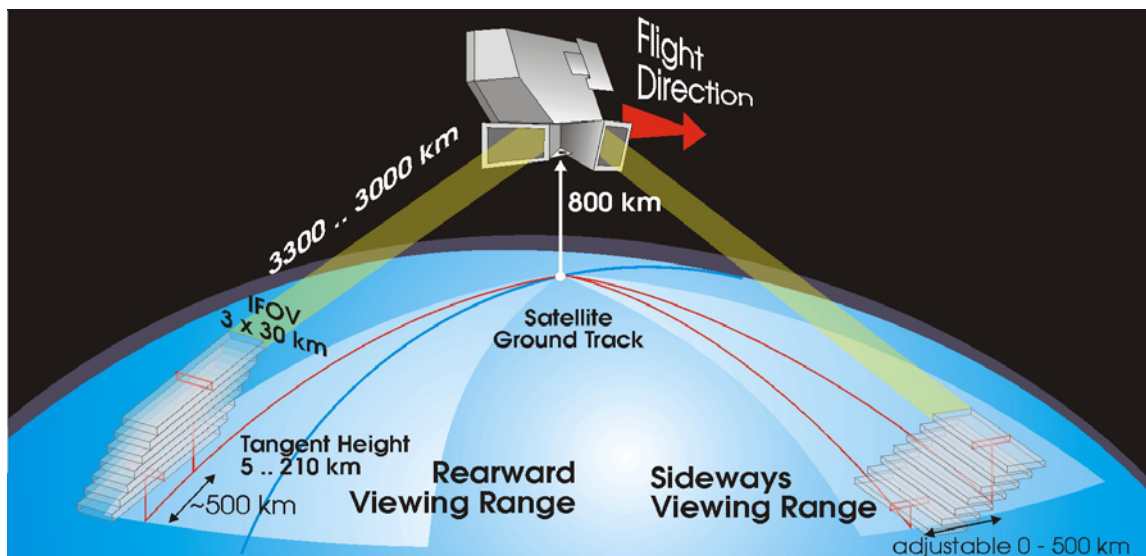


# **ENVISAT MIPAS MONTHLY REPORT: NOVEMBER 2007**



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|---|------------------------|----------------------------------|
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## **T A B L E O F C O N T E N T S**

|          |  |          |
|----------|--|----------|
| <b>1</b> | <b>INTRODUCTION .....</b>                  | <b>1</b> |
| 1.1      | Scope .....                                | 1        |
| 1.2      | Acronyms and Abbreviations.....            | 1        |
| <b>2</b> | <b>THE REPORT .....</b>                    | <b>4</b> |
| 2.1      | Summary .....                              | 4        |
| 2.2      | Instrument and products availability ..... | 5        |
| 2.2.1    | Instrument planning .....                  | 5        |
| 2.2.2    | Instrument availability .....              | 6        |
| 2.2.3    | Level 0 Product availability .....         | 6        |
| 2.2.4    | Level 0 Products statistics.....           | 7        |
| 2.2.4.1  | Monthly statistics .....                   | 7        |
| 2.2.4.2  | Long term statistics .....                 | 8        |
| 2.2.5    | Level 1 off-line Products statistics.....  | 9        |
| 2.3      | Instrument monitoring.....                 | 10       |
| 2.3.1    | Thermal Performance.....                   | 10       |
| 2.3.2    | Interferometer Performance .....           | 13       |
| 2.3.3    | Cooler Performance .....                   | 15       |
| 2.3.4    | ADC counts long-term monitoring .....      | 16       |
| 2.4      | Level 1b product quality monitoring .....  | 17       |
| 2.4.1    | Processor Configuration.....               | 17       |
| 2.4.1.1  | Version .....                              | 17       |
| 2.4.1.2  | Auxiliary Data Files.....                  | 19       |
| 2.4.2    | Spectral Performance .....                 | 20       |
| 2.4.3    | Radiometric Performance .....              | 21       |
| 2.4.3.1  | Weekly monitoring .....                    | 21       |
| 2.4.3.2  | Long term monitoring .....                 | 23       |
| 2.4.3.3  | Interpolated gains .....                   | 26       |
| 2.4.4    | Pointing Performance.....                  | 26       |
| 2.4.5    | Quality control of L1 OFL data .....       | 28       |
| 2.4.5.1  | FCE monitoring.....                        | 28       |
| 2.4.5.2  | Spikes monitoring .....                    | 30       |
| 2.4.6    | Level 0 and Level 1 Anomaly Status .....   | 31       |
| 2.5      | Level 2 product quality monitoring .....   | 32       |
| 2.5.1    | Processor Configuration.....               | 32       |
| 2.5.1.1  | Version .....                              | 32       |
| 2.5.1.2  | Auxiliary Data Files.....                  | 32       |
| 2.5.2    | Quality control of L2 OFL data .....       | 33       |
| 2.5.3    | Level 2 Anomaly Status.....                | 33       |
| 2.6      | Processing/Re-processing Status.....       | 34       |

|          |   |           |
|----------|---|-----------|
| 2.6.1    | First re-processing of FR mission .....                                 | 34        |
| 2.6.2    | OFL processing of RR mission .....                                      | 34        |
| 2.6.2.1  | Level 1b.....   | 34        |
| 2.6.2.2  | Level 2.....  | 34        |
| <b>3</b> | <b>APPENDICES .....</b>   | <b>35</b> |
| 3.1      | Appendix A – Level 1 IPF historical updates .....                       | 35        |
| 3.2      | Appendix B – Level 1 ADF historical updates .....                       | 36        |
| 3.3      | Appendix C – Interpolated gains .....                                   | 38        |
| 3.4      | Appendix D – Level 0 and Level 1 anomaly status .....                   | 40        |
| 3.4.1    | MIPAS wrong consolidated products .....                                 | 40        |
| 3.4.2    | Excessive number of MISSING ISPS in the MPH for MIPAS L0 products ..... | 40        |
| 3.4.3    | Non-valid band A at the same geo-location.....                          | 41        |
| 3.4.4    | Wrong MIPAS L1 product in D-PAC server.....                             | 41        |
| 3.4.5    | Badly calibrated L1b data during 3 – 23 June 2005 .....                 | 42        |
| 3.4.6    | MIPAS Aircraft Emission Measurements.....                               | 46        |
| 3.4.7    | Wrongly calibrated L1 products .....                                    | 46        |
| 3.4.8    | Anomalous scan pattern .....  | 48        |
| 3.5      | Appendix E – Level 2 IPF historical updates .....                       | 49        |
| 3.6      | Appendix F – Level 2 ADF historical updates .....                       | 51        |
| 3.7      | Appendix G – Level 2 anomaly status .....                               | 53        |
| 3.7.1    | Excessive chi-square .....  | 53        |
| 3.7.2    | Difference on L2 products between v4.61 and v4.62 .....                 | 53        |
| 3.7.3    | NO2 retrieval during polar condition.....                               | 54        |
| 3.7.4    | Missing L2 profiles aournd the South Pole.....                          | 55        |
| 3.7.5    | Continuum Anomaly .....   | 56        |

# 1 INTRODUCTION

The MIPAS Monthly Report (MR) documents the current status and recent changes to the MIPAS instrument, its data processing chain, and its data products.

The MR is composed of analysis results obtained by the DPQC (Data Processing and Quality Control), combined with inputs received from the different groups working on MIPAS operation, calibration, product validation and data quality. The following groups participate in the MIPAS Quality Working Group (QWG):

- ESRIN-DPQC
- ESOC
- ESTEC
- ABB BOMEM
- Oxford University (OU)
- IFAC-CNR
- EADS-Astrium GmbH
- Leicester University
- LISA
- IMK
- University of Bologna
- ISAC-CNR
- IAA
- DLR
- ECMWF

In addition, the group interfaces with the Atmospheric Chemistry Validation Team (ACVT).

## 1.1 *Scope*

The main objective of the MR is to give, on a regular basis, the status of MIPAS instrument performance, data acquisition, results of anomaly investigations, calibration activities and validation campaigns.

## 1.2 *Acronyms and Abbreviations*

|      |                                       |
|------|---------------------------------------|
| ACVT | Atmospheric Chemistry Validation Team |
| ADF  | Auxiliary Data File                   |
| ADS  | Annotated Data Set                    |
| AMT  | Anomaly Management Tool               |
| ANX  | Ascending Node Crossing               |
| AE   | Aircraft Emission                     |
| AR   | Anomaly Report                        |
| BB   | Black Body                            |

---

|        |   |
|--------|---|
| CBB    | Calibration Black-Body                                    |
| CTI    | Configuration Table Interface                             |
| D-PAC  | German Processing and Archiving Centre for ENVISAT        |
| DPM    | Detailed Processing Model                                 |
| DPQC   | Data Processing and Quality Control                       |
| DS     | Deep Space  |
| DSD    | Data Set Description                                      |
| ECMWF  | European Centre for Medium-Range Weather Forecasts        |
| ESF    | Engineering Support Facility                              |
| FCA    | FPS (Focal Plane Subsystem) Cooler Assembly               |
| FCE    | Fringe Count Error  |
| FOCC   | Flight Operation Control Centre                           |
| FOS    | Flight Operations Segment                                 |
| FR     | Full Resolution   |
| HD     | Help-Desk   |
| HSM    | High-Speed Multiplexer                                    |
| ICU    | Instrument Control Unit                                   |
| IDU    | Interferometer Drive Unit                                 |
| IECF   | Instrument Engineering and Calibration Facilities         |
| IF     | In-Flight   |
| IG     | Initial Guess   |
| IGM    | Interferogram   |
| ILS    | Instrument Line Shape                                     |
| INT    | Interferometer  |
| I/O DD | Input/Output Data Definition                              |
| IOP    | In-orbit Performance                                      |
| IPF    | Instrument Processing Facility                            |
| LOS    | Line of Sight   |
| MA     | Middle Atmosphere   |
| MDS    | Measurements Data Set                                     |
| MIO    | MIPAS Optics Module                                       |
| MIPAS  | Michelson Interferometer for Passive Atmospheric Sounding |
| MPH    | Main Product Header                                       |
| MPS    | Mission Planning System                                   |
| MR     | Monthly Report  |
| MW     | Micro-Window  |
| NCR    | Non-Conformance Report                                    |
| NESR   | Noise Equivalent Spectral Radiance                        |
| NOM    | Nominal   |
| NRT    | Near-Real-Time  |
| OAR    | Operational Anomaly report                                |
| OBT    | On-board time   |
| OCM    | Orbit Control Manoeuvre                                   |
| OFL    | Off-Line  |
| OM     | Occupation Matrix   |
| PCD    | Product Confidence Data                                   |
| PCF    | Product Control Facility                                  |

---

|       |                                      |
|-------|--------------------------------------|
| PDS   | Payload Data Segment                 |
| PFHS  | Processing Facility Host Structure   |
| PLSOL | Payload Switch off-line              |
| PPM   | Part per million                     |
| QC    | Quality Control                      |
| QWG   | Quality Working Group                |
| RGC   | Radiometric Gain Calibration         |
| RR    | Reduced Resolution                   |
| SEM   | Special Event Measurement            |
| SPH   | Specific Product header              |
| SPR   | Software Problem Report              |
| ST    | Science Team                         |
| UA    | Upper Atmosphere                     |
| UTLS  | Upper Troposphere Lower Stratosphere |
| VCM   | Variance Covariance Matrix           |
| VMR   | Volume Mixing Ratio                  |
| WCC   | Wear Control Cycle                   |

## 2 THE REPORT

### 2.1 Summary

- During the reporting month MIPAS performed really well; in fact only 2 instrument anomalies occurred due to IDU errors (see §2.2.2).
- The instrument planning for the reporting month is hereafter summarized:
  - The duty cycle was set to 80%
  - The *Baseline scenario* was planned, it consists of the following measurements: 3 days NOM + 1 day MA + 1 day UA + 3 days NOM + 2 days off
- A more detailed description of the instrument planning for the reporting month can be found in §2.2.1, see in particular Table 1.
- The availability of the instrument was high (97.8 % of the planned time) due to the good performances of the interferometer. The measurement segments not processed to L0 due to failures in the PDS were about 0.6% of the planned measurement time (see § 2.2.4).
- The long term analysis of L0 data availability shows the increased duty cycle since April 2006 and highlights the improved instrument performances in the last months (see §2.2.4.2).
- In this report we present the long term availability of L1 consolidated data in the D-PAC server. We can see that the availability of L1 products with respect to the expected time is approaching 100% in the last months (see §2.2.5).
- The instrument temperatures are stable over the reporting month, the variations being included in 1K (see § 2.3.1).
- The cooler performs well during the reporting month; the vibrations were always well below the warning level of 8 mg (see § 2.3.3).
- The long term trend of ADC max counts in channel A1 shows a strong correlation with the instrument self-emission and with the detector ice contamination. During the reporting month the ADC counts remain stable (see §2.3.4).
- The monitoring of the spectral correction factor shows a slight decreasing trend; however the variations over more than two years of operations are really small (~ 2 ppm). The observed spreading of the points is due to the noise in the determination of this parameter (see § 2.4.2).
- The gain weekly increase during the reporting month is nominal, the maximum of gain increase in all the MIPAS bands remains well below the acceptance criterion of 1%/week (see § 2.4.3.1).
- The analysis of the accumulated gain allows monitoring the level of detector ice contamination. During the last months we observed a decreasing slope of the gain curve, showing that the detector is more and more ice-free. This is due to the better performances of the cooler obtained with more frequent decontamination (see §2.4.3.2).
- The absolute mispointing is stable around a value of -25mdeg. The seasonal variations of the pointing error are small and below the fixed threshold of 8mdeg (see §2.4.4).
- The long term monitoring of fringe count errors (FCE) shows that the width of the statistical distribution of the FCE can be used as a measure of the INT performances. In particular we observed that the FCE can be correlated with the number of IDU errors. This correlation is evident during the bad period of the MIPAS mission (June 2005 February 2006), while in



the last months with the improved instrument performances no clear correlation can be highlighted (see § 2.4.5.1).

- The long term monitoring of the detected spikes shows that the number of detected spikes in channels A1, A2, B1 and B2 is varying with time with some peaks probably related to variation of the solar activity. The channels C and D (the detector most affected by spikes) didn't show any trend so far. From this analysis we can conclude that the number of detected spikes is still really small to impact the L1b products quality (see § 2.4.5.2).
- The level 0 NRT daily reports can be accessed at the following address:  
[http://earth.esa.int/pcs/envisat/mipas/reports/daily/Level\\_0\\_NRT/](http://earth.esa.int/pcs/envisat/mipas/reports/daily/Level_0_NRT/)
- The level 1b OFL daily reports can be accessed at the following address:  
[http://earth.esa.int/pcs/envisat/mipas/reports/daily/Level\\_1\\_OFL/](http://earth.esa.int/pcs/envisat/mipas/reports/daily/Level_1_OFL/)

## 2.2 *Instrument and products availability*

### 2.2.1 INSTRUMENT PLANNING

The planning for the MIPAS operations during the reporting month is briefly described in this section.

- All measurement mode are double slide operation with medium resolution (41% - 1.64 sec sweeps) with asymmetric transitory sweeps
- Radiometric Gain calibrations (RGC) is planned once per day
- Deep Space (DS) offset is planned every 800 sec
- LOS calibrations are planned every 5 days (one sideways every two rearward sequences)
- The duty cycle was set to 80%
- The *Baseline scenario* was planned, it consists in the following series of measurements: 3 days NOM + 1 day MA + 1 day UA + 3 days NOM + 2 days off
- IDU re-initialization was set every 3 orbits

An overview of the measurements planned during the reporting month is presented in Table 1. In this table the calibration measurements are discarded. For more detailed information about mission planning you should refer to the mission planning excel sheet available on Uranus server at the following location:

[ftp://uranus.esrin.esa.it/Mission\\_Planning/MIPAS/](ftp://uranus.esrin.esa.it/Mission_Planning/MIPAS/)

**Table 1** – Overview of the measurements planned during the reporting month. RGC and LOS calibration sequences are discarded here, refer to the planning excel sheet for further details.

| Date              | Orbit         | Measurement mode       |
|-------------------|---------------|------------------------|
| 01 – 03<br>Nov 07 | 29644 – 29686 | NOM                    |
| 04 Nov 07         | 29687 – 29701 | MA – Middle Atmosphere |
| 05 Nov 07         | 29702 – 29715 | UA – Upper Atmosphere  |
| 06 – 08<br>Nov 07 | 29716 – 29759 | NOM                    |
| 09 – 10 Nov 07    |               | Instrument OFF         |
| 11 – 13<br>Nov 07 | 29787 – 29829 | NOM                    |
| 14 Nov 07         | 29830 – 29844 | MA – Middle Atmosphere |
| 15 Nov 07         | 29845 – 29858 | UA – Upper Atmosphere  |
| 16 – 18<br>Nov 07 | 29859 – 29902 | NOM                    |
| 19 – 20 Nov 07    |               | Instrument OFF         |
| 21 – 23<br>Nov 07 | 29931 – 29973 | NOM                    |
| 24 Nov 07         | 29974 – 29987 | MA – Middle Atmosphere |
| 25 Nov 07         | 29988 – 30001 | UA – Upper Atmosphere  |
| 27 – 28<br>Nov 07 | 30002 – 30045 | NOM                    |
| 29 – 30 Nov 07    |               | Instrument OFF         |

## 2.2.2 INSTRUMENT AVAILABILITY

During the reporting month the MIPAS performances were really satisfactory; indeed only 2 instrument anomalies were observed due to IDU errors. All the unavailability intervals for the reporting month are reported in next table.

**Table 2** List of MIPAS unavailabilities during the reporting month.

| Start time |          | Stop time |          | Duration<br>sec | Ref              | Orbit |       | Comments  |
|------------|----------|-----------|----------|-----------------|------------------|-------|-------|-----------|
| Date       | UTC      | Date      | UTC      |                 |                  | Start | Stop  |           |
| 22-nov-07  | 1.47.56  | 22-nov-07 | 11.51.17 | 36201           | EN-UNA-2007/0248 | 29945 | 29951 | IDU error |
| 24-nov-07  | 14.09.28 | 24-nov-07 | 19.11.02 | 18094           | EN-UNA-2007/0250 | 29981 | 29984 | IDU error |

## 2.2.3 LEVEL 0 PRODUCT AVAILABILITY

The planned measurements that were not processed to level 0 (MIP\_NL\_\_0P) due to failure in the Payload Data Segment (PDS) are reported in the next table.

**Table 3** List of missing gaps for MIP\_NL\_\_0P during the reporting month.

| Start time |          | Stop time |          | Duration<br>sec | Start<br>Orbit | Stop<br>Orbit |
|------------|----------|-----------|----------|-----------------|----------------|---------------|
| Date       | UTC      | date      | UTC      |                 |                |               |
| 02-nov-07  | 9.49.26  | 02-nov-07 | 9.49.40  | 14              | 29663          | 29664         |
| 07-nov-07  | 10.32.34 | 07-nov-07 | 10.32.48 | 14              | 29735          | 29736         |
| 28-nov-07  | 14.59.06 | 28-nov-07 | 16.34.36 | 5730            | 30039          | 30040         |
| 12-nov-07  | 7.17.27  | 12-nov-07 | 7.17.41  | 14              | 29805          | 29805         |
| 17-nov-07  | 10.17.01 | 17-nov-07 | 10.17.15 | 14              | 29878          | 29878         |
| 18-nov-07  | 22.59.05 | 19-nov-07 | 0.38.56  | 5991            | 29900          | 29901         |
| 22-nov-07  | 1.43.52  | 22-nov-07 | 1.47.56  | 244             | 29945          | 29945         |
| 22-nov-07  | 11.51.17 | 22-nov-07 | 11.51.32 | 15              | 29951          | 29951         |
| 24-nov-07  | 14.05.25 | 24-nov-07 | 14.09.28 | 243             | 29981          | 29981         |
| 24-nov-07  | 19.11.02 | 24-nov-07 | 19.11.17 | 15              | 29984          | 29984         |
| 27-nov-07  | 8.08.01  | 27-nov-07 | 8.08.15  | 14              | 30020          | 30020         |

During the reporting month the following LOS calibrations were not processed to level 0 (MIP\_LS\_\_0P) due to failure in the Payload Data Segment.

**Table 4** List of missing gaps for MIP\_LS\_\_0P during the reporting month.

| Start time |         | Stop time |         | Duration<br>sec | Start<br>Orbit | Stop<br>Orbit |
|------------|---------|-----------|---------|-----------------|----------------|---------------|
| Date       | UTC     | date      | UTC     |                 |                |               |
| 02-nov-07  | 6.58.23 | 02-nov-07 | 6.58.43 | 20              | 29662          | 29662         |
| 12-nov-07  | 6.36.15 | 12-nov-07 | 6.36.21 | 6               | 29805          | 29805         |
| 17-nov-07  | 7.27.05 | 17-nov-07 | 7.27.07 | 2               | 29877          | 29877         |
| 27-nov-07  | 6.52.54 | 27-nov-07 | 6.53.01 | 7               | 30020          | 30020         |
| 27-nov-07  | 7.28.16 | 27-nov-07 | 7.28.23 | 7               | 30020          | 30020         |

## 2.2.4 LEVEL 0 PRODUCTS STATISTICS

### 2.2.4.1 Monthly statistics

During the reporting month the instrument duty cycle was set to 80%. The instrument availability with respect to the planned measurement time was very high (97.8%) due to the very good performances of the interferometer. The measurement time that was lost due to failures in the L0 generation in the PDS was about 0.6% of the expected measurement time. MIPAS L0 NRT products statistics are reported in the next table.

**Table 5** MIPAS level 0 NRT products statistics for the reporting month.

|  |  | <b>Time [s]</b> |
|--|--|-----------------|
| Total time over one month  | $t_{tot}$  | 2678400         |
| Time of planned measurements                                     | $t_{plan}$   | 2019832         |
| Time of expected measurements                                    | $t_{exp}$  | 1974753         |
| Time of L0 gaps  | $t_{L0gaps}$   | 12308           |
| Time of instrument unavailability                                | $t_{unav} = t_{plan} - t_{exp}$                                    | 45079           |
| <b>Planned duty cycle</b>  |  |                 |
|  | $(t_{plan} / t_{tot}) * 100$                                       | <b>75,41</b>    |
| <b>Instrument availability Vs planning (instrument failures)</b> |  |                 |
|  | $[1 - t_{unav} / t_{plan}] * 100$                                  | <b>97,77</b>    |
| <b>L0 availability Vs planning (PDS failures)</b>                |  |                 |
|  | $[(t_{exp} - t_{L0gaps}) / t_{exp}] * 100$                         | <b>99,38</b>    |
| <b>L0 availability Vs planning (PDS + instrument failures)</b>   |  |                 |
|  | $[(t_{exp} - t_{L0gaps}) / t_{plan}] * 100$                        | <b>97,16</b>    |
| <b>L0 availability Vs Total time</b>                             |  |                 |
|  | $[(t_{exp} - t_{L0gaps}) / t_{plan}] * (t_{plan} / t_{tot}) * 100$ | <b>73,27</b>    |

#### 2.2.4.2 Long term statistics

In this paragraph we present a long term statistics of the L0 products availability. The results are reported in Figure 1. In this figure the blue and magenta lines represent respectively the instrument and the L0 products availability with respect to the planned time, the green and the red lines are the instrument and L0 availability with respect to the total time. The improved instrument performances can be observed in this plot. In fact the availability of the instrument remains always higher than 95% since April 2006. The products availability, which takes also into account the PDS performances in the L0 generation, is also generally high a part from July 2006 when an anomaly in the ARTEMIS antenna downlink prevents the acquisition of many L0 products. Furthermore the increase of duty cycle since April 2006 can be appreciated in this figure, this value has been raised from 30% to about 80% and this increased duty cycle did not affect the instrument performances. As a result the data availability was increased during last year except for the periods when a platform switch-off has occurred or a decontamination was planned.

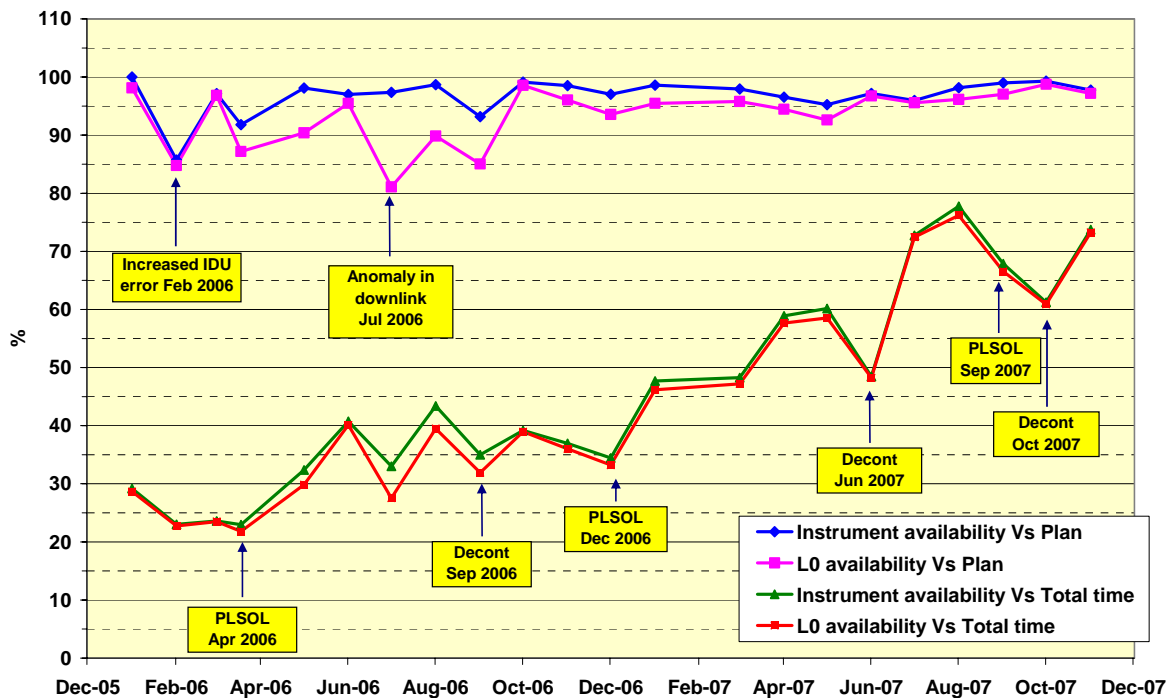


Figure 1 – MIPAS L0 NRT long term statistics since Jan 2006.

### 2.2.5 LEVEL 1 OFF-LINE PRODUCTS STATISTICS

Since February 2006 MIPAS L1 data are routinely processed off-line at D-PAC, these data are commonly used by the MIPAS science community. Since August 2007 ESRIN can access directly the D-PAC server, this allows us to provide rapid and reliable information to the user community about L1 data availability on the D-PAC site. In particular a script was developed to provide the list of available L1 products on the ftp server with some associated product information (e.g.: sensing start/stop, number of scan, measurement mode). This information can be found now for the whole MIPAS mission in the Uranus server, see the following link:

[ftp://uranus.esrin.esa.it/MIPAS/DPAC\\_archive/](ftp://uranus.esrin.esa.it/MIPAS/DPAC_archive/)

In this chapter we report the long term statistics of the L1 products availability in the D-PAC server. This is presented in Figure 2, where the statistics since June 2006 are reported with respect to the expected time and to the total time. Note that this statistic is updated with a delay of one month with respect to the reporting period; this is due to the delay in the generation of consolidated products (about 2 weeks). From this figure a problem can be observed in the data generation during March 2007, while in the last months the data availability is approaching the 100% of the expected time.

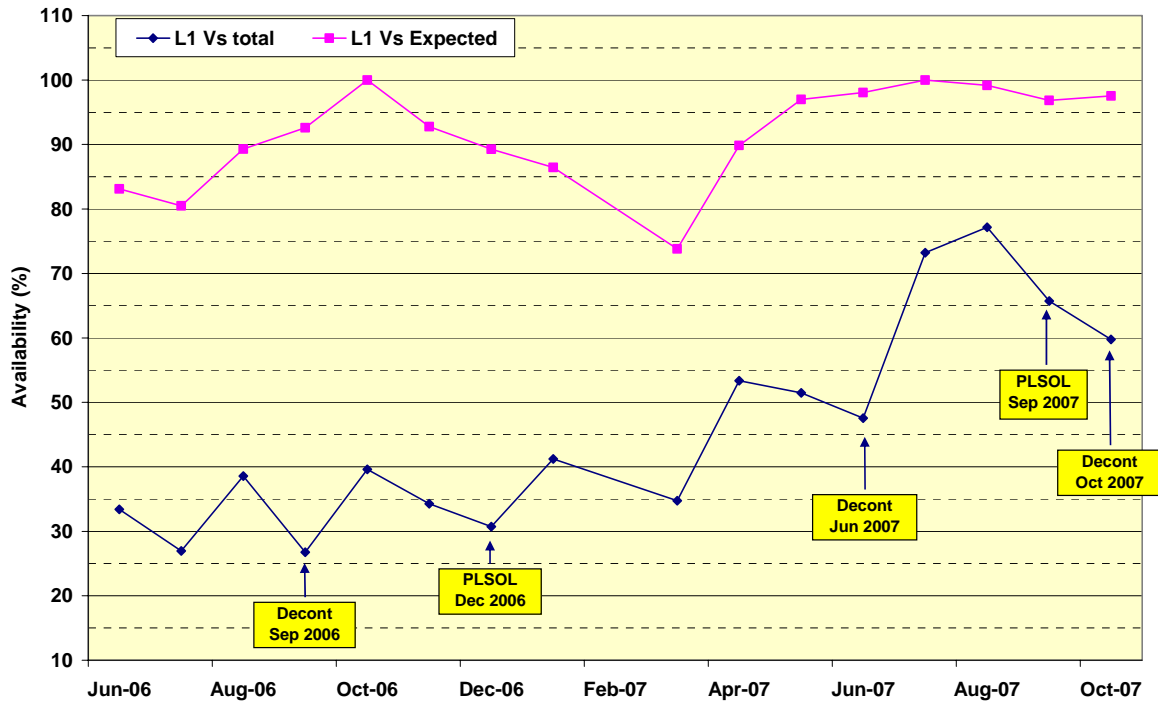


Figure 2 – MIPAS L1 off-line data at D-PAC: long term statistics since Jun 2006.

## 2.3 Instrument monitoring

### 2.3.1 THERMAL PERFORMANCE

The following two plots (Figure 3 and Figure 4) show the long-term trends of the IDU and MIO base plate temperature (analysis performed by Astrium). The yearly seasonal variations and the interferometer heater switching (see Tab. 5 for the schedule of heater switch-on/off) are clearly visible within these plots. Furthermore the effects of instrument decontamination are also evident with a reduction of the instrument temperatures (e.g.: the decrease of about 0.6K after the decontamination of June 2007).

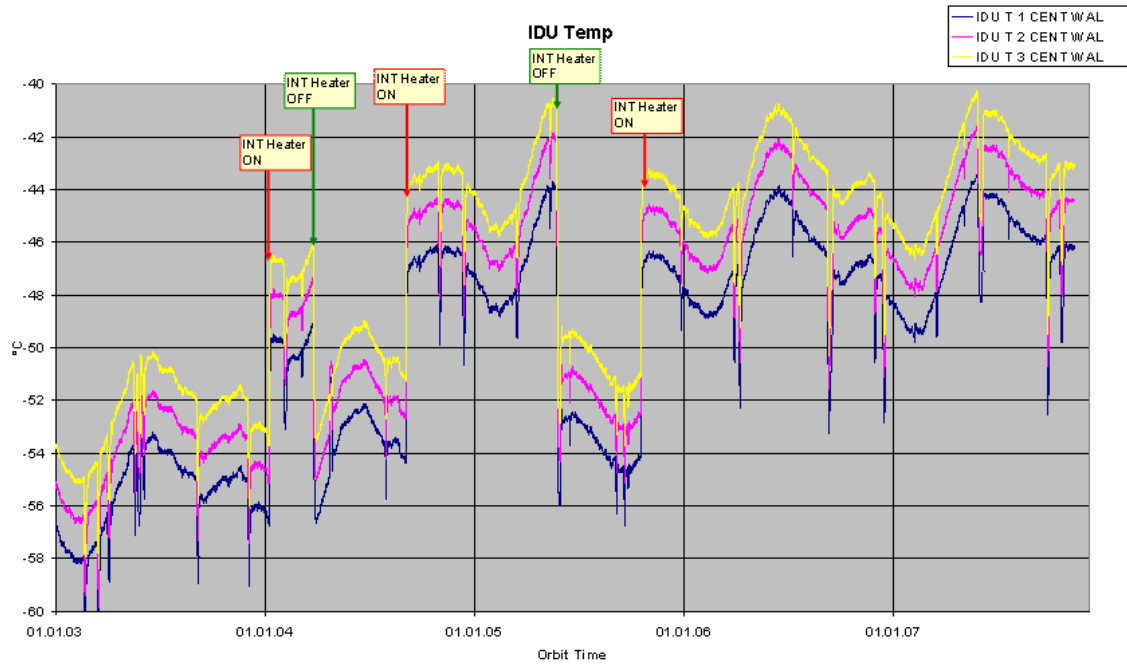


Figure 3 IDU temperatures as a function of time since November 2002 (courtesy of Astrium).

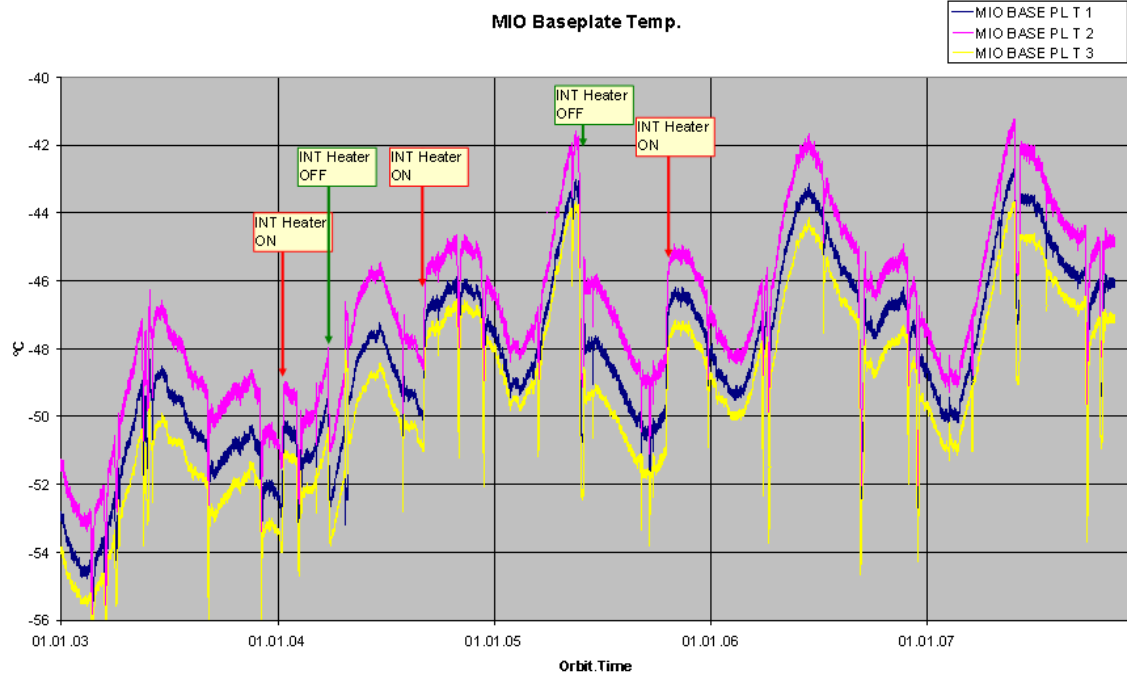


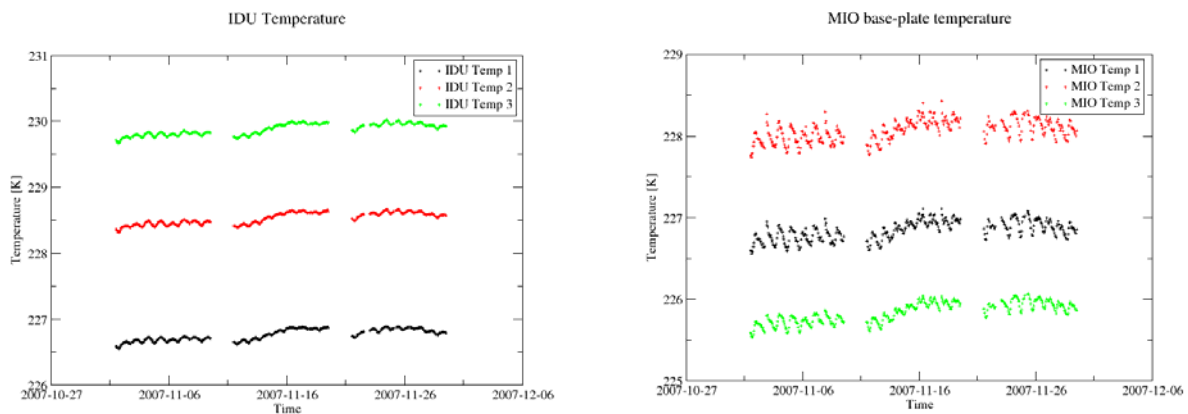
Figure 4 MIO base plate temperatures as a function of time since November 2002 (courtesy of Astrium).

The time of switch-on of the INT heater are reported in the following table.

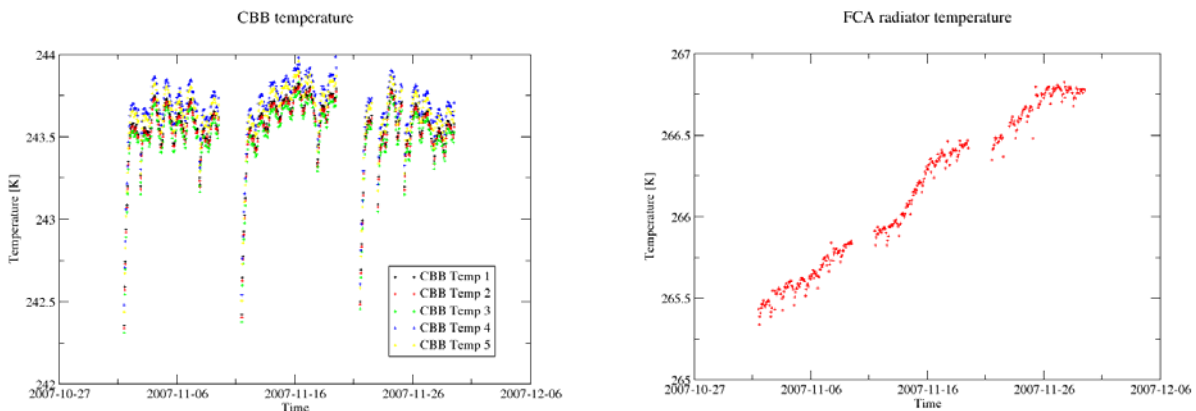
**Table 6** Schedule of interferometer heater switch-on/off.

|                   |                    |
|-------------------|--------------------|
| <b>Heater on</b>  | <b>09-Jan-2004</b> |
| <b>Heater off</b> | <b>26-Mar-2004</b> |
| <b>Heater on</b>  | <b>03-Sep-2004</b> |
| <b>Heater off</b> | <b>25-May-2005</b> |
| <b>Heater on</b>  | <b>17-Oct-2005</b> |

The monthly monitoring of the instrument temperatures is reported in the following plots, which show the IDU, MIO, CBB and FCA temperatures. These plots show a stable situation of the instrument temperature for the reporting month, the variations being always lower than 1K.



**Figure 5** IDU and MIO Base-Plate temperature during reporting period.



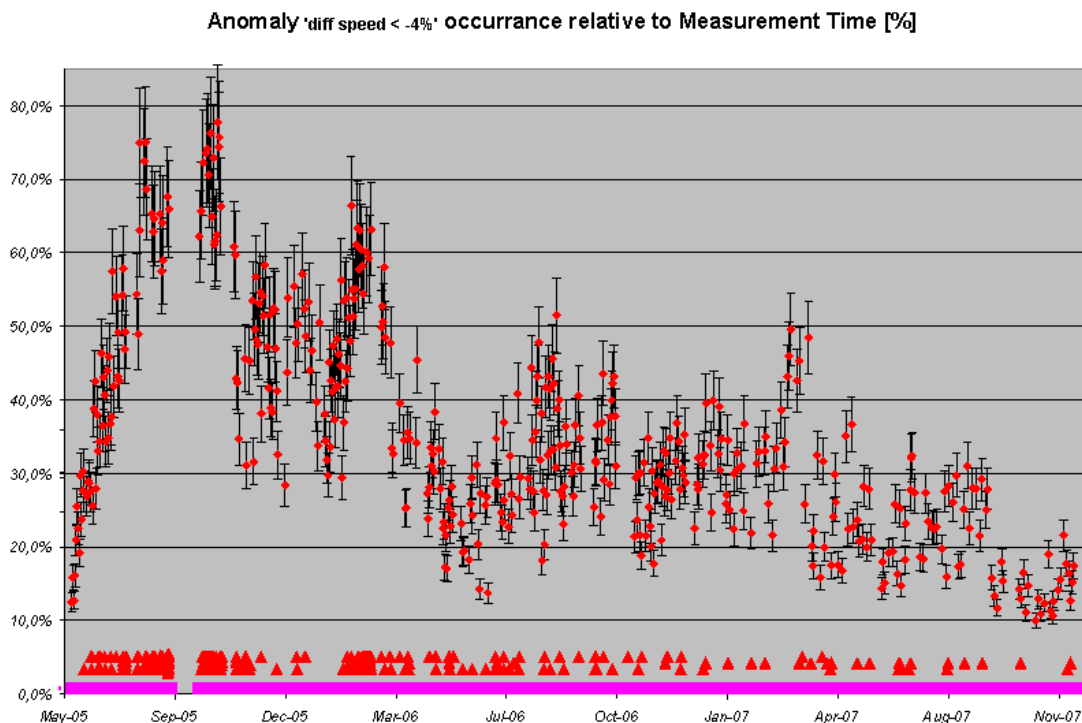
**Figure 6** CBB and FCA radiator temperature during reporting period.



### 2.3.2 INTERFEROMETER PERFORMANCE

The historical record of differential speed errors can be seen in Figure 7 (analysis carried out by Astrium). The -4% differential speed error is an indicator for non-perfections in the IDU system. This historical trend can be summarized in the following bullets:

- The very bad periods of August 2005, October 2005 and February 2006 can be distinguished. During these periods the INT velocity errors occurred with high frequency and the differential speed errors reached the maximum value of about 70%. It was noticed that when this parameter reaches this value the number of turn-around anomalies starts to increase significantly.
- The positive effect of the heater switch-on (end of October 2005) can be appreciated with a drastic reduction of the occurrence of differential speed errors.
- The impact of the ENVISAT anomaly of 6<sup>th</sup> April 2006 is manifest in this plot, this anomaly yields to improved cooler performances, due to the not intended decontamination and reflects into a significant improvement of the INT performances with a reduction of -4% differential speed errors.
- The effect of the planned decontamination of September 2006 is not visible within this plot; however it should be stressed that the instrument performances were already very good before the decontamination and the situation did not changed afterward.
- During the last months the -4% differential speed error remains constant around a value of 30%. A further reduction of this parameter is observed since Sep 2007. This observation confirms that the instrument performances remain stable despite the fact that the duty cycle was progressively increased since May 2006.



**Figure 7** Occurrence of -4% differential speed error relative to measurement time since May 2005 (courtesy of Astrium).

The historical record of the INT velocity errors since October 2005 can be seen in the Figure 8 (analysis carried out by Astrium). The following points can be highlighted from this long term monitoring:

- We observed that the occurrence of turn-around errors is drastically reduced since Oct 2005 demonstrating that the switch-on of the INT-heater, the better performances of the cooler and the frequent decontaminations improved significantly the instrument performances.
- It has to be stressed that since Oct 2006 only 1 turn-around error has been detected, while this error was the most frequent one before that date
- On the other hand the frequency of the start-up failures that occur after an instrument interruption didn't change significantly in the last months, showing that this type of error is not correlated with INT temperatures or cooler performances. The frequency of this error is closely monitored, but it is still at an acceptable level.
- In conclusion the analysis of the INT anomaly historical record demonstrates that the instrument is performing very well in the last months and that the increase of duty cycle did not affect the instrument performances.

Anomaly INT since 1.10.2005

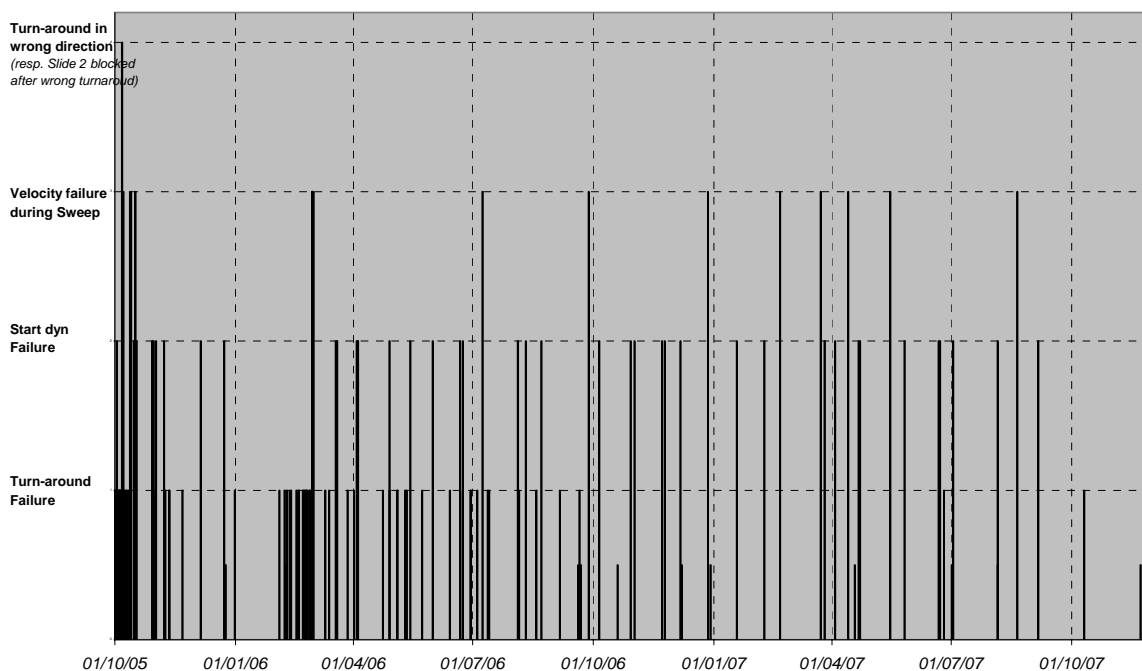


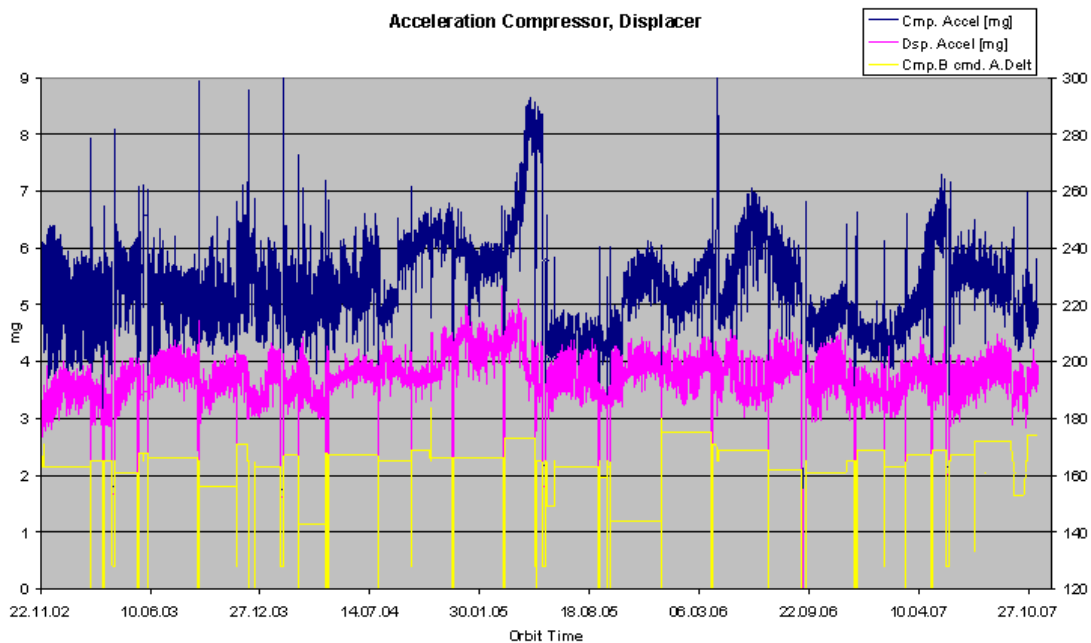
Figure 8 INT anomalies since Oct 2005 (courtesy of Astrium).

### 2.3.3 COOLER PERFORMANCE

The Figure 9 shows the cooler displacer and compressor vibration level historical trend. The variations of the cooler vibrations are linked to INT heater switch and decontamination events, the decontaminations can be planned or caused by platform switch-off. Furthermore the seasonal dependency of the cooler vibrations can be clearly appreciated, indeed the vibrations increase during the hottest period of the year (May-Jun), while are decreasing on winter time (Dec-Jan).

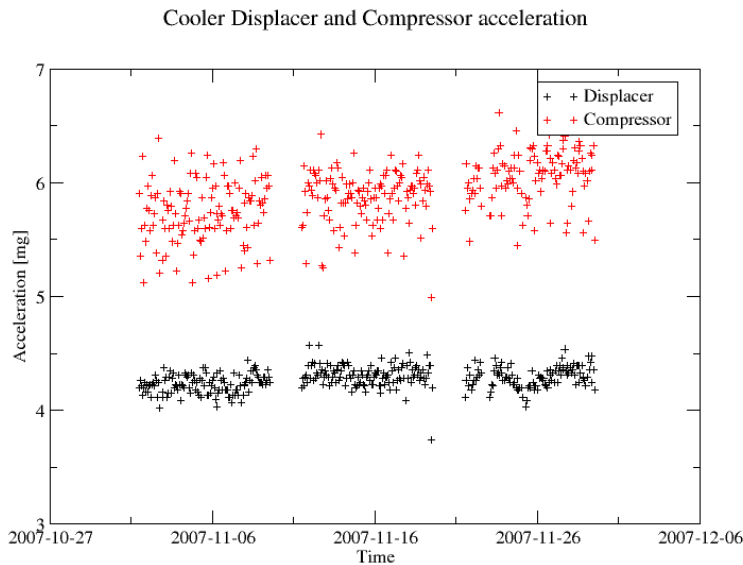
From the plot of Figure 9 the following historical events can be distinguished:

- A significant decrease of the cooler vibrations was detected on June 2005 after the decontamination and the switch-off of the INT-heater
- A slight increase of the compressor vibration by about 1 mg is observed after the switch-on of the INT heater at the end of October 2005
- An important improvement in the cooler performances with a reduction of the compressor vibration can be noticed after the ENVISAT anomaly of 6<sup>th</sup> April 2006. In fact this anomaly acts as a decontamination event and results in a significant improvement of the cooler performances.
- A significant reduction of the compressor acceleration can be observed after the decontamination of September 2006 and the PLSOL at the end of November 2006
- After the passive decontamination of June 2007 the compressor acceleration levels were reduced from about 6.8 mg to 5.6 mg and in general all the cooler parameters were significantly improved after this period.



**Figure 9** Cooler Displacer and Compressor vibration level, historical trend since 2005 (courtesy of Astrium).

The cooler acceleration levels during the reporting period were stable with values well below the warning level of 8 mg, as can be seen in the figure below.



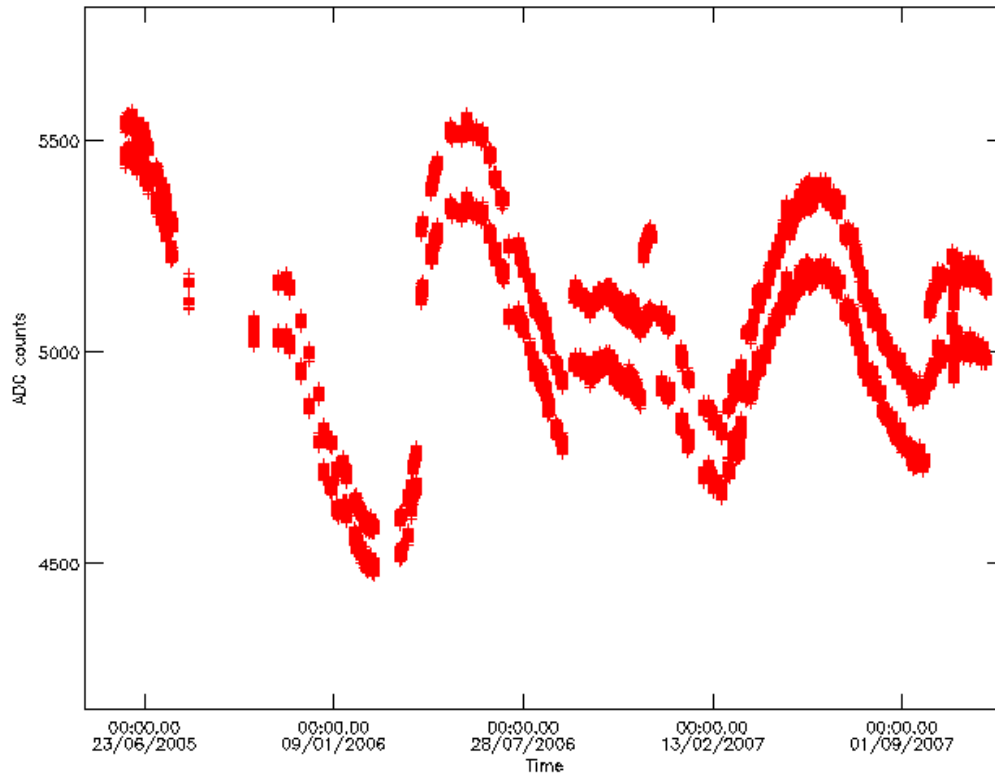
**Figure 10** Cooler displacer and compressor vibration level for the reporting month.

### 2.3.4 ADC COUNTS LONG-TERM MONITORING

The long term monitoring of the ADC Min/Max counts along the mission is presented in this paragraph. The ADC counts is monitored only for deep-space measurements, when the instrument is looking at the cold space; in fact for the rest of the measurement modes this value depends upon the measurement scenario (e.g. when looking down in the atmosphere the signal increases). The monitoring of ADC counts could give interesting insight into different instrument-related topics such as instrument self-emission, forward/reverse effects, detector non-linearity and gain increase.

The long term trend of the ADC max counts in channel A1 since June 2005 is shown in Figure 11. In this figure the seasonal variation of the instrument thermal condition is clearly visible, demonstrating the effect of instrument self-emission. The split of the curve in two is due to the forward/reverse effect and it is coming from a different sampling of the IGM at its maximum in the two directions. Another effect that is superimposed to the seasonal variation is the impact of the decontamination events and the platform switch-off with a resulting increase of the signal at the detector due to the ice removal. An example of the effect of decontamination and PLSOL can be seen in correspondence to September and December 2006.

During the reporting month the ADC counts remain relatively stable.



**Figure 11** ADC max counts in channel A1 during DS measurements since June 2005.

## 2.4 *Level 1b product quality monitoring*

### 2.4.1 PROCESSOR CONFIGURATION

#### 2.4.1.1 *Version*

The new IPF 4.67 was put into operations at D-PAC on 4<sup>th</sup> September 2006. This processor corrects for five NCRs with respect to the previous version (v4.65), further details about this release are reported in **Appendix A and F**. It is important to stress that this new release does not impact the scientific L1 products, in fact the modification implemented for L1 processing are only operational issues related to processing performances on D-PAC machine. On the contrary for L2 processing important upgrades were introduced in order to fix two anomalies (the high NO<sub>2</sub> chi-square value and the difference between 4.61 and 4.62 versions).

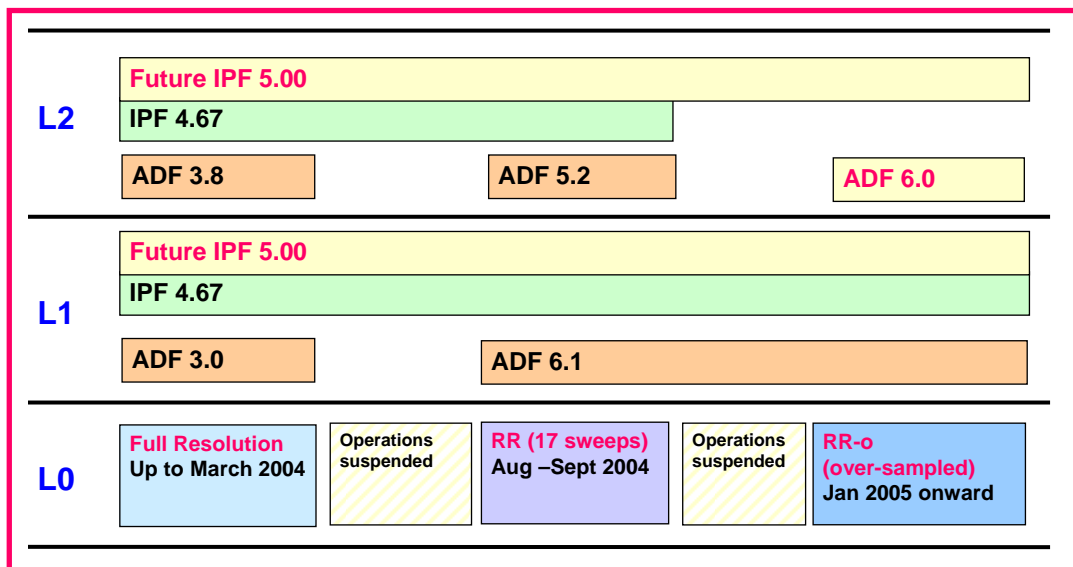
The table below shows the list of IPF updates and the aligned prototype, DPM, IODD and the related NCR/SPRs.

**Table 7** Historical updates of MIPAS processor, related prototype, DPM, IODD and NCR/SPR.

| IPF Version | Prototype |          | DPM |     | IODD |     | Processor update   |  |
|-------------|-----------|----------|-----|-----|------|-----|--|--|
|             | L1 Migsp  | L2 ml2pp | L1  | L2  | L1   | L2  | Level 1  | Level 2  |
| 4.67        | 2.6       | 4.0      | 4Ia | 4.1 | 4E   | 4.0 | Fixed <b>NCR_1594</b><br>Fixed <b>NCR_1676</b>             | Fixed <b>NCR_1458</b><br>Fixed <b>NCR_1521</b><br>Fixed <b>NCR_1522</b>                                |
| 4.65        | 2.5       | 4.0      | 4I  | 4.1 | 4E   | 4.0 |  | Fixed <b>NCR_1310</b>  |
| 4.64        | 2.5       | 4.0      | 4I  | 4.1 | 4E   | 4.0 | Fixed <b>SPR-12100-2011</b>                                |  |
| 4.63        | 2.5       | 4.0      | 4I  | 4.1 | 4E   | 4.0 | Fixed <b>SPR-12000-2000</b><br>Fixed <b>SPR-12000-2001</b> | Fixed <b>NCR_1278</b><br>Fixed <b>NCR_1308</b><br>Rejected <b>NCR_1310</b><br>Rejected <b>NCR_1317</b> |
| 4.62        | 2.5       | 4.0      | 4H  | 4.0 | 4E   | 4.0 | Fixed <b>NCR_1157</b><br>Fixed <b>NCR_1259</b>             | Fixed <b>NCR_1128</b><br>Fixed <b>NCR_1275</b><br>Fixed <b>NCR_1276</b>                                |

The historical updates in the MIPAS L1 processor are detailed in *Appendix A* with all the information on the related NCRs and SPRs.

The Figure 12 shows the alignment between the measurement mode (full resolution, RR with 17 sweeps and over-sampled RR) and the corresponding valid IPF and ADF for the L1 and L2 processing.



**Figure 12** IPF and ADF validity for processing level 1 and level 2 products. IPF 4.62 – 4.61 were used for re-processing of FR mission, while the IPF 4.67 is now operational at D-PAC for OFL processing of RR mission. IPF 5.00 is the future IPF that will be used for OFL processing and for reprocessing of the whole mission. IPF 5.0 will be the only one able to process RR over-sampled measurements up to L2.

The historical update of the IPF at each processing site is shown in the following table.

**Table 8** Historical updates of MIPAS processor at near real time (NRT) processing sites (PDHS-K and PDHS-E) and OFL processing sites (LRAC and D-PAC), in red is the current operational IPF.

| Centre       | Facility Software | Date              |
|--------------|-------------------|-------------------|
| <b>D-PAC</b> | <b>V4.67</b>      | <b>04-09-2006</b> |
| D-PAC        | V4.65             | 09-02-2006        |
| D-PAC        | V4.62             | 06-09-2004        |
| LRAC         | V4.62             | 02-09-2004        |
| D-PAC        | V4.61             | 15-03-2004        |
| LRAC         | V4.61             | 18-03-2004        |
| PDHS-K       | V4.61             | 17-03-2004        |
| PDHS-E       | V4.61             | 17-03-2004        |
| LRAC         | V4.59             | 20-08-2003        |
| D-PAC        | V4.59             | 06-08-2003        |
| PDHS-K       | V4.59             | 23-07-2003        |
| PDHS-E       | V4.59             | 23-07-2003        |
| PDHS-K       | V4.57             | 22-07-2003        |
| LRAC         | V4.57             | 22-07-2003        |
| PDHS-K       | V4.59             | 21-07-2003        |
| LRAC         | V4.59             | 21-07-2003        |
| LRAC         | V4.57             | 19-03-2003        |
| PDHS-K       | V4.57             | 18-03-2003        |
| D-PAC        | V4.57             | 05-03-2003        |
| PDHS-E       | V4.57             | 04-03-2003        |

#### 2.4.1.2 Auxiliary Data Files

The strategy for the level 1 ADFs update is as follows:

- The MIP\_CO1\_AX, MIP\_CG1\_AX and MIP\_CS1\_AX are updated every week and after a long detectors/cooler switch-off or after a long unavailability
- The MIP\_CL1\_AX is analyzed every two weeks and updated when the pointing error differs with respect to the last disseminated by more than 8 mdeg.
- The MIP\_PS1\_AX is updated every time there is a setting update.
- The MIP\_MW1\_AX is updated when the micro-window is changed.
- The MIP\_CA1\_AX is updated when new characterization parameters are defined.

The level 1 ADF files generated and disseminated during the reporting month are listed in the following table.

**Table 9** Level 1 ADFs valid in December 2006.

| Auxiliary Data File   | Start Validity | Stop Validity | Updated during this month |
|---|----------------|---------------|---------------------------|
| V6.1<br>MIP_MW1_AXVIEC20050627_094928_20040809_000000_20090809_000000<br>MIP_PS1_AXVIEC20050627_100609_20040809_000000_20090809_000000<br>MIP_CA1_AXVIEC20050627_094412_20040809_000000_20090809_000000 | 08-JAN-05      | 08-JAN-09     | No                        |
| MIP_CL1_AXVIEC20050420_152028_20050420_095747_20100420_095747   | 20-APR-05      | 20-APR-10     | No                        |
| MIP_CS1_AXVIEC20071107_074035_20071101_000000_20121101_000000<br>MIP_CG1_AXVIEC20071107_075301_20071101_000000_20121101_000000<br>MIP_CO1_AXVIEC20071107_172740_20071101_000000_20121101_000000         | 01-NOV-07      | 01-NOV-12     | Yes                       |
| MIP_CG1_AXVIEC20071113_171050_20071111_000000_20121111_000000<br>MIP_CO1_AXVIEC20071113_150141_20071111_000000_20121111_000000<br>MIP_CS1_AXVIEC20071113_172718_20071111_000000_20121111_000000         | 11-NOV-07      | 11-NOV-12     | Yes                       |
| MIP_CG1_AXVIEC20071123_150607_20071121_000000_20121121_000000<br>MIP_CO1_AXVIEC20071123_150102_20071121_000000_20121121_000000<br>MIP_CS1_AXVIEC20071123_151524_20071121_000000_20121121_000000         | 21-NOV-07      | 21-NOV-12     | Yes                       |

The characterization level 1 ADFs (MIP\_PS1\_AX, MIP\_CA1\_AX, MIP\_MW1\_AX) are generated by Bomem. The following table illustrates the history of level 1 ADF deliveries, more details can be found in *Appendix B*.

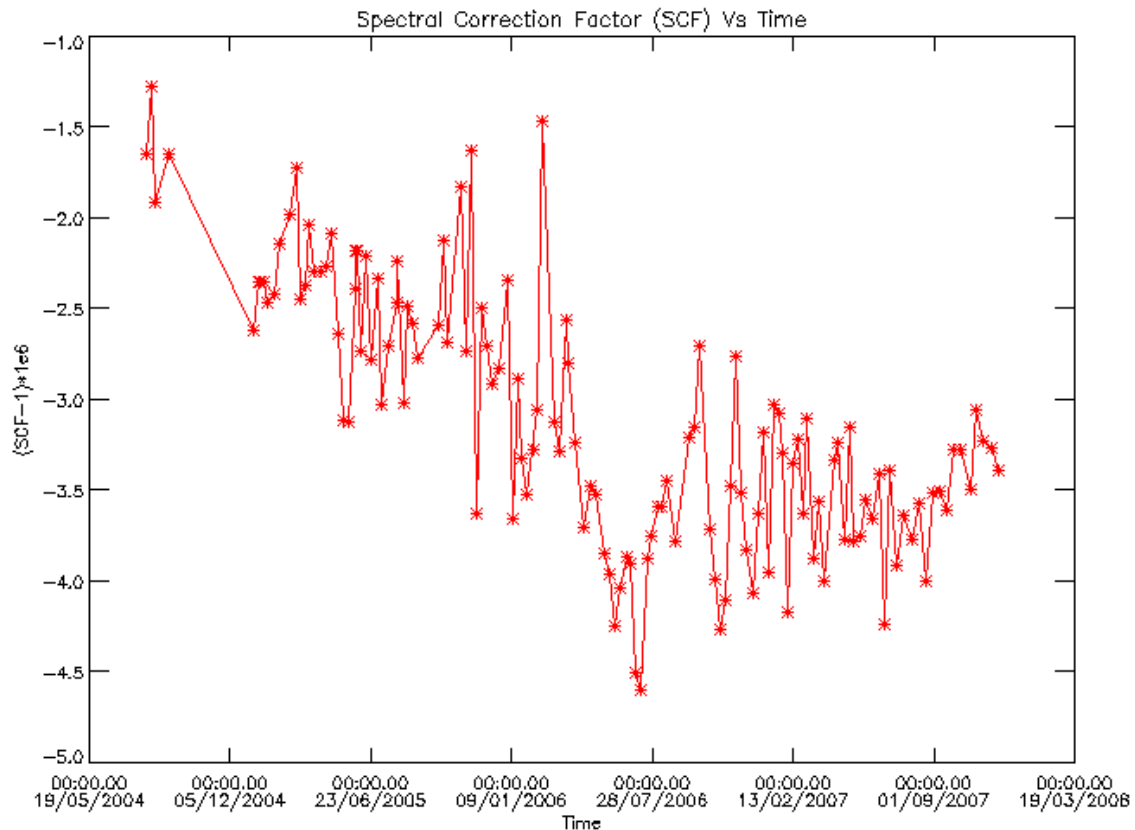
**Table 10** Historical deliveries of level 1 ADF by Bomem

| ADFs Version | Updated ADF                            | Start Validity Date | IPF version | Dissemination date |
|--------------|--|---------------------|-------------|--------------------|
| 6.1          | MIP_PS1_AX                             | 09-Aug-2004         | 4.63        | 27-Jun-2005        |
| 6.0          | MIP_PS1_AX                             | Not disseminated    | 4.63        | -                  |
| 5.0 draft    | MIP_PS1_AX                             | Not disseminated    | 4.63        | -                  |
| 4.1 TDS6     | MIP_PS1_AX                             | 09- Aug-2004        | 4.63        | 15-Mar-2005        |
| 4.0 draft    | MIP_PS1_AX                             | Not disseminated    | 4.62        | -                  |
| 3.2          | MIP_PS1_AX                             | 26-Mar-2004         | 4.61        | 21-Apr-2004        |
| 3.1          | MIP_PS1_AX                             | 09-Jan-2004         | 4.61        | 17-Mar-2004        |
| 3.0          | MIP_CA1_AX<br>MIP_MW1_AX<br>MIP_PS1_AX | April-2002          | 4.61        | 4-Nov-2003         |

## 2.4.2 SPECTRAL PERFORMANCE

The calibration file MIP\_CS1\_AX contains the linear spectral correction factor (SCF), which compensates for variations in the instrument metrology (e.g.: aging of the laser). Figure 13 gives the variation trend over the RR mission (from August 2004). We observe a very stable situation since the variations are of the order of 3 ppm over almost two years of operations. A decreasing trend can be observed, even though the spreading of the points is large due to noise in the determination of this parameter.





**Figure 13** MIPAS Spectral Calibration Factor (SCF) since August 2004.

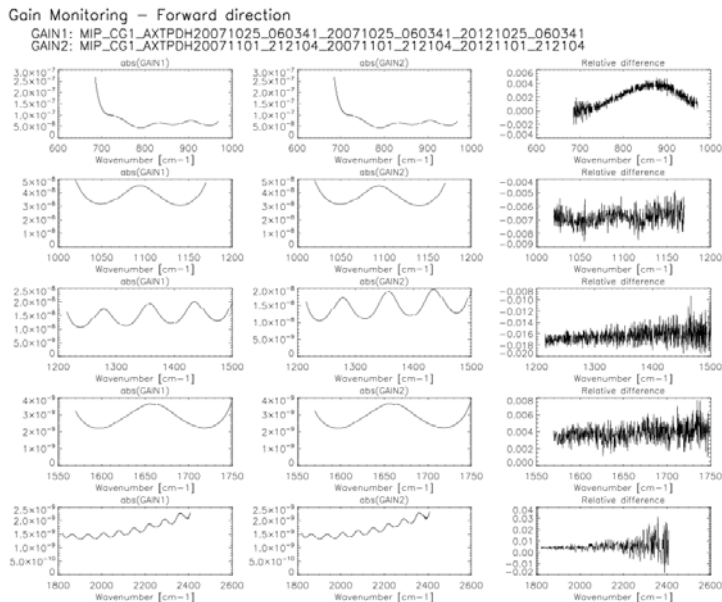
### 2.4.3 RADIOMETRIC PERFORMANCE

The radiometric calibration is performed on a weekly basis, furthermore the gain is always updated after long mission interruption, in case of instrument anomalies or when the instrument thermal conditions change (e.g.: heater or cooler switching). The maximum of the gain increase between two consecutive disseminated gains in the band A (where we expect the maximum of gain variation due to ice contamination) is closely monitored. The increase of gain in band A is expected to be less than 1%/week at its maximum.

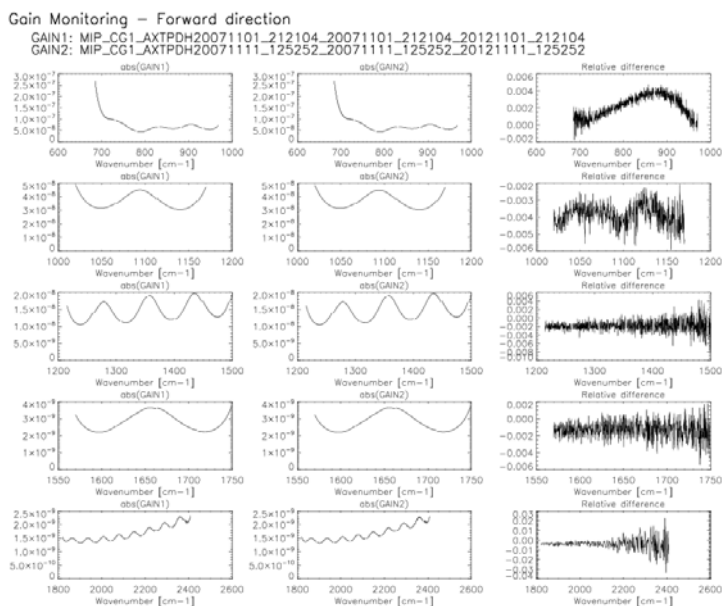
#### 2.4.3.1 Weekly monitoring

During the reporting month the weekly gain trend was nominally monitored. The following plots show the relative changes of gain for the reporting month, it can be observed that the maximum increase in the *band A* between two consecutive gains remains well below the expected level of 1%/week. The other bands show similar gain variations. Some non-corrected spikes are observed on

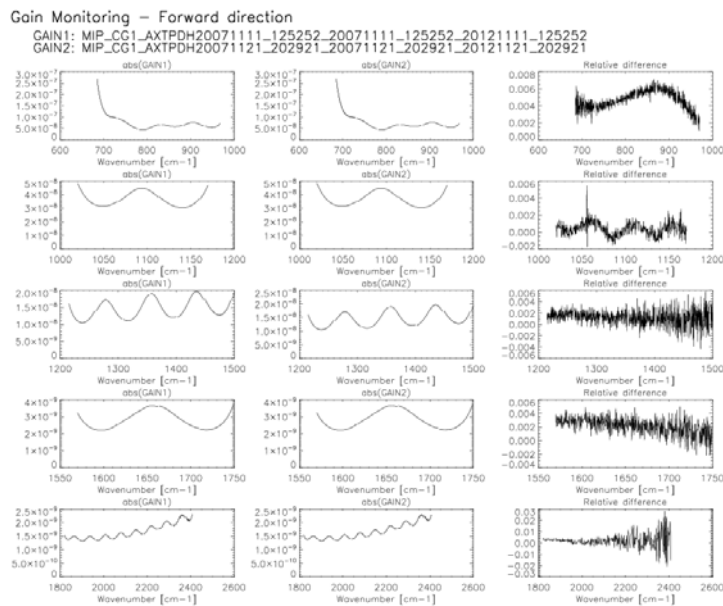
band AB and B always at the same spectral position, this behavior is well known and is due to the aliasing spike caused by the on-board IGM rounding and decimation.



**Figure 14** Relative variations of radiometric gain for consecutive disseminated gains in band A for the forward direction. The first two plots in each row are the complex modulus of the gain for each of the 5 MIPAS bands, the third plot is the ratio:  $(abs(GAIN2) - abs(GAIN1)) / abs(GAIN1)$ . This plot refers to a gain measured on 1<sup>st</sup> Nov 2007.



**Figure 15** The same as Figure 14 but for a gain measured on 11 Nov 2007.



**Figure 16** The same as Figure 14 but for a gain measured on 21 Nov 2007.

The maximum of gain increase is obtained as the maximum of the curves of gain relative difference presented in the previous plots. The maxima in *band A* are reported in Table 11. In this table it is also reported the long term increase, in this case we use as a reference a gain corresponding to low contaminated conditions. Note that the reference gain was changed on September 2006 after the planned decontamination.

From this table we can see that the maximum of gain variation was always lower than the acceptance level.

**Table 11** Weekly and long term gain increase for gains disseminated during the reporting month in *band A*.

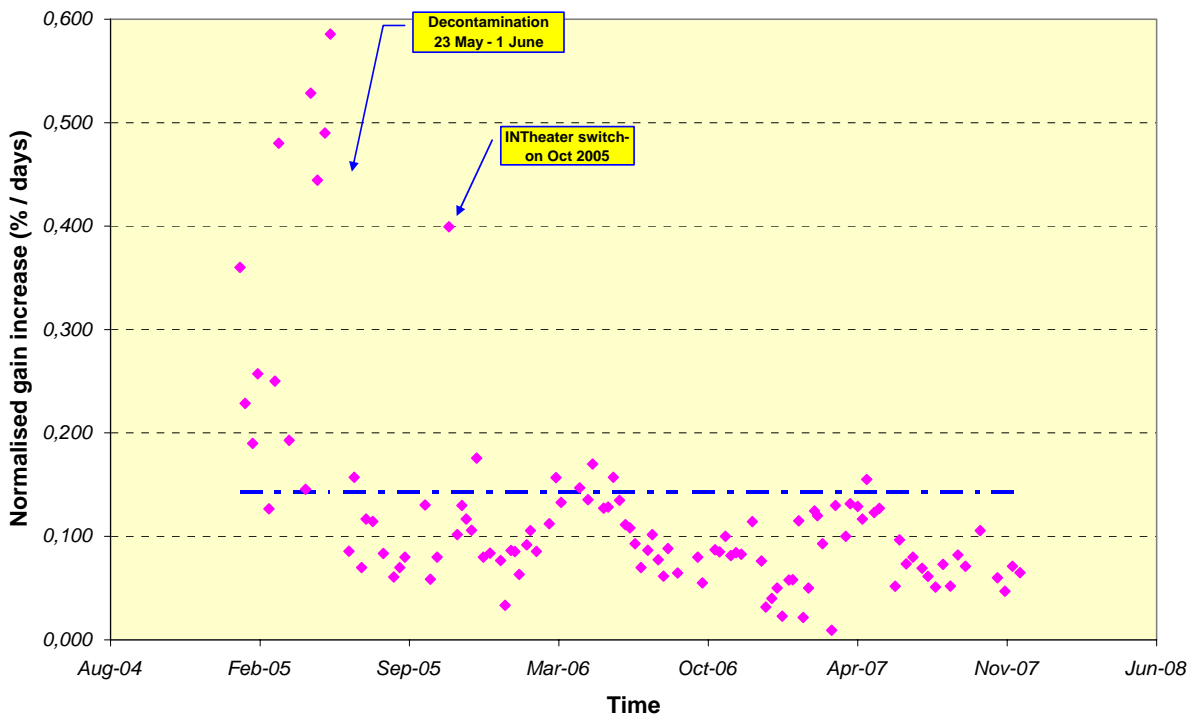
| Orbit # | Date       | Weekly max increase (%) | Long term max increase <sup>1</sup> (%) |
|---------|------------|-------------------------|---|
| 29644   | 01/11/2007 | 0,48                    | 2,45                                    |
| 29787   | 11/11/2007 | 0,47                    | 2,68                                    |
| 29931   | 21/11/2007 | 0,71                    | 3,28                                    |

### 2.4.3.2 Long term monitoring

The long term plot of gain changes in *band A* between two consecutive disseminated gains is shown in Figure 17; in this figure the maximum of gain increase is normalized with respect to the time between two consecutive gains. The acceptance criterion of 1% of weekly increase is reported in the

<sup>1</sup> Note that the long term increase is calculated using a different reference gain function, therefore this value doesn't correspond to a cumulative sum of the weekly increase.

plot with the dash-dotted blue line. The anomalous increase of gain during Jan – May 2005 can be observed in this figure. After the decontamination (end of May 2005) the gain rate suddenly decreases and it remains always lower than the acceptance level unless some peaks due to instrument temperatures changes, instrument outages or decontamination. Note that these variations are not presented in this plot since at this stage the goal is only to verify that the acceptance criterion of 1% of weekly increase is verified in nominal condition (e.g. excluding mission interruption or decontamination events). The effect of decontamination and changes in the instrument thermal conditions can be appreciated by analyzing the accumulation of gain over time as discussed in the next paragraph.



**Figure 17** Gain maximum increase normalized to the time difference between consecutive disseminated gains since January 2005.

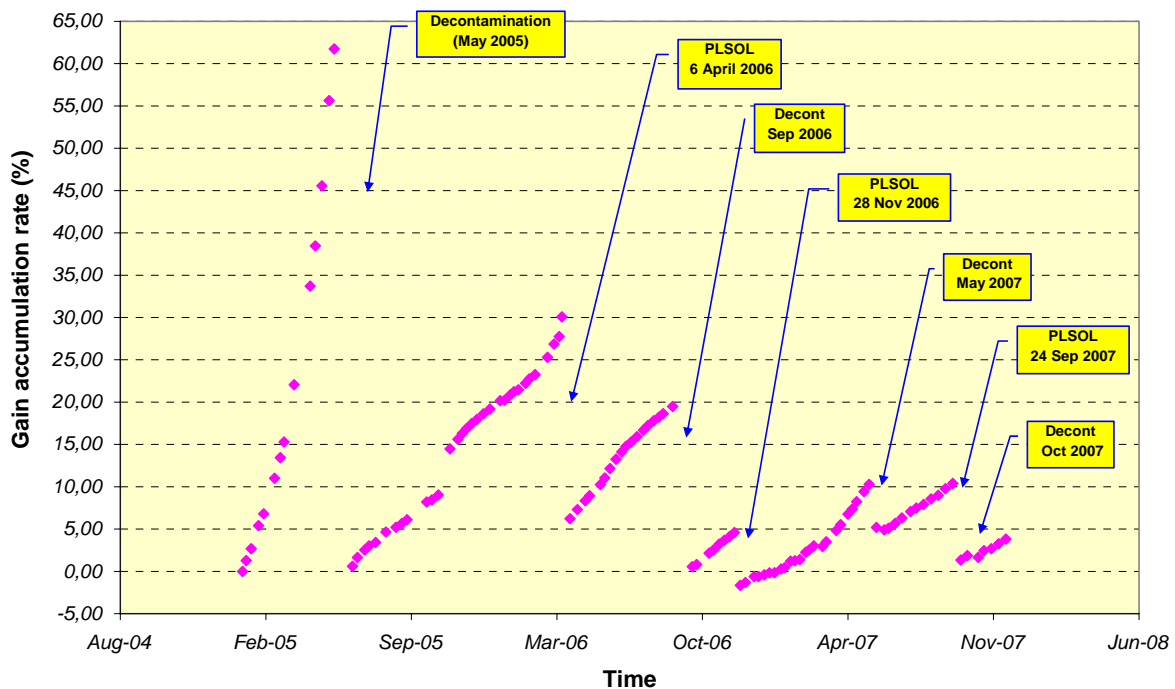
The long term monitoring of the gain accumulation increase in band A is presented in Figure 18. This plot shows the increase of gain taking as reference the first calibration orbit of Jan 2005 for the period Jan – May 2005 and the first orbit of June 2005 for the period June 2005 – September 2006. The reference gain was updated after the planned decontamination of September 2006. This long term investigation is useful in order to plan possible decontamination along the mission. As suggested by M. Birk (DLR) the decontamination should be planned when the gain has increased by more than 20% in order to prevent NESR value to become not acceptable for level 2 products retrieval precision. The following main points can be highlighted in this figure:

- The very high increase of gain during the period Jan – May 2005. At the end of this period the gain increase reached a value of about 60%. The situation was resolved with the decontamination of June 2005.
- The linear increase of gain in the period Jun-Oct 2005.

- A sudden increase of gain due to the INT heater switch-on of October 2005.
- The significant decrease of gain after the PLSOL of April 2006 was due to the platform (and cooler) switch-off and the consequent warming up of the detector. As a result the gain was dramatically reduced by more than 25%. After this non-intended decontamination the gain increased with a constant slope up to September 2006.
- The decrease of gain by about 10% after the decontamination of September 2006 and the PLSOL of 28<sup>th</sup> November 2006.
- The decrease of gain by about 5% after the decontamination planned at the beginning of June 2007 and the other decrease due to the PLSOL of end September 2007. A slight gain decrease was also obtained with the passive decontamination planned on October 2007.

As a result of this analysis the following conclusions can be drawn:

- Planned decontamination and platform switch-off always cause an ice removal from the detector and a consequent increase of the signal; as a result the gain factor is reduced.
- The dramatic increase of gain that was observed at the beginning of 2005 was never observed again due to the improvement of the cooler performances obtained with more frequent decontaminations.
- The slope of the gain increase is progressively decreasing in the last months demonstrating that the detector is more and more “ice-free”.
- The slope of the curve of the gain accumulation rate is closely related to the performances of the cooler.



**Figure 18** Gain accumulation increase since January 2005.

### 2.4.3.3 Interpolated gains

During the period January-May 2005, a strong gain increase was observed in the gain variation, as observed in the previous paragraph. This increase acts on the data quality in two ways:

- If the gain functions are only determined once per week, the drift leads to a scaling error in the calibrated spectra of up to 3.5 % in band A.
- The increase of the gain function corresponds to a decrease of the instrument response. This also decreases the signal-to-noise-ratio and leads to higher NESR-values.

In order to reduce the scaling error in the calibrated spectra the solution was to calculate and disseminate further gain values in between the already disseminated ones in order to comply with the condition for the gain weekly increase to be lower than 1%. This gain reprocessing has been done with the support of Bomem and the results are reported in *Appendix C*.

### 2.4.4 POINTING PERFORMANCE

The LOS calibration measurements are performed every week and the mispointing is analyzed on a bi-weekly basis. This plan allows the pointing stability to be analyzed and guarantees the availability of the data in case of missing products. The baseline for LOS calibration is now that the absolute bias is compared to the last disseminated one, then a new LOS calibration ADF is disseminated only if the difference between the two is a higher than **8 mdeg**.

The long term trend of mispointing since start of mission is reported in Figure 19. The figure shows the absolute pointing error (evaluated taking into account the commanded elevation angle for the LOS calibration). The very pronounced annual trend at the beginning of the mission was not due to the MIPAS instrument itself, but to a mispointing of the entire ENVISAT platform resulting from the software response to orbit control information. In fact, after the update of the pointing software (December 2003) the deviation trend was drastically reduced. During the last months the absolute bias is stable around a value of -25 mdeg with a seasonal oscillation.

The problem observed during October 2006 on LOS calibration, namely the increase of noise in channel D2 with a resulting degradation of the star signal is still present. In fact the number of available stars for the mispointing determination is much lower than one year ago (in average 3-5 stars are now available).

During the reporting month the calculated absolute bias remain in the range [-25:-30] mdeg. So far no results are available concerning sideways LOS calibrations that have been routinely planned since March 2007. The problem in processing the sideways data is the poor signal recorded. The acquisition and processing status of the LOS calibration for the reporting month is presented in the next table.

**Table 12** LOS calibrations performed during the reporting period, in red are the sideways LOS.

| Date       | Orbit       | Type | Acquisition and processing status | Absolute error [deg] |
|------------|-------------|------|-----------------------------------|----------------------|
| 02/11/2007 | 29662-29663 | rear | Processed 6 stars                 | -0,028165            |
| 12/11/2007 | 29805       | side | Processing failure, only noise    | /                    |
| 17/11/2007 | 29877-29878 | rear | Processed 7 stars                 | -0,025258            |
| 27/11/2007 | 30020       | side | PDS failure                       | /                    |

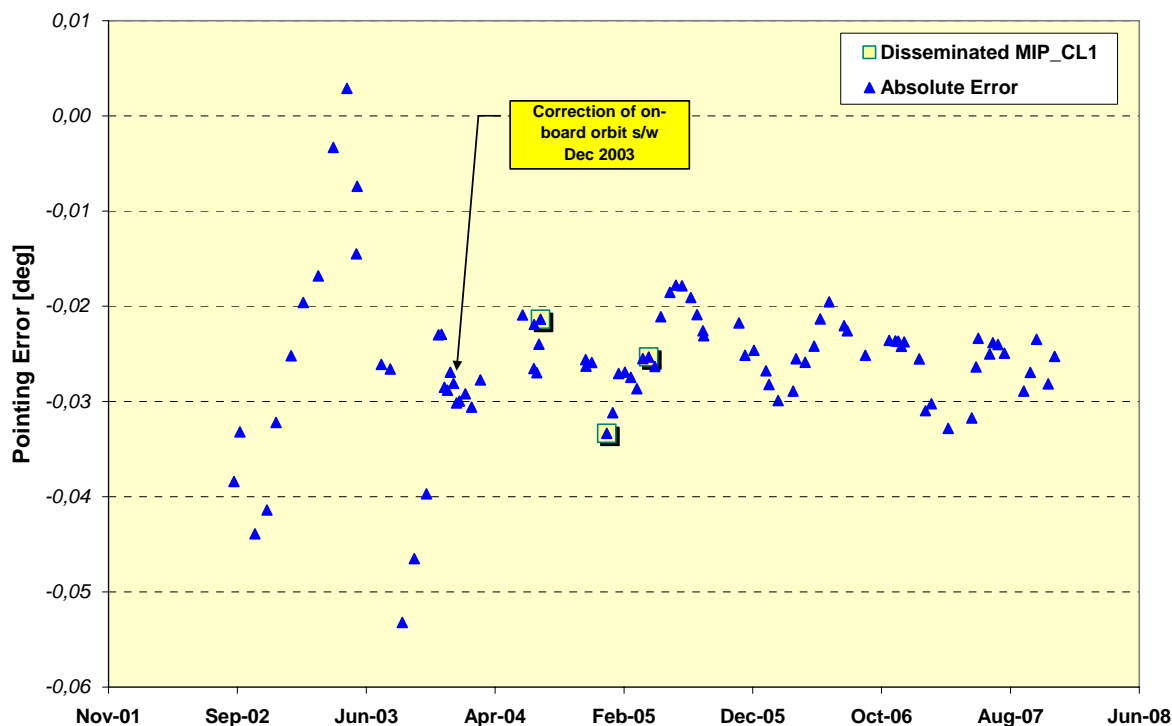


Figure 19 MIPAS long-term pointing error as a function of time since September 2002.

Table 13 shows the history of the commanded angle for LOS measurements. Starting from the second part of September 2003, only measurements from channel D2 are processed because of the increased noise affecting channel D1. In order to reduce that noise, from 21 November 2004 (orbit 14265), the planning strategy for LOS measurements has been changed and the number of observations per star has been doubled.

Table 13 LOS commanded angle updates.

| Start Date  | Start Orbit | Stop Date   | Stop Orbit | Angle [mdeg] |
|-------------|-------------|-------------|------------|--------------|
| beginning   | /           | 28 Sep 2002 | 3024       | 0            |
| 05 Oct 2002 | 3123        | 26 Oct 2002 | 3424       | - 22         |
| 02 Nov 2002 | 3524        | 30 Nov 2002 | 3926       | - 25         |
| 07 Dec 2002 | 4025        | 01 Nov 2003 | 8738       | - 40         |
| 08 Nov 2003 | 8835        | 08 Nov 2003 | 8836       | - 25         |
| 10 Nov 2003 | 8864        | 10 Nov 2003 | 8865       | 0            |
| 15 Nov 2003 | 8934        | 6 Mar 2004  | 10538      | - 25         |
| 13 Mar 2004 | 10639       | 20 Nov 2004 | 14250      | 0            |
| 21 Nov 2004 | 14265       | /           | /          | - 30         |

## 2.4.5 QUALITY CONTROL OF L1 OFL DATA

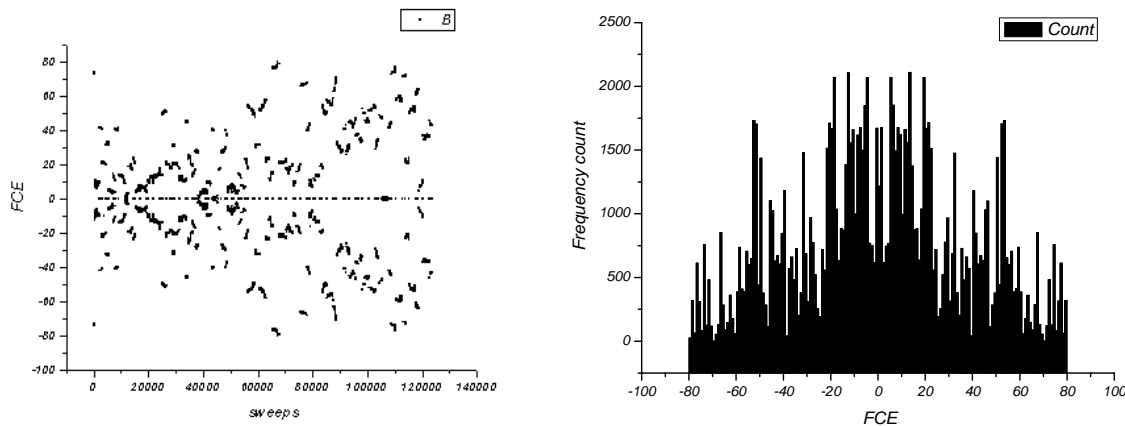
The quality control of L1 data processed at D-PAC is going-on in parallel with the OFL processing, the L1b daily report are uploaded on the web as soon as they are generated, they can be accessed at the following address:

[http://earth.esa.int/pcs/envisat/mipas/reports/daily/Level\\_1\\_OFL/](http://earth.esa.int/pcs/envisat/mipas/reports/daily/Level_1_OFL/)

### 2.4.5.1 FCE monitoring

The number of fringe count error (FCE) represents the number of points for which the measured IGM should be translated in order to match the reference IGM. As reference IGM we use the gain that is updated on a weekly basis. FCE are detected by the L1b processor and corrected, therefore no impact on the data quality is expected. A long term monitoring of the detected/corrected FCE was proposed during QWG#10 aiming at the verification of the FCE stability over time. A statistical approach based on the distribution of FCE was proposed. The outline of this approach is reported in this paragraph together with the results.

As a first step all the FCE values since Jan 2005 were analyzed on a monthly basis and the frequency distribution of the FCE was investigated. An example of the total number and frequency distribution of the FCE of one month of data is reported in the following figure.



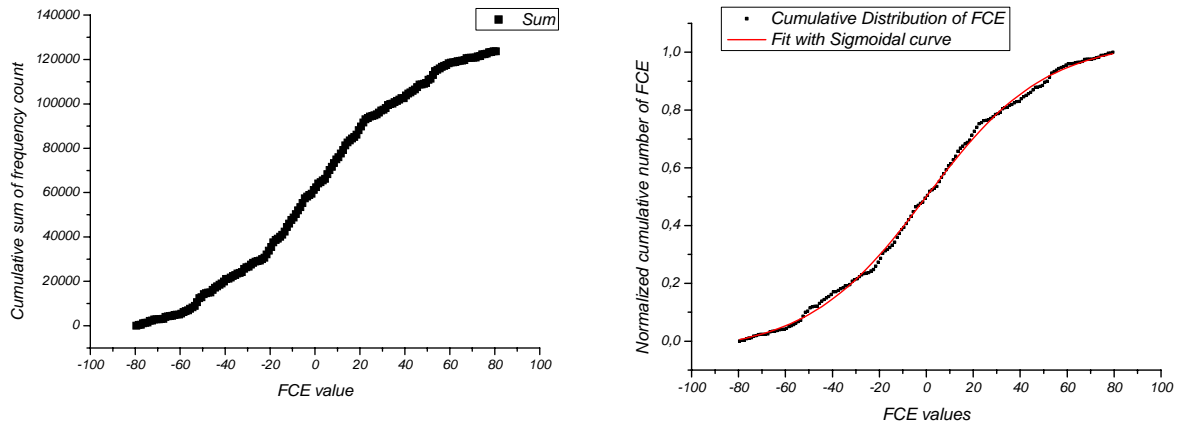
**Figure 20** FCE values for one month of measurements and corresponding frequency distribution,

In order to quantify the dispersion of the frequency distribution around the mean we decide to consider the cumulative distribution function of the FCE and fit it with a sigmoid curve. The

following expression was used to represent the sigmoid curve,  $F(x) = A2 \frac{(A1 - A2)}{1 + e^{-\frac{(x-x_0)}{s}}}$ , where  $x_0$  is

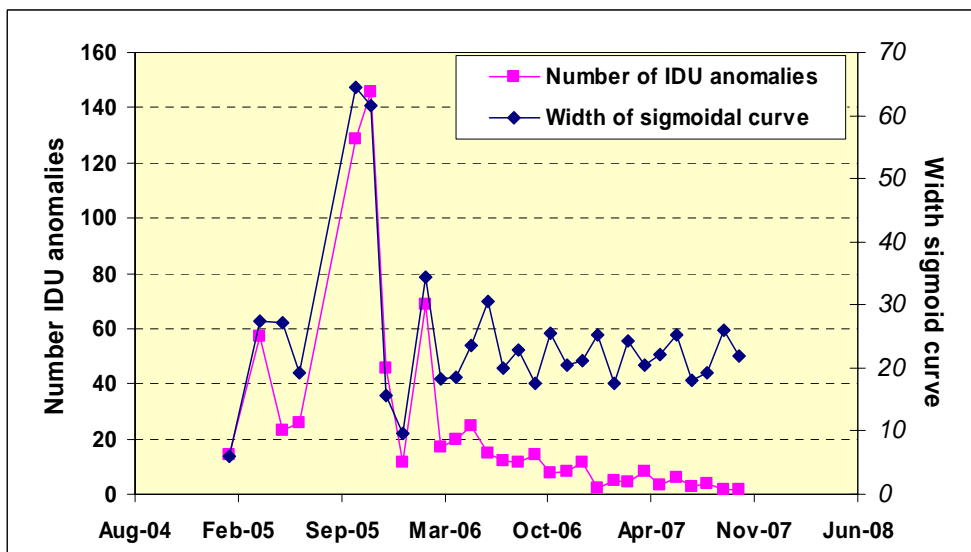
the mean of the distribution, and  $s$  gives an indication of the slope of the sigmoid curve. An example of a typical cumulative distribution function and of the fitted curve is reported in the next figure.





**Figure 21** Cumulative distributions function of the FCE for one month of data. The fit with a sigmoid curve is reported on the right side.

The value of  $s$  in the expression of the fitted sigmoid curve gives an indication of the width of the probability distribution. As  $s$  is decreasing we approach a step-like curve, while the curve is close to be a straight line when  $s$  is very high. In other terms when  $s$  is really small we expect a distribution similar to a delta function, while when  $s$  is high we approach a bell-like curve. Therefore the parameter  $s$  can be seen as a measure of the dispersion of the points around the mean. The value of this parameter was calculated for every month since Jan 2005 and it is reported in Figure 22 together with the number of IDU errors. This figure shows that the width of the FCE distribution is highly correlated with the number of IDU errors up to May 2006, while in the last months no clear correlation can be observed. The dependency of the FCE on the IDU temperature needs to be investigated in more details.



**Figure 22** Width of the sigmoid curve (used to fit the FCE statistic distribution) plotted on a long term basis together with the number of IDU errors.

### 2.4.5.2 Spikes monitoring

During QWG#11 it was suggested to investigate the number of spikes detected in each MIPAS detectors. We recall here that the presence of spikes in an interferogram can be caused by cosmic radiation or transmission errors. Since the presence of a spike in the IGM will give an artefact (sinusoidal component) in the Fourier transformed spectrum, the scene IGM affected by a spike are corrected during the L1b processing by taking the mean between adjacent non affected points. Note that when a spike is detected during black body or deep space calibration measurement the corresponding IGM is discarded in order to avoid contamination in the co-addition of IGM. The L1 processor reports in the L1 products the number of detected and corrected spike for each measured scene IGM. This number was used to derive a long term statistic of detected spikes for each channel. The results are presented in Figure 23 and Figure 24 for the RR mission (starting from January 2005) in terms of percentage of sweeps affected by spikes and number of spikes/sweep. The channel C and D are the ones most affected by spikes, since they are more sensitive to high energy particle generated by cosmic rays.

A significant variability of the number of detected spikes can be observed in channels A1, A2, B1 and B2, this could be related to variation in the solar activity, but this correlation is still under investigation. The channels C and D (the detector most affected by spikes) didn't show any significant trend. In general the percentage of sweeps affected by spikes is small for the most important MIPAS bands (A, AB) while it is about 3% for band D; however the number of detected spikes is always very low for all the MIPAS bands. Finally taking into account that the spike's signal is smoothed out by the L1 processing we can conclude that the presence of spikes does not impact the quality of MIPAS L1 data.

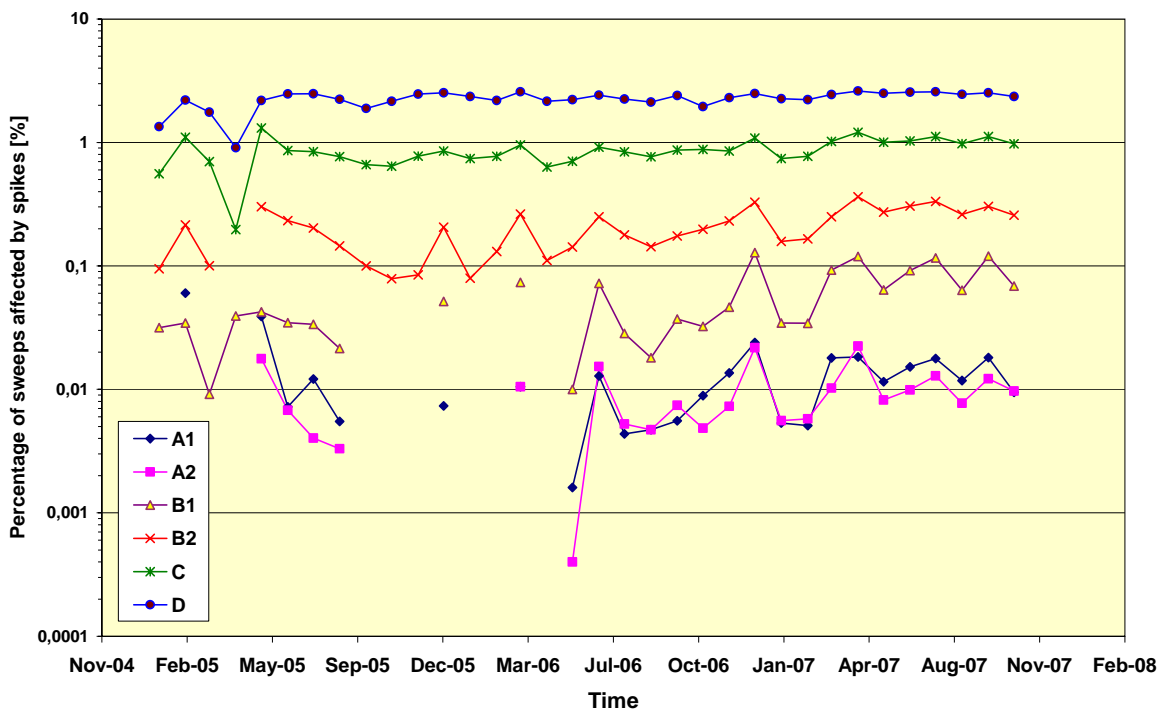


Figure 23 MIPAS long-term monitoring of spikes: percentage of spike-affected sweeps.

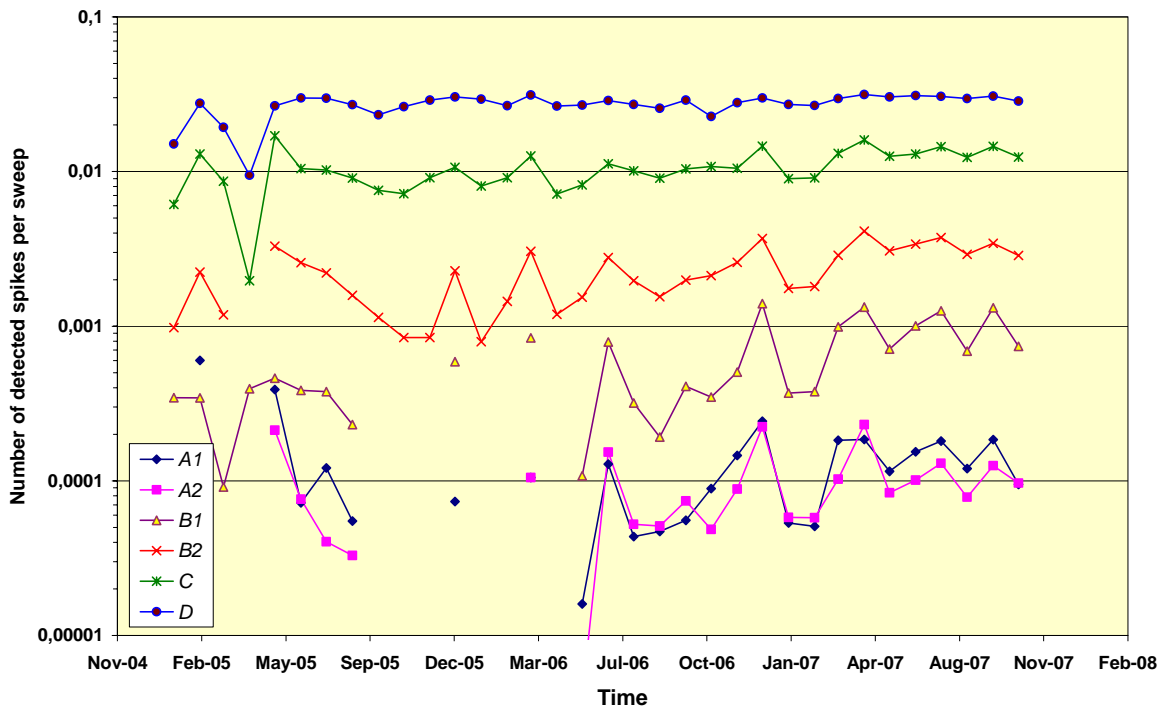


Figure 24 MIPAS long-term monitoring of spikes: number of detected spikes per sweep.

## 2.4.6 LEVEL 0 AND LEVEL 1 ANOMALY STATUS

The following table summarizes the anomalies affecting Level 0 and Level 1 products and shows the associated SPR, NCR, OAR and HD code, more details on anomalies investigation are reported in §3.4.

Table 14 Level 0 and Level 1 anomaly list. Refer to the appendices for further details on anomaly investigation.

| Anomaly  | Proto/DPM<br>SPR | IPF<br>NCR | OAR  | HD | Status                       | Ref.   |
|--|------------------|------------|------|----|------------------------------|--------|
| MIPAS wrong consolidated products  | /                | /          | 2097 | /  | Closed                       | §3.4.1 |
| Excessive number of MISSING ISPS in the MPH for MIPAS L0 products          | /                | /          | 2165 | /  | Closed and corrected         | §3.4.2 |
| Non-valid band A at the same geo-location                                  | /                | 1594       | 2263 | /  | Closed corrected in IPF 4.67 | §3.4.3 |
| Wrong MIPAS L1 product in D-PAC server                                     | /                | /          | 2303 | /  | Closed                       | §3.4.4 |
| Badly calibrated L1 b spectra during 3 – 23 June and 29 July – 11 Aug 2005 | /                | /          | /    | /  | Closed                       | §3.4.5 |
| MIPAS Aircraft Emission measurements                                       | /                | /          | /    | /  | Closed                       | §3.4.6 |

|                                      |   |   |   |   |        |         |
|--------------------------------------|---|---|---|---|--------|---------|
| Wrongly calibrated MIPAS L1 products | / | / | / | / | Closed | \$3.4.7 |
| Anomalous scan pattern               | / | / | / | / | Closed | \$3.4.8 |

## 2.5 Level 2 product quality monitoring

### 2.5.1 PROCESSOR CONFIGURATION

#### 2.5.1.1 Version

The list of IPF updates and the aligned DPM and the related NCR/SPRs is presented in the paragraph 2.4.1. The historical updates in the MIPAS Level 2 processor are listed in detail in *Appendix F*.

#### 2.5.1.2 Auxiliary Data Files

This paragraph reports the historical update of the level 2 ADF. The latest delivery for processing FR mission is the v3.8, whereas for the processing of RR data of Aug 2004 the latest delivery is the v5.2. The ADF version 5.2 was used for the L2 processing of RR not over-sampled data (Aug – Sept 2004). Further details on the Level 2 ADF deliveries provided by IFAC are reported in §3.6.

**Table 15.** Historical update of Level 2 configuration ADFs.

| Version  | Date of delivery | List of files upgraded by IFAC   | Main modifications  |
|----------|------------------|--|---|
| ADF V5.2 | 05.12.2005       | MIP_SP2_AX_V5.2<br>MIP_OM2_AX_V5.2_october   | Correct for a bug in the binary conversion of these two ADF. The ascii version of these files was correct then it was just a problem in the binary conversion of the ADF.   |
| ADF V5.1 | 05.07.2005       | MIP_MW2_AX_V5.1<br>MIP_SP2_AX_V5.1<br>MIP_OM2_AX_V5.1  | Spectroscopic line list relative to the new microwindow database for reduced spectral resolution; PT error propagation matrices for nominal OMs added in file MIP_OM2_AX; upper limit of a microwindow for cloud detection changed.   |
| ADF V5.0 | 18.03.2005       | MIP_PS2_AX_V5<br>MIP_CS2_AX_V5<br>MIP_MW2_AX_V5<br>MIP_PI2_AX_V5<br>MIP_IG2_AX_V5_july<br>MIP_IG2_AX_V5_october<br>MIP_OM2_AX_V5 | New microwindows selected for reduced spectral resolution, and corresponding cross section LUT, occupation matrices and Initial Guess for continuum (July and October seasons). Boundaries of the microwindows for cloud detection modified to match the new spectral grid at reduced resolution. New Pointing Information (PI) with a smaller error in LOS, new settings (PS) for handling reduced resolution measurements and optimised convergence criteria thresholds for reduced resolution mws. |
| ADF V4.1 | 03.09.2004       | NRT:<br>MIP_PS2_AX_NRT_V4.1<br>OFL:<br>MIP_PS2_AX_OFL_V4.1   | Changed the flag in PS2 file spec_events_flag from "B" (dec 66) to "N" (dec 78).<br>NESR threshold in PS2 files as in V3.6.   |

|             |            |  |   |
|-------------|------------|--|---|
| ADF<br>V4.0 | 03.09.2004 | NRT:<br>MIP_PS2_AX_NRT_V4.0<br>OFL:<br>MIP_PS2_AX_OFL_V4.0 | Changed the flag in PS2 file spec_events_flag from "B" (dec 66) to "N" (dec 78).<br>Increased NESR threshold in PS2 files as in V3.7. |
|-------------|------------|--|---|

### 2.5.2 QUALITY CONTROL OF L2 OFL DATA

A quality control of L2 RR17 products (Aug – Sept 2004) was carried out at ESRIN, daily reports were generated and can be accessed at the following address:

[http://earth.esa.int/pcs/envisat/mipas/reports/daily/Level\\_2\\_OFL/](http://earth.esa.int/pcs/envisat/mipas/reports/daily/Level_2_OFL/)

Looking at these daily reports we observe an overall good quality of L2 products. Only one major problem was found for the period: 21 – 22 Aug 2004. The investigation of this problem showed that a corruption in the band D was verified for these orbits. The corruption was due to a corrupted gain used for spectra calibration. As reported by Astrium the processor flags as corrupted one sweep even though only one band is corrupted. This processor specification seems excessively restrictive in particular in this case, since the band D is not used in the operational retrieval.

### 2.5.3 LEVEL 2 ANOMALY STATUS

The following table summarizes the anomalies affecting Level 2 products and shows the associated SPR, NCR, OAR and HD code. Further details on anomalies investigation are reported in §3.7.

**Table 16** Level 2 anomaly list. Refer to the appendices for more information on the anomaly investigation.

| Anomaly  | Proto/DPM<br>SPR | IPF<br>NCR | OAR  | HD | Status                  | Ref    |
|--|------------------|------------|------|----|-------------------------|--------|
| Excessive Chi-square                                 | /                | 1458       | 1929 | /  | Closed with IPF<br>4.67 | §3.7.1 |
| Difference on L2 products between<br>v4.61 and v4.62 | /                | 1521       | 2074 | /  | Closed with IPF<br>4.67 | §3.7.2 |
| NO2 retrieval during polar condition                 | /                | /          | /    | /  | Closed                  | §3.7.3 |
| L2 OFL missing data around the<br>South Pole         | /                | /          | /    | /  | Closed                  | §3.7.4 |
| L2 continuum anomaly                                 | /                | /          | /    | /  | Closed                  | §3.7.5 |

## 2.6 Processing/Re-processing Status

### 2.6.1 FIRST RE-PROCESSING OF FR MISSION

The first re-processing of the FR MIPAS mission was terminated at D-PAC using IPF software version 4.61, 4.62. All the received consolidated L0 products were processed to L1 and L2. The complete list of L1 and L2 re-processed products at D-PAC (with the corresponding IPF software version) was provided to the QWG and can be found on Uranus ftp server (MIPAS/To\_QWG/DPAC\_L1\_L2\_archive\_FR\_mission.xls).

### 2.6.2 OFL PROCESSING OF RR MISSION

#### 2.6.2.1 Level 1b

The Level 1 processing of RR mission has started at D-PAC the 9<sup>th</sup> of February 2006 with IPF 4.65. Since Sept 2006 the IPF 4.67 was switched at D-PAC. The processing of the backlog RR data (from Aug 2004 to Dec 2005) was completed. The OFL processing is going on in parallel with the mission. All these data are available on D-PAC ftp server.

#### 2.6.2.2 Level 2

The level 2 processing of RR mission at D-PAC has started the mid of February 2006 with the IPF 4.65. A total of 158 orbits were processed up to L2. All these data are available on D-PAC ftp server.

**Table 17** Measurement segments processed OFL up to Level 2 for RR mission data.

|                              | UTC                      |                          | Orbit # |       |
|------------------------------|--------------------------|--------------------------|---------|-------|
|                              | start                    | stop                     | start   | stop  |
| <b>1<sup>st</sup> period</b> | 9 Aug 2004<br>16:42:00   | 22 Aug 2004<br>20:41:10  | 12783   | 12965 |
| <b>2<sup>nd</sup> period</b> | 16 Sept 2004<br>12:00:10 | 17 Sept 2004<br>22:06:43 | 13318   | 13338 |

## 3 APPENDICES

### 3.1 *Appendix A – Level 1 IPF historical updates*

The historical updates to the MIPAS Level 1 IPF processor are listed here:

- **Version V4.67** the following updates were introduced for L1 processing
  - Fixed NCR-1522 → The MIPAS IPF (from version 4.61 to version 4.65) generates L1b products with wrong "NUM\_DSR" value in the SPH; in particular this value differs by one unit from the "TOT\_SCAN" value, while the two should be the same. The L1 prototype doesn't show this anomaly.
  - Fixed NCR-1676 → This problem was detected at D-PAC during OFL L1 processing of MIPAS RR data; in particular it was observed that the MIPAS IPF 4.65 is violating the shared memory area of PFHS. PFHS performance is seriously affected, because too many manual re-starts become necessary.
- **Version V4.65** no update of Level 1 for this version
- **Version V4.64** (aligned with DPM 4I and ADFs V4.1) introduced modifications only for the Level 1 processor, with the following update:
  - Fixed internal SPR-12100-2011: Problem with the block sequence
- **Version V4.63** (aligned with DPM 4I and ADFs V4.1) introduced modifications for both Level 1 and Level 2 processors. For the Level 1 processor, the following updates were introduced:
  - Processing of low resolution measurements, with reduced resolution also for offset and gain data.
  - Solution of internal SPR-12000-2000: Band D oscillations in forward sweeps for MIPAS reduced-resolution products
  - Solution of internal SPR-12000-2001: NESR data problem
- **Version V4.62** (aligned with DPM 4H and ADFs V4.0) introduced modifications for both Level 1 and Level 2 processors. For the Level 1 processor, the following updates were introduced:
  - Processing of low resolution measurements, without reduced resolution for offset and gain data that will be implemented in IPF 4.63.
  - Fixed NCR\_1157: Bug in the MIPAS processor ILS retrieval.
  - Fixed NCR\_1259: Scans with null NESR.
- **Version V4.61** consists of updates for both Level 1 and Level 2:
  - Fixed NCR\_1143: Sparse corruption of bands between 1 and 4 January 2004.
- **Version V4.59** has introduced only upgrade on Level 2 processor.
- **Version V4.57** involved only Level 1 processor update, introducing the following modifications:
  - Modification of FCE algorithm
  - Elimination of strong anomalous oscillations in the spectra
  - Modification of NESR reporting
  - ADC saturation flagging
  - Addition of aliasing spike suppression algorithm

### 3.2 Appendix B – Level 1 ADF historical updates

The Level 1 characterization files (MIP\_CA1\_AX, MIP\_MW1\_AX, MIP\_PS1\_AX) are provided by Bomem and updated when needed, the activation date of these ADFs with respect to the operational processor are reported in the table below.

**Table 18** Level 1 ADF start validity date

| ADFs Version | Updated ADF                            | Start Validity Date       | IPF version  | Dissemination Date      |
|--------------|--|---------------------------|--------------|-------------------------|
| 6.1          | MIP_PS1_AX                             | 09-Aug-2004<br>RR mission | 4.65<br>4.67 | 27-Jun-2005             |
| 5.0          | MIP_PS1_AX                             | /                         | /            | Not used for processing |
| 4.1          | MIP_PS1_AX                             | /                         | /            | Not used for processing |
| 3.2          | MIP_PS1_AX                             | 26-Mar-2004               | 4.61         | 21-Apr-2004             |
| 3.1          | MIP_PS1_AX                             | 09-Jan-2004               | 4.61         | 17-Mar-2004             |
| 3.0          | MIP_CA1_AX<br>MIP_MW1_AX<br>MIP_PS1_AX | April-2002<br>FR mission  | 4.61         | 4-Nov-2003              |

A more detailed description of the historic updates of the L1 ADF is reported hereafter.

#### **Version 6.1**

##### **MIP\_PS1\_AX**

- OPD set to 8.2 cm
- Spike detection standard deviation threshold set to 10
- Spike detection number of points per block set to 256
- Set standard deviation threshold to 5 for Scene measurement quality

#### **Version 6.0**

##### **MIP\_PS1\_AX**

- OPD set to 20 cm
- Spike detection standard deviation threshold set to 10
- Spike detection number of points per block set to 256
- Set standard deviation threshold to 5 for Scene measurement quality

#### **Version 5.0 draft**

##### **MIP\_PS1\_AX**

- OPD set to 10 cm
- Channel A set to 5701 points
- Channel AB set to 3001 points
- Channel B set to 5701 points
- Channel C set to 3601 points



- Channel D set to 11801 points
- Set standard deviation threshold to 5 for Scene measurement quality

#### **Version 4.1 (TDS 6)**

##### **MIP\_PS1\_AX**

- OPD set to 8.2 cm
- Channel A set to 4561 points
- Channel AB set to 2401 points
- Channel B set to 4561 points
- Channel C set to 2881 points
- Channel D set to 9441 points
- Number of co-additions for ILS retrieval was set to 5
- Set standard deviation threshold to 5 for Scene measurement quality

#### **Version 4.0 draft**

##### **MIP\_PS1\_AX**

- OPD set to 8.2 cm
- Channel A set to 4561 points
- Channel AB set to 2401 points
- Channel B set to 4561 points
- Channel C set to 2881 points
- Channel D set to 9441 points
- Number of co-additions for ILS retrieval was set to 5

#### **Version 3.2**

##### **MIP\_PS1\_AX**

- Changed the threshold to take into account the modified noise level

#### **Version 3.1**

##### **MIP\_PS1\_AX**

- Changed the threshold to take into account the modified noise level

#### **Version 3.0**

##### **MIP\_CA1\_AX**

- Modify non-linearity coefficients for reverse sweep. Coefficients for forward are kept as is
- Neutral equalization filter for band A

##### **MIP\_MW1\_AX**

- Removal of band D microwindow D\_H20b at 1870.8049 cm-1
- Set spectral calibration microwindow altitude to 32 km

##### **MIP\_PS1\_AX**

- Number of co-additions for spectral calibration was set to 4
- Number of co-additions for ILS retrieval was set to 10

When one ADF is modified the three AUX file are disseminated with the same START/STOP time and this correspond to a new level 1 ADF delivery, this prevents confusion.

### 3.3 Appendix C – Interpolated gains

Due to missing L0 products to calculate all the gain calibration ADF files, a program was developed to estimate the missing gain calibration files using the gain calibration ADF files available (already disseminated via the IECF). The program simply performs a linear interpolation between 2 known gains. The second gain is first aligned on the same fringe as the 1<sup>st</sup> gain before doing the interpolation. The interpolation factor is specified such that there is less than 1% gain difference between 2 consecutive gains.

$$\text{Gain}_i = (G2 \times \text{factor}) + (G1 \times (1 - \text{factor}))$$

- Gain<sub>i</sub>: Interpolated Gain vector
- G1: 1<sup>st</sup> Gain Calibration vector
- G2: 2<sup>nd</sup> Gain Calibration vector
- Factor: Interpolation factor ( 0 < range < 1 )

For the interpolated gain calibration files, the “SENSING\_START” and “SENSING\_STOP” fields are set according to the interpolation factors. For example, an interpolation factor of 0.33 applied to two existing gains (acquired 8 days apart), will fix the interpolated gain “SENSING\_START” to 8 \* 0.33 = 2.6 days later than the 1st gain “SENSING\_START”. The sensing stop is set to the end of the mission: “SENSING\_STOP” = “SENSING\_START” + 5 years.

The complete list of the new interpolated gains MIP\_CG1\_\_AX files provided by Bomem and disseminated via IECF is reported in the table below. These 45 MIP\_CG1\_\_AX files were used for the reprocessing of the 2005 RR MIPAS mission.

**Table 19** List of the gain files to be used during the period of enhanced gain increase of Jan – May 2005, the gain files already disseminated are highlighted in green, while the newly generated gains are in orange.

| ADF file name   | Type<br>(* - interpolated gains) |
|---|----------------------------------|
| MIP_CG1_AXVIEC20050309_081858_20050108_000000_20090108_000000 | Gain calibration (CG_0)          |
| MIP_CG1_AXVIEC20051115_085521_20050118_120000_20100118_120000 | Gain (CG_0_a) *                  |
| MIP_CG1_AXVIEC20050310_091646_20050116_000000_20090116_000000 | Gain calibration (CG_1)          |
| MIP_CG1_AXVIEC20051115_085521_20050118_120000_20100118_120000 | Gain (CG_1_a) *                  |
| MIP_CG1_AXVIEC20050311_085855_20050121_000000_20090121_000000 | Gain calibration (CG_2)          |
| MIP_CG1_AXVIEC20051115_090016_20050124_120000_20100124_120000 | Gain (CG_2_a) *                  |
| MIP_CG1_AXVIEC20050314_154134_20050128_000000_20090128_000000 | Gain calibration (CG_3)          |
| MIP_CG1_AXVIEC20051115_090529_20050130_150000_20100130_150000 | Gain (CG_3_a) *                  |
| MIP_CG1_AXVIEC20051115_091036_20050202_080000_20100202_080000 | Gain (CG_3_b) *                  |
| MIP_CG1_AXVIEC20050315_131822_20050205_000000_20090205_000000 | Gain calibration (CG_4)          |
| MIP_CG1_AXVIEC20051115_101639_20050209_120000_20100209_120000 | Gain (CG_4_a) *                  |
| MIP_CG1_AXVIEC20050316_081309_20050214_000000_20090214_000000 | Gain calibration (CG_5)          |
| MIP_CG1_AXVIEC20051115_102136_20050217_000000_20100217_000000 | Gain (CG_5_a) *                  |
| MIP_CG1_AXVIEC20051115_102701_20050220_000000_20100220_000000 | Gain (CG_5_b) *                  |
| MIP_CG1_AXVIEC20051115_103156_20050223_000000_20100223_000000 | Gain (CG_5_c) *                  |
| MIP_CG1_AXVIEC20051115_103702_20050226_000000_20100226_000000 | Gain (CG_5_d) *                  |
| MIP_CG1_AXVIEC20050405_145110_20050301_000000_20090301_000000 | Gain calibration (CG_6)          |
| MIP_CG1_AXVIEC20051115_104209_20050303_150000_20100303_150000 | Gain (CG_6_a) *                  |

|   |                          |
|---|--------------------------|
| MIP_CG1_AXVIEC20051115_104705_20050306_080000_20100306_080000 | Gain (CG_6_b) *          |
| MIP_CG1_AXVIEC20050406_070802_20050309_000000_20090309_000000 | Gain calibration (CG_7)  |
| MIP_CG1_AXVIEC20051115_105212_20050311_000000_20100311_000000 | Gain (CG_7_a) *          |
| MIP_CG1_AXVIEC20050407_072135_20050314_000000_20090313_000000 | Gain calibration (CG_8)  |
| MIP_CG1_AXVIEC20051115_105723_20050315_000000_20100315_000000 | Gain (CG_8_a) *          |
| MIP_CG1_AXVIEC20051115_110250_20050316_115754_20100316_000000 | Gain (CG_8_b) *          |
| MIP_CG1_AXVIEC20051115_122231_20050319_000000_20100319_000000 | Gain (CG_8_c) *          |
| MIP_CG1_AXVIEC20050407_143713_20050321_000000_20090321_000000 | Gain calibration (CG_9)  |
| MIP_CG1_AXVIEC20051115_122732_20050323_070000_20100323_070000 | Gain (CG_9_a) *          |
| MIP_CG1_AXVIEC20051115_123244_20050325_160000_20100325_160000 | Gain (CG_9_b) *          |
| MIP_CG1_AXVIEC20050411_123723_20050328_000000_20090328_000000 | Gain calibration (CG_10) |
| MIP_CG1_AXVIEC20051115_123754_20050330_070000_20100330_070000 | Gain (CG_10_a) *         |
| MIP_CG1_AXVIEC20051115_124300_20050401_160000_20100401_160000 | Gain (CG_10_b) *         |
| MIP_CG1_AXVIEC20050412_072926_20050404_000000_20090404_000000 | Gain calibration (CG_11) |
| MIP_CG1_AXVIEC20051115_124808_20050406_000000_20100406_000000 | Gain (CG_11_a) *         |
| MIP_CG1_AXVIEC20051115_125321_20050408_000000_20100408_000000 | Gain (CG_11_b) *         |
| MIP_CG1_AXVIEC20051115_125829_20050410_000000_20100410_000000 | Gain (CG_11_c) *         |
| MIP_CG1_AXVIEC20050415_073538_20050412_231018_20100412_231018 | Gain calibration (CG_12) |
| MIP_CG1_AXVIEC20051115_130340_20050414_000000_20100414_000000 | Gain (CG_12_a) *         |
| MIP_CG1_AXVIEC20051115_130903_20050416_000000_20100416_000000 | Gain (CG_12_b) *         |
| MIP_CG1_AXVIEC20051115_131404_20050418_000000_20100418_000000 | Gain (CG_12_c) *         |
| MIP_CG1_AXVIEC20050421_065554_20050420_133450_20100420_133450 | Gain calibration (CG_13) |
| MIP_CG1_AXVIEC20051115_131917_20050421_120000_20100421_120000 | Gain (CG_13_a) *         |
| MIP_CG1_AXVIEC20051115_132409_20050423_000000_20100423_000000 | Gain (CG_13_b) *         |
| MIP_CG1_AXVIEC20051115_132925_20050424_120000_20100424_120000 | Gain (CG_13_c) *         |
| MIP_CG1_AXVIEC20050427_150526_20050426_225532_20100426_225532 | Gain calibration (CG_14) |
| MIP_CG1_AXVIEC20051115_133432_20050427_160000_20100427_160000 | Gain (CG_14_a) *         |
| MIP_CG1_AXVIEC20051115_133942_20050429_070000_20100429_070000 | Gain (CG_14_b) *         |
| MIP_CG1_AXVIEC20051115_134453_20050501_000000_20100501_000000 | Gain (CG_14_c) *         |
| MIP_CG1_AXVIEC20051115_134947_20050502_160000_20100502_160000 | Gain (CG_14_d) *         |
| MIP_CG1_AXVIEC20051115_135453_20050504_070000_20100504_070000 | Gain (CG_14_e) *         |
| MIP_CG1_AXVIEC20050509_150546_20050506_153444_20100506_153444 | Gain calibration (CG_15) |
| MIP_CG1_AXVIEC20051115_154052_20050507_030000_20100507_030000 | Gain (CG_15_a) *         |
| MIP_CG1_AXVIEC20051115_151144_20050508_060000_20100508_060000 | Gain (CG_15_b) *         |
| MIP_CG1_AXVIEC20051115_151255_20050509_090000_20100509_090000 | Gain (CG_15_c) *         |
| MIP_CG1_AXVIEC20051115_151358_20050510_120000_20100510_120000 | Gain (CG_15_d) *         |
| MIP_CG1_AXVIEC20051115_151458_20050511_150000_20100511_150000 | Gain (CG_15_e) *         |
| MIP_CG1_AXVIEC20051115_151558_20050512_180000_20100512_180000 | Gain (CG_15_f) *         |
| MIP_CG1_AXVIEC20051115_151702_20050513_210000_20100513_210000 | Gain (CG_15_g) *         |
| MIP_CG1_AXVIEC20050523_090017_20050515_000000_20090515_000000 | Gain calibration (CG_16) |
| MIP_CG1_AXVIEC20051115_150616_20050516_090000_20100516_090000 | Gain (CG_16_a) *         |
| MIP_CG1_AXVIEC20051115_150747_20050517_190000_20100517_190000 | Gain (CG_16_b) *         |
| MIP_CG1_AXVIEC20051115_150831_20050519_040000_20100519_040000 | Gain (CG_16_c) *         |
| MIP_CG1_AXVIEC20051115_150940_20050520_140000_20100520_140000 | Gain (CG_16_d) *         |
| MIP_CG1_AXVIEC20050524_081749_20050522_000000_20090522_000000 | Gain calibration (CG_17) |

### 3.4 Appendix D – Level 0 and Level 1 anomaly status

#### 3.4.1 MIPAS WRONG CONSOLIDATED PRODUCTS

LRAC wrong consolidated L0 products (type “O” from cycle 7, 10, 11; end of 2002) were ingested into the D-PAC database and processed to L1 and L2 anomalous products. There was a bug in the LRAC consolidation at that time, this bug was fixed later and in general is not found in the consolidated “P” products. As a result in D-PAC L1/L2 archive (from the end of 2002) you can find wrong products: the consolidated data are shorter than unconsolidated near-real-time ones (type N).

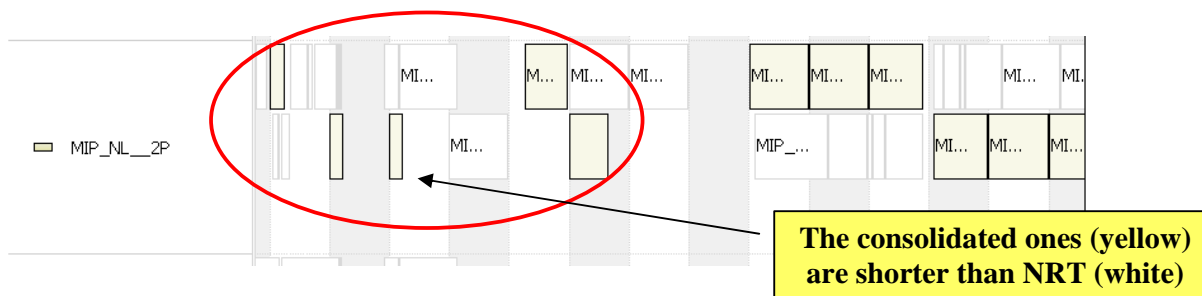


Figure 25 GANTT chart showing the anomaly in the consolidation of L2 “O” products.

The wrong consolidated orbits have been identified; a list was provided to QWG and can be found on Uranus ftp server (/MIPAS/To\_QWG/Wrong\_MIPAS\_consolidated\_Products.xls). These products were deleted from D-PAC and re-consolidated at LRAC.

#### 3.4.2 EXCESSIVE NUMBER OF MISSING ISPS IN THE MPH FOR MIPAS L0 PRODUCTS

Several MIPAS level 0 products have excessive NUM MISSING ISPS in the MPH, while the content of the products is correct. An example of this anomalous number can be found for the following product:

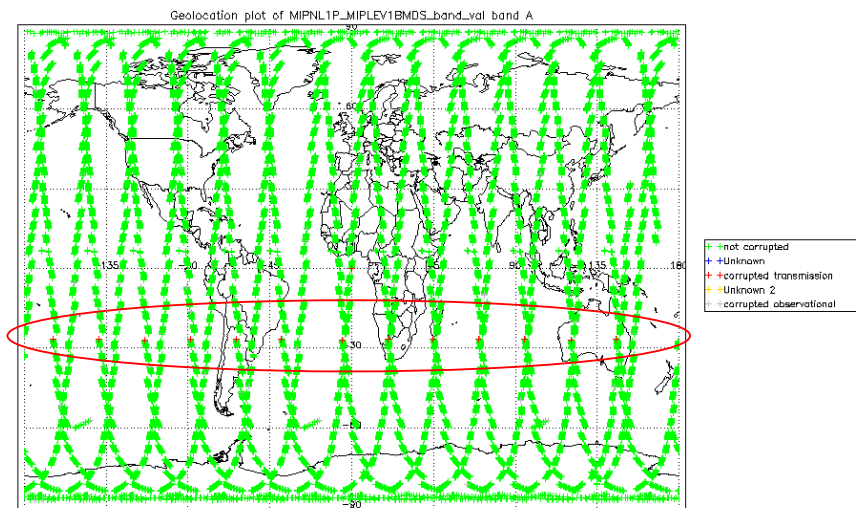
MIP\_NL\_\_0PNPDE20060209\_020145\_000033732045\_00032\_20627\_0104.N1

In the MPH we find:  
 NUM\_MISSING\_ISPS=+0002102752  
 MISSING\_ISPS\_THRESH=+0.00000000E+00  
 NUM\_DISCARDED\_ISPS=+0000000000  
 DISCARDED\_ISPS\_THRESH=+0.00000000E+00  
 NUM\_RS\_ISPS=+0000000000  
 RS\_THRESH=+0.00000000E+00

The investigation on the ground segment has demonstrated that the problem is due to the L0 processing of the MIPAS instrument source packets. The problem was resolved since Dec 2006 after the switch of the “new” FEOMI infrastructure with the EXTPS module.

### 3.4.3 NON-VALID BAND A AT THE SAME GEO-LOCATION

As can be observed in the following plot corrupted sweeps in band A are always found at the same geo-location (level 1b OFL consolidated products type "P"). The same is observed for all the other bands as can be observed in the following figure.



**Figure 26** Corrupted sweeps are observed always at the same geo-location for these OFL L2 products of 10 March 2004 processed at D-PAC.

The investigation of the anomaly is now closed, since the reason of the problem has been recognized as an implementation error in the IPF, indeed the error is not obtained with the prototype.

The problem is the following: the IPF (version 4.61 up to 4.65) generates L1b products with wrong "NUM\_DSR" value in the MPH; in particular this value is one unit higher than the "TOT\_SCAN" value, while the two should be the same. As a result the Quadas tool recognize as corrupted the last scan of each orbit because the corresponding DSR is empty. For consolidated product this gives the same corruption at the same latitude for all the orbits (as observed in the figure above).

This problem was corrected within IPF 4.67 even though a discrepancy between the prototype and the IPF number of scans still remains.

### 3.4.4 WRONG MIPAS L1 PRODUCT IN D-PAC SERVER

One L1 product in D-PAC ftp server is corrupted (see red crosses in Figure 27), the product was generated using one outdated ADF. The product name is:

MIP\_NL\_1PPDPA20051002\_233211\_000060362041\_00188\_18779\_0667.N1

The IPF used the following outdated ADF:

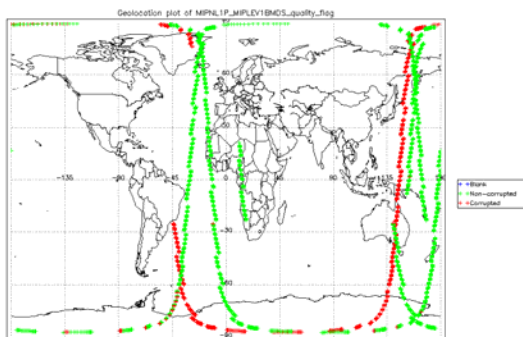
MIP\_CO1\_AXVIEC20050705\_134752\_20050703\_044401\_20100703\_044401

instead of the correct ADF:

MIP\_CO1\_AXVIEC20051003\_180613\_20050926\_000000\_20100926\_000000

The other L1 ADFs of this day were correctly selected by the IPF. To be understood why the IPF used this ADF and why the problem occurred only for this product and only with the MIP\_CO1\_AX aux file.

The investigation by Task 4 shows that the source of the problem is a wrong auxiliary file selection by PFHS; the problem seems to be the same than the one described in OARs 2009 and 1845. The wrong MIPAS product has been removed and reprocessed at D-PAC, the new filename is: MIP\_NL\_1PPDPA20051002\_233211\_000060362041\_00188\_18779\_1478.N1



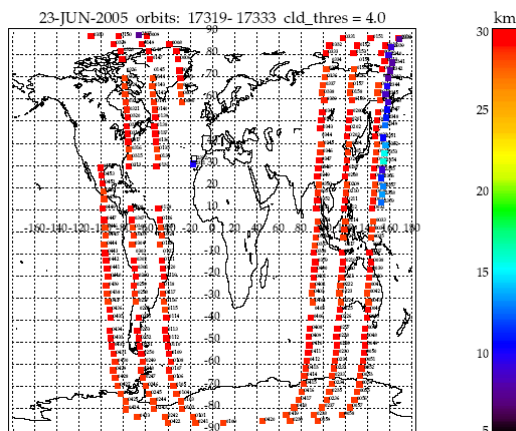
**Figure 27** L1b PCD quality flag, corrupted sweep detected for 3 Oct 2005 L1b spectra

### 3.4.5 BADLY CALIBRATED L1B DATA DURING 3 – 23 JUNE 2005

The quality control of RR data generated OFL at D-PAC shows that a series of L1 spectra were highly corrupted due to a wrong calibration. This anomaly affects the L1 products corresponding to the following mission interval:

3 – 23 June 2005. Orbit # 17039 – 17332  
 29 Jul – 11 Aug 2005. Orbit # 17835 – 18021

M. Hopfner (IMK) detects this problem by carrying out a systematic calculation of the clouds top heights for all the L1b spectra processed at D-PAC. The cloudy sweeps were detected using the colour index, calculated as the ratio of the integrated radiance in two specific MWs of the band A. We can see the excessive cloud top height value found on 23 June 2005 (see Figure 28).



**Figure 28** Cloud top height calculated by M. Hopfner (IMK) for 23 June 2005, the red points are due probably to a corruption in the band A spectrum.

The problem was also detected with the quality monitoring tool in ESRIN; in fact looking at the NESR level of 23 June 2005 we can see excessively high value (see red lines in the Figure 29). The two plots highlights the same anomaly in the spectra, indeed by the end of the day, when the cloud top height stops to be unrealistically high also the NESR comes back to nominal level, this is exactly the time when the correct ADF starts to be used by the processor. The problem is therefore due to a wrong calibration ADF. The first step of the investigation was to remove all the affected products from the D-PAC ftp server.



**Figure 29** NESR level for different scan during 23 June 2005, each square is a scan made of 27 sweeps in nominal mode, the red lines show the anomaly of excessive high NESR, the anomaly stops when the correct ADF start to be used by the processor.

The ADFs suspected were identified and removed from all the processing centers. A first quality check (for format and scientific issue) of these ADFs didn't show any manifest anomaly; furthermore the gain calibration looks nominal, as resulted from comparison to other gain measurements of the same mission period. In order to better understand the problem we re-generate these ADFs from the same gain measurement orbit. The lists of outdated wrong ADFs and of the new ADFs are reported in the tables below. The only difference between these two sets of aux files is that the old ADFs were created from L0 NRT data, while the new ones are obtained from consolidated L0 products.

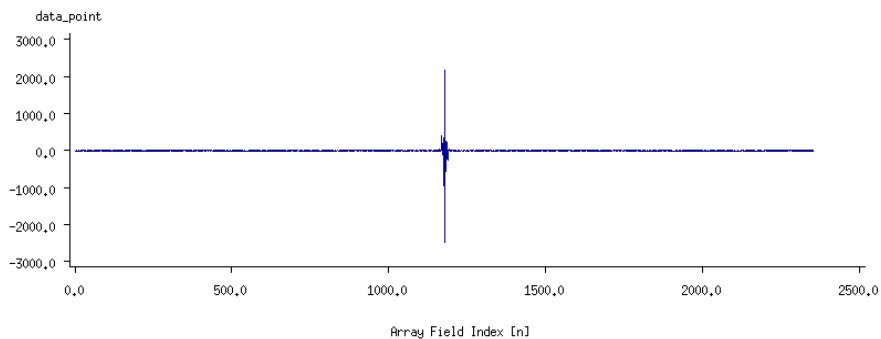
**Table 20** List of wrong ADFs used by the OFL processor, which causes the anomaly of badly calibrated L1 data.

|   |
|---|
| MIP_CS1_AXVIEC20051115_101936_20050601_082740_20090601_000000 |
| MIP_CO1_AXVIEC20051115_101908_20050601_082740_20090601_000000 |
| MIP_CG1_AXVIEC20051115_141026_20050601_082740_20090601_000000 |
| MIP_CS1_AXVIEC20050627_084317_20050609_000000_20090609_000000 |
| MIP_CO1_AXVIEC20050617_090408_20050609_000000_20090609_000000 |
| MIP_CG1_AXVIEC20050617_090045_20050609_000000_20090609_000000 |
| MIP_CS1_AXVIEC20050721_081614_20050616_000000_20090616_000000 |
| MIP_CO1_AXVIEC20050617_132252_20050616_000000_20090616_000000 |
| MIP_CG1_AXVIEC20050617_132141_20050616_000000_20090616_000000 |
| MIP_CS1_AXVIEC20051115_102512_20050729_005430_20100729_000000 |
| MIP_CO1_AXVIEC20051115_102420_20050729_005430_20100729_000000 |
| MIP_CG1_AXVIEC20051115_141830_20050729_005430_20100729_000000 |

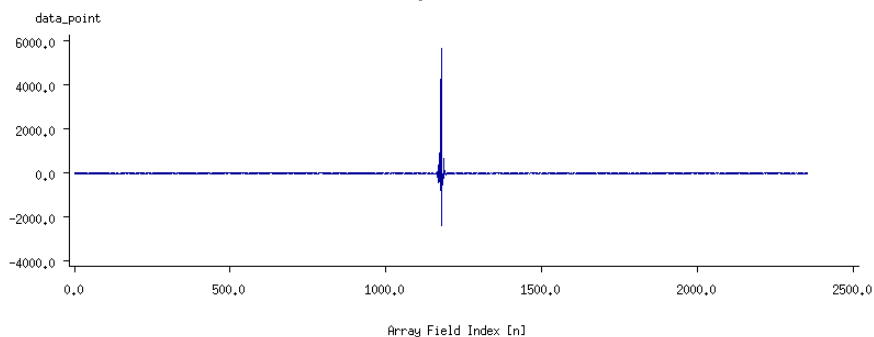
**Table 21** List of new ADFs generated for repairing the anomaly.

|   |
|---|
| MIP_CS1_AXVIEC20060524_152132_20050601_000000_20100601_000000 |
| MIP_CO1_AXVIEC20060524_150040_20050601_000000_20100601_000000 |
| MIP_CG1_AXVIEC20060524_152144_20050601_000000_20100601_000000 |
| MIP_CS1_AXVIEC20060524_152232_20050609_000000_20100609_000000 |
| MIP_CO1_AXVIEC20060525_080629_20050609_000000_20100609_000000 |
| MIP_CG1_AXVIEC20060524_152244_20050609_000000_20100609_000000 |
| MIP_CS1_AXVIEC20060524_152325_20050616_000000_20100616_000000 |
| MIP_CO1_AXVIEC20060524_171909_20050616_000000_20100616_000000 |
| MIP_CG1_AXVIEC20060524_152334_20050616_000000_20100616_000000 |
| MIP_CS1_AXVIEC20060524_152430_20050729_000000_20100729_000000 |
| MIP_CO1_AXVIEC20060524_172132_20050729_000000_20100729_000000 |
| MIP_CG1_AXVIEC20060524_152419_20050729_000000_20100729_000000 |
| MIP_CS1_AXVIEC20060524_152523_20050808_000000_20100808_000000 |
| MIP_CO1_AXVIEC20060524_172132_20050808_000000_20100808_000000 |
| MIP_CG1_AXVIEC20060524_152537_20050808_000000_20100808_000000 |

Comparing the two sets of ADFs we observed an anomaly in the off-set calibration data set (MIPAS OFFSET VECTOR field in the MIP\_CO1\_AX ADF). The interferogram (IGM) recorded during the deep-space scene is compared for the old and the new ADF in the following figures. The IGM of the old ADFs looks really different, the maximum being much less pronounced with respect to the new offset calibration ADF.



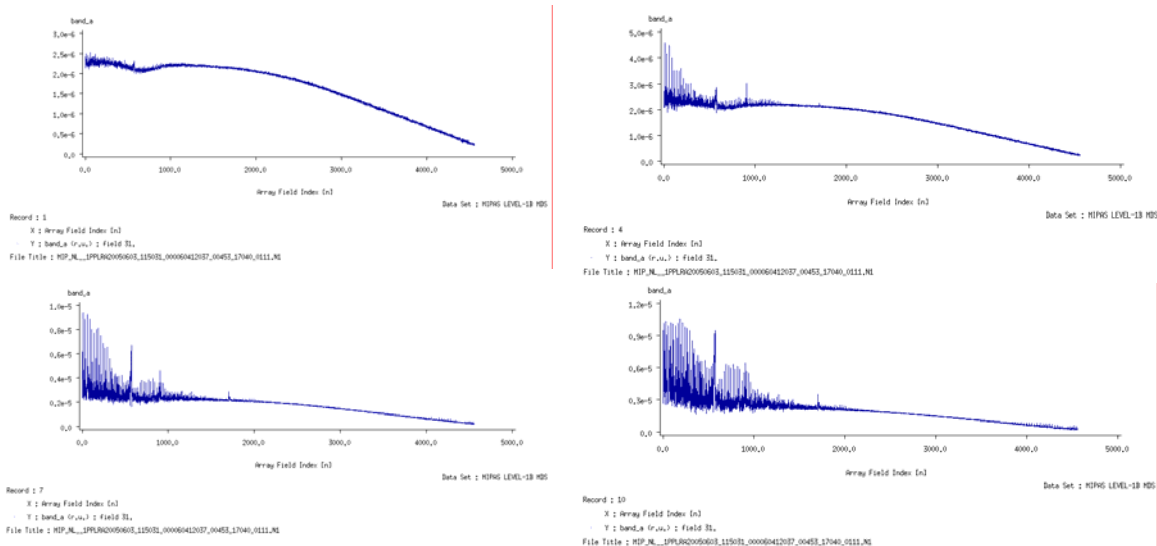
**Figure 30** IGM recorded in the deep space measurement and stored in the wrong ADF.



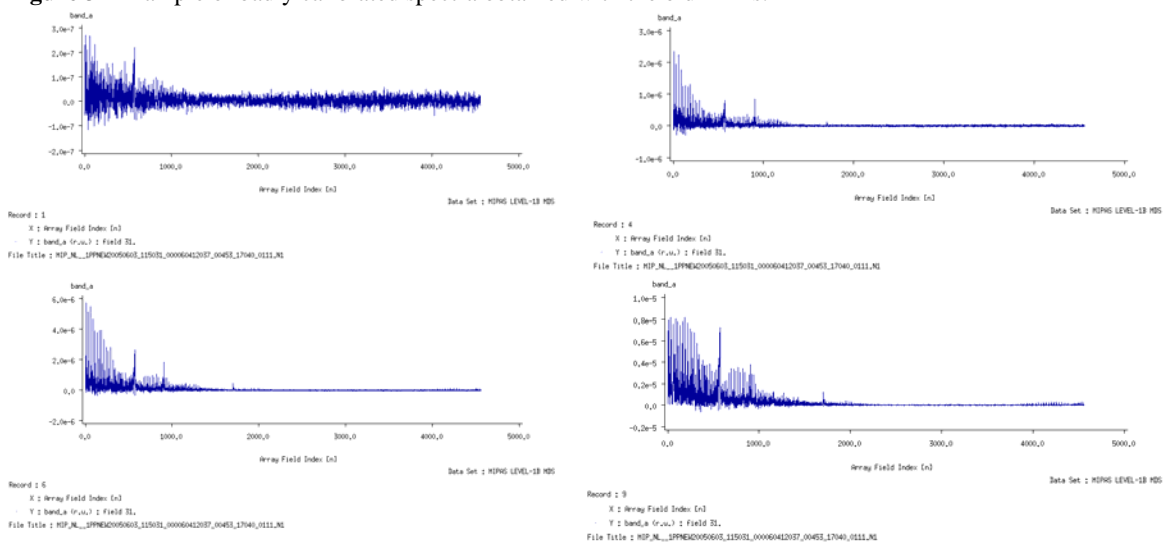
**Figure 31** IGM recorded in the deep space measurement and stored in the new correct ADF.

The problem appears to be due to the offset calibration auxiliary file (MIP\_CO1\_AX). As a second step we generate two L1 prototype products from the same level 0, using respectively the old and the new set of ADFs. The comparison of the two resulting level 1 products is presented in the following figures. The comparison of the calibrated spectra shows that the use of the old MIP\_CO1\_AX file introduces a strange offset in the spectra, while the new set of ADFs allows a correct calibration of the measurements.





**Figure 32** Example of badly calibrated spectra obtained with the old ADFs.



**Figure 33** Example of correctly calibrated spectra obtained with the new ADFs.

The reason for these results was anyhow not fully clear; in fact the MIP\_CO1\_AX file is not used by the processor for the offset calibration of the spectra, for this calibration the IPF is using the closest offset scene contained in the L0 product. Note that one offset measurement is made every 4 MIPAS scans, which means that each L0 products contains several offset scenes. This choice is due to the fact that the instrument self-emission strongly depends on the platform position (e.g.: illumination) along the orbit; therefore in order to improve the quality of the offset calibration, the closest offset scene from the L0 product is used, instead of using the ADF. Support was requested to Bomem to understand why the processor used the offset contained in the ADF instead of using one offset scene from the L0 product. Bomem explained that since the offset scene contained in the L0 product is very different from the one stored in the wrong ADF, the processor automatically flags as corrupted the off-set of the L0 and it uses the off-set of the ADF, resulting in a weird calibration. The final step of the investigation consisted in trying to understand why the calibration

algorithm (mical) generates such strange MIP\_CO1\_AX file. The problem is still not fully understood, it is probably related to an anomaly in the NRT L0 products.

The anomaly is now closed, since the D-PAC centre reprocessed all the affected L1 products. The list of re-processed products was delivered to QWG and can be found on Uranus (MIPAS/To\_QWG/New\_L1\_June-Aug\_2005.txt).

### 3.4.6 MIPAS AIRCRAFT EMISSION MEASUREMENTS

Looking at the AE L1B file taken on 5/6 May 2005 (processed with MIGSP), the tangent altitudes seem to be approximately 2km below the 7-38 km range specified in Mission\_Plan\_V4.1.pdf dated 3 May 2005.

Bomem check these L1B products and the problem does not seem to be due to processing (MIGSP 2.5). The problem was found to be due to the commanding, in particular to the software (SEM mode algorithm) used for the AE measurements. The software was designed only for localized SEM measurements, such as volcano eruptions. The use of this algorithm over a wide area around the globe (such is the case of AE measurements) can lead to very important deviations owing to the earth ellipsoid. This is the cause of the deviation between the planned and measured tangent altitude for these AE measurements. In this sense the planning anomaly is closed, nevertheless Anu Dudhia reported at the QWG#8 a further anomaly affecting these products. This consists of a difference of almost 3 km between the retrieved and engineering altitude. This anomaly is not related to the planning and the investigation is ongoing in collaboration with BOMEM and OU.

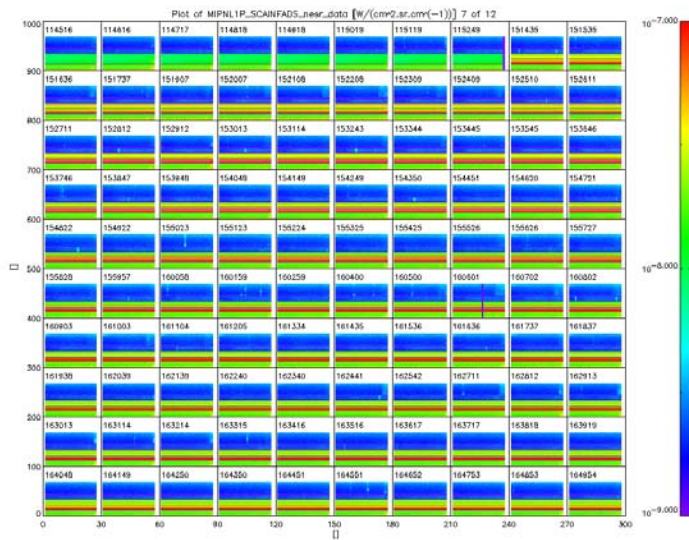
### 3.4.7 WRONGLY CALIBRATED L1 PRODUCTS

This anomaly was detected during the daily monitoring of the L1 products of 18<sup>th</sup> April 2007 generated at D-PAC. The problem consists in a wrong calibration for the following data:

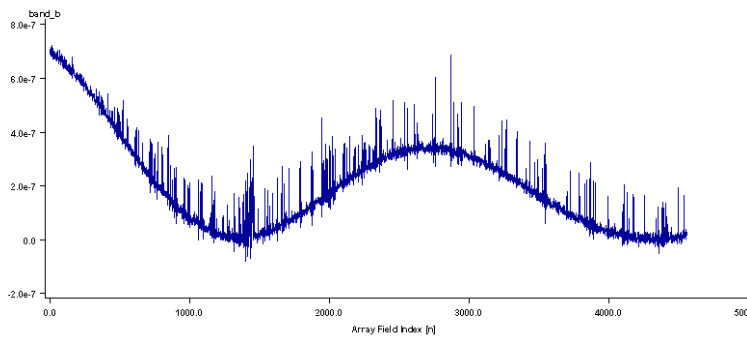
```
MIP_NL__1PPDPA20070418_151435_000060452057_00226_26833_2624.N1
MIP_NL__1PPDPA20070418_165526_000060292057_00227_26834_2626.N1
MIP_NL__1PPDPA20070418_183601_000060162057_00228_26835_2629.N1
MIP_NL__1PPDPA20070418_201623_000060452057_00229_26836_2630.N1
MIP_NL__1PPDPA20070418_215714_000060292057_00230_26837_2632.N1
MIP_NL__1PPDPA20070418_233749_000060162057_00231_26838_2633.N1
MIP_NL__1PPDPA20070419_011811_000060452057_00232_26839_2636.N1
MIP_NL__1PPDPA20070419_025902_000060292057_00233_26840_2637.N1
MIP_NL__1PPDPA20070419_043937_000060162057_00234_26841_2638.N1
MIP_NL__1PPDPA20070419_061958_000060452057_00235_26842_2639.N1
MIP_NL__1PPDPA20070419_080049_000060292057_00236_26843_2645.N1
```

The anomaly was detected by looking at the NESR values (see Figure 34). The problem consisted in excessive NESR values in the band AB and B and was due to the usage of a wrong MIP\_CO1\_AX file. If the input MIP\_CO1\_AX is very different from the offsets in the L0 product, all the offsets are flagged as invalid and the IPF uses the input MIP\_CO1\_AX as the good offset and subtract it from the scene. In this case, the ZPD position of the offset and the ZPD position of the scene are mostly not aligned creating this oscillation in the calibrated spectrum. This oscillation effect was already observed in the past in case of usage of a wrong MIP\_CO1\_AX auxiliary file, it can be observed also in the products of 19<sup>th</sup> April 2007 as shown in Figure 35.

These products were deleted from D-PAC archive and reprocessed using correct auxiliary files.



**Figure 34** NESR value during 18<sup>th</sup> Apr 2007. The red stripes show the anomaly consisting in excessive NESR values in the band AB and B.



**Figure 35** Band B spectrum for orbit 26839 measured on 19<sup>th</sup> April 2007.

The corrupted products have been reprocessed at D-PAC, below is the list of the re-processed data:

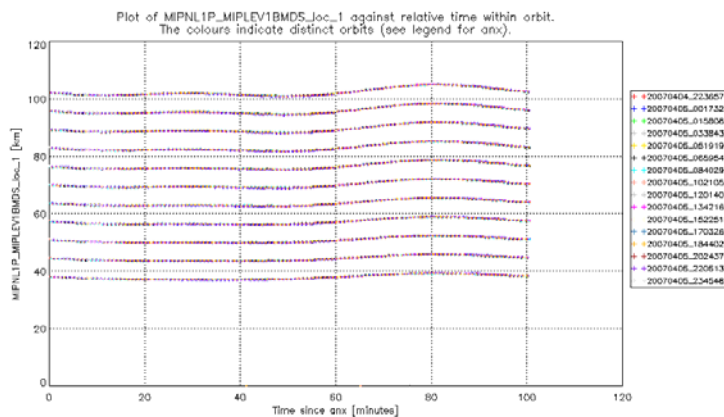
- MIP\_NL\_\_1PPDPA20070418\_151435\_000060452057\_00226\_26833\_0940.N1
- MIP\_NL\_\_1PPDPA20070418\_165526\_000060292057\_00227\_26834\_0012.N1
- MIP\_NL\_\_1PPDPA20070418\_183601\_000060162057\_00228\_26835\_0927.N1
- MIP\_NL\_\_1PPDPA20070418\_201623\_000060452057\_00229\_26836\_0932.N1
- MIP\_NL\_\_1PPDPA20070418\_215714\_000060292057\_00230\_26837\_0929.N1
- MIP\_NL\_\_1PPDPA20070418\_233749\_000060162057\_00231\_26838\_0930.N1
- MIP\_NL\_\_1PPDPA20070419\_011811\_000060452057\_00232\_26839\_0931.N1
- MIP\_NL\_\_1PPDPA20070419\_025902\_000060292057\_00233\_26840\_0933.N1
- MIP\_NL\_\_1PPDPA20070419\_043937\_000060162057\_00234\_26841\_0934.N1
- MIP\_NL\_\_1PPDPA20070419\_061958\_000060452057\_00235\_26842\_0935.N1
- MIP\_NL\_\_1PPDPA20070419\_080049\_000060292057\_00236\_26843\_0936.N1

### 3.4.8 ANOMALOUS SCAN PATTERN

On 21 May Anu Dudhia (OU) reported an anomalous scan pattern that was performed in the period 3-11 April 2007, in particular the following measurement pattern was adopted:

- 22-sweep scans
- tangent heights from 101 to 37 Km, at 6 Km steps
- each tangent altitude scanned twice

The altitudes of these measurements as a function of ANX are presented in Figure 36.



**Figure 36** Altitude of the measured sweeps as a function of ANX for the anomalous scan pattern.

The investigation shows that the CTI tables were not correctly up linked to the platform. In fact when the CTI table were supposed to be sent there was a planned unavailability due to the OCM. As a result the instrument starts the measurement without all the correct CTI tables even though the planning was correctly prepared.

All the measurements taken during 3 – 11 April 2007 have this anomalous scan pattern and the L2 processing of these data will be strongly affected.

### 3.5 *Appendix E – Level 2 IPF historical updates*

The historical updates to the MIPAS Level 2 IPF processor are listed hereafter:

- **Version V4.67** the following updates were introduced for L2 processing:
  - Fixed NCR-1458 → NO2 MIPAS products relative to orbit #7000 (3 July 2003) came with high values of chi<sup>2</sup>, that were not reproduced in the retrievals performed with the prototype using the same set of auxiliary files.
  - Fixed NCR-1521 → Some Level 2 products processed at DPAC with IPF 4.62 differ from the corresponding products processed with IPF 4.61, revealing a problem in the new 4.62 data. In fact the IPF 4.61 results were carefully validated using a balloon flight with very good space and time collocation.
  - Fixed NCR-1522 → Some L2 products processed at DPAC with IPF 4.61 and IPF 4.62 give beat-check format error. The same L2 production made with the prototype doesn't show this anomaly.
  
- **Version V4.65** (aligned with DPM 4.1 and ADFs V5.1, under validation) introduces modifications only for the Level 2 processor, with the following update:
  - Solution of NCR\_1310: Problem with MIP\_NL\_\_2P
- **Version V4.64** no update for the Level 2 processor in this version
- **Version V4.63** (aligned with DPM 4.1 and ADFs V5.1) has introduced the following modifications:
  - Processing of reduced resolution measurements in old configuration (17 sweeps per scan and fixed altitude – August/September 2004 measurements).
  - Solution of NCR\_1278: Some MIPAS profiles have zero pressure
  - Solution of NCR\_1308: MIPAS Level 2 failure.
  - Rejection of NCR\_1310: Problem with MIPNL\_\_2P
  - Rejection of NCR\_1317: One second discrepancy in IPF 4.61
- **Version V4.62** (aligned with DPM 4.0) has solved the following problems:
  - Fixed NCR\_1128: Cloud-detection anomaly.
  - Fixed NCR\_1275: Inconsistent values in MIPAS files.
  - Fixed NCR\_1276: Level2 profile counting bug.
- **Version V4.60, V4.61** has solved the following problems:
  - Fixed NCR\_992: Inconsistency in number of profiles in MIPAS Level\_2.
  - Fixed NCR\_1068: Number of computed residual spectra not consistent with the number of observations.
- **Version V4.59**, operational since 23 July 2003, has introduced only Level 2 processing modifications. The main improvements introduced via both the processor V4.59 and the installation of a new set of ADFs have been:
  - Fixed NCR\_892: Inconsistency in number of scans.
  - Fixed NCR\_893: Different values for same scans.
  - The cloud filtering (that is, every time a cloud is detected at a given altitude, the retrieval is performed only above that altitude)
  - The removal of the gaps between the altitude validity ranges (allowing retrievals in the Antarctic region not feasible with the old MIP\_MW2\_AX)
  - Altitudes margins fixed to +/- 4 km

- MIPAS-SPR-MAINT-0011 Wrong DSD name in L2 product in case of not requested VMR
- MIPAS-SPR-MAINT-0012 Filling of SPH field 22 of MIPAS Level 2 Products
- MIPAS-SPR-MAINT-0013 Filling of the MIPAS MPH and MIPAS Level 2 SPH fields
- MIPAS-SPR-MAINT-0014 Wrong writing of PCD String to the PCD Information ADS
- MIPAS-SPR-MAINT-0015 Too strong test and skipping retrieval
- MIPAS-SPR-MAINT-0016 Not initialised nucl1 and nucl2 in R 8.5.6.3-7A
- ENVI-GSOP-EOAD-NC-03-0539 MIPAS L2 processing aborted

### 3.6 Appendix F – Level 2 ADF historical updates

The Level 2 ADF files historical deliveries by IFAC are reported in the following table and paragraph. Version 4 corresponds to a set of ADFs for processing of full resolution measurements, with the noise level adjusted for when the interferometer heaters are switched-on and a flag set for processing of only nominal measurements. Version 5 corresponds to ADFs for processing of reduced spectral resolution measurement (17 sweeps operations), so is able to process the measurements done in the Aug-Sept 2004 period.

**Table 22.** Historical update of Level 2 configuration ADFs.

| Auxiliary Data File   | Start Validity                | Description   |
|---|-------------------------------|---|
| <b>ADFs V5.2</b><br>MIP_CS2_AXVIEC20060105_121012_20040809_000000_20040917_220643<br>MIP_IG2_AXVIEC20060105_113531_20040901_000000_20040917_220643<br>MIP_IG2_AXVIEC20060105_114108_20040809_000000_20040901_000000<br>MIP_MW2_AXVIEC20060105_130642_20040809_000000_20040917_220643<br>MIP_OM2_AXVIEC20060105_130954_20040809_000000_20040917_220643<br>MIP_PI2_AXVIEC20060105_131141_20040809_000000_20040917_220643<br>MIP_PS2_AXVIEC20060105_131340_20040809_000000_20040917_220643<br>MIP_SP2_AXVIEC20060105_131744_20040809_000000_20040917_220643  | 9-AUG-04                      | Correction of a bug in the previous L2 ADF v5.1<br>MIP_IG2_AX,<br>MIP_SP2_AX  |
| <b>ADFs V5.1</b><br>MIP_CS2_AXVIEC20050722_082136_20040809_000000_20040917_220643<br>MIP_IG2_AXVIEC20050721_130007_20040809_000000_20040901_000000<br>MIP_IG2_AXVIEC20050721_134702_20040901_000000_20040917_220643<br>MIP_MW2_AXVIEC20050721_144629_20040809_000000_20040917_220643<br>MIP_OM2_AXVIEC20050721_143058_20040809_000000_20040917_220643<br>MIP_PI2_AXVIEC20050721_142545_20040809_000000_20040917_220643<br>MIP_PS2_AXVIEC20050721_141630_20040809_000000_20040917_220643<br>MIP_SP2_AXVIEC20050721_140636_20040809_000000_20040917_220643  | 9-AUG-04                      | For processing RR measurement with fixed altitude and old vertical sampling   |
| <b>ADFs V3.8</b><br>NRT<br>MIP_PS2_AXVIEC20040421_095623_20040326_143428_20090326_000000<br>Off-line<br>MIP_PS2_AXVIEC20040421_095923_20040326_143428_20090326_000000   | 26-MAR-04                     | With respect to V3.7, adjusted the threshold to the new noise level.  |
| <b>ADFs V3.7:</b><br>NRT<br>MIP_MW2_AXVIEC20031021_145505_20020706_060000_20080706_060000<br>MIP_OM2_AXVIEC20040302_110723_20020706_000000_20080706_000000<br>MIP_PS2_AXVIEC20040302_110923_20040109_000000_20090209_000000<br>MIP_PI2_AXVIEC20031021_145745_20020706_060000_20080706_060000<br>MIP_CS2_AXVIEC20031021_145337_20020706_060000_20080706_060000<br>MIP_SP2_AXVIEC20031021_150016_20020706_060000_20080706_060000<br>Off-line<br>MIP_MW2_AXVIEC20031027_100858_20020706_060000_20080706_060000<br>MIP_OM2_AXVIEC20040302_110823_20020706_000000_20080706_000000<br>MIP_PS2_AXVIEC20040302_111023_20040109_000000_20090209_000000<br>MIP_PI2_AXVIEC20031027_101146_20020706_060000_20080706_060000<br>MIP_CS2_AXVIEC20031027_100559_20020706_060000_20080706_060000<br>MIP_SP2_AXVIEC20031027_101441_20020706_060000_20080706_060000<br>MIP_IG2_AXVIEC20040227_081527_20040301_000000_20090301_000000 | 06-JUL-02<br>and<br>09-JAN-04 | With respect to V3.6:<br>Eliminated scans with one or two altitude levels; adjusted the threshold to the new noise level. |
| MIP_IG2_AXVIEC20031118_151533_20031201_000000_20081201_000000   | 01-MAR-04                     | Seasonal update of climatological initial guess.  |
| MIP_IG2_AXVIEC20031118_151533_20031201_000000_20081201_000000   | 01-DEC-03                     | Seasonal update of climatological initial guess.  |
| <b>ADFs V3.6:</b><br>NRT<br>MIP_MW2_AXVIEC20031021_145505_20020706_060000_20080706_060000<br>MIP_OM2_AXVIEC20031021_145630_20020706_060000_20080706_060000  | 06-JUL-02                     | Activation of cloud detection; removal of the gaps between the altitude validity ranges; altitudes margins fixed to +/-   |

|  |           |  |
|--|-----------|--|
| MIP_PS2_AXVIEC20031021_145858_20020706_060000_20080706_060000<br>MIP_PI2_AXVIEC20031021_145745_20020706_060000_20080706_060000<br>MIP_CS2_AXVIEC20031021_145337_20020706_060000_20080706_060000<br>MIP_SP2_AXVIEC20031021_150016_20020706_060000_20080706_060000<br>Off-line<br>MIP_MW2_AXVIEC20031027_100858_20020706_060000_20080706_060000<br>MIP_OM2_AXVIEC20031027_101029_20020706_060000_20080706_060000<br>MIP_PS2_AXVIEC20031027_101319_20020706_060000_20080706_060000<br>MIP_PI2_AXVIEC20031027_101146_20020706_060000_20080706_060000<br>MIP_CS2_AXVIEC20031027_100559_20020706_060000_20080706_060000<br>MIP_SP2_AXVIEC20031027_101441_20020706_060000_20080706_060000 |           | 4 km; short-term ILS bug fix.<br><b>NRT</b><br>Old convergence criteria;<br>nominal altitude range.<br><b>Off-line</b><br>Improved convergence<br>criteria; altitude range<br>extended to 6-68 km. |
| MIP_IG2_AXVIEC20030731_134035_20030901_000000_20080901_000000  | 01-SEP-03 | Seasonal update of<br>climatological initial guess.  |
| MIP_IG2_AXVIEC20030522_104714_20030601_000000_20080601_000000  | 01-JUN-03 | Seasonal update of<br>climatological initial guess.  |
| MIP_IG2_AXVIEC20030307_142141_20030310_000000_20080301_000000  | 10-MAR-03 | Seasonal update of<br>climatological initial guess:<br>This dissemination substitute<br>the corrupt file disseminated<br>previously.   |
| MIP_IG2_AXVIEC20030214_130918_20030301_000000_20080301_000000  | 01-MAR-03 | Seasonal update of<br>climatological initial guess:<br>This auxiliary file turned out<br>to be corrupt, and a corrected<br>version has been disseminated<br>on 10 March 2003.                      |
| ADFs V3.1:<br>MIP_MW2_AXVIEC20030722_134301_20030723_000000_20080722_000000<br>MIP_OM2_AXVIEC20030722_134602_20030723_000000_20080722_000000<br>MIP_PS2_AXVIEC20030722_102142_20030723_000000_20080722_000000<br>MIP_PI2_AXVIEC20030722_134848_20030723_000000_20080722_000000<br>MIP_CS2_AXVIEC20030722_133331_20030723_000000_20080722_000000<br>MIP_SP2_AXVIEC20030722_093046_20030723_000000_20080722_000000   | 23-JUL-03 | Cloud detection enabled and<br>improved validity mask range<br>in Microwindows files;<br>improved Occupation<br>Matrices (no gaps between<br>altitude validity ranges).                            |



### 3.7 Appendix G – Level 2 anomaly status

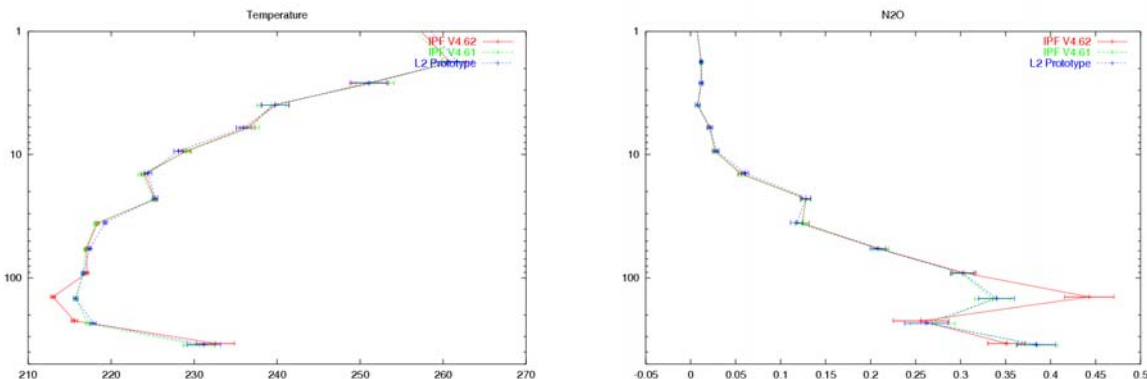
#### 3.7.1 EXCESSIVE CHI-SQUARE

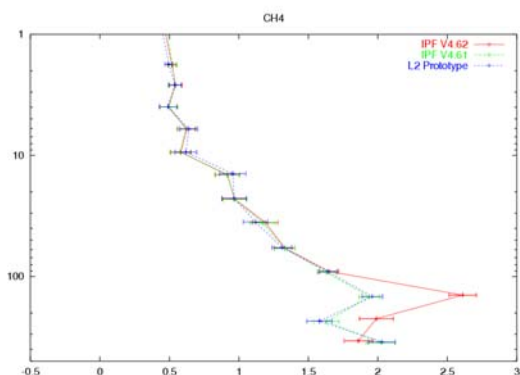
NO2 MIPAS products for orbit #7000 (3 July 2003) came with high values of chi2, that were not reproduced in retrievals performed with the prototype using the same aux files set. This NCR 1458 was classified as critical and is going to be analyzed by the IPF developers.

The first analysis by DJO shows that we were actually looking at an implementation error, then a bug in the IPF. DJO found a bug in the code in the 'Compute Optimum Estimate for Temperature/VMR' R 8.2.8.7-6. There was a wrong assignment of PS2 setting for Eo, po, grad E and Cr1 to the corresponding profile. After correction of this bug the IPF and prototype NO2 chi2 values for these orbit show to be the same. A patched version of the IPF will be delivered by DJO (4.66).

#### 3.7.2 DIFFERENCE ON L2 PRODUCTS BETWEEN V4.61 AND V4.62

Some Level 2 products processed at D-PAC with IPF 4.62 differ from the corresponding products processed with IPF 4.61. Since the IPF 4.61 products were validated using one IMK balloon flight (with a very good space/time coincidence), this discrepancy reveals a problem in the new 4.62 data. In particular the most significant differences were detected for seq. # 16 of orbit 2975 (measured on 24 Sept 2002) for T, N2O and CH4 profile at low altitude (around 140 hPa). This anomaly on 4.62 L2 products was not observed with the prototype, which is in accordance with 4.61 data and with the reference balloon profiles. The following three figures show the tests made by IFAC on seq. no. 16 of orbit 2975 with Level 2 prototype using the same input data as the operational processor. This test confirms that the anomalous results in the ESA processor V4.62 cannot be reproduced with the prototype. In the following plots all the results by IPF 4.62, IPF 4.61 and L2 prototype are reported for T, N2O and CH4 profiles (the profiles for which the most significant discrepancies have been detected). This problem was corrected with IPF 4.67 delivery.

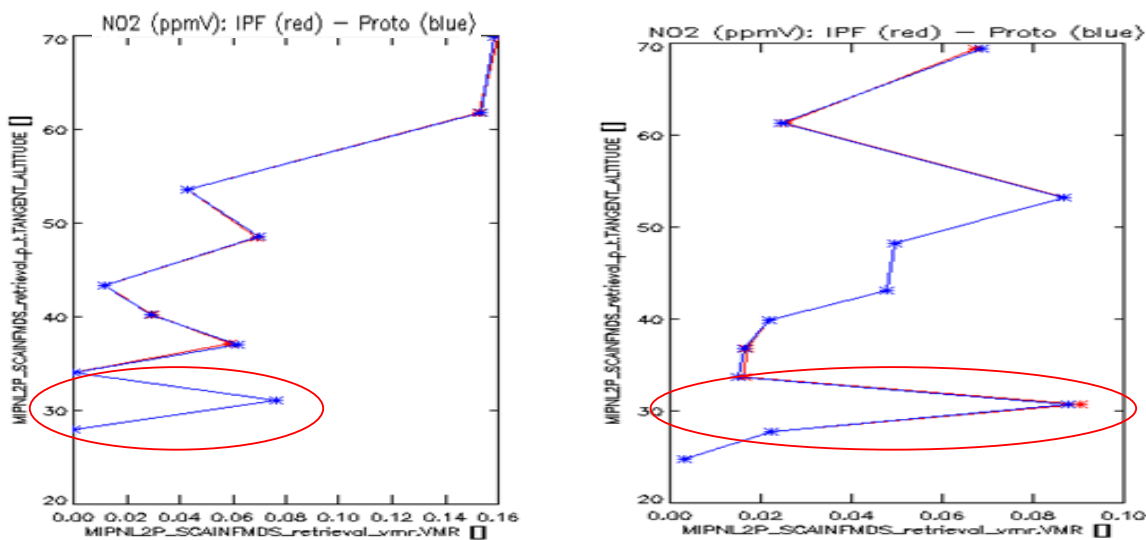




**Figure 37** Temperature N2O and CH4 profiles as a function of pressure retrieved with IPF 4.62 and 4.61 compared to the prototype for seq. 16 of orbit 2975. The 4.61 profile is the reference, validated by a IMK balloon flight.

### 3.7.3 NO2 RETRIEVAL DURING POLAR CONDITION

NO2 profiles of OFL products during Antarctic winter (June 2003) show unrealistically high value in the low stratosphere and in general they present a degradation of the NO2 profiles (zigzagging zero value). This happens in correspondence of very high NO2 in the stratosphere. The same behavior was observed with the prototype (see plots below).



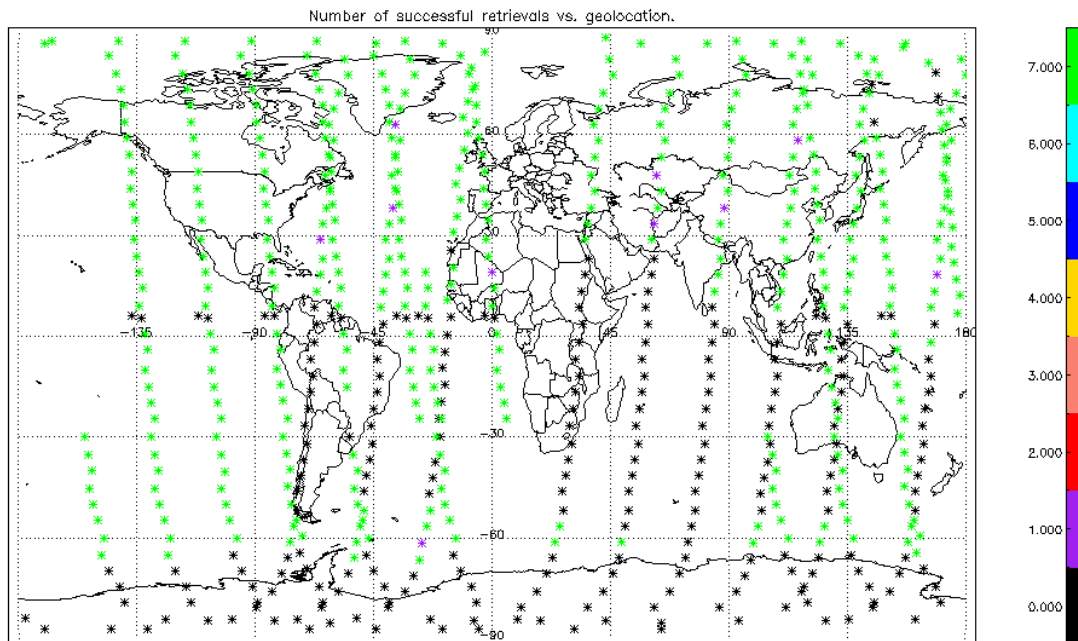
**Figure 38** NO2 profiles obtained with the IPF and prototype for two particular scan of 6 June 2003 in Antarctic winter condition, highlighted in red are the region around 30 km with sudden increase of NO2 value, which has no physical meaning. Note the degraded profile shape, namely the zigzag and the zero value.

The investigation done by IFAC arrives at the following conclusions:

- It seems that the cause of the instabilities in the NO<sub>2</sub> profile for the analyzed scans is the saturation of NO<sub>2</sub> lines below 43 km
- No significant improvements were obtained when adding other micro-windows in the OM from the current NO<sub>2</sub> MW database
- The micro window selection should consider the case of enhanced NO<sub>2</sub> concentration.

### 3.7.4 MISSING L2 PROFILES AROUND THE SOUTH POLE

An anomaly on L2 OFL data of the FR mission was reported by Chiara Piccolo (OU). The problem is that several L2 products from July to Nov 2002 have missing data around the South Pole; the anomaly can be observed in Figure 39 where the number of successful retrieval is plotted as a function of geo-location. In this figure we observe that all the retrievals around the South Pole failed, in particular the processing chain fails already with the pT retrieval.

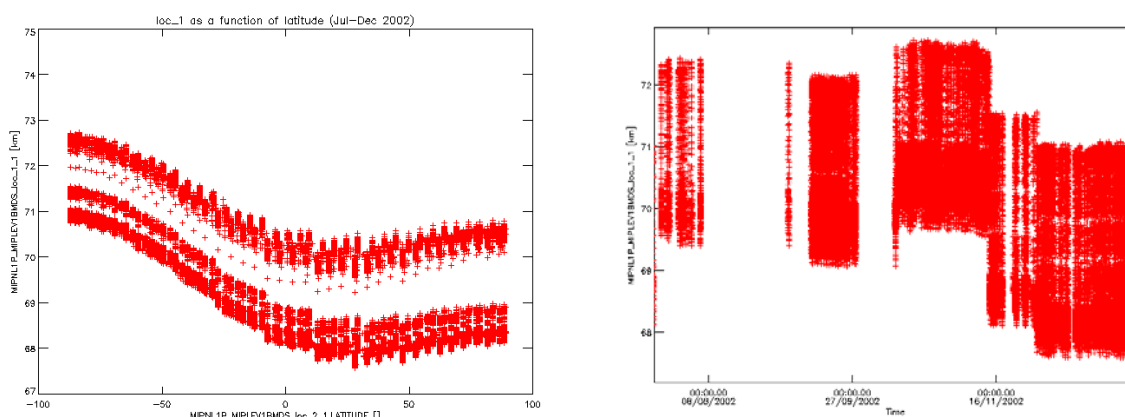


**Figure 39** MIPAS number of successful retrieval for 25 July 2002. Note that 7 is the nominal value corresponding to the target species of the ESA MIPAS products. Zero value means that the retrieval fails already at the p-T stage.

The anomaly was investigated in collaboration with S. Bartha (Astrium). It was found that the problem is due to a too restrictive definition of the altitude range of the OM. In the used PS2 file the maximum altitude for a sweep was fixed to 72 km. During July – Nov 2002 around the South Pole it happens that the highest sweep exceeds sometimes this upper altitude limit, in such a case the algorithm couldn't select a valid OM for p-T and the retrieval of the corresponding scan was skipped. The problem happens in particular around the South Pole where the engineering tangent altitudes are higher with respect to other latitude regions (see left plot of Figure 40), this feature already known and is due to a problem on the MIPAS pointing knowledge. It should be noted also

that the 72km limit is exceeded several times from July to November 2002, while afterwards the maximum of tangent altitude remains lower than the critical value. This can be observed in the right panel of Figure 40, where a long term trend of the pointing is clearly noticed. This annual trend of the tangent altitude is due to a mispointing of the entire ENVISAT platform which was already discussed in the LOS long term analysis (see Figure 19). The problem was corrected on December 2003 with the upgrades of the platform s/w.

An easy solution to the problem of missing L2 profiles around the South Pole will be to relax the altitude range in the OM, however this problem will be overcome with the new algorithm baseline (ml2pp 5.00) where the floating altitude scenario will be handled.



**Figure 40** MIPAS engineering tangent altitude as written in the L1b files (loc\_1 field) as a function of latitude and time.

### 3.7.5 CONTINUUM ANOMALY

This anomaly was reported by C. Bellotti (IFAC) at the QWG#10. The problem is that for some scans the operational processor retrieves continuum value even for very high altitude sweeps, while in the PS2 setting the highest altitude at which the continuum shall be fitted (rzUcl) is set to 20km. This anomaly doesn't affect the quality of the data, since when continuum is fitted for very high altitude the retrieved value is equal to zero. Nevertheless this feature is time consuming, since we spend time to retrieve a quantity which is known to be zero, moreover it was important to understand why this problem happens.

The investigation carried out with the support of S. Bartha (Astrium) highlights an anomaly in the algorithm baseline; in fact the same behaviour was observed when using the prototype. The problem appears whenever the lowest fitted sweep is above the limit defined by rzUcl parameter (20km); this can happen in case of cloud flagging or corruption of the lowermost sweeps. In these cases the algorithm has a weakness and it fits the continua for all the sweeps except for the highest one. This problem has been recognized and it was corrected within the new algorithm baseline delivery (ml2pp 5.0).