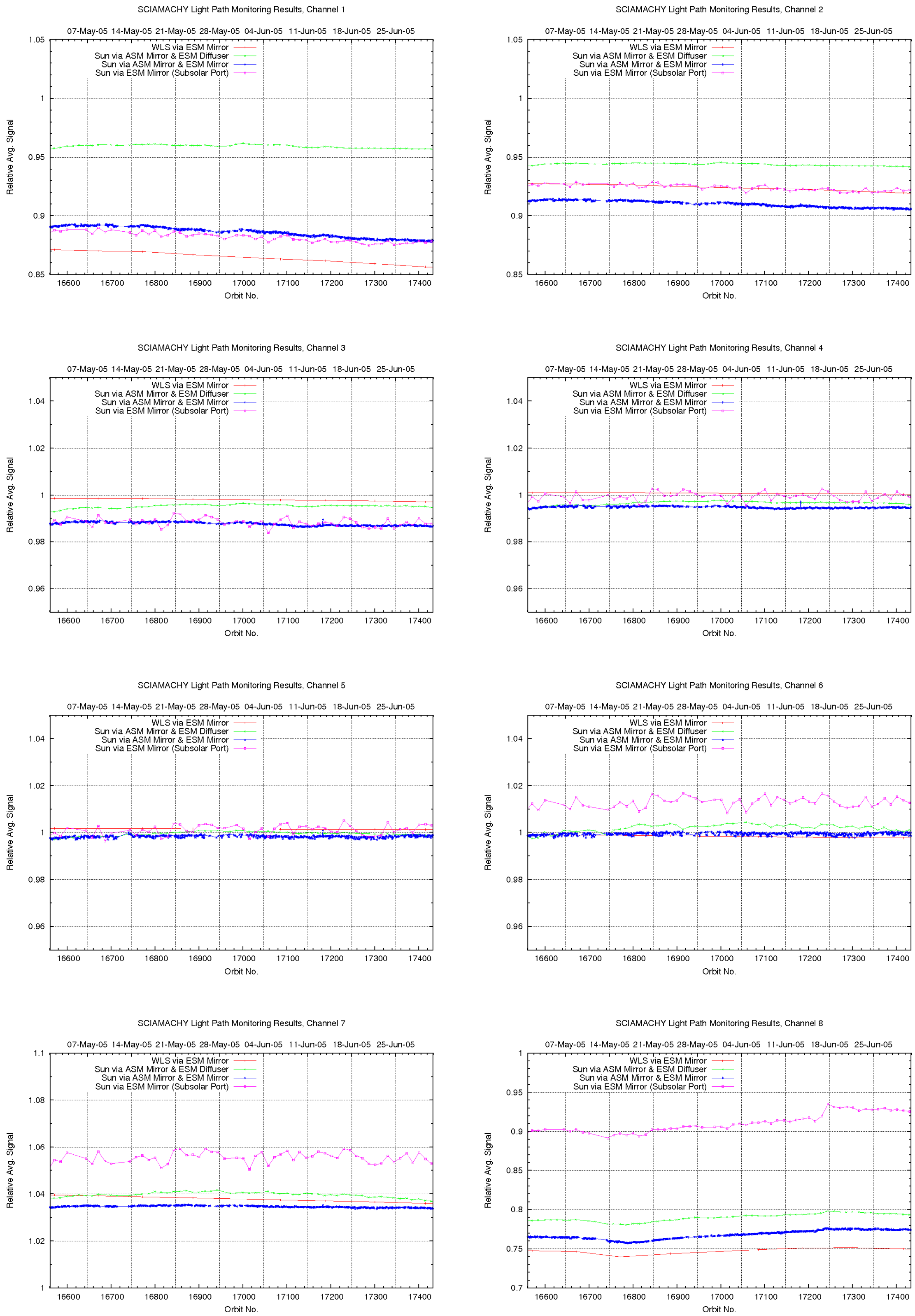


Fig 3-9: Light path monitoring results May 2005 to June 2005.

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

- The small degradation in the UV (channels 1 & 2) continues. Currently, the throughput loss for all light paths involving the ESM mirror is about 1% (for channel 1) and 0.5% (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 smaller than for other light paths, indicating that the ESM diffuser degrades less than the ESM mirror.
- Channels 3 to 6 remain stable, although there is an indication of a slight throughput loss in channel 3 for the ESM mirror light paths which needs further observation.
- The channel 7 throughput remains stable over the whole time interval.
- Channel 8 seems to have reached the minimum transmission/maximum icing around mid of May 2005. The channel 8 throughput remains at about 75-80%, depending on light path. A slight throughput increase towards the end of June 2005 is visible, possibly related to an increased detector temperature. The systematically higher throughput for the subsolar light path is still unexplained.

3.1.6 Problem Report Status (DLR-BO)

The problem report statistics is as follows:

- Total number of problem reports: 43
- Open problem reports: 5
- Problem reports which have been closed during the reporting period: 3
- New problem reports during the reporting period: 0

PR-ID 29: Deviation between expected and measured azimuthal LOS direction
PR ID-29 adressed the azimuth jump of 0.1° LOS at the end of a solar occultation state when switching from scanning to pointing by using the Sun Follower. The decision 'use-as-is' was the result of a telecon between DLR-BO, SOST and SRON. No impact of the jump on nadir, limb and occultation measurements or monitoring results derived thereof has been identified. Therefore PR ID-29 is closed.

PR-ID 36: Nadir FoV for the extreme -x direction seems to be partly obstructed
The problem was solved by adjustment of the scanning (see OCR 2). SRON has committed that the reported nadir TCFoV obstruction when SCIAMACHY is looking to the West is fully in line with the ambient test results obtained in the first half of 1999. Therefore PR-ID 36 is closed

PR-ID 38: WLS shows a decay of ~2% in channel 1
It is assumed that the reduction is due to an aging effect of the WLS. The subject will be covered by the M-factor determination, which is ongoing work. Therefore PR-ID 38 is closed.

4 DATA AVAILABILITY STATISTICS

4.1 Downlink/Acquisition Performance

No problems are known for the period May-June 2005.

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.

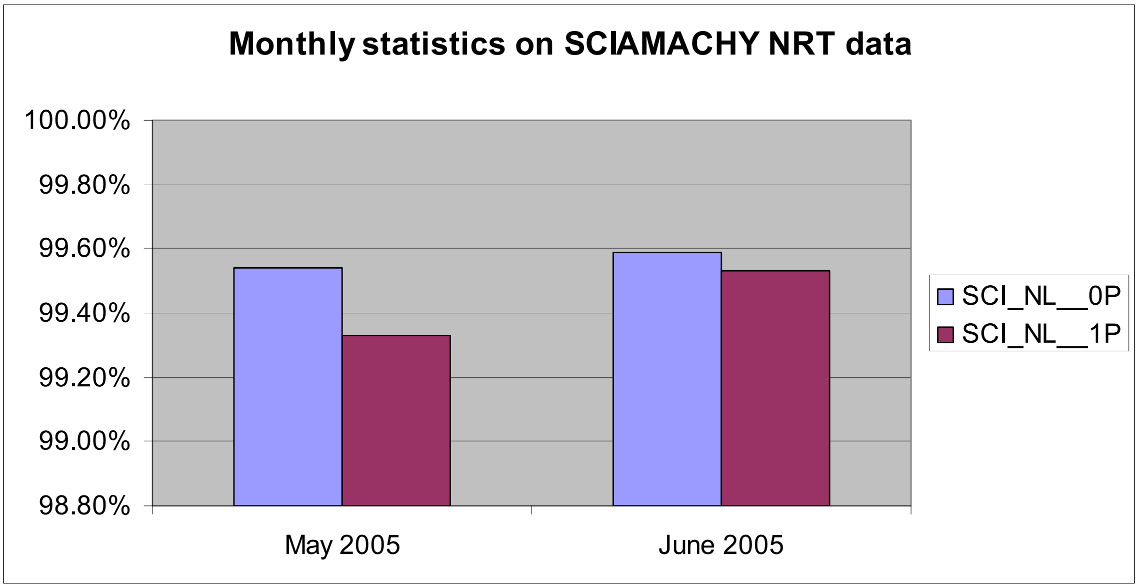


Fig. 4-2: Statistics on available unconsolidated Level 0 and Level 1 products

4.3 Statistics on consolidated data

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

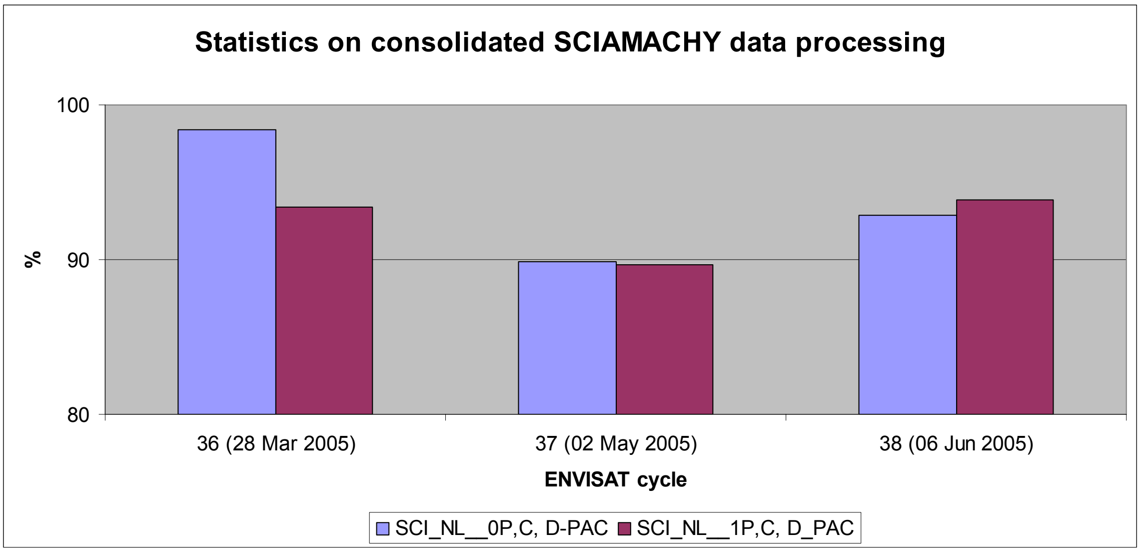


Fig. 4-3: Statistics on consolidated Level 0 and Level 1 products

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. 4-4 is from 24/05/2005).
Data sets that lie in non-nominal decontamination periods are not re-processed to L2 products as the science data are not reliable. However during cycles 12 and 19 that contain decontamination periods, also L1b processing is reduced. This is currently under investigation.

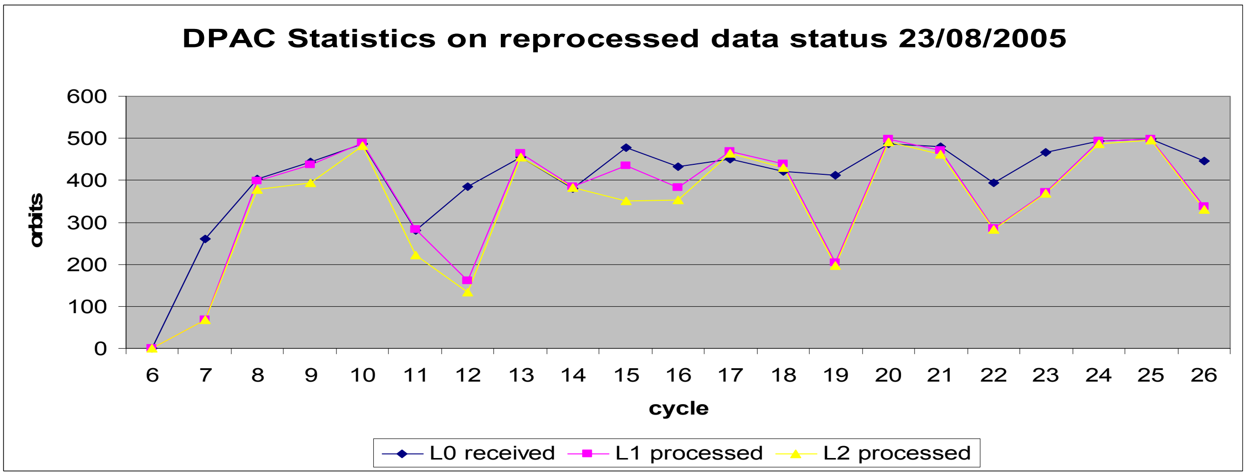


Fig. 4-4: DPAC statistics on reprocessed data

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 *[4]*. 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.

IPF Version	Description	Proc Centre	Date	Start Orbit
5.04	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: • 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 May - June 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 May 2005 was 100%, during June 2005 97%.
The LK1 ADF statistic is calculated by dividing the number of all LK1 ADFs by number of all available (to IECF) level 1 orbits. In average ADFs are 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. This had impact for processing L1b Near Realtime products being processed with ADFs older than 1 week. This especially occurred at the end of May (

days 25-31) and again end of June (days 20 – 30). Especially SU1 ADFs for days 27-30 June were not processed.

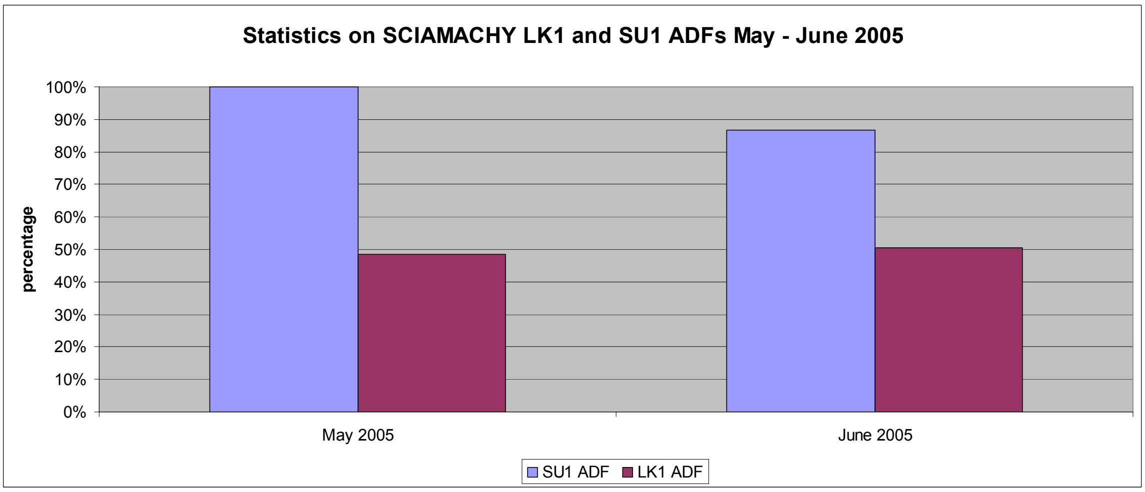


Fig. 5-1: Statistics on LK1 and SU1 processing

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, etc).
Fig. 5-2 to Fig. 5-5 show the ratios of SMR spectra derived from calibrated SMR/ESM during the month May - June 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:

- **May 2005**
  Reference SMR - 01 May 2005
  SMR used for ratios: 02, 03, 04, 05, 06, 07, 14, 21, 28 May 2005
- **June 2005**
  Reference SMR - 01 Jun 2005
  SMR used for ratios: 02, 03, 04, 05, 06, 07, 14, 21, 28 Feb 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.

January and February ratios of SMRs showed some strong etalon like features (see previous 4-monthly report), especially in channel 3. This behaviour is not noticed during May – June 2005.

Fig. 5-6 shows a SMR ratio on a long term trend dividing the ESM spectra from days 27-Jun-2003 and 27-Jun-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 27/06/2003. This is consistent with the Light Path monitoring at SOST-IFE. The effect is due to ice contamination for the last two channels.

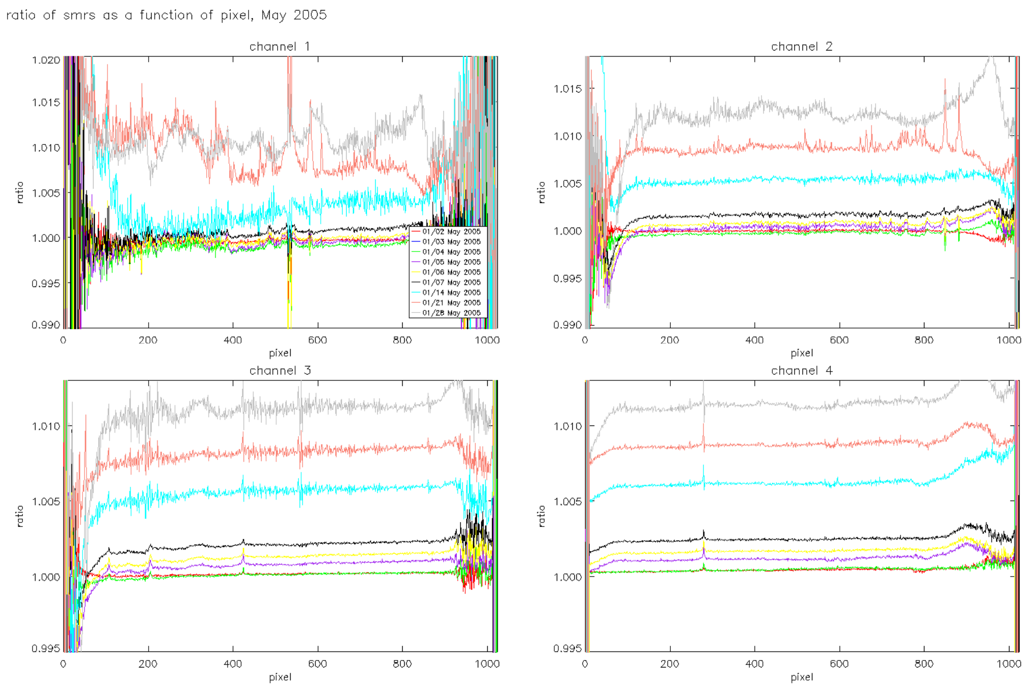


Fig. 5-2: SMR ratios per detector channel 1-4 (changes during May 2005)

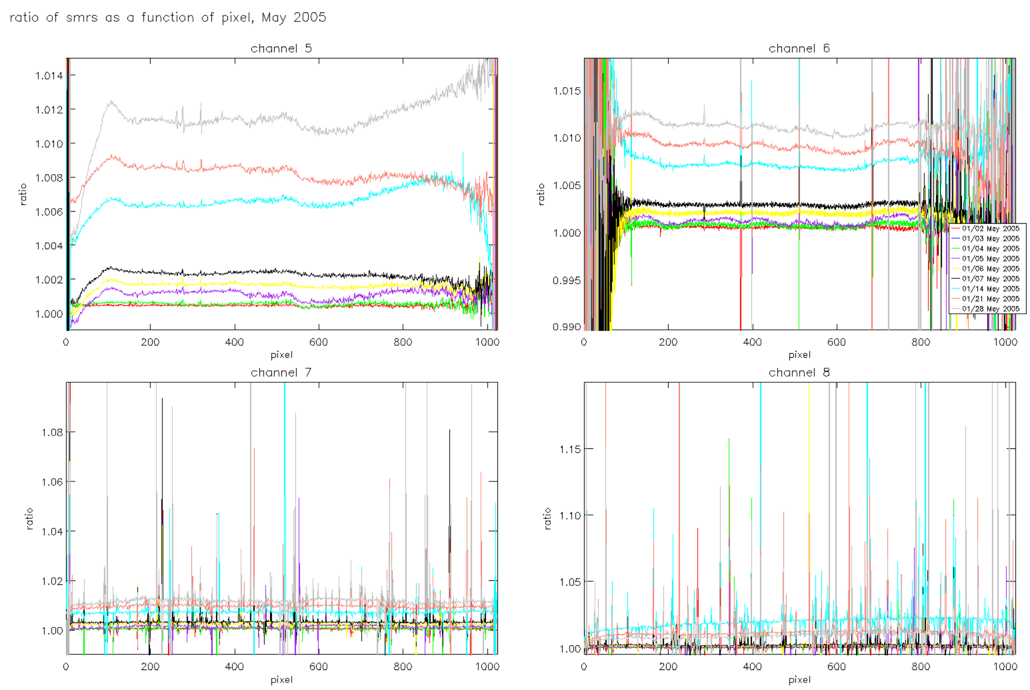


Fig. 5-3: SMR ratios per detector channel 5-8 (changes during May 2005)

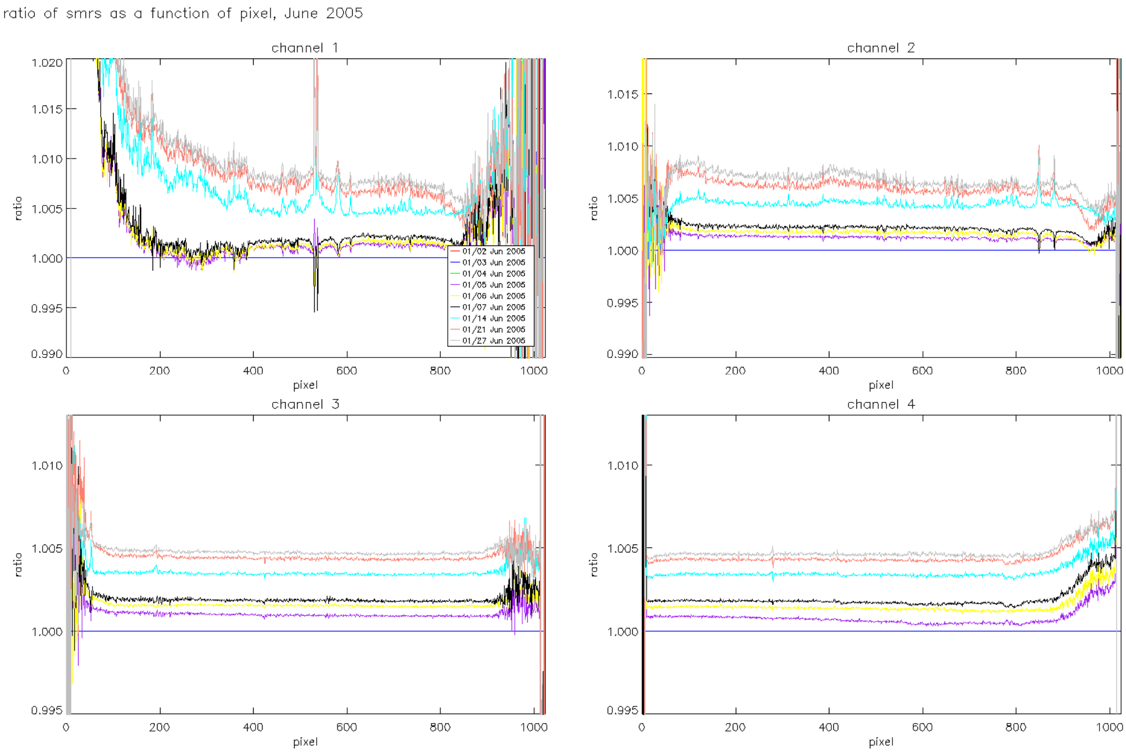


Fig. 5-4: SMR ratios per detector channel 1-4 (changes during June 2005)

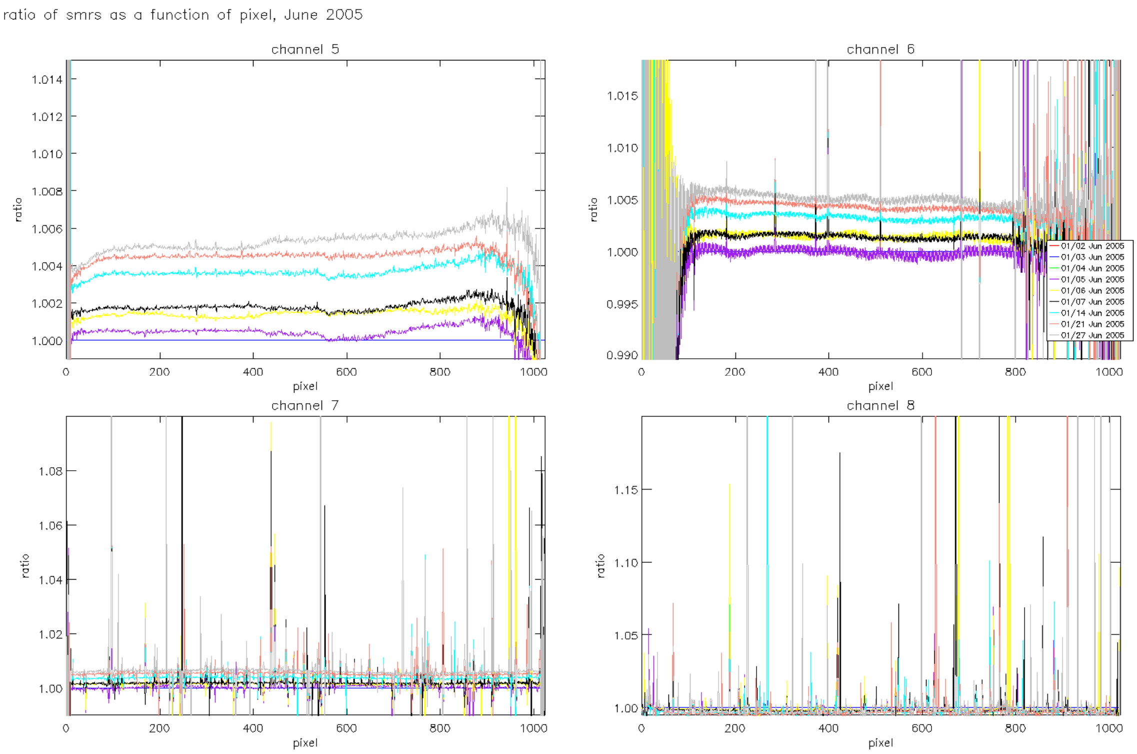


Fig. 5-5: SMR ratios per detector channel 5-8 (changes during June 2005)

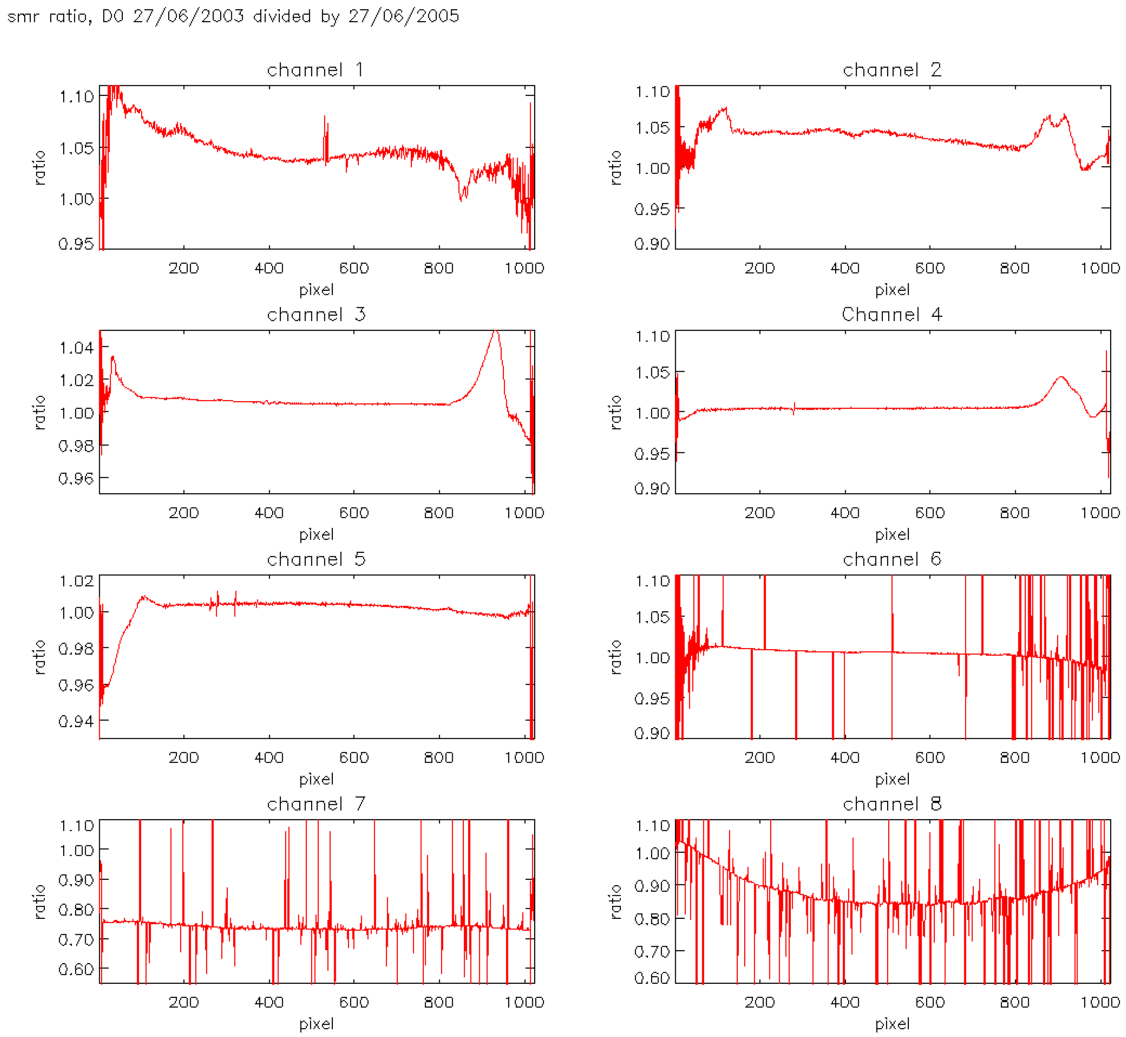


Fig. 5-6: SMR ratios per detector channel on Long Term Trend

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. 5-7 to Fig. 5-10 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 (only May), 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 a new processor version, where the time dependent part of the leakage current will be considered.

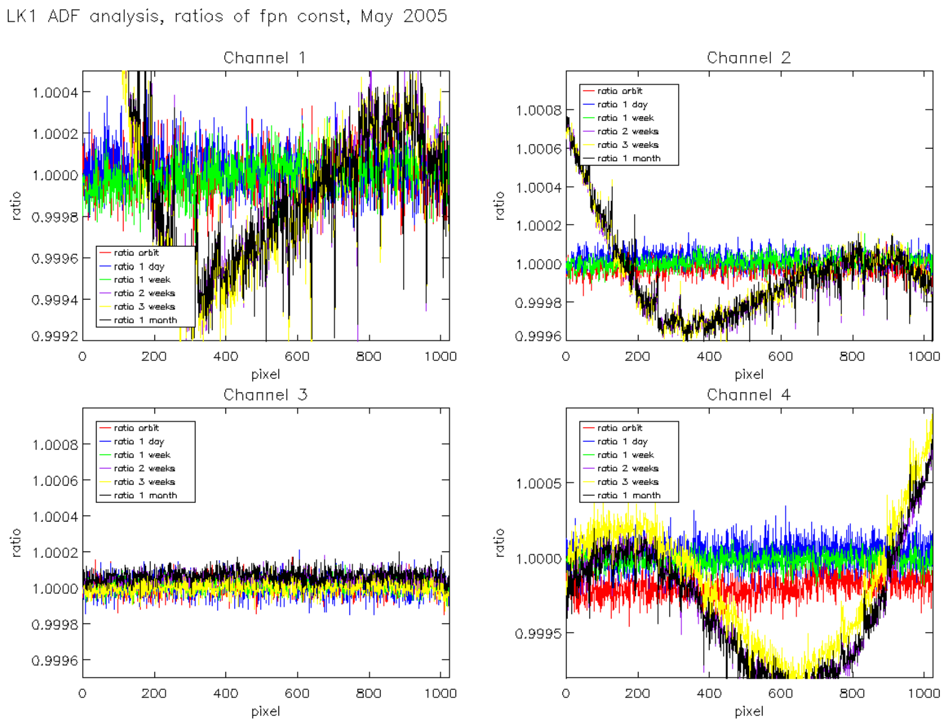


Fig. 5-7: dark current ratios (constant part) channel 1-4 during May 2005, Reference Spectrum used: Orbit 16565, 01-May-2005

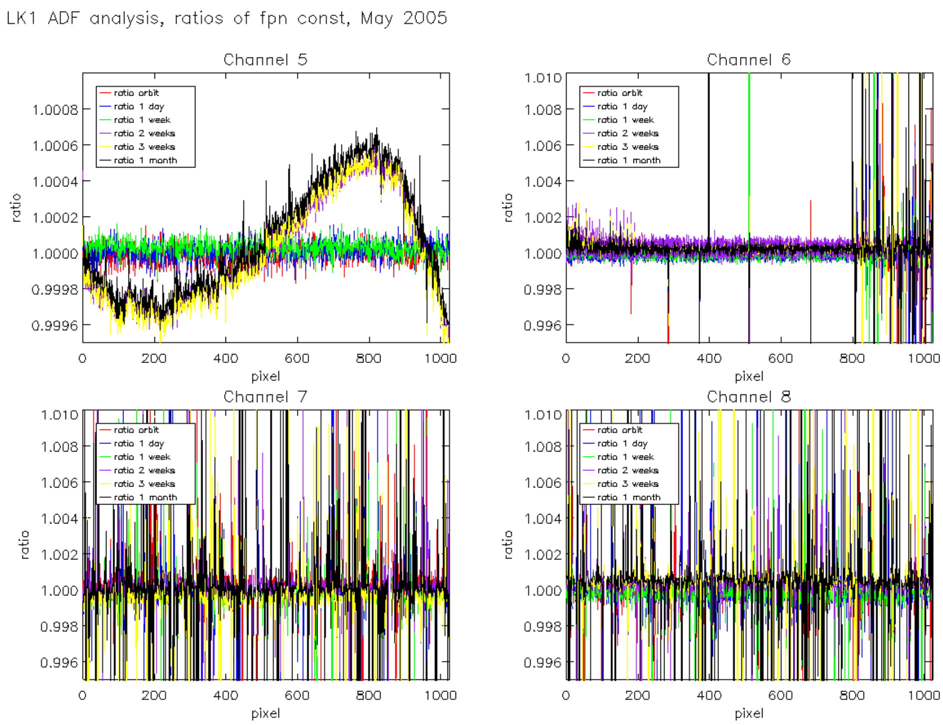


Fig. 5-8: dark current ratios (constant part) channel 5-8 during May 2005, Reference Spectrum used: Orbit 16565, 01-May-2005

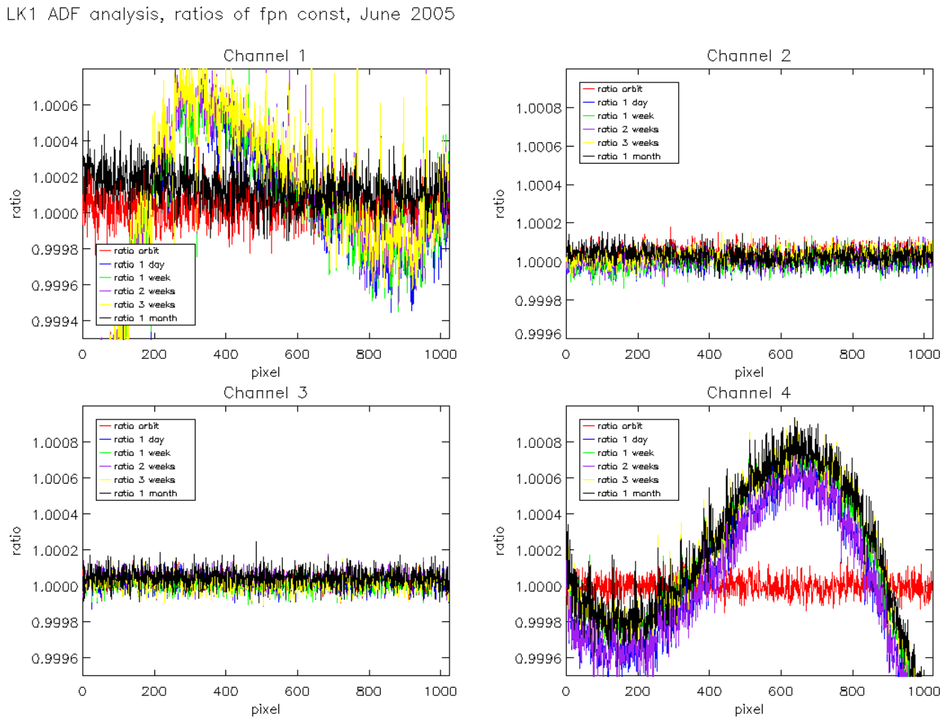


Fig. 5-9: dark current ratios (constant part) channel 1-4 during June 2005, Reference Spectrum used: Orbit 17009, 01-Jun-2005

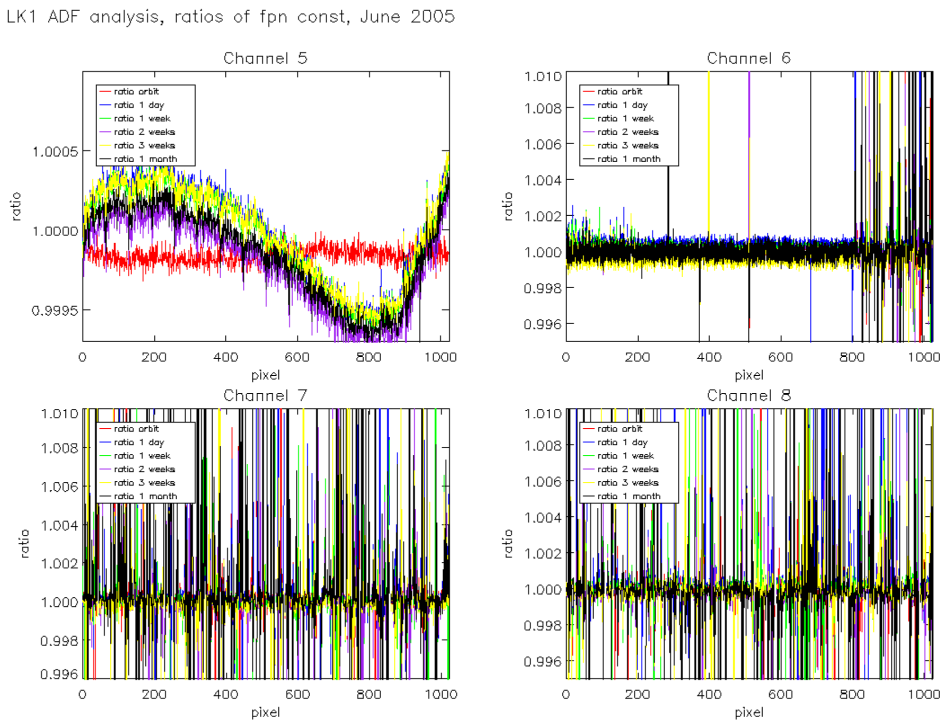


Fig. 5-10: dark current ratios (constant part) channel 5-8 during June 2005, Reference Spectrum used: Orbit 17009, 01-Jun-2005

5.1.6 Pointing Performance

The in-orbit ENVISAT pointing characterization in view of a new restituted attitude file delivered by ESOC (AOCS data) was assessed and results are described in detail in a dedicated technical note *[1]*.
This analysis was further extended comparing the harmonic components and the SCIAMACHY limb mis-pointing retrieved from SCIAMACHY limb scattering observations using the TRUE [Kaiser et al, 2004] algorithm.

This analysis that is summarised here is further reported in the technical note *[5]*.

- The data set used for comparison was extended from selected orbits on 32 days between November 2003 and January 2005 to all available TRUE and AOCS data.
- The AOCS harmonic attitude functions were used instead of noisier AOCS estimator data
- AOCS attitude correction values were taken at the same times as the tropical SCIAMACHY limb measurements and not when the ENVISAT is within the 20°N to 20°S latitude range.

Fig 5-11 shows a scatter plot with linear least squares fits where only the constant offset was fitted for and the slope was set to 1.The retrieved offsets c are |c| =16.88 mdeg after the December 2003 update, |c| = 16.648 mdeg before the December 2003 update and |c| =16.82 mdeg for the entire available data set. A pitch offset of 16.88 mdeg corresponds to a tangent height (TH) offset of about 970 m at TH =0 km and about 910 m at TH =100 km.

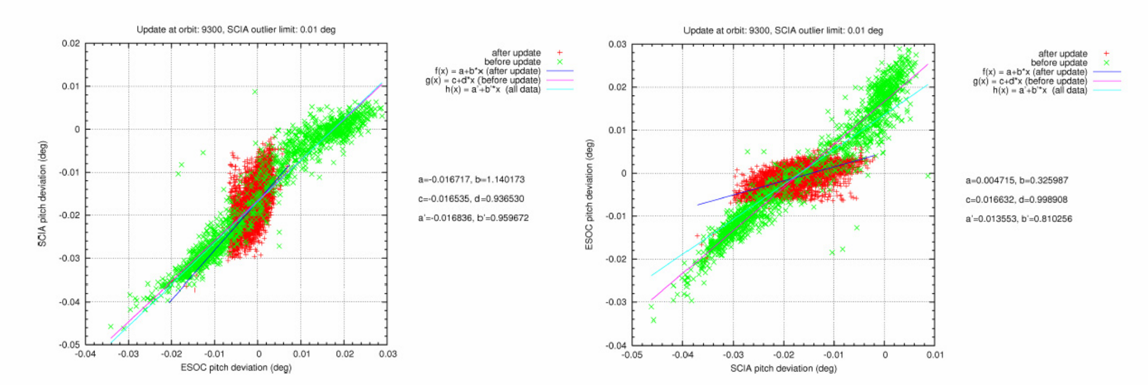


Fig. 5-11: Scatter plots of harmonic pitch corrections and TRUE pitch error retrievals. The left and right panel show the same data set, but with reversed axes. Each plot shows linear fits for the periods before the December 2003 update (magenta line) , after the December 2003 update (blue lines) and all data (turquoise line).

The results of this study are being implemented in the new SCIAMACHY processor IPF 6.0 to become operational end 2005.

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 *[4]*. The disclaimer at http://envisat.esa.int/dataproducts/availability/disclaimers/SCI_NL__2P_Disclaimers.pdf describes known artefacts. 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	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: • 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 LRAC PDHS-E DPAC	21-AUG-2004 20-AUG-2004 16-AUG-2004 12-AUG-2004	12942 12750 12823 12879
5.01	• description for cloud MDS updated • minor changes in MPI and USA	DPAC PDHS-E PDHS-K	31-MAR-2004 24-MAR-2004	

	climatology description • latitude grids fixed • list of surface types fixed, note about vegetation index added • O_3 FM formula fixed sizes of SCIA FM spectra fixed latitude zones fixed • solar zenith angle grid fixed	LRAC		

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, Fig. 6-2, Fig. 6-3, Fig. 6-6 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 May 2005

High NO_2 VCD values at high latitudes need to be reviewed.

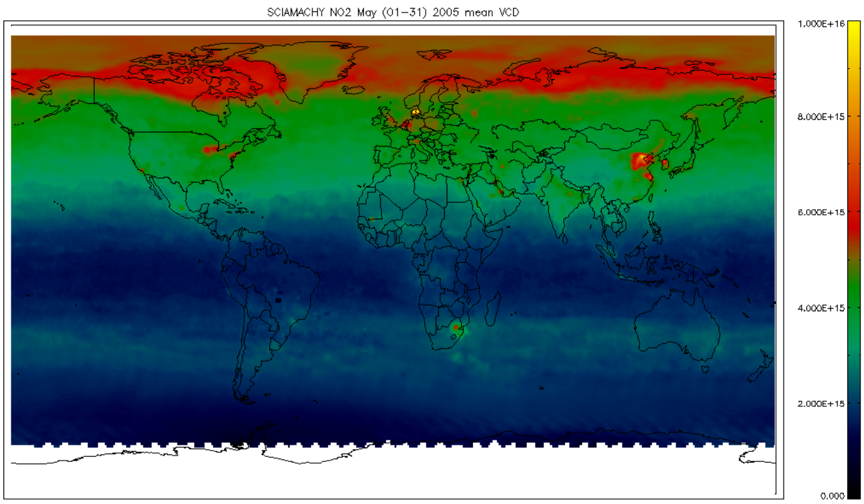


Fig. 6-1: NO_2 VCD world map 01-31 May 2005 – monthly average

6.3.2 NO_2 VCD map June 2005

Also for the June world map showing the distribution of mean values of NO_2 VCD, a review is needed to understand unphysical values at high latitudes.

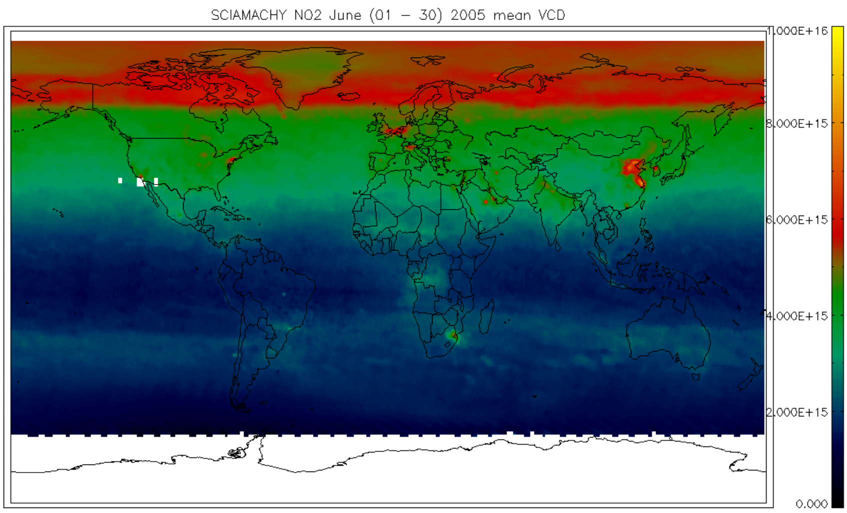


Fig. 6-2: NO_2 VCD world map 01-30 June 2005 – monthly average

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 O_3, NO_2 Nadir measurements as well as stratospheric Limb profiles of O_3, NO_2.

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 May 2005

- SCIAMACHY data quality stable in May.
- SCIAMACHY data about 5 DU lower in the global mean than ECMWF ozone values.
- Decrease of the SCIAMACHY data standard deviations in the global mean.
- This monitoring report was produced with the operational ECMWF model (CY29R1).

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.

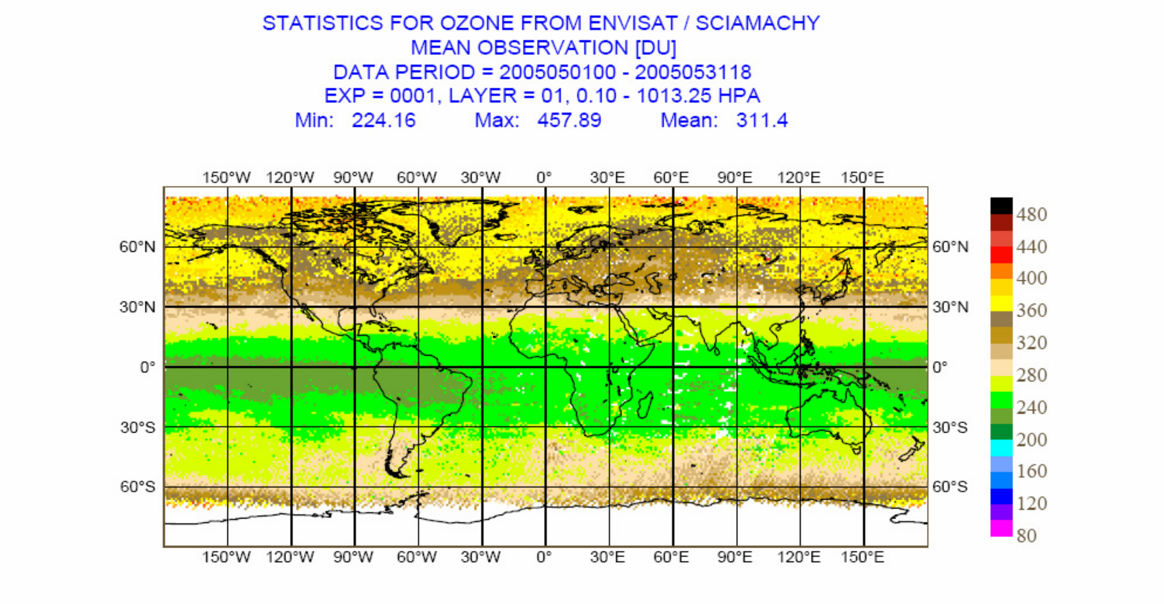


Fig. 8-1: Ozone Mean ECMWF May 2005

8.1.2 Summary of the ECMWF SCIAMACHY monthly report for June 2005

- SCIAMACHY data quality stable throughout June.
- SCIAMACHY data about 5 DU lower in the global mean than ECMWF ozone values.
- Decrease of the SCIAMACHY data standard deviations in the global mean.
- On 28 June the operational ECMWF model version changed from version CY29R1 to CY29R2.

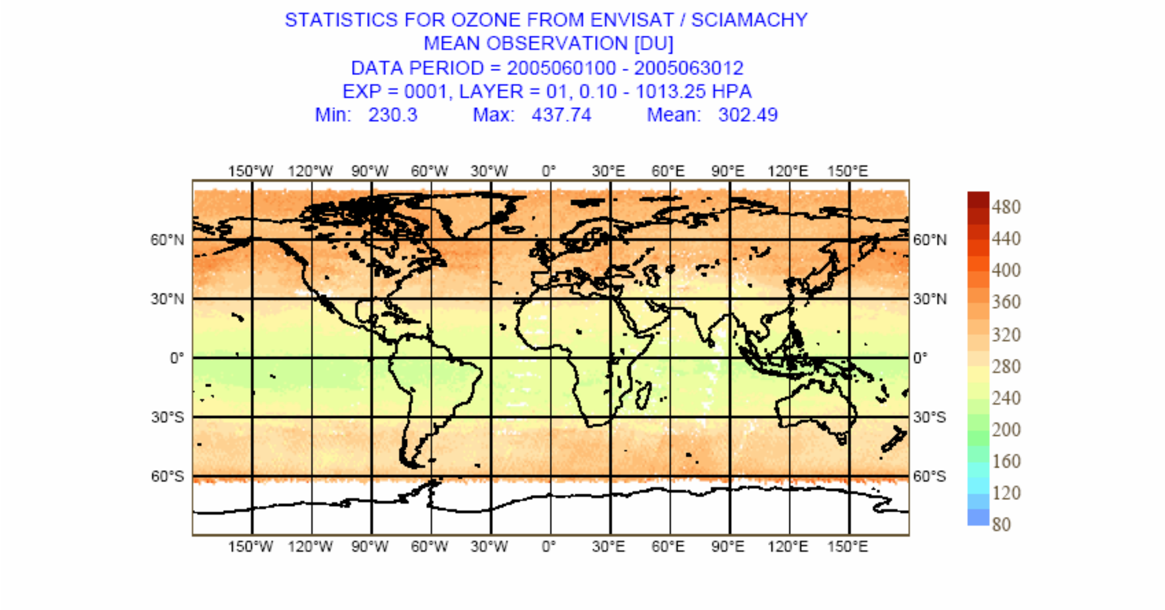


Fig. 8-2: Ozone Mean ECMWF June 2005

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_AXVIEC20050127_112836_20050123_000000_20900101_000000
	SCI_PE1_AXVIEC20050526_092947_20050508_000000_20900101_000000
	SCI_PE1_AXVIEC20050627_154704_20050621_000000_20900101_000000
SP1_AX	SCI_SP1_AXVIEC20050428_131041_20050424_000000_20051001_000000
	SCI_SP1_AXVIEC20050526_093838_20050523_000000_20051101_000000
	SCI_SP1_AXVIEC20050627_160323_20050621_000000_20051201_000000
SU1_AX	SCI_SU1_AXVIEC20050504_001229_20050501_003025_20050515_020803
	SCI_SU1_AXVIEC20050505_000903_20050502_013634_20050516_214800
	SCI_SU1_AXVIEC20050506_001317_20050503_010853_20050517_211622
	SCI_SU1_AXVIEC20050507_025121_20050504_032836_20050518_222447
	SCI_SU1_AXVIEC20050508_003036_20050505_014318_20050519_215245
	SCI_SU1_AXVIEC20050509_001930_20050506_011304_20050520_212253
	SCI_SU1_AXVIEC20050510_002058_20050507_004250_20050521_222703
	SCI_SU1_AXVIEC20050511_165441_20050508_172307_20050522_215446
	SCI_SU1_AXVIEC20050512_001803_20050509_183727_20050523_212651
	SCI_SU1_AXVIEC20050513_002829_20050510_004156_20050524_022123
	SCI_SU1_AXVIEC20050514_004319_20050511_015005_20050525_220300
	SCI_SU1_AXVIEC20050516_001305_20050513_114027_20050527_224001
	SCI_SU1_AXVIEC20050517_001355_20050514_045408_20050528_220802
	SCI_SU1_AXVIEC20050518_001111_20050515_012934_20050529_213945
	SCI_SU1_AXVIEC20050519_002544_20050516_005957_20050530_114352
	SCI_SU1_AXVIEC20050520_042424_20050517_050241_20050531_221602
	SCI_SU1_AXVIEC20050521_001411_20050518_013421_20050601_214317
	SCI_SU1_AXVIEC20050522_003037_20050519_010452_20050602_114858
	SCI_SU1_AXVIEC20050523_000735_20050520_003641_20050603_021122
	SCI_SU1_AXVIEC20050524_000922_20050521_013914_20050604_215016
	SCI_SU1_AXVIEC20050525_000608_20050522_010734_20050605_211845
	SCI_SU1_AXVIEC20050526_002014_20050523_003847_20050606_222742
	SCI_SU1_AXVIEC20050527_004119_20050524_014444_20050607_215359
	SCI_SU1_AXVIEC20050601_144854_20050529_145117_20050612_223917
	SCI_SU1_AXVIEC20050607_085343_20050525_201009_20050608_212348
	SCI_SU1_AXVIEC20050607_090626_20050526_004419_20050609_022110
	SCI_SU1_AXVIEC20050607_093907_20050527_001323_20050610_015221
	SCI_SU1_AXVIEC20050607_095251_20050528_201257_20050611_212849
	SCI_SU1_AXVIEC20050607_100106_20050530_001850_20050613_015631
	SCI_SU1_AXVIEC20050607_101251_20050531_202026_20050614_213639
	SCI_SU1_AXVIEC20050604_221022_20050601_224352_20050616_002703
	SCI_SU1_AXVIEC20050606_114648_20050603_121708_20050617_214046
	SCI_SU1_AXVIEC20050606_203435_20050603_202849_20050617_214046
	SCI_SU1_AXVIEC20050607_001159_20050604_021301_20050618_114712
	SCI_SU1_AXVIEC20050607_102023_20050602_002519_20050616_020301
	SCI_SU1_AXVIEC20050608_003012_20050605_002931_20050619_020850
	SCI_SU1_AXVIEC20050609_001415_20050606_025127_20050620_214549
	SCI_SU1_AXVIEC20050610_001101_20050607_010859_20050621_115230
	SCI_SU1_AXVIEC20050611_003231_20050608_003636_20050622_021434

	SCI_SU1_AXVIEC20050612_002707_20050609_000413_20050623_014454
	SCI_SU1_AXVIEC20050613_003337_20050610_011302_20050624_212210
	SCI_SU1_AXVIEC20050614_001219_20050611_004332_20050625_021952
	SCI_SU1_AXVIEC20050615_001541_20050612_001109_20050626_015044
	SCI_SU1_AXVIEC20050616_001355_20050613_011723_20050627_212759
	SCI_SU1_AXVIEC20050617_001032_20050614_004842_20050628_223707
	SCI_SU1_AXVIEC20050618_001149_20050615_001704_20050629_015546
	SCI_SU1_AXVIEC20050619_011127_20050616_012426_20050630_213147
	SCI_SU1_AXVIEC20050620_003409_20050617_005456_20050701_020703
	SCI_SU1_AXVIEC20050621_154543_20050618_205508_20050702_220843
	SCI_SU1_AXVIEC20050622_031911_20050619_024328_20050703_213936
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