SCIAMACHY

Bi-Monthly Report:

September - October 2011

prepared by/préparé par Gabriele Brizzi

reference/référence ENVI-SPPA-EOPG-TN-11-0033
issue/édition 1.1
revision/révision 0
date of issue/date d’édition 30 November 2011
status/état
Document type/type de document Technical Note
APPROVAL

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<th>author</th>
<th>Gabriele Brizzi, IDEAS-SERCO, Angelika Dehn, IDEAS-SERCO, Manfred Gottwald, SOST-DLR, Stefan Noël, SOST-IFE, Richard von Hees, SRON</th>
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CHANGE RECORD

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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 IDEAS, combined with inputs received from the different groups working on SCIAMACHY operation, calibration, product validation and data quality. The first part of the report is dedicated to Instrument Configuration and Performance. It is composed of contributions from SOST-DLR, SOST-IFE and SRON. The remainder of the report is dedicated to Level 1b and Level 2 performance assessment and is generated by ESA/ESRIN IDEAS 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;
- Degradation monitoring and correction;
- Data Availability Statistics;
- Level 1 Product Quality Monitoring;
- Level 2 NRT and OFL Product Quality Monitoring;
- Validation Activities and Results.
1.2 References


### 1.3 Acronyms and Abbreviations

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
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<tbody>
<tr>
<td>ADC</td>
<td>Analogue to Digital Converter</td>
</tr>
<tr>
<td>ADF</td>
<td>Auxiliary Data File</td>
</tr>
<tr>
<td>ANX</td>
<td>Ascending Node Crossing</td>
</tr>
<tr>
<td>AOCS</td>
<td>Attitude and Orbit Control System</td>
</tr>
<tr>
<td>APSM</td>
<td>Aperture Stop Mechanism</td>
</tr>
<tr>
<td>ASM</td>
<td>Azimuth Scan Mechanism</td>
</tr>
<tr>
<td>ATC</td>
<td>Active Thermal Control</td>
</tr>
<tr>
<td>BMR</td>
<td>Bi-Monthly Report</td>
</tr>
<tr>
<td>CA</td>
<td>Corrective Action</td>
</tr>
<tr>
<td>CCA</td>
<td>Communication Area</td>
</tr>
<tr>
<td>CTI</td>
<td>Configurable Transfer Item</td>
</tr>
<tr>
<td>DAC</td>
<td>Digital Analogue Converter</td>
</tr>
<tr>
<td>DLR-IMF</td>
<td>Deutsches Zentrum fuer Luft- und Raumfahrt</td>
</tr>
<tr>
<td>EOL</td>
<td>End of Life</td>
</tr>
<tr>
<td>ESM</td>
<td>Elevation Scan Mechanism</td>
</tr>
<tr>
<td>FAT</td>
<td>Factory Acceptance Test</td>
</tr>
<tr>
<td>FPN</td>
<td>Fixed Pattern Noise</td>
</tr>
<tr>
<td>HK</td>
<td>Housekeeping</td>
</tr>
<tr>
<td>HSM</td>
<td>High Speed Multiplexer</td>
</tr>
<tr>
<td>ICE</td>
<td>Instrument Control Electronics</td>
</tr>
<tr>
<td>ICU</td>
<td>Instrument Control Unit</td>
</tr>
<tr>
<td>IDEAS</td>
<td>Instrument Data quality Evaluation and Analysis Service</td>
</tr>
<tr>
<td>IECF</td>
<td>Instrument Engineering and Calibration Facilities</td>
</tr>
<tr>
<td>IOM</td>
<td>Instrument Operation Manual</td>
</tr>
<tr>
<td>LK1</td>
<td>Leakage Current Auxiliary File (SCI_LK1_AX)</td>
</tr>
<tr>
<td>LLI</td>
<td>Life Limited Item</td>
</tr>
<tr>
<td>LOS</td>
<td>Line of Sight</td>
</tr>
<tr>
<td>MCMCD</td>
<td>Macro Command</td>
</tr>
<tr>
<td>MPH</td>
<td>Main Product Header</td>
</tr>
<tr>
<td>MPS</td>
<td>Mission Planning Schedule</td>
</tr>
<tr>
<td>NCWM</td>
<td>Nadir Calibration Window Mechanism</td>
</tr>
<tr>
<td>NDFM</td>
<td>Neutral Density Filter Mechanism</td>
</tr>
<tr>
<td>NIVR</td>
<td>Netherlands Agency for Aerospace Programmes</td>
</tr>
<tr>
<td>NNDEC</td>
<td>Non-nominal Decontamination</td>
</tr>
<tr>
<td>NRT</td>
<td>Near Real Time</td>
</tr>
<tr>
<td>OAR</td>
<td>Observation Anomaly Report</td>
</tr>
<tr>
<td>OBM</td>
<td>Optical Bench Module</td>
</tr>
<tr>
<td>OCM</td>
<td>Orbit Control manoeuvre</td>
</tr>
<tr>
<td>OCR</td>
<td>Operations Change Request</td>
</tr>
<tr>
<td>OFL</td>
<td>Off-line</td>
</tr>
<tr>
<td>OSDF</td>
<td>Orbit Sequence Definition File</td>
</tr>
<tr>
<td>OSV</td>
<td>Orbit State Vector</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>PCF</td>
<td>Product Control Facility</td>
</tr>
<tr>
<td>PDHS</td>
<td>Payload Data Handling Station (PDS)</td>
</tr>
<tr>
<td>PDHS-E</td>
<td>Payload Data Handling Station – ESRIN</td>
</tr>
<tr>
<td>PDHS-K</td>
<td>Payload Data Handling Station – Kiruna</td>
</tr>
<tr>
<td>PDS</td>
<td>Payload Data Segment</td>
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<td>PE1</td>
<td>Pixel to Pixel/ Etalon Auxiliary File (SCI_PE1_AX)</td>
</tr>
<tr>
<td>PLSO</td>
<td>Payload Switch OFF</td>
</tr>
<tr>
<td>PMD</td>
<td>Polarization Measurement Device</td>
</tr>
<tr>
<td>QUADAS</td>
<td>Quality Analysis of Data from Atmospheric Sounders</td>
</tr>
<tr>
<td>QWG</td>
<td>Quality Working Group</td>
</tr>
<tr>
<td>SAA</td>
<td>South Atlantic Anomaly</td>
</tr>
<tr>
<td>SCIAMACHY</td>
<td>Scanning Imaging Absorption Spectrometer for Atmospheric Chartography</td>
</tr>
<tr>
<td>SCIAVALIG</td>
<td>SCIAMACHY Validation and Interpretation Group</td>
</tr>
<tr>
<td>SCICAL</td>
<td>SCIAMACHY Calibration tool</td>
</tr>
<tr>
<td>SEU</td>
<td>Single Event Upset</td>
</tr>
<tr>
<td>SLS</td>
<td>Spectral Line Source</td>
</tr>
<tr>
<td>SM</td>
<td>Service Module</td>
</tr>
<tr>
<td>SMR</td>
<td>Sun Mean Reference</td>
</tr>
<tr>
<td>SOST</td>
<td>SCIAMACHY Operations Support Team</td>
</tr>
<tr>
<td>SP1</td>
<td>Spectral Calibration Auxiliary File (SCI_SP1_AX)</td>
</tr>
<tr>
<td>SU1</td>
<td>Sun Reference Auxiliary File (SCI_SU1_AX)</td>
</tr>
<tr>
<td>SZA</td>
<td>Sun Zenith Angle</td>
</tr>
<tr>
<td>TC</td>
<td>Thermal Control</td>
</tr>
<tr>
<td>TCFoV</td>
<td>Total Clear Field of View</td>
</tr>
<tr>
<td>TOA</td>
<td>Top of Atmosphere</td>
</tr>
<tr>
<td>TRUE</td>
<td>Tangent height Retrieval by UV-B Exploitation</td>
</tr>
<tr>
<td>VCD</td>
<td>Vertical Column Density</td>
</tr>
<tr>
<td>WLS</td>
<td>White Light Source</td>
</tr>
<tr>
<td>WUR</td>
<td>Wageningen University and Research</td>
</tr>
<tr>
<td>YSM</td>
<td>Yaw Steering Mode</td>
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</table>
2 SUMMARY

- **SCIAMACHY configuration change for off-line Level 1b processing**

  On 04 October 2011, a configuration change was applied to the operational processing of SCIAMACHY off-line Level 1b data. The Processing Stage Flag for the SCIAMACHY Level 1b off-line products was changed to the new value "W" replacing flag "U". The filename of SCIAMACHY Level 1b off-line products was accordingly changed from "SCI_NL__1PU\*" to "SCI_NL__1PW\*". No processor upgrade or product format change was applied as the processor IPF remained as before at version 7.04, in operation since 17 June 2010. The configuration change was necessary in order to identify unambiguously the new Level 1b data adopting improved auxiliary data information. Please consult the SCIAMACHY Product Quality Readme file before using the data.

  The new configuration will be adopted for the Level 1b full-mission reprocessing campaign which will improve the quality of the existing data set for the complete mission.

- **SCIAMACHY upgrade of the Level 2 fast-delivery and off-line processor**

  On 04 October 2011, the new SCIAMACHY Level 2 processor version 5.02 was successfully activated both for the Level 2 fast-delivery and consolidated off-line forward processing chains replacing processor version 5.01. The new Level 2 processor version 5.02 corrects deficiencies identified during the validation campaign of SCIAMACHY Level 2 version 5.01 products. In particular, it optimizes the retrieval settings for several trace gases and implements algorithmic optimizations leading to a significant overall quality improvement. The new off-line Level 2 products are generated with a modified processing stage flag "W", while for the fast-delivery processing the current flag "N" is maintained. Please consult the SCIAMACHY Product Quality Readme file before using the data.

  This new configuration will be adopted for the Level 2 reprocessing of the full mission data set.

- During September 2011, ENVISAT completed its 50 000th circuit of Earth – travelling 2.25 billion km since its launch on 28 February 2002. This unique milestone was announced with a message on the ESA EO web portal available [here](#).
• For the reporting period (orbits 49701 - 50576) SCIAMACHY measurements were nominal with respect to planning.

• During the reporting period, regular monthly calibration was scheduled between orbits
  
  ➢ 49854-49858 (11-Sep-2011)
  ➢ 50285-50289 (11-Oct-2011)

• During the reporting period, occultation measurements with the moon rising on the night side were executed between orbits
  
  ➢ 49848-49879 (11-Sep-2011 until 13-Sep-2011)

• During the reporting period, no OCR was implemented.

• No TC adjustments were required.

• SCIAMACHY instrument performances and products’ quality are checked on a daily basis, monitoring the operational data processing chains. Results are presented by means of Daily Reports published on-line.

The Level 0 NRT daily reports can be accessed at the following address:
http://earth.eo.esa.int/pcs/envisat/sciamachy/reports/daily/Level_0/

The NRT and OFL Level 1b daily reports can be accessed at:
http://earth.eo.esa.int/pcs/envisat/sciamachy/reports/daily/Level_1/

The Fast-Delivery and OFL Level 2 daily reports can be accessed at:
http://earth.eo.esa.int/pcs/envisat/sciamachy/reports/daily/Level_2/
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 49701 (ANX = 01-Sep-2011, 01:30:42.280) to 50576 (ANX = 31-Oct-2011, 23:14:15.680). Two OSDFs specified the planning baseline. Since the planning was cycle oriented, both OSDFs cover a much wider period.

<table>
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<th>Start</th>
<th>Stop</th>
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<tbody>
<tr>
<td>49355</td>
<td>69101</td>
<td>01-Aug-2011 01:30:42.280</td>
</tr>
<tr>
<td>50122</td>
<td>61007</td>
<td>01-Oct-2011 23:14:15.680</td>
</tr>
</tbody>
</table>

Table 3.1: SCIAMACHY OSDF planning file from July/August – October/November 2011, including the reporting period.

Measurements were nominal, i.e. timelines executed limb/nadir sequences with wide swath settings on the dayside of the orbit. Each month they were interleaved with 2 blocks of 14-15 orbits each where the limb state was replaced by the limb_mesosphere_thermosphere state (see below). In-flight calibration and monitoring measurements occurred on daily, weekly and monthly timescales. Regular monthly calibration was scheduled between orbits

- 49854-49858 (11-Sep-2011)
- 50285-50289 (11-Oct-2011)

The moon was in the limb TCFOV between orbits

- 49786-49882 (06-Sep-2011 until 13-Sep-2011)

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

- 49848-49879 (11-Sep-2011 until 13-Sep-2011)

Five blocks of limb_mesosphere_thermosphere measurements were scheduled.
Table 3.2: Scheduled `limb_mesosphere_thermosphere` measurements in September – October 2011.

- No OCR was implemented.

### 3.1.2 Instrument Measurement Status (SOST-DLR)

The final flight status as from 10-Jan-2011 remained unchanged.

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

**Measurements and instrument availability**

The OSDF planning file has been scheduled as requested except for two periods:

- Orbit 49800-49820 (08/09-Sep-2011): SCIAMACHY was transferred to HTR/RF triggered by a Single Event Upset (SEU).
- Orbit 50003-50021 (22/23-Sep-2011): SCIAMACHY was again transferred to HTR/RF triggered by a Single Event Upset (SEU).
Figure 3.1: Current instrument availability status including the reporting period.

*Detector thermal adjustment (TC)*

No TC adjustment was required. The TC settings remained at

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

*APSM/NDFM health checks & PMD ADC cal*

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

<table>
<thead>
<tr>
<th>APSM/NDFM</th>
<th>PMD ADC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orbit</td>
<td>ANX</td>
</tr>
<tr>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>50508</td>
<td>27-OCT-2011 07:09:35</td>
</tr>
</tbody>
</table>

Table 3.3: APSM/NDFM health check and PMD ADC calibration.
Anomalies

Two major and one minor instrument anomalies had occurred:

- Orbit 49800-49820 (08/09-Sep-2011): A transfer to HTR/RF, triggered by a sequence of SDPU anomalies (SDPU2 ProAliveStatus) and a final PMTC error, was likely caused by a Single Event Upset (SEU). The failure occurred when ENVISAT was right in the South Atlantic Anomaly (SAA). In total measurement data for 20 orbits could not be generated as planned.

- Orbit 50003-50021 (22/23-Sep-2011): SCIAMACHY was again transferred to HTR/RF mode, now triggered by a SDPU_Tx buffer overflow, a known failure. A SEU is considered to be the cause of the anomaly. Recovery had started immediately and only 18 orbits were missed.

- Orbit 50319-50321 (14-Oct-2011): Due to an in-plane orbit control manoeuvre on 14-Oct-2011 the platform was operated in fine pointing mode. This caused a loss-of-object message when Sun acquisition with the Sun Follower was scheduled in state 49. Measurements continued as planned.

<table>
<thead>
<tr>
<th>Orbit</th>
<th>Date</th>
<th>Entry UTC</th>
<th>Level</th>
<th>Entry Type</th>
<th>ID Content/Transition</th>
<th>Mode</th>
<th>Remark</th>
</tr>
</thead>
</table>
| 49800 | 08/09-Sep-2011 | 01:42:07 | Instrument | HE PARAMETER LIMIT EXCEEDING | 04 (0000) | MEAS-01 | HTR/RF mode (ME)
| 49800 | 08/09-Sep-2011 | 02:42:07 | Instrument | AUTOMATION SWITCHING | 04 (0000) | MEAS-01 | HTR/RF mode (ME)
| 49900 | 22/23-Sep-2011 | 21:03:00 | Instrument | AUTOMATION SWITCHING | 15 (0000) | MEAS-01 | HTR/RF mode (ME)
| 50003 | 14-Oct-2011 | 02:30:00 | Instrument | HE PARAMETER LIMIT EXCEEDING | 06 (0000) | MEASUREMENT | State 49 - loss of object (OF) 3 sec OD.
| 50219 | 14-Oct-2011 | 02:53:00 | Instrument | HE PARAMETER LIMIT EXCEEDING | 06 (0000) | MEASUREMENT | State 49 - loss of object (OF) 3 sec OD.
| 50319 | 14-Oct-2011 | 03:48:00 | Instrument | HE PARAMETER LIMIT EXCEEDING | 06 (0000) | MEASUREMENT | State 49 - loss of object (OF) 3 sec OD.

Table 3.4: Instrument and platform anomalies from September – October 2011.

Data Quality

The periods with reduced data quality are caused by the anomalies which transferred SCIAMACHY to a mode lower than MEASUREMENT (ATC/TC) and the degraded platform attitude mode during the orbit control manoeuvre (line-of-sight).

<table>
<thead>
<tr>
<th>Orbit</th>
<th>UTC</th>
<th>Event</th>
<th>Affected System</th>
</tr>
</thead>
<tbody>
<tr>
<td>49800</td>
<td>09-SEP-2011 00:42:07</td>
<td>recovery from HTR/RF</td>
<td>ATC/TC</td>
</tr>
<tr>
<td>50021</td>
<td>23-SEP-2011 10:03:34</td>
<td>recovery from HTR/RF</td>
<td>ATC/TC</td>
</tr>
<tr>
<td>50319</td>
<td>14-OCT-2011 02:53:00</td>
<td>platform in YSM/FPF</td>
<td>Line-of-Sight (LoS) possible</td>
</tr>
</tbody>
</table>

Table 3.5: Periods with degraded data quality from September – October 2011.
3.1.4 Performance Monitoring - System (SOST-DLR)

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

Detector temperatures

For each detector the average temperatures per orbit are determined from HK telemetry parameters. Figure 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 temperatures of channels 1-3 and 6-8 were in limits over the entire reporting period. Channels 4 and 5 exceeded their upper limits. This behaviour has been discussed with calibration and retrieval experts and is currently considered uncritical.

OBM temperatures

The average OBM temperature per orbit is determined from specific HK telemetry parameters. In addition power readings for the ATC heaters are monitored. Temperatures and ATC heater powers are given in Figures 3.3 and 3.4. Colour coding is as in Figure 3.2.

OBM temperatures and ATC heater powers remained within limits during nominal operations.

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.
Figure 3.2: Detector temperatures.
Figure 3.3: OBM temperatures (top: derived OBM, middle: limb sensor, bottom: nadir sensor).

Figure 3.4: ATC heater power (top: ATC limb, middle: ATC nadir, bottom: ATC Rad A).
**LLI status**

Life Limited Items are monitored based on analysis of the

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

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

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

- NDFM: 0.65
- APSM: 0.60
- NCWM (sub-solar port): 0.94
- WLS (switches): 0.19
- WLS (burning time): 0.35
- SLS (switches): 0.09
- SLS (burning time): 0.02

For the NDFM and APSM the safety margin factor of 2 is no longer applied in the calculation of the fractional usage since it had been found acceptable to stay below the figures of the life-tests. How the relative LLI usage has accumulated since launch is illustrated in Figure 3.5. ‘EOL’ assumes a total mission lifetime until end of 2013.

![LLI usage graph](image)

**Figure 3.5:** Relative usage of LLIs. ‘EOL’ is derived for a mission lifetime until 2013. For the NDFM and APSM no margin factors have been applied to derive the EOL relative usage.
Note that the NCWM usage exceeding 100% by the end of 2013 has been discussed with the SSAG and SQWG and is currently considered uncritical. Operations of the subsolar port, i.e. execution rates of subsolar states, remain unchanged.

The number of cryogenic heatpipe cycles did not increase (no decontamination). The budget used remained at 40% 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 with respect to the reference orbit, then the difference predicted – reference time is > 0 sec; in the other case it is < 0 sec.

Figure 3.6 displays the time difference predicted – reference. Orbit manoeuvres cause distinct discontinuities.

![Figure 3.6: Time difference between predicted and reference time.](image-url)
3.1.5 Performance Monitoring - Light Path (SOST-IFE)

This section summarises the performance monitoring results for the two months time interval covered by this report.
A more detailed description of the performance monitoring activities is given in the SCIAMACHY Bi-Monthly Report May-June 2008.

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 sub solar 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 Figure 3.7 show results of these monitoring activities for the time interval September to October 2011.

Note that the reported channel averages are medians. The currently used scan angle correction is based on Version 6 radiometric key data.

The light path monitoring results presented in this section may be regarded as a first step towards spectrally resolved monitoring factors (m-factors) which is produced based on fully calibrated data.

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

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

- The instrument behaved as expected except that the throughput in the UV-Vis for all light paths involving the ESM mirror is now rapidly increasing. A similar effect was already observed in spring/summer 2011, but the increase of throughput is now even faster.
- Data gaps on 8/9 and 22/23 September result from instrument anomalies. Furthermore, some data are missing around 26 October due to temporary problems with the DDS receiver at IUP.
- The downward peaks in the limb data on 14 October are related to pointing issues caused by an orbit control manoeuvre.
- The minimum average throughput in channel 1 increased from about 31% to around 40% (for the limb light path) during the two months of this reporting period. The minimum channel 2 throughput also increased from about 58% to 63%.
- The throughput of the calibration light path is still stable for channels 1 to 5 and currently at about 78% in channels 1 and 2 and around 97-98% for channels 3 to 5.
- The overall degradation of channel 3 is still very small (3 – 7%, depending on light path) compared to channels 1 and 2, but also shows an increase of about 1-2% during the two months for the limb and nadir light paths.
- Even channel 4 shows a small increase of throughput of about 0.5% in two months.
- Channel 5 remains stable on a sub-percent level.
- In channels 6 to 8 a slight decrease of throughput of about 0.5% per month or less is observed.
- The throughput of channel 8 is currently at about 68%.
Figure 3.7: Light path monitoring results September to October 2011 (medians).
3.1.5.2 Spectral light path monitoring results

Starting from the Bi-Monthly report January-February 2010, spectral light path monitoring results have been replaced by corresponding m-factor results (based on fully calibrated Level 1 data) shown in Section 4. Nevertheless, the Level 0 based spectral monitoring data are still available via the SOST-IFE web site (see http://www.iup.unibremen.de/sciamachy/LTM/LTM_spectral/LTM_spectral.html).

3.1.5.3 PMD monitoring results

The SCIAMACHY PMDs are monitored in a similar way as the science channels, but of course no channel averaging is performed. However, the results presented here are based on the same measurements as the science channel results (but using the PMD low gain signal), and they have been normalized to the same reference times as the spectral results. Figure 3.8 shows the PMD throughput variation for the whole time period between 2 August 2002 and end of October 2011. Note that a constant dark signal for each of the PMDs has been assumed. To verify this assumption, Figure 3.8 also shows the variation of the PMD dark signal over time, which is usually quite low.

Considering the broadband character of the PMDs, the observed PMD throughput changes are (except for PMD 4 and 7) very similar to those of the science channels. The rapid increase of throughput for the limb and nadir light paths is also visible in the UV-Vis PMDs.
Figure 3.8: PMD monitoring results August 2002 to October 2011.
4 DEGRADATION MONITORING AND CORRECTION

Since Level 2 product version 5.01, a correction for the radiometric degradation of SCIAMACHY is included in the operational processing. This degradation correction is performed by so-called m-factors. An m-factor is defined as the ratio between a measured spectrum of a constant light source (typically the sun) at a certain time to a spectrum obtained for the same optical path at a reference time. M-factors therefore provide an end-to-end degradation correction for each individual light path.

In general, m–factors have an impact on the polarization correction and on the absolute radiometric calibration. The m–factors for the science detectors are multiplicative factors to the absolute radiometric calibration of SCIAMACHY. The m–factors for the PMDs influence in a non-linear way the polarization correction of SCIAMACHY. Currently, only the science channel m-factors are used in operational data processing. M-factors are regularly calculated by SOST-IFE and provided to ESA.

More details on m-factors and also the m-factors themselves can be found on the IUP Bremen web site under http://www.iup.uni-bremen.de/sciamachy/mfactors.

Figures 4.1 to 4.3 show plots of the science channel degradation (=1/m-factor) observed for each of the SCIAMACHY light paths (nadir, limb, calibration). The current plots cover the time range 2 August 2002 (reference time) to end of October 2011. For each science channel, the plots consist of three main areas: The central part is the contour plot of the degradation. On top of it is the median of the degradation over the detector pixels plotted, showing the overall behaviour of the channel. Right of the main area, the degradation of the last plotted day is shown. The grey bars in the plot are times of instrument unavailabilities (no data at all or the instrument was not in nominal state).

The current status of the degradation can be summarised as follows:

- The increase of the throughput observed in the level 0 based monitoring data is also visible in the m-factor medians and now also in the contour plots.
- The throughput is below 40% below about 275 nm for the limb light path in channel 1. In the nadir light path the throughput is lower than 40% below about 250 nm.
- The minimum throughput around 350 nm in channel 2 is currently about 50%.
- The minimum throughput in channel 3 is currently about 80% (not considering the overlaps).
- The throughput of channels 4 and 5 is rather stable over the whole spectral range (except for the overlaps).
- Channel 6 shows a small throughput decrease at the lower wavelength edge, which is an indication for ice growth.
- The throughput of channels 7 and 8 remains rather stable (except for dead/bad pixels).
Figure 4.1: Degradation derived from m-factors August 2002 to October 2011 (nadir light path).
Figure 4.2: Degradation derived from m-factors August 2002 to October 2011 (limb light path).
Figure 4.3: Degradation derived from m-factors August 2002 to October 2011 (calibr. light path).
## 5 DATA AVAILABILITY STATISTICS

### 5.1 Downlink/Acquisition Performance

For the reporting period, problems are known for the Level 0 products listed in Table 5.1.

<table>
<thead>
<tr>
<th>Day</th>
<th>Filename</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-09-2011</td>
<td>SCI_NL__0PNPDK20110920_073819_00000003106_00394_49977_5729.N1</td>
<td>ERROR: incorrect file size</td>
</tr>
<tr>
<td></td>
<td>SCI_NL__0PNPDK20110920_073819_00000003106_00394_49977_5730.N1</td>
<td></td>
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<tr>
<td></td>
<td>SCI_NL__0PNPDK20110920_073819_00000003106_00394_49977_5731.N1</td>
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<tr>
<td></td>
<td>SCI_NL__0PNPDK20110920_073819_00000003106_00394_49977_5732.N1</td>
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<td></td>
<td>SCI_NL__0PNPDK20110920_130516_000021773106_00397_49980_5766.N1</td>
<td>ERROR: trying to read beyond the end of the file</td>
</tr>
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<td>26-09-2011</td>
<td>SCI_NL__0PNPDE20110926_205645_00006533107_00057_50071_7217.N1</td>
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<td>SCI_NL__0PNPDK20111013_093933_000059063107_00295_50309_6119.N1</td>
<td>ERROR: trying to read beyond the end of the file</td>
</tr>
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<td>SCI_NL__0PNPDK20111013_093933_000059063107_00295_50309_7840.N1</td>
<td></td>
</tr>
<tr>
<td></td>
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<td>SCI_NL__0PNPDK20111013_094447_00000003107_00295_50309_6078.N1</td>
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<tr>
<td></td>
<td>SCI_NL__0PNPDK20111013_094447_00000003107_00295_50309_6079.N1</td>
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<td>SCI_NL__0PNPDK20111013_125759_00000003107_00297_50311_6093.N1</td>
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<td></td>
<td>SCI_NL__0PNPDK20111013_130002_00000003107_00297_50311_6096.N1</td>
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</tr>
<tr>
<td>13-10-2011</td>
<td>SCI_NL__0PNPDK20111013_130204_00000003107_00297_50311_6098.N1</td>
<td></td>
</tr>
<tr>
<td>18-10-2011</td>
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<td>ERROR: trying to read beyond the end of the file</td>
</tr>
<tr>
<td>19-10-2011</td>
<td>SCI_NL__0PNPDE201111019_204819_0000041643107_00388_50402_7360.N1</td>
<td>ERROR: trying to read beyond the end of the file</td>
</tr>
<tr>
<td>20-10-2011</td>
<td>SCI_NL__0PNPDK201111020_183504_00000013107_00401_50415_6176.N1</td>
<td>ERROR: incorrect file size</td>
</tr>
</tbody>
</table>

Table 5.1: Level 0 products containing format errors or duplicated.
5.2 Statistics on unconsolidated data (SCI_NL__0P, SCI_NL__1P)

This paragraph reports the availability of NRT data on a monthly basis.

The statistics in Figure 5.1 are based on Level 0 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. Statistics of Level 1 NRT data production are calculated with respect to Level 0 product availability.

For the reporting period, the retrieval from the MMFI tool of the generated NRT data products has experienced some problems and several products result missing even if correctly generated and disseminated. The issue has been notified and will be fixed if possible.

![Monthly statistics on SCIAMACHY NRT data](image)

Figure 5.1: Statistics on available unconsolidated Level 0 and Level 1b products.

5.3 Statistics on consolidated data

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

5.3.1 Anomalies on Level 0 consolidated data products

In the past it had been reported by SOST-DLR that the SCIAMACHY consolidated Level 0 data contain errors and are not complete. The following specific problems have been identified and are reported in detail in the technical notes [3], [4], [5], [6]:
• For one orbit there can be more than one consolidated Level 0 product. These products may be identical or different in content (disregarding the product type file counter).

• Some orbits are not covered by consolidated Level 0 products although SCIAMACHY was operational.

• Some orbits are covered by consolidated Level 0 products but the product duration does not comply with the actually planned and executed instrument operations in that particular orbit.

• Some consolidated Level 0 products exceed the Reed Solomon correction threshold and are flagged accordingly. The occurrence of Reed Solomon errors is non-uniform.

More details on consolidated Level 0 anomalies can be found on the SOST web page, which contains a catalogue of available Level 0 consolidated data and description of errors (http://atmos.caf.dlr.de/projects/scops/data_availability/availability.html).

The consolidation activity, reprocessing erroneous Level 0 data, has been completed up to year 2009. The overall goal is to achieve a Level 0 consolidated data ‘master set’ that allows data reprocessing of improved data quality.

5.3.2 Availability of consolidated SCI_NL__1P products

SCIAMACHY Level 1b consolidated data are generated at D-PAC using the consolidated Level 0 products as input for processing. The available Level 1b off-line products on the D-PAC ftp-server are regularly checked for completeness and an overview for the months of September and October 2011 is summarised here, considering flight segment and ground segment anomalies. Note that also interfile gaps are considered, but no data gaps inside the products.

Please, note that the SCIAMACHY historic Level 1b data set from August 2002 to January 2010, processed with the previous processor version 6 and processing flag "R" (SCI_NL__1PR), initially migrated to a dedicated user account at D-PAC (scia1old on eoa-dp.eo.esa.int), was put off-line on November 2010.

Please consider that the operational SCIAMACHY Level 1b off-line data production switched to a new configuration on 04 October 2011. See details here.

Starting from orbit 50000 (sensed on 21 September 2011) the SCIAMACHY Level 1b consolidated data are generated with IPF version 7.04 and an upgraded processing stage flag "W" (replacing the previous flag “U”), also adopting improved auxiliary files to fix incorrect calibration information which were enclosed in the previous Level 1b data set (version 7.03-U). For the resulting overall improvement in the data quality, users are recommended to use the SCIAMACHY Level 1b products version 7.04-W.
These new consolidated Level 1b data (SCI_NL__1PW) are nominally accessible from the D-PAC FTP server (ftp-ops-dp eo.esa.int, scia1usr account). The scia1usr account also hosts products generated with prior IPF versions and processing stage flag “U” from the past reprocessing campaign and from the operational forward processing (from 22 January 2010 - orbit 41287 to 21 September 2011 - orbit 49999).

Please consider that the SCIAMACHY Level 1b data set stored at D-PAC will be soon reorganized upgrading the current archiving system to a new infrastructure.

The up-to-date version of the Level 1b Product Quality Readme file (formerly known as Disclaimer) SCI_NL__1P Readme is available.

Access to the operational Level 1b off-line data products remains unchanged at the D-PAC archiving centre.

<table>
<thead>
<tr>
<th>Month/Year</th>
<th>Planned orbit range</th>
<th>Number of products unavailable due to anomalies</th>
<th>Number of unique products available at D-PAC</th>
<th>Expected number of products (considering anomalies)</th>
<th>Availability in percentage during month</th>
</tr>
</thead>
<tbody>
<tr>
<td>September 2011</td>
<td>49701-50131</td>
<td>36</td>
<td>385</td>
<td>395</td>
<td>87.40%</td>
</tr>
<tr>
<td>October 2011</td>
<td>50132-50576</td>
<td>0</td>
<td>443</td>
<td>445</td>
<td>99.09%</td>
</tr>
</tbody>
</table>

Table 5.2: Statistics on consolidated Level 1b products.

5.3.3 Availability of consolidated SCI_OL__2P products

SCIAMACHY Level 2 consolidated data are generated at D-PAC using the consolidated Level 1b products as input for processing. The available Level 2 off-line products on the D-PAC ftp-server are regularly checked for completeness and an overview for the months of September and October 2011 is reported in Figure 5.2 and Figure 5.3; for the reporting months, 382 and 439 Level 2 products are available respectively.

Orbits missing in the plots indicate

- Instrument unavailability (highlighted in red).
- Level 2 products not generated at D-PAC as a consequence of processing failures or missing inputs (either consolidated Level 0 or Level 1b files). Recovery of the missing products will be performed when possible.
- Orbits sensed during monthly calibrations for which Nadir or Limb measurements were not planned. For the reporting months orbits 49855, 49856 (11/09) and 50286, 50287 (11/10) were not processed up to Level 2 products.
Figure 5.2: SCIAMACHY Level 2 off-line data production at D-PAC for September 2011.

Figure 5.3: SCIAMACHY Level 2 off-line data production at D-PAC for October 2011.
5.4 Statistics on reprocessed data

5.4.1 Level 1b re-processing

During 2010, the complete SCIAMACHY Level 1b data set was reprocessed with IPF version 7.03 - processing flag “U” - and provided to the user community. In May 2011, significant shortcomings in the Level 1b data were identified: not up-to-date auxiliary information was integrated into SCIAMACHY Level 1b GADS. In order to provide correct calibrations and assure the best possible data for the subsequent Level 2 reprocessing, a new reprocessing campaign has started, using the latest IPF version 7.04 and an improved set of auxiliary files. All the resulting Level 1b consolidated will present the upgraded processing stage flag "W".

The Level 1b reprocessing activity will cover orbits from 02 August 2002 (orbit 2204) to the activation of the new configuration for the off-line forward processing on 21 September 2011 (orbit 49999).

5.4.2 Level 2 re-processing

The new full-mission reprocessing campaign of SCIAMACHY consolidated Level 2 data with new processor SGP version 5.02 will soon commence at D-PAC. The previous reprocessing campaign with SGP 5.01 performed on 2010 was discontinued on the basis of results from the validation activities that highlighted the nadir products of SO2, OClO, and CO being of insufficient quality.

The end of the reprocessing campaign is expected in spring 2012; data will be made available after thorough quality control.
6 LEVEL 1 PRODUCT QUALITY MONITORING

6.1 Processor Configuration

6.1.1 Version

The IPF currently in use at Kiruna and ESRIN PDHS for the operational processing of near-real-time SCIAMACHY Level 1b data is version 7.04 since 15 June 2010. The same IPF is adopted at D-PAC for the forward processing of Level 1b off-line data and was activated since acquisition data from 17 June 2010, orbit 43375.

The SCIAMACHY processor IPF 7.04 was developed in order to meet the requirements for the ENVISAT 2010+ mission extension project aimed to extend the ENVISAT mission beyond its nominal lifetime of five years. Since 22 October 2010, the ENVISAT satellite has been placed in a new orbit, 17.4 km lower than the original one. With the modified scenario, a new mission phase has started with operations planned up to end of 2013. Products generated from 02 November 2010 onwards for the ENVISAT mission extension orbit scenario report in the mission phase MPH ASCII field flag 3 instead of previous flag 2. More details can be found on the ESA news available at

http://earth.esa.int/object/index.cfm?fobjectid=6999
http://earth.esa.int/object/index.cfm?fobjectid=7024
http://earth.esa.int/object/index.cfm?fobjectid=7223

The SCIAMACHY processor was changed to be compliant with the new orbit scenario. No evolution aspects in the algorithm for the Level 0 to 1b data processing were included into IPF 7.04 - compared to its predecessors of version 7.03, but the CFI software library implemented (i.e. CFI 5.6) was replaced with new CFI routines version 5.8.1 (Linux 32 bit) capable to handle measurements for both the old and the new satellite’s orbit. As established during validation, CFI 5.8.1 has no influence on data processing performance, and no impact on the generated SCIAMACHY Level 1b products was detected.

IPF 7.04 has been adopted for the operational processing of SCIAMACHY near-real-time and off-line Level 1b data since June 2010. No format change has been introduced in the Level 1b product version 7.04.

On 04 October 2011, a configuration change was successfully implemented for the off-line Level 1b operational processing at D-PAC. Starting from orbit 50000 (21 September 2011), SCIAMACHY off-line Level 1b products adopt the new Processing Stage Flag "W" replacing flag "U". The filename of SCIAMACHY Level 1b off-line products was changed from "SCI_NL__1PU*" to "SCI_NL__1PW*". The corresponding MPH fields for product's name and processing stage flag were updated as well.
The processing stage flag was upgraded to “W” to identify unambiguously the SCIAMACHY Level 1b data set for the complete mission obtained from the reprocessing campaign with IPF 7.04.

The corresponding **Product Specification** is Volume 15 issue 3L version 1.1 [2]. This document is available at http://earth.eo.esa.int/pub/ESA_DOC/ENVISAT/Vol15_Sciamachy_3L_1.1.pdf

A **Readme file** describing data quality and known instrument and processing issues as well as major improvements with respect to previous IPF versions is regularly maintained by the SCIAMACHY Quality Working Group and provided to the users. The document - updated corresponding to the IPF version 7.04 - applies to the SCIAMACHY Level 1b Near-Real-Time and Off-Line products (SCI_NL__1P) and is available at http://envisat.esa.int/handbooks/availability/disclaimers/SCI_NL__1P_README.pdf

Table 6.1 gives a brief overview of changes implemented in the SCIAMACHY Level 0 to Level 1b processing baseline compared to prior processor versions.

Starting from the operational Level 1b data version 7.03, a new type of limb state is available; Mesospheric Limb Measurements (state ID 55) are performed scanning altitudes between 60 and 150 km. The measurements are performed instead of "normal" limb states for 30 orbits every month split on two separate days. The operational Level 2 processor does not process these scientific Mesospheric Limb Measurements.

The radiometric degradation of SCIAMACHY can be compensated using m-factors, calculated from the new NRT Level 1b data. M-factors are not part of the Level 1b product and are not used at present in the Level 0-1b processing itself. They are applied in the Level 2 data processing only. The m–factors are provided by an external database accessible at http://www.iup.uni-bremen.de/sciamachy/mfactors/.
### Table 6.1: Processor version and main changes.

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<thead>
<tr>
<th>IPF Version</th>
<th>Description</th>
<th>Proc Centre</th>
<th>Date</th>
<th>Start Orbit</th>
</tr>
</thead>
<tbody>
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<td>7.04</td>
<td>In view of the ENVISAT 2010+ mission extension requiring the lowering of the satellite’s orbit, the new IPF 7.04 was developed without introducing changes in the algorithm but updating the CFI library to version 5.8.1.</td>
<td>D-PAC</td>
<td>17-JUN-2010</td>
<td>43375</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PDHS-E</td>
<td>15-JUN-2010</td>
<td>43355</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PDHS-K</td>
<td>15-JUN-2010</td>
<td>43347</td>
</tr>
<tr>
<td>7.03</td>
<td>Following changes are implemented with IPF 7.03:</td>
<td>D-PAC</td>
<td>22-JAN-2010</td>
<td>41287</td>
</tr>
<tr>
<td></td>
<td>- Degradation correction using m-factors implemented in SciaL1c.</td>
<td>PDHS-E</td>
<td>04-FEB-2010</td>
<td>41479</td>
</tr>
<tr>
<td></td>
<td>- Improved spectral stray light correction using a matrix approach in channel 2.</td>
<td>PDHS-K</td>
<td>04-FEB-2010</td>
<td>41472</td>
</tr>
<tr>
<td>6.05</td>
<td>No evolution in the algorithm has been introduced with IPF 6.05 but the processor was ported from AIX to LINUX operating system.</td>
<td>D-PAC</td>
<td>05-OCT-2009</td>
<td>39634</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PDHS-E</td>
<td>29-SEP-2009</td>
<td>39633</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PDHS-K</td>
<td>29-SEP-2009</td>
<td>39639</td>
</tr>
<tr>
<td>6.03</td>
<td>The following changes are implemented with IPF 6.03</td>
<td>D-PAC</td>
<td>04-JUL-2007</td>
<td>27937</td>
</tr>
<tr>
<td></td>
<td>- New pointing correction (new SCI_L1I_AX)</td>
<td>PDHS-E</td>
<td>19-JUL-2007</td>
<td>28153</td>
</tr>
<tr>
<td></td>
<td>- Updated of the ESA CFI (5.6) software</td>
<td>PDHS-K</td>
<td>19-JUL-2007</td>
<td>28145</td>
</tr>
<tr>
<td></td>
<td>- Correction of a non-compliancy report, impacting the Leakage GADS in the consolidated data processing chain (channels 6-8)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6.1.2 Anomalies

No anomalies detected for the reporting period.

During the off-line processing of SCIAMACHY Level 1b products, duplicated files might be generated in the D-PAC processing environment. Duplicates are regularly identified in the D-PAC data archive and removed. Users are systematically notified for duplicates via the SCIAMACHY anomaly web-page at http://earth.eo.esa.int/pcs/envisat/sciamachy/reports/anomalies/

6.2 Auxiliary Data Files

For operation of the SCIAMACHY Level 1 processor, a set of auxiliary files as input is required. One subset of these auxiliary files usually changes only in correspondence with a new IPF version, namely the Initialisation file (SCI_LI1 AX) and the Key Data file (SCI_KD1 AX).

Table 6.2 lists the actual Key Data File and Initialisation File used with IPF 7.03.

<table>
<thead>
<tr>
<th>Table 6.2: Key Data and Initialisation configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCI_KD1 AXNIEC20091126_123849_20020701_000000_20991231_235959</td>
</tr>
<tr>
<td>SCI_LI1 AXNIEC20091126_125714_20020701_000000_20991231_235959</td>
</tr>
</tbody>
</table>

Another subset of auxiliary files is the in-flight calibration data files, which are generated when calibration measurements are included in the set of Level 0 data to be processed.

Four types of in-flight calibration auxiliary files exist:
- Leakage Current Calibration (SCI_LK1 AX - updated on orbital basis)
- Solar Reference Spectrum (SCI_SU1 AX - updated on daily basis)
- Spectral Calibration Parameters (SCI_SP1 AX - updated on a weekly basis)
- Pixel-to-Pixel Gain and Etalon Parameters (SCI_PE1 AX - updated on orbital basis).

Figure 6.1 shows statistics of the SU1, LK1, PE1 and SP1 auxiliary data files (ADFs) generated operationally with SciCal 2.2 for September and October 2011. Statistics are based on the SciCal ADFs production/distribution to PDGS and are calculated with respect to the number of auxiliary files expected. It has to be noted that unavailability periods are excluded from statistics as well as duplicated products identified on the basis of the start/stop validity time in the filename.

LK1 statistics are calculated dividing the number of LK1 auxiliary files (generated on orbital basis) by the number of available (to SciCal) Level 0 products. These statistics do not exclude dark measurements that cannot be used for ADF generation due to SAA and orbit phase constraints leading to an over-estimation of missing files. SU1, SP1 and PE1
statistics are calculated with respect to the number of ADFs expected for the reporting months.

Figure 6.1: Statistics on SU1, LK1, PE1 and SP1 productions.

6.2.1 Auxiliary Data File quality analysis

6.2.1.1 SMR analysis

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

- fully calibrated
- not radiometrically calibrated.

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

Note the following recommendation:

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

From Figure 6.2 to Figure 6.5, plots show the ratios of SMR spectra derived from calibrated SMR/ESM (D0) during the months September - October 2011. The ratios were determined by dividing the spectra of a set of days during each month to a spectrum at the beginning of each month. Ratios are not corrected for variation of distance Earth/Sun.
In detail the spectra used for the ratios of each month are the following:

- **September 2011**
  Reference SMR - 01 September 2011
  SMR used for ratios: 02, 03, 04, 05, 06, 07, 09, 10, 11, 14, 21, 30 September 2011.

- **October 2011**
  Reference SMR - 01 October 2011
  SMR used for ratios: 02, 03, 04, 05, 06, 07, 08, 09, 10, 14, 21, 31 October 2011.

The overall changes lie usually at about 1-2% during one month for all channels, which is at least partially caused by the decreasing distance between Sun and Earth. In channel 1, around pixel 550 (at 282 nm), some strong features can be noticed, as well as in channel 2 near pixel 840 (near 393 nm). These strong features coincide with the Mg II and Ca Fraunhofer lines respectively. These lines are partially formed in the solar Chromosphere and are known to change with solar variability.

The weaker spectral features in channel 2 (e.g. near pixels 550, 650, 750), on the other hand, correlate with strong Fraunhofer lines, which are not chromospheric. These features probably arise from small wavelength shifts (order of 1/100 of a pixel). Generally a spectral feature could have significant impact on the product quality, especially when the affected spectral parts are used for DOAS retrieval.

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

Figure 6.6 and Figure 6.7 show SMR ratios as long term trends; plots are obtained dividing the ESM spectra from day 30 September 2011 and 31 October 2011, respectively with spectra from 30 September 2003 and 31 October 2003. The first spectrum available exists for 18 July 2002. However to consider Sun/Earth distance, the ratio was performed with spectra from same calendar days. All SCI_SU1_AX files used were generated with SciCal version 2.2.

What can be concluded is that for channels 1 and 2 an average degradation in 6 years of about 10-15% is observed, channels 3 degrades by about 2% and channels 4-5 degrade by less than 1%, channel 6 by about 4-5%. The signal in channel 7 has increased with respect to the SMR of year 2003. This is due to the impact of the icing of the IR detectors. This is consistent with the Light Path monitoring at SOST-IFE and available at http://www.iup.uni-bremen.de/sciamachy/LTM/LTM_spectral/LTM_spectral.html.
Figure 6.2: SMR ratios per detector channels 1-4 (changes during September 2011).

Figure 6.3: SMR ratios per detector channels 5-8 (changes during September 2011).
Figure 6.4: SMR ratios per detector channels 1-4 (changes during October 2011).

Figure 6.5: SMR ratios per detector channels 5-8 (changes during October 2011).
Figure 6.6: SMR ratios per detector channel on Long Term Trend 30/09/2011 divided by 30/09/2003.

Figure 6.7: SMR ratios per detector channel on Long Term Trend 31/10/2011 divided by 30/10/2003.
6.2.1.2 LK1 analysis

6.2.1.2.1 Leakage Constant part

On an orbital basis a leakage current calibration is performed, whenever measurement data do not lie in the South Atlantic Anomaly region.

![LK1 ADF analysis, ratios of FPN const September 2011](image)

In plots from Figure 6.8 to Figure 6.11 the leakage constant part FPN (fixed pattern noise) of the LK1 ADFs is analysed by determining the ratios of the FPN of each month with a time distance of one orbit, one day, one week, two weeks, three weeks and a month.

For channels 1-5 and the first part of channel 6, during up to three weeks nearly no changes can be noticed. Sudden jumps however between the different dark current ratios can be seen for channels 1, 2, 4 and 5 between 4 weeks. They are very small but above the noise level.

The IR channels show a lot of noise.

Note that since the processor version IPF 6.03, the time dependent part of the leakage current is considered as well (see 6.2.1.2.2).
Figure 6.8: Dark current ratios (constant part) channels 1-4 during September 2011. Reference spectrum used: Orbit 49704, 01 September 2011.

Figure 6.9: Dark current ratios (constant part) channels 5-8 during September 2011. Reference spectrum used: Orbit 49704, 01 September 2011.
Figure 6.10: Dark current ratios (constant part) channels 1-4 during October 2011. Reference spectrum used: Orbit 50135, 01 October 2011.

Figure 6.11: Dark current ratios (constant part) channels 5-8 during October 2011. Reference spectrum used: Orbit 50135, 01 October 2011.
6.2.1.2.2 Leakage Variable part

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

Figure 6.12 shows the evolution of the leakage variable part of the SCI_LK1_AX ADF during the time span from 01 September 2011 to 31 October 2011. The leakage variation for pixel 222 in channel 7 corresponding to orbit phase 6 is shown.

Updates of the leakage variable values are expected after the processing of the monthly calibration orbits, usually once per month. During the reporting period, monthly calibration sequences were scheduled between orbits:

- 49854-49858 (11-Sep-2011)
- 50285-50289 (11-Oct-2011)

For these dates, the change of the Leakage Variable value can be clearly seen in Figure 6.12, demonstrating that calibrations were performed successfully.

![Figure 6.12: Leakage variable part from 01 September 2011 to 31 October 2011, for channel 7, orbit phase 6, pixel 222.](image-url)
6.3  Bad and Dead Pixel Mask

The SWIR channels 6-8 suffer from a rising number of bad pixels that are not (or only to a small degree) usable for retrieval. The reason is a lattice constant mismatch between the substrate material and the light detecting material of the detectors. The bad pixels are detected using dark, WLS and sun measurements. The number of bad pixels rises with the life time of the instrument due to proton impact. The mask is calculated on an orbital basis.

6.3.1  Operational Processor Analysis

Starting from the Level 1b IPF 7.03 baseline, SCIAMACHY bad and dead detector pixel masks are generated on an orbital basis. The PPG/Etalon correction parameters required for the SCIAMACHY Level 0 to 1b processing are calculated by SciCal and enclosed in the SCI_PE1_AX auxiliary data files. The set of parameters generated is then written into the Level 1b Pixel-to-Pixel Gain (PPG) ETALON GADS indicating the position of pixels which may not be used for further processing. In the next BMR, results for the operational Bad and Dead Pixel Mask will be presented. The mask currently provided in the Level 1b products is not identical to the mask generated at SRON. It is planned to align the two masks in future processor versions.

6.3.2  SRON Analysis

SRON performs routinely analysis on the SCIAMACHY Bad and Dead Pixel Mask identifying bad pixels of the detector arrays with the SCIAMACHY Detector Monitoring Facility (SDMF) using 11 flagging criteria. These criteria are based on the dark signal model, transmission, gain and noise of a pixel. Bad pixel masks are calculated on an orbital basis and combined into a "smoothmask" with masks from about 50 orbits. In Figure 6.13 we show the number/fraction of pixels that is flagged as bad for channels 6, 6+, 7 and 8. Note that channel 6 consists of two parts employing different detector materials. Channel 6+ starts at pixel 794. The rate at which the number of pixels that is flagged is increasing is similar for the IR channels 6+, 7 and 8. The fraction of flagged pixels in channel 6 is much lower and almost constant over the mission, because of the different detector materials used in this part of the channel.

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Figure 6.13: Number/Fraction of pixels that is flagged as bad by the SDMF smoothmask for channels 6 (blue), 6+ (red), 7 (green) and 8 (cyan).
6.3.3 Pointing Performance

No updates to present in the reporting period.

6.4 SciaL1c tool

The SciaL1c tool is an application provided to the users of SCIAMACHY Level 1b products. This application allows selecting specific calibrations to apply to Level 1b data, which are in case of SCIAMACHY defined as not fully calibrated Level 0 channel information in combination with calculated calibration data. The generated Level 1c products are suitable for the user's particular applications.

The SciaL1c Calibration and Extraction Software was upgraded to be compatible with IPF 6.03 data. It is downward compatible, i.e. it can also be used with data from older IPF versions. SciaL1c can be downloaded at: http://envisat.esa.int/scial1c/

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

The latest updated version 2.1 of the SciaL1c tool was provided to the users end of November 2008.

Please, note that an anomaly in the handling of the m-factor file during the calibration of SCIAMACHY Level 1b data was observed. The m-factor file (SCI_MF1_AX) is not correctly reported into the child product restituted from the SciaL1c processing. In particular, the MF1 ADF filename does not fully appear in the DSD descriptor. The quality of the product is not impacted; the anomaly will be fixed in the next delivery of SciaL1c.
7 LEVEL 2 NRT PRODUCT QUALITY MONITORING

7.1 Processor Configuration

7.1.1 Version

Since 08 May 2006, the near-real-time processing of SCIAMACHY Level 2 data has been suspended, evolution is restricted to the Level 2 off-line processor (see Section 8). The last IPF version used was 5.04. The corresponding product specification is [2]. The Product Quality Disclaimer at http://envisat.esa.int/dataprod/availability/disclaimers/SCI_NL__2P_Disclaimers.pdf describes known artefacts.

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

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

With the activation of the SCIAMACHY Level 2 processor Version 5.01, the Fast Delivery processing of Level 2 products has operationally started at D-PAC. Level 1b near real time products and predicted instead of consolidated Auxiliary Data Files are used as input for the Level 2 off-line processor. With this new service ESA provides to the users within 24 hours from data acquisition the full SCIAMACHY Level 2 products. Data monitoring of the SCIAMACHY Level 2 Fast Delivery processing chain is routinely performed and the corresponding Daily Reports are published on ESA’s PCS web-pages at the link: http://earth.eo.esa.int/pcs/envisat/sciamachy/reports/daily/Level_2/

The main difference between SCIAMACHY off-line and Fast Delivery products is that the Restituted Attitude file cannot be used for processing. It also adopts Level 1b NRT data, which can differ in the used calibration measurements from the consolidated data. However, the difference between off-line processor products and fast delivery products is small in most cases.
8 LEVEL 2 OFF-LINE PRODUCT QUALITY MONITORING

8.1 Processor Configuration

8.1.1 Version

The current Level 2 processor for the off-line processing chain at D-PAC is version 5.02 since 04 October 2011 in alignment with the activation of the new configuration for Level 1b IPF version 7.04 adopting processing stage flag value “W”. For the fast-delivery processing chain, Level 2 products were generated with the new processor version 5.02 starting from orbit 50174 (04 October 2011). For the off-line processing chain, the new processor version was activated from orbit 50000 (21 September 2011).

The new processor version introduces the following changes:

Nadir SO2 Vertical Column Density:
- Fix for background database;
- Max-SZA cut-off decreased from 89 to 80 deg.;
- Fix quality flag;
- Earthshine stretch implemented;
- Reference Ring spectrum improved;
- Change in eta spectrum reference.

Nadir OClO Slant Column Density:
- Correction of the polynomial degree used in DOAS fit;
- SZA cut-off changed from 95 to 92 deg.

Nadir CO Vertical Column Density:
- Introduction of a linear wavelength-dependent wavelength shift spectral correction.

The Product Specification corresponding to the Level 2 off-line processor 5.02 is Volume 15, issue 3L, version 1.1 [2] and can be found at http://earth.eo.esa.int/pub/ESA_DOC/ENVISAT/Vol15_Sciamachy_3L_1.1.pdf

The up-to-date version of the Level 2 Product Quality Readme file (formerly known as Product Quality Disclaimer) SCI OL_2P Readme is available.

Access to the operational Level 2 data products remains unchanged at the D-PAC archiving centre.
SCIOL_2P products contain geo-located vertical column amounts of trace gases retrieved from Nadir measurements, as well as stratospheric Limb profiles of O₃, NO₂ and BrO. Additionally fractional cloud coverage, cloud-top height, and cloud optical thickness are derived and provided as product to the user. The major upgrades with respect to prior processor versions are summarised in Table 8.1.

<table>
<thead>
<tr>
<th>Processor Version</th>
<th>Description</th>
<th>Proc Centre</th>
<th>Date</th>
<th>Start Orbit</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.02</td>
<td>Main processor changes:</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nadir SO2 Vertical Column Density:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Fix for background database;</td>
<td>D-PAC</td>
<td>04-OCT-2011</td>
<td>50000</td>
</tr>
<tr>
<td></td>
<td>• Max-SZA cut-off decreased from 89 to 80 deg.;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Fix quality flag;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Earthshine stretch implemented;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Reference Ring spectrum improved;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Change in eta spectrum reference.</td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Nadir OCIO Slant Column Density:</td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>• Correction of the polynomial degree used in DOAS fit;</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• SZA cut-off changed from 95 to 92 deg.</td>
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<tr>
<td></td>
<td>Nadir CO Vertical Column Density:</td>
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<tr>
<td></td>
<td>• Introduction of a linear wavelength-dependent wavelength shift spectral correction.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.01</td>
<td>Main processor changes:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>D-PAC</td>
<td>23-JAN-2010</td>
<td>41295</td>
</tr>
<tr>
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<td>Nadir MDS now contain additional trace gas columns: SO2, BrO, H2O, OCIO and CO.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Limb MDS now contain the trace gas profiles of BrO.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Limb Cloud MDS Contains height resolved indicators for cloud presence and type (water clouds, PSCs and NLCs).</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Table 8.1: Level 2 off-line Processor configuration.
8.1.2 Anomalies

No anomalies detected for the reporting period.

During the off-line processing of SCIAMACHY Level 2 products, duplicated files might be generated in the D-PAC processing environment. Duplicates are regularly identified in the D-PAC data archive and removed. Users are systematically notified for duplicates via the SCIAMACHY anomaly web-page at http://earth.eo.esa.int/pcs/envisat/sciamachy/reports/anomalies/

8.1.3 Auxiliary Data Files

Input for Level 2 off-line processing is the so-called Initialization File. For processor version 5.0 a new Initialization file became active which is

SCI_IN__AXNPDE20110201_120000_20020301_000000_20991231_235959

This ADF is usually changed only in case of a processor upgrade.

8.2 Monitoring results

8.2.1 Nadir: NO₂ consistency checking

The world map plots of Nadir NO₂ vertical column density (VCD) values averaged over one month are generated from the SCI_Ol__2P Nadir products. Figure 8.1 and Figure 8.3 show the monthly world map plots for September and October 2011.

Figure 8.2 and Figure 8.4 show errors for the VCD monthly average plots. The errors are given in absolute values (molec/cm²). Generally the equator region has NO₂ values with higher errors. An overall reduction of the error associated to NO₂ mean VCDs has been obtained with the new processor version 5.01.

High concentration of NO₂ is expected over industrial regions, such as over North America, especially the East coast, over central Europe, China and South Africa, which is reflected in the world maps.
8.2.1.1 Nadir: VCD NO₂ map September 2011

Figure 8.1: NO₂ VCD (molec/cm²) world map for 01 - 30 September 2011 – monthly average.

PLOT CURRENTLY NOT AVAILABLE FOR THE CORRUPTION OF THE DATABASE

Figure 8.2: NO₂ VCD error (molec/cm²) for 01 - 30 September 2011 - monthly average.
8.2.1.2 Nadir: VCD NO2 map October 2011

Figure 8.3: NO$_2$ VCD (molec/cm$^2$) world map for 01 – 31 October 2011 – monthly average.

Figure 8.4: NO$_2$ VCD error (molec/cm$^2$) for 01 – 31 October 2011- monthly average.
8.2.2 *Nadir: O₃ consistency checking*

Analogous to the NO₂ world maps, O₃ vertical column density (VCD) values averaged over one month are generated from the SCL OL_2P Nadir products and plotted on a world map. Figure 8.5 and Figure 8.7 show the ozone distribution converted to Dobson units for September and October 2011. The VCD error as monthly average plots is shown in Figure 8.6 and Figure 8.8 as relative fraction.
8.2.2.1 Nadir: VCD O₃ map September 2011

Figure 8.5: O₃ VCD (DU) world map for 01 - 30 September 2011 – monthly average.

Figure 8.6: O₃ VCD error for 01 - 30 September 2011 - monthly average.
8.2.2.2 Nadir: VCD O3 map October 2011

Figure 8.7: O₃ VCD (DU) world map for 01 - 31 October 2011 – monthly average.

Figure 8.8: O₃ VCD error for 01- 31 October 2011 - monthly average.
8.2.3 Nadir: $H_2O$ consistency checking

The world map plots of Nadir $H_2O$ vertical column density (VCD) values in g/cm$^2$ averaged over one month are generated from the SCI\_OL\_2P Nadir products version 5.01. Figure 8.9 and Figure 8.11 show the monthly plots for September and October 2011. Figure 8.10 and Figure 8.12 show the VCD error for the monthly average plot. Errors are absolute values (g/cm$^2$).

In the plots, data over high mountain areas (Himalayas and the Andes range) are masked out by the processor’s internal quality checks. No correction for surface elevation is performed.

Please note that these plots are preliminary results after the implementation of the new processor version and are still under review.
8.2.3.1 Nadir: VCD $H_2O$ map September 2011

Figure 8.9: $H_2O$ VCD (g/cm$^2$) world map for 01 - 30 September 2011 – monthly average.

Figure 8.10: $H_2O$ VCD (g/cm$^2$) error for 01 - 30 September 2011 - monthly average.
8.2.3.2 Nadir: \( VCD \) \( H_2\O \) map October 2011

Figure 8.11: \( H_2\O \) VCD (g/cm\(^2\)) world map for 01 – 31 October 2011 – monthly average.

Figure 8.12: \( H_2\O \) VCD (g/cm\(^2\)) error for 01 – 31 October 2011- monthly average.
8.2.4  *Nadir: BrO consistency checking*

The world map plots of Nadir BrO vertical column density (VCD) values averaged over one month are generated from the SCI\_OL\_2P Nadir products version 5.01. Figure 8.13 and Figure 8.15 show the monthly world map plots for September and October 2011.

Figure 8.14 and Figure 8.16 show the VCD errors for the monthly average plots. Errors are given in absolute values (molec/cm$^2$).

Large emissions of inorganic bromine are expected in the Tropospheric Polar Regions at the end of the winter (bromine explosion event) and in the troposphere and possibly in the stratosphere as a consequence of active volcanoes. Low values are present in correspondence with the SAA.

Please note that these plots are preliminary results after the implementation of the new processor version and are still under review.

For year 2002 the BrO column densities are substantially too low with a lot of negative values. We recommend users not to use the 2002 BrO data in the current implementation.
8.2.4.1 Nadir: VCD BrO map September 2011

Figure 8.13: BrO VCD (molec/cm²) world map for 01 – 31 September 2011 – monthly average.

Figure 8.14: BrO VCD error (molec/cm²) for 01 – 31 September 2011- monthly average.
8.2.4.2 Nadir: VCD BrO map October 2011

Figure 8.15: BrO VCD (molec/cm²) world map for 01 – 31 October 2011 – monthly average.

Figure 8.16: BrO VCD error (molec/cm²) for 01 – 31 October 2011- monthly average.
8.2.5 Nadir: SO\textsubscript{2} consistency checking

The world map plots of Nadir SO\textsubscript{2} vertical column density (VCD) values in molec/cm\textsuperscript{2} averaged over one month are generated from the SCI\_OL\_2P Nadir products version 5.01. Each Level 2 product now contains one MDS for an anthropogenic scenario (SO\textsubscript{2} present in the boundary layer) and one MDS for the volcanic scenario (SO\textsubscript{2} layer between 10 and 11 km).

Since SO\textsubscript{2} distribution varies to a large degree between an anthropogenic scenario (pollution dominated) and a volcanic scenario, the AMF cannot be determined for both with a single climatology. Two types of AMF for the calculation of the “anthropogenic” SO\textsubscript{2} vertical columns and the “volcanic” ones are derived assuming a constant profile shape for two typical scenarios:

- a profile with 1 DU of SO\textsubscript{2} from surface to 1 km height simulating an Anthropogenic Pollution scenario;
- a profile with 10 DU of SO\textsubscript{2} between a 10 and 11 km simulating a volcanic eruption.

Accordingly, two types of SO\textsubscript{2} vertical columns - anthropogenic and volcanic - are computed and written into two different MDSs of the Level 2 products.

Both retrievals use the same background subtracted slant column as input, calculated from a reference sector over the Pacific Ocean as a pollution free correction.

Figure 8.17, 8.19, 8.21 and 8.23 show the monthly world map plots for anthropogenic and volcanic vertical columns for September and October 2011. Figure 8.18, 8.20, 8.22 and 8.24 show the VCD errors for the monthly average plots. Errors are given in absolute value (molec/cm\textsuperscript{2}). SO\textsubscript{2} values measured in the ascending node (the satellite moving northwards) have been filtered out.

Please note that these plots are preliminary results after the implementation of the new processor version and are still under review. The operational SO\textsubscript{2} product picks-up the main relevant features, but VCDs are strongly affected by negative values, presumably resulting from problems with the reference sector subtraction. Due to the poor results, it is recommended not to use the current version of the anthropogenic columns for quantitative studies. Usage of the volcanic columns as indicator of volcanic eruptions seems to be feasible.
8.2.5.1 Nadir: SO\textsubscript{2} Anthropogenic scenario - September 2011

Figure 8.17: SO\textsubscript{2} VCD (molec/cm\textsuperscript{2}) world map for 01 –30 September 2011 – monthly average.

Figure 8.18: SO\textsubscript{2} VCD error (molec/cm\textsuperscript{2}) for 01 –30 September 2011- monthly average.
8.2.5.2 Nadir: SO\textsubscript{2} Anthropogenic scenario - October 2011

Figure 8.19: SO\textsubscript{2} VCD (molec/cm\textsuperscript{2}) world map for 01 – 31 October 2011 – monthly average.

Figure 8.20: SO\textsubscript{2} VCD error (molec/cm\textsuperscript{2}) for 01 – 31 October 2011- monthly average.
8.2.5.3 Nadir: SO₂ Volcanic scenario - September 2011

Figure 8.21: SO₂ VCD (molec/cm²) world map for 01 – 30 September 2011 – monthly average.

PLOT CURRENTLY NOT AVAILABLE FOR THE CORRUPTION OF THE DATABASE

Figure 8.22: SO₂ VCD error (molec/cm²) for 01 – 30 September 2011 – monthly average.
8.2.5.4 Nadir: SO$_2$ Volcanic scenario - October 2011

Figure 8.23: SO$_2$ VCD (molec/cm$^2$) world map for 01 – 31 October 2011 – monthly average.

Figure 8.24: SO$_2$ VCD error (molec/cm$^2$) for 01 – 31 October 2011 – monthly average.
8.2.6 Nadir: OClO consistency checking

The polar maps of Nadir OClO slant column density (SCD) values averaged over one month are generated from the SCI_OL__2P Nadir products version 5.01. Figure 8.25 and Figure 8.27 show the monthly SCD values for October 2011 over the Northern and the Southern Hemisphere respectively. Figure 8.26 and Figure 8.28 show the corresponding SCD absolute errors for the monthly average plots.

Computation of VCD is difficult for the rapid photochemistry of OClO. The vertical column given in the product does not contain any correction for photochemical effects and should thus not be used as given.

Significant amounts of OClO are expected only in the activated polar vortex. OClO values measured in the ascending node (the satellite moving northwards) introduce artifacts in the plots (i.e. spurious high OClO values in the summer hemisphere in the absence of chlorine activation) and have been filtered out from the monthly maps.

Please note that these plots are preliminary results after the implementation of the new processor version and are still under review.
8.2.6.1 Nadir: SCD OCIO maps September 2011

Figure 8.25: OCIO SCD (molec/cm$^2$) for 01 – 30 September 2011 – monthly average over the Northern Hemisphere.

Figure 8.26: OCIO SCD error (molec/cm$^2$) for 01 – 30 September 2011- monthly average over the Northern Hemisphere.
Figure 8.27: OClO SCD (molec/cm$^2$) for 01 – 30 September 2011 – monthly average over the Southern Hemisphere.

Figure 8.28: OClO SCD error (molec/cm$^2$) for 01 – 30 September 2011- monthly average over the Southern Hemisphere.
8.2.6.2 Nadir: SCD OClO maps October 2011

Figure 8.29: OCIO SCD (molec/cm²) for 01 – 31 October 2011 – monthly average over the Northern Hemisphere.

Figure 8.30: OCIO SCD error (molec/cm²) for 01 – 31 October 2011 - monthly average over the Northern Hemisphere.
Figure 8.31: OCIO SCD (molec/cm$^2$) for 01 – 31 October 2011 – monthly average over the Southern Hemisphere.

Figure 8.32: OCIO SCD error (molec/cm$^2$) for 01 – 31 October 2011- monthly average over the Southern Hemisphere.
8.2.7 Nadir: CO consistency checking

Due to erroneous retrieval settings in the operational software, the CO column densities from Level 2 version 5.01 products are not reported in the bi-monthly report. Users are recommended not to use the CO data set.

8.2.8 Limb: Ozone profile averages

This paragraph reports on the monitoring of SCIAMACHY limb profiles on a monthly basis, showing the results for Ozone limb profiles binned for two tangent height regions.

Starting with processor version 5.01, a new limb retrieval grid of 27 tangent altitudes has been adopted instead of the 19 values grid used by processor 3.01. As a consequence, the limb profile average plots in this section use different altitude bins with different thickness according to the new product’s configuration for limb measurements.

In particular, for the O₃ limb VMR profile extracted from Level 2 products version 5.01, the average plots are reported for the following two tangent height bins

- 22.75 – 24.5 km
- 36.75 – 38.5 km.

The data of the first half of each month (calendar days 1 - 15) and the second half (calendar days 16 - 31) are averaged for selected tangent heights into geo-location bins of 10 degrees longitude and 5 degrees latitude. The binning algorithm uses a single longitude and latitude value for the entire profile, being the value for the middle of the integration time as reported in the Geo-location Limb Dataset. The corresponding error is averaged as well.

The world maps of the averaged Ozone values show comparably low errors over the SAA region, which is not as expected. Investigation showed that the low SAA errors result from irregular conditions of the limb retrieval in that region.

Figures from 8.33 to 8.36 show the results for the months of September and October 2011 and for the two different tangent height regions.
8.2.8.1 Ozone limb profiles September 2011

Figure 8.33: Limb Ozone profiles, binned over 22.75 – 24.5 km, September 2011.

Figure 8.34: Limb Ozone profiles, binned over 36.75 – 38.5 km, September 2011.
8.2.8.2 Ozone limb profiles October 2011

Figure 8.35: Limb Ozone profiles binned over 22.75 – 24.5 km, October 2011.

Figure 8.36: Limb Ozone profiles binned over 36.75 – 38.5 km, October 2011.
8.2.9 *Limb: NO₂ profile averages*

Analogous as for the limb Ozone profiles monthly averages for NO₂ limb averages were generated. For the new Level 2 products version 5.01, the tangent height region chosen is:

- 24.5-26.25 km.

As for the ozone averages the data of the first half of each month (calendar days 1 - 15) and the second half (calendar days 16 - 31) are averaged for selected tangent heights into geo-location bins of 10 degrees longitude and 5 degrees latitude. The binning algorithm used is the same as the described in 8.2.8. The corresponding error is averaged as well. Figures 8.37 and 8.38 show the results for the months of September and October 2011 respectively.
Figure 8.37: Limb NO₂ profiles binned over 24.5 – 26.25 km, September 2011.

Figure 8.38: Limb NO₂ profiles binned over 24.5 – 26.25 km, October 2011.
8.2.10 *Limb: BrO profile averages*

Analogous as for the limb O₃ and NO₂ profiles, monthly averages of BrO limb profiles were generated. The tangent height region chosen is:

- 24.5-26.25 km.

As for the ozone averages, data of the first half of each month (calendar days 1 - 15) and the second half (calendar days 16 - 31) are averaged for selected tangent heights into geo-location bins of 10 degrees longitude and 5 degrees latitude. The binning algorithm used is the same as the described in Section 8.2.8. The corresponding error is averaged as well.

Figure 8.39 and Figure 8.40 show the results for the months of September and October 2011 respectively.
Figure 8.39: Limb BrO profiles binned over 24.5 – 26.25 km, September 2011.

Figure 8.40: Limb BrO profiles binned over 24.5 – 26.25 km, October 2011.
9 VALIDATION ACTIVITIES AND RESULTS

Validation activities of products from re-processing with Level 1b IPF 7.03 and Level 2 off-line processor 5.01 are on-going. A first validation meeting organised by SCIAVALIG took place on 06/07 September 2010. While most of the new and updated geophysical parameters retrieved show very good quality, the retrieval of CO and SO\textsubscript{2} has resulted unreliable in their current implementation. As a consequence the Level 2 reprocessing has been interrupted.

Validation was done on the basis of the SCIAMACHY validation data set and the forward processed data. The data set covers around 1900 selected orbits identified by the core validation teams for the complete mission until 2010.

The quality of the SCI\_OL\_2P data re-processed with off-line processor version 5.01 has been checked and can be viewed via the Level 2 daily reports that are available at http://earth.eo.esa.int/pcs/envisat/sciamachy/reports/daily/Level_2/

Validation of products from the previous re-processing campaign (Level 1 IPF 6.03 and Level 2 off-line processor 3.01) was performed by the SCIAMACHY Validation and Interpretation Group (SCIAVALIG). Results are published at http://www.sciamachy.org/validation/documentation/technotes/SCIAVALIG/Summary_operational_product_quality_20080326.pdf