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MONTHLY REPORT: MARCH 2004

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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 Product Control Facility (PCF), 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-PCF
- ESOC
- ESTEC
- ABB BOMEM
- Oxford University
- IFAC-CNR
- EADS-Astrium GmbH
- Leicester University
- LPM
- IMK
- University of Bologna,
- ISAC,
- 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. The MR is composed of the following six sections:

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

1.2 Acronyms and Abbreviations

ACVT	Atmospheric Chemistry Validation Team
ADF	Auxiliary Data File
ADS	Annotated Data Set
AIRS	Atmospheric Infrared Sounder
ANX	Ascending Node Crossing
APID	Application Process Identifier
APS	Absolute Position Sensor
AR	Anomaly Report
ASP	Analogue Signal Processor
ASU	Azimuth Scan Unit
CBB PRT	Calibration Blackbody Platinum Resistance Thermometer
CCU	Central Communication Unit
CFS	CCU Flight Software
CTI	Configuration Table Interface
DLR	Deutsches Zentrum für Luft und Raumfahrt
DSD	Data Set Description
ECMWF	European Centre for Medium-Range Weather Forecasts
ESL	Expert Support Laboratory
ESU	Elevation Scan Unit
FCA	FPS (Focal Plane Subsystem) Cooler Assembly
FPS	Focal Plane Subsystem
IAA	Astrophysics Institute of Andalusia
ICE	Instrument Control Electronics
IDE	IDU Electronics
IDSE	Interferometer Differential Speed Error
IDU	Interferometer Drive Unit
IF	In-Flight
IFAC-CNR	Istituto di Fisica Applicata Nello Carrara – Consiglio Nazionale delle Ricerche
IG	Initial Guess
ILS	Instrument Line Shape
IMK	Institute für Meteorologie und Klimaforschung
INT	Interferometer
IPF	Instrument Processing Facility
ISP	Instrument Source Packet
LOS	Line of Sight
MIO	MIPAS Optical Module
MIPAS	Michelson Interferometer for Passive Atmospheric Sounding
MPH	Main Product Header
MR	Monthly Report
MW	Micro-Window
NESR	Noise Equivalent Spectral Radiance
NL	Non Linear
NOM	Nominal

OCM	Orbit Control Manoeuvre
ODS	Optical Path Difference Measurement Sensor
OPD	Optical Path Difference
PAW	Pre-Amplifier Warm
PCD	Product Confidence Data
PCF	Product Control Facility
QWG	Quality Working Group
REC	Residual and Error Correlation
RGC	Radiometric Gain Calibration
SCF	Spectral Correction Factor
SEM	Special Event Measurement
SPH	Specific Product header
VCS	Vibration Cancellation System
VMR	Volume Mixing Ratio
WCC	Wear Control Cycle

2 THE MONTHLY REPORT

2.1 SUMMARY

- Seven instrument unavailabilities occurred caused by IDU velocity error. To avoid having a mechanical blockage within the instrument, ESA took the decision to interrupt temporarily the regular instrument operations on 26 Mar 2004 04:18:21 (orbit 10823). Tests have been defined for April, aimed at identification of the error source, and in preparation of a return to operations.
- The Interferometer heater was switched-off on 26 Mar 2004 14.34.28.
- The IPF has been changed from V4.59 to V4.61.
- New sets of ADFs have been disseminated: V3.1 for Level 1 and V3.7 for Level 2.
- REC Analysis on NRT products: The derivative signatures all show a decrease in magnitude compared to the previous month, returning to the January levels. For the constituent species the vertical structure of the residual signatures is similar to the previous month but either the same or reduced in magnitude. The general reduction in residual amplitudes suggests an improvement in retrieval quality.
- Occupation Matrix Statistics: Occupation matrix statistics indicate less successful retrievals per day of operation than February, but a larger fraction of `nominal' retrievals (i.e. using the nominal OMs) and a larger percentage of pT retrievals for which constituent profiles were also retrieved. Fewer cases of cloud-contaminated spectra were also detected. Additional OMs were introduced with v4.61 from 17th March onwards (OM# >700) to handle combinations of low altitude cloud and high altitude corrupt spectra but these have not been used often enough to appear in these statistics.
- Monthly Mean: There are continued changes in pointing altitudes that affect the retrieved tangent values. The main changes from the previous month are in the Northern Polar Region, with a large reduction in water vapour at 47 km and above and a distortion of the O3 peak. This month's data included a change in processing from V4.59 to V4.61.

2.2 UNAVAILABILITY

2.2.1 Instrument Unavailability

MIPAS switched to Heater/Refuse mode due to IDU velocity error during the following time intervals:

Start time: 5 Mar 2004 23:06:38 (10533)
Stop time: 7 Mar 2004 16:16:00 (10558)

Start time: 10 Mar 2004 12:36:18 (10599)
Stop time: 10 Mar 2004 14:40:00 (10600)

Start time: 13 Mar 2004 16:37:17 (10644)
Stop time: 15 Mar 2004 12:10:00 (10670)

Start time: 19 Mar 2004 05:56:22 (10723)
Stop time: 19 Mar 2004 10:04:00 (10726)

Start time: 22 Mar 2004 17:17:43 (10773)
Stop time: 22 Mar 2004 21:40:00 (10776)

Start time: 23 Mar 2004 15:18:46 (10786)
Stop time: 23 Mar 2004 19:27:00 (10789)

Start time: 24 Mar 2004 03:09:24 (10793)
Stop time: 24 Mar 2004 10:48:00 (10798)

To avoid having a mechanical blockage within the instrument, ESA took the decision to interrupt temporarily the regular instrument operations on 26 Mar 2004 04:18:21 (orbit 10823).

2.2.2 Data Generation Gaps

2.2.2.1 MIP_NL__0P

Table 1 lists the MIP_NL__0P missing intervals.

Tab. 1 List of missing intervals: MIP_NL__0P.

Start Time	Stop Time	Duration [s]	Start Orbit	Stop Orbit
01-Mar-04 04:19:12	01-Mar-04 04:59:50	2438	10465	10465
01-Mar-04 04:59:50	01-Mar-04 05:00:17	27	10465	10465
01-Mar-04 05:00:17	01-Mar-04 05:41:58	2501	10465	10466
01-Mar-04 05:42:33	01-Mar-04 05:43:02	29	10466	10466
01-Mar-04 05:43:03	01-Mar-04 05:59:48	1005	10466	10466
05-Mar-04 23:06:32	05-Mar-04 23:06:38	6	10533	10533
07-Mar-04 16:16:00	07-Mar-04 16:16:14	14	10558	10558
10-Mar-04 12:36:13	10-Mar-04 12:36:18	5	10599	10599
10-Mar-04 14:40:00	10-Mar-04 14:40:14	14	10600	10600
12-Mar-04 01:51:43	12-Mar-04 03:15:25	5022	10621	10622
12-Mar-04 03:16:00	12-Mar-04 03:16:29	29	10622	10622
12-Mar-04 03:16:30	12-Mar-04 03:33:17	1007	10622	10622
13-Mar-04 07:36:53	13-Mar-04 07:36:57	4	10638	10638
13-Mar-04 10:58:14	13-Mar-04 10:58:28	14	10640	10640
15-Mar-04 12:10:00	15-Mar-04 12:10:14	14	10670	10670
19-Mar-04 10:04:00	19-Mar-04 10:04:14	14	10726	10726
20-Mar-04 10:38:23	20-Mar-04 10:38:37	14	10740	10741

22-Mar-04 17:17:38	22-Mar-04 17:17:43	5	10773	10773
22-Mar-04 21:40:00	22-Mar-04 21:40:14	14	10776	10776
23-Mar-04 15:18:44	23-Mar-04 15:18:46	2	10786	10786
23-Mar-04 19:27:00	23-Mar-04 19:27:14	14	10789	10789
24-Mar-04 10:48:00	24-Mar-04 10:48:14	14	10798	10798
26-Mar-04 04:18:18	26-Mar-04 04:18:21	3	10823	10823

2.2.2.2 MIP_LS__0P

Missing 6 March (orbits 10538, 10539) and 27 March (orbits 10839, 10840) measurements. Table 2 lists the MIP_LS__0P missing intervals.

Tab. 2 List of missing intervals: MIP_LS__0P.

Start Time	Stop Time	Duration [s]	Start Orbit	Stop Orbit
13-Mar-04 07:37:57	13-Mar-04 07:38:17	20	10639	10639
13-Mar-04 10:57:06	13-Mar-04 10:57:33	27	10640	10640
20-Mar-04 07:18:33	20-Mar-04 07:18:53	20	10739	10739
20-Mar-04 07:46:42	20-Mar-04 07:47:10	28	10739	10739
20-Mar-04 07:52:12	20-Mar-04 07:52:31	19	10739	10739
20-Mar-04 10:37:28	20-Mar-04 10:37:42	14	10740	10740

2.2.2.3 MIP_RW__0P

No raw measurements done in March.

2.2.2.4 MIP_NL__1P

Percentage of missing products: 18%.

2.3 INSTRUMENT CONFIGURATION AND PERFORMANCE

2.3.1 MIPAS Operations

Here a summary of the MIPAS operations planning for the March is presented.

Operations planning:

- Special Event Measurement (SEM) activity every orbit at the same ANX time (=527.1 sec); background SEM compensation time set to low resolution (=10.2 sec).
- Nominal (NOM) background mission; NOM scan starts every orbit at ANX =574.3 sec.
- Line Of Sight (LOS) activity with a prime sequence in the first two orbits visible from Kiruna station on Saturday and a backup sequence on the first two orbits visible from Kiruna station on Sunday.

- Starting from orbit #10300 (18 February) the periodic RGC is performed every 28 orbits, starting at ANX = 5500 sec.
- Periodic Wear Control Cycle (WCC) performed every 5 orbits, starting at ANX =4000 sec.
- Changed configuration for LOS measurements. Pitch: Bias=+0.0 deg, no harmonics, rearward + sideways observations.
- A short test has been performed on the MIPAS instrument by operating it at 95% resolution in the orbit range 10812 to 10815.

CTI needed for planning:
The SEMs are needed to re-start the NOM measurements in each orbit always at the same latitude. Each SEM is composed by a single scan of two sweeps. In order to execute that special measurement it is needed to define a Configuration Table Interface (CTI) per orbit (CTI_SEM_MP) containing information about: orbit number, SEM start and stop ANX time, number of sweeps (presently 2), resolution (presently high) and DS flag before the SEM. Two further CTI are needed to define respectively the elevation increment and the azimuth increment for the SEM sweep: CTI_S22_MP and CTI_S23_MP.

2.3.2 Thermal Performance

The monthly thermal trend (Fig. 1) is characterized by an increase of about 1.8 K clearly visible also in the long-term thermal trend (Fig. 2).

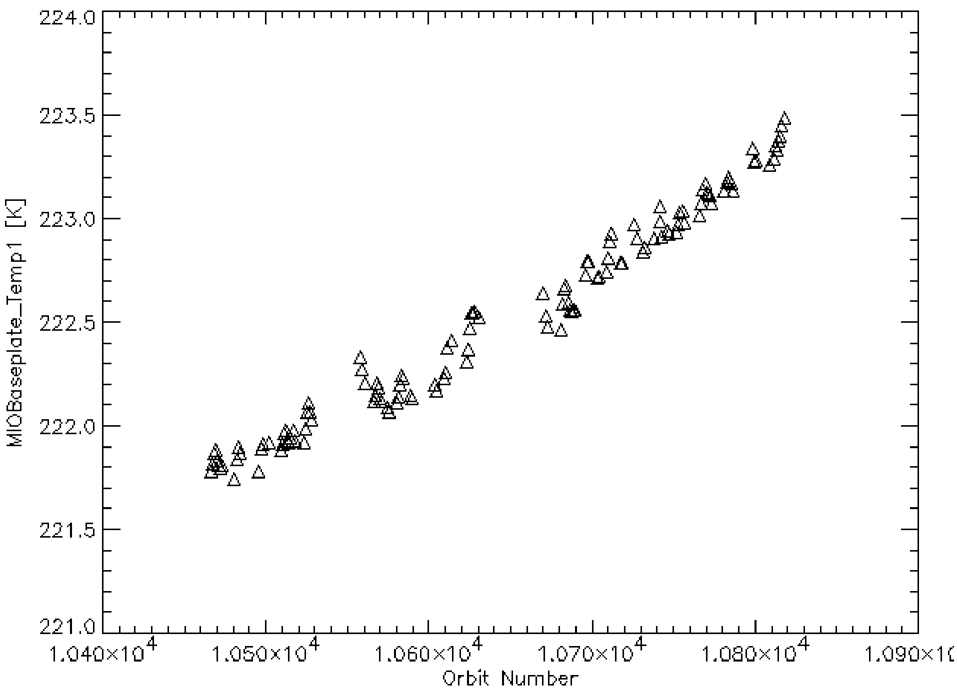

Fig. 1 Short-term trend of instrument temperature (each point represents the orbit mean value): March 2004.

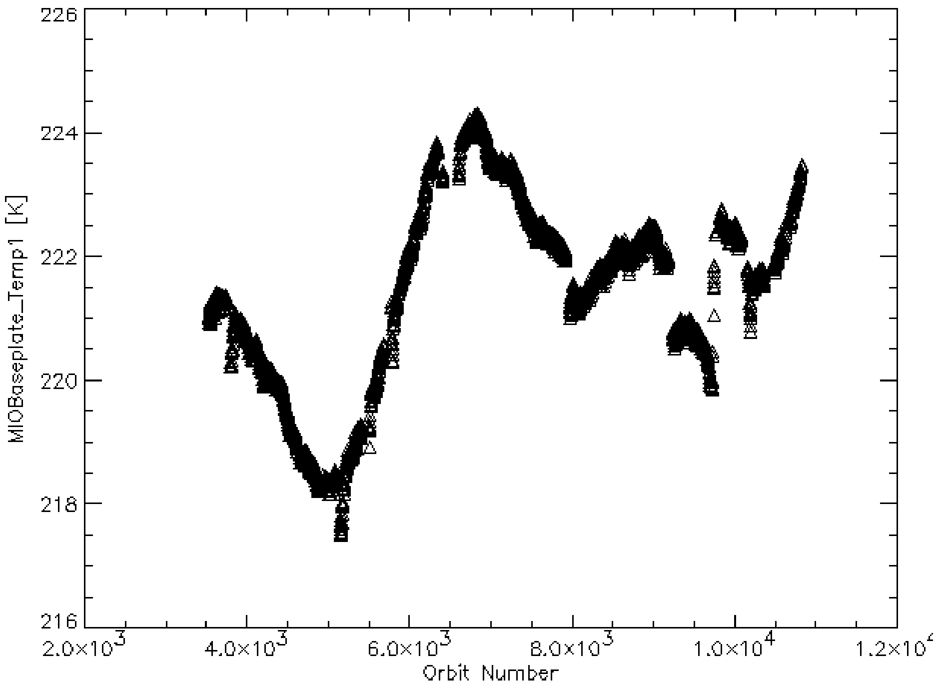

Fig. 2 Long-term trend of instrument temperature (each point represents the orbit mean value): November 2002 - March 2004.

2.3.3 Mechanical Performance

2.3.3.1 Cooler Performance

The Compressor and Displacer vibration level, together with the Radiator temperatures, are monitored on a daily basis (an example is shown if Fig. 3). The monitoring foresees a warning message whenever the Compressor vibration level exceeds a threshold value (8 mg) well below the tolerance error that activates the MIPAS Standby/Refuse mode. During March, the spikes characterizing the threshold exceeding have not been observed and the warning threshold has not been reached.

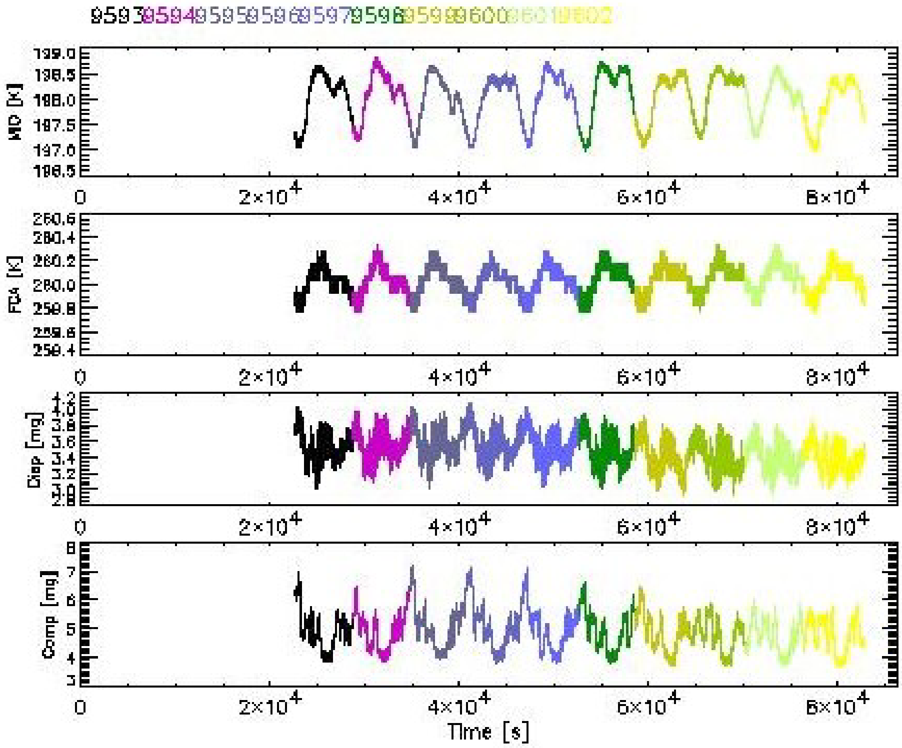

Fig. 3 Daily Compressor and Displacer vibration level, together with the Radiator temperatures as a function of time (each colour refers to a single orbit).

2.3.3.2 Interferometer Performance

Although the Interferometer is running with a very stable scan gate, there are still two anomalies, which are of importance:

- The Interferometer velocity error leading to a Heater/Refuse mode and consequently a MIPAS outage.
- The Interferometer differential speed errors (IDSE) of +4% and -4%; the -4% error has a significantly increased statistics.

Interferometer velocity error:

As already seen for January and February, in March MIPAS suffered from an increased occurrence of the IDU velocity error. In total seven events occurred which are listed below:

- 05 Mar 2004 23:06:38
- 10 Mar 2004 12:36:18
- 13 Mar 2004 16:37:17
- 19 Mar 2004 05:56:22
- 22 Mar 2004 17:17:43
- 23 Mar 2004 15:18:46
- 24 Mar 2004 03:09:24

In order to cope with this anomaly, the Interferometer heaters were switched on 9 January. However, the observation was that directly after the heater switching there were additional velocity errors, which was attributed to thermal gradients within the Interferometers. Therefore it was decided to let the temperature stabilise and to leave MIPAS in Heater Mode (unavailability between 12 January and 15 January). After the stabilisation period, MIPAS was put back into measurement, but even at the higher operational temperature the anomaly was still present, which was in contradiction to on-ground testing experiences and the related earlier anomaly investigations. As a result of this unexpected behaviour, a detailed investigation started to collect all the Interferometer related anomalies observed so far and to match them with error hypotheses. The investigation on this subject is ongoing. To avoid having a mechanical blockage within the instrument, ESA took the decision to interrupt temporarily the regular instrument operations on 26 Mar 2004 04:18:21 (orbit 10823) and the Interferometer heater was switched-off on 26 Mar 2004 14.34.28. Tests have been defined for April, aimed at identification of the error source, and in preparation of a return to operations.

<u>Interferometer differential speed error:</u>

Figure 4 shows the number of +4% anomalies (positive differential speed errors) per day as a function of time starting from October 2003, Figure 5 shows the increase of the -4% error (negative differential speed errors) since August 2003. From both plots it can be seen that the number of differential speed errors were reduced after the Interferometer heater switch-on, but reached the previous levels after about 3 weeks. This points to a temperature dependent phenomenon.

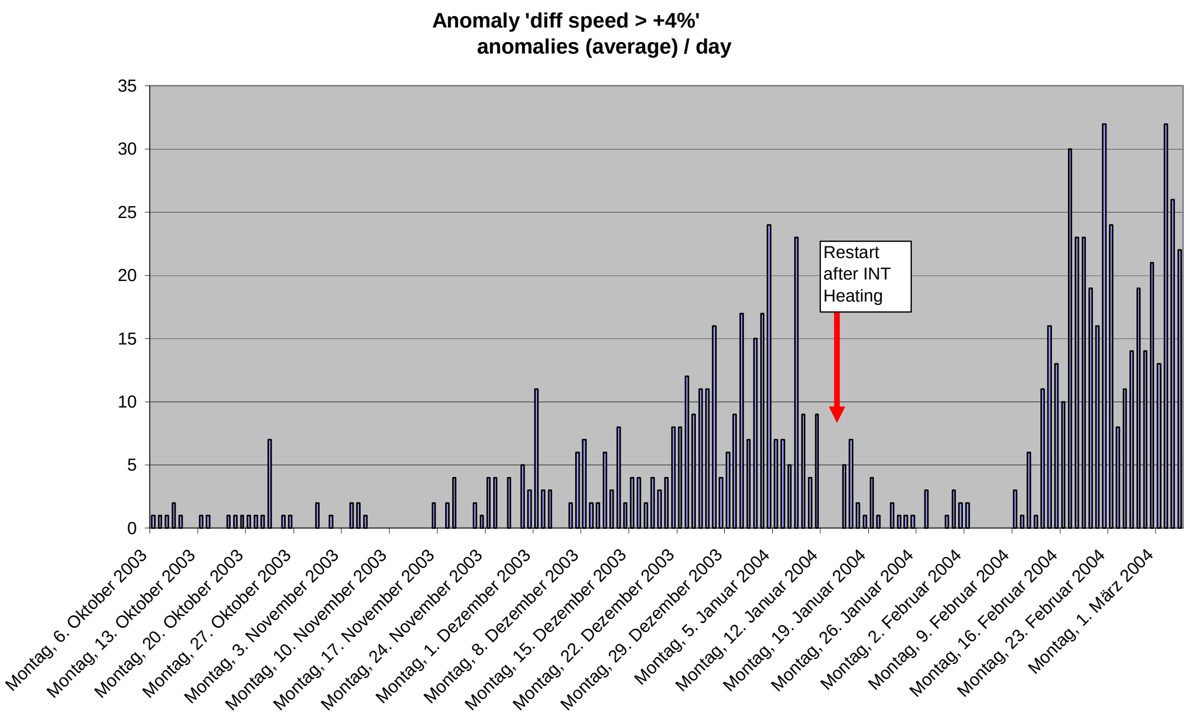

Fig. 4 Number of +4% IDSE per day as a function of time (starting from October 2003).

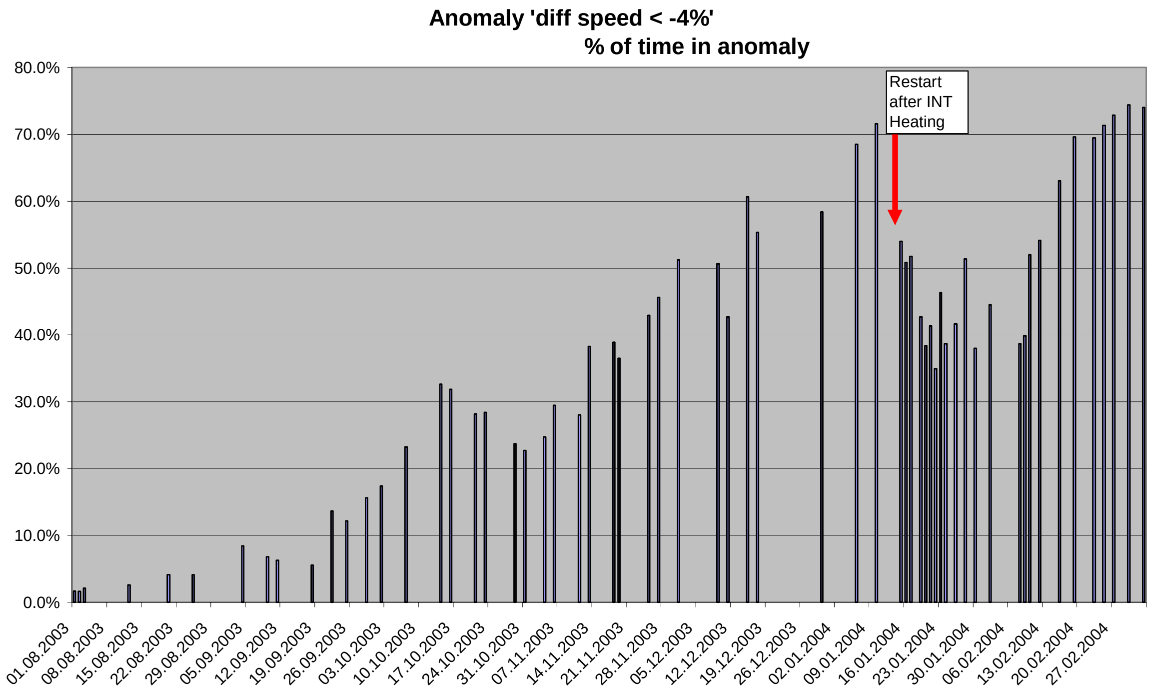

Fig. 5 Number of -4% IDSE per day as a function of time (since August 2003).

2.3.3.3 ASU/ESU Performance

ASU/ESU are performing nominal.

2.3.4 Other Instrument Parameters

N/A.

2.4 LEVEL 1 PRODUCT QUALITY MONITORING

2.4.1 Processor Configuration

2.4.1.1 Version

Table 3 lists the historical updates of the MIPAS processor. Version V4.57 has introduced upgrade only on Level 1 processor, 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

Version V4.59 has introduced only upgrade on Level 2 processor.

Version V4.61 has introduced variations for both Level 1 and Level 2 processor removing the problem that generated oscillating spectra.

Tab. 3 Historical updates of MIPAS processor at near real time (NRT) processing sites (PDHS-K and PDHS-E) and off-line processing sites (LRAC for Level 1 and D-PAC for Level 2).

Centre	Facility Software	Date
DPAC	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

Table 4 lists the ADFs valid in March. The new ADFs this month have been: Gain (MIP_CG1_AX), Offset (MIP_CO1_AX) and Spectral (MIP_CS1_AX) calibration files, which are updated weekly in order to prevent degradation of data quality due to gradual accumulation of contamination; Processing Settings (V3.1: MIP_PS1_AX) file, which has been updated in order to adjust the threshold to the modified noise level after the Interferometer heating.

Tab. 4 Level 1 ADFs valid in March.

Auxiliary Data File	Start Validity	Stop Validity	Updated in March
V3.0 MIP_CA1_AXVIEC20031021_143953_20020706_060000_20080706_060000	06-JUL-02	06-JUL-08	No
MIP_CL1_AXVIEC20040220_144507_20040117_000000_20050117_000000	17-JAN-04	17-JAN-05	No
V3.0 MIP_MW1_AXVIEC20031021_144135_20020706_060000_20080706_060000	06-JUL-02	06-JUL-08	No
V3.1 MIP_PS1_AXVIEC20040317_134725_20040109_000000_20090209_000000	09-JAN-04	09-FEB-09	Yes
MIP_CS1_AXVIEC20040329_065625_20040307_161600_20040313_163717	07-MAR-04	13-MAR-04	Yes
MIP_CO1_AXVIEC20040326_154040_20040307_161600_20040313_163717	07-MAR-04	13-MAR-04	Yes
MIP_CG1_AXVIEC20040326_145954_20040307_161600_20040313_163717	07-MAR-04	13-MAR-04	Yes
MIP_CS1_AXVIEC20040326_140817_20040315_121000_20040330_045227	15-MAR-04	30-MAR-04	Yes
MIP_CO1_AXVIEC20040326_154542_20040315_121000_20040330_045227	15-MAR-04	30-MAR-04	Yes
MIP_CG1_AXVIEC20040326_150455_20040315_121000_20040330_045227	15-MAR-04	30-MAR-04	Yes
MIP_CS1_AXVIEC20040325_151525_20040324_205841_20090324_205841	24-MAR-04	24-MAR-09	Yes
MIP_CO1_AXVIEC20040325_154853_20040324_224436_20090324_224436	24-MAR-04	24-MAR-09	Yes
MIP_CG1_AXVIEC20040325_150535_20040324_223232_20090324_223232	24-MAR-04	24-MAR-09	Yes

The strategy for the ADFs update is the following one:

- The MIP_CO1_AX, MIP_CG1_AX and MIP_CS1_AX will be updated every week and after a long cooler switch-off.
- The MIP_CL1_AX will be analysed every two weeks and updated when the pointing error differs with respect to the last disseminated one more than 10 mdeg.

For MIPAS data reprocessing, the generation of the historical ADFs has been completed and disseminated:

- Weekly generation of MIP_CG1_AX, MIP_CO1_AX and MIP_CS1_AX (and after a long cooler switch-off).
- Monthly generation of MIP_CL1_AX.

2.4.2 Spectral Performance

Regeneration of MIPAS ADF calibration files (MIP_CG1_AX, MIP_CO1_AX and MIP_CS1_AX) was done for the period starting from August 2002 to November 2003. Among them, the spectral calibration file MIP_CS1_AX contains the spectral correction factor (SCF), which compensate for instrument metrology variation e.g., aging of laser. The Fig. 6 below gives the variation trend over the period. We observed that the laser frequency had a drift of less than 6 ppm over a period of one year, which is very stable. Note that short-term variations are not necessary due a laser variation itself, the SCF depends on radiance noise because it is computed from atmospheric lines in the spectrum. The SCF variation over an orbit is typically less than +/-0.4 ppm.

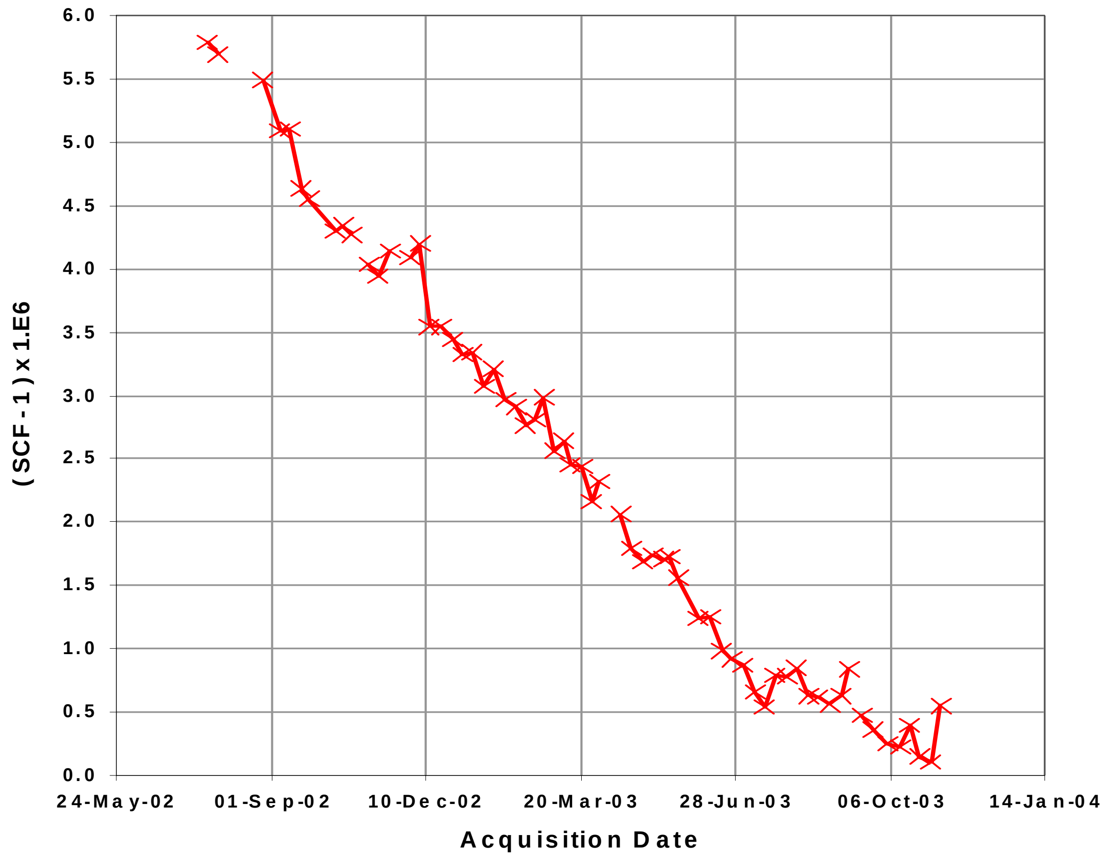

Fig. 6 MIPAS Spectral Calibration Factor (SCF) variation over August 2002 to November 2003.

2.4.3 Radiometric Performance

Figure 7 shows that the radiometric gain is characterized by an increase induced by the ice contamination affecting the MIPAS detectors. Orbits processed:

07-MAR-04 10558

16-MAR-04 10684

24-MAR-04 10798

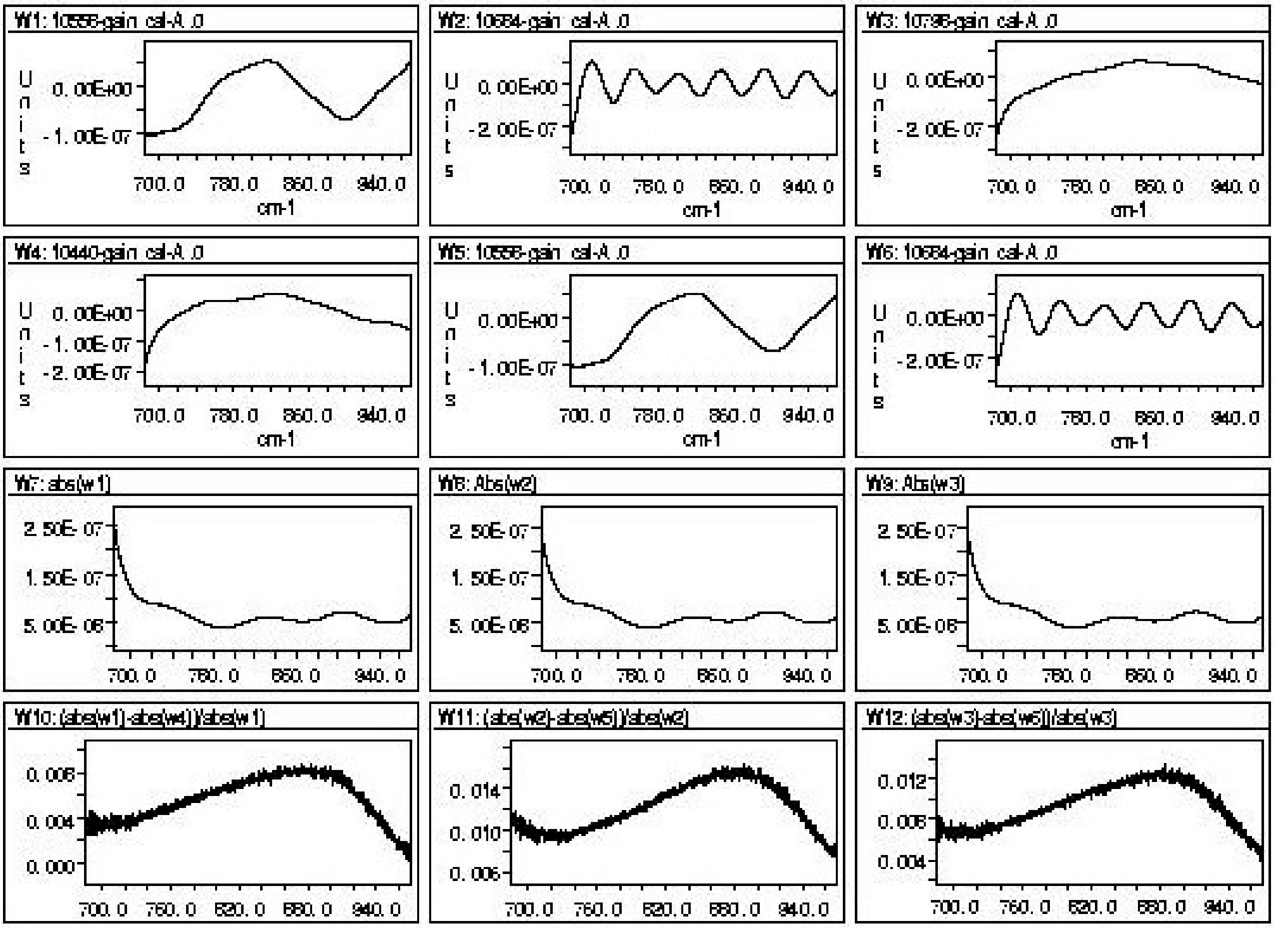

Fig. 7 Relative variation of gains disseminated in March taking as a reference the last disseminated one.

2.4.4 Pointing Performance

The LOS calibration measurements are performed every week. This configuration allows the analysis of the pointing stability and guaranties the availability of the data in case of missing products. Initial analysis has evidenced a marked annual cycle (as shown in Fig. 8) covering the period September 2002 – March 2004. The figure shows the relative and the absolute (evaluated taking into account the commanded elevation angle for the LOS calibration) pointing error. That annual trend is not due to the MIPAS instrument itself, but to a mispointing of the entire ENVISAT satellite resulting from software response to orbit control information. In fact, the update in the platform pointing software implemented on 12 December 2003 (orbit 9321) has evidently reduced the pointing deviation trends (see last points in Fig. 8).

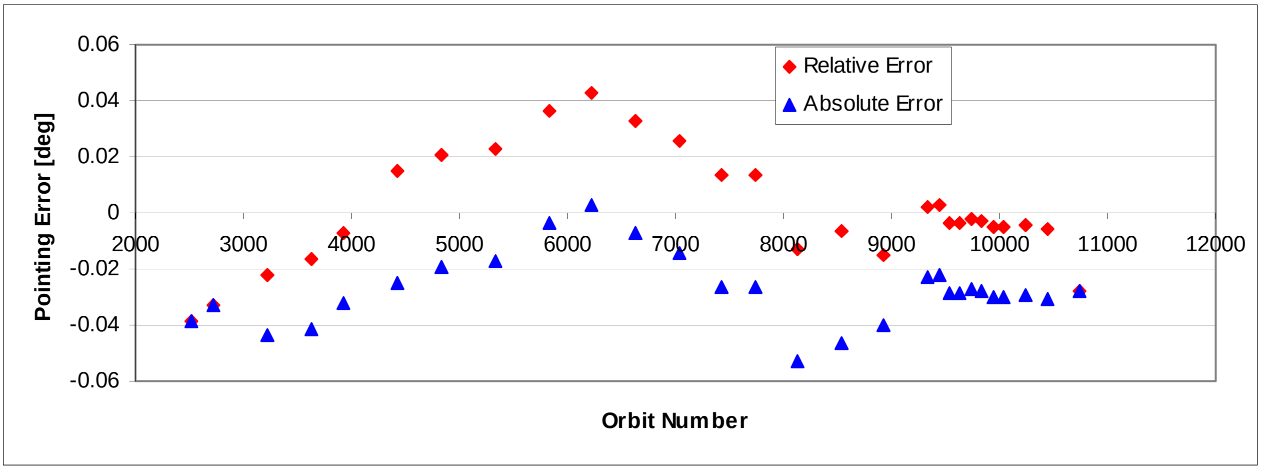

Fig. 8 MIPAS pointing error as a function of the orbit number: September 2002- March 2004.

As it can be seen in Fig. 8, starting from orbit 10639 Relative and Absolute Error are coincident because the angle for LOS measurements has been commanded to 0 mdeg.

Two LOS calibration measurements have been performed in March (the other two planned have been missed because of instrument unavailability):
13 March 2004, orbit 10639-10640
20 March 2004, orbit 10739-10740

Only measurements from channel D2 are processed because of the increase noise affecting channel D1 starting from the second part of September 2003.

2.4.5 Other Results

INCREASED NOISE LEVEL
During January (9 January 2004) the MIPAS interferometer has been heated in order to prevent the frequent IDU velocity error. A new MIP_PS1_AX has been generated and disseminated in March in order to adjust the threshold to the modified noise level. Nevertheless, there are no evidences of an increase in the MIPAS noise level as shown in Fig. 9-11 where the $NESR_T$ for orbit 503 is compared with the $NESR_T$ for orbit 9622 (2 January 2004; before heating) and 9816 (15 January 2004; after heating).

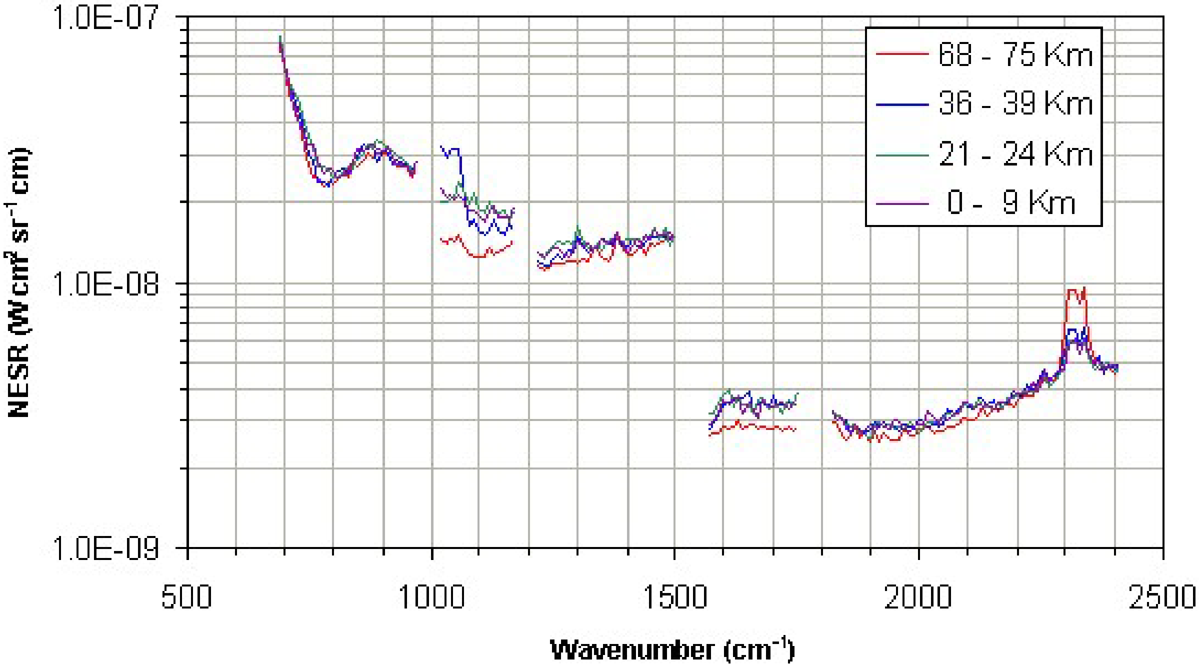

Fig. 9 NESR$_T$ as a function of wavenumber: orbit 503.

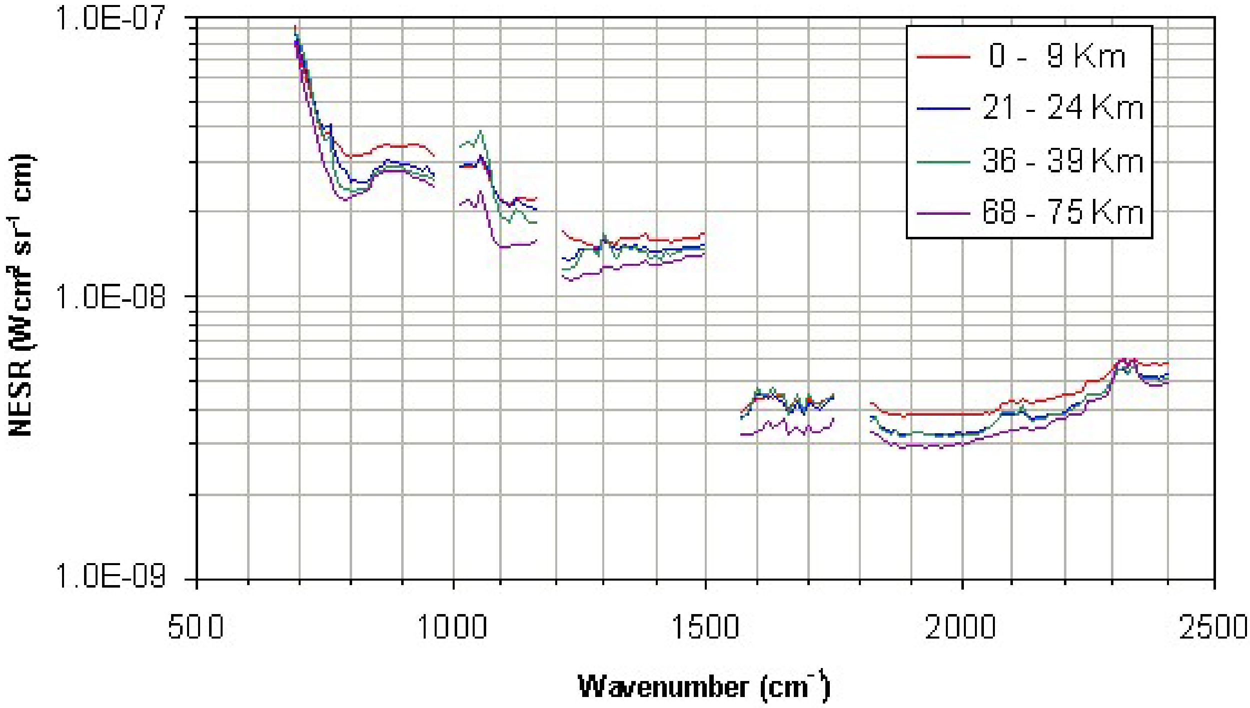

Fig. 10 NESR$_T$ as a function of wavenumber: orbit 9622.

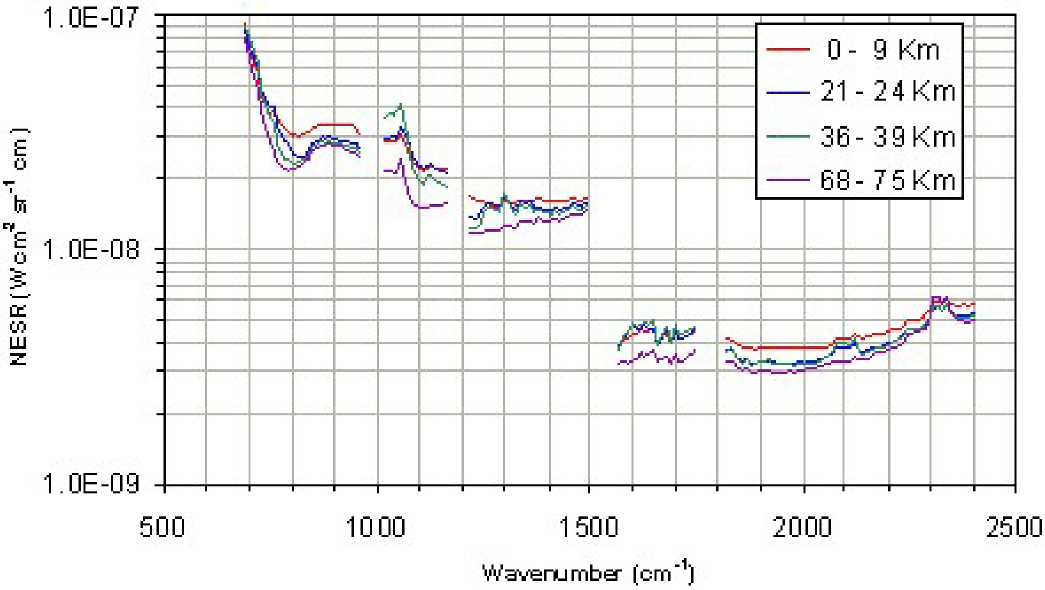

Fig. 11 $NESR_T$ as a function of wavenumber: orbit 9816.

ILS RETRIEVAL DISCREPANCY
The ILS retrievals performed by IPF 4.59 are different with respect to retrievals done with prototype. The problem is still under analysis, and therefore no modification has been implemented in IPF 4.61. Fortunately, the ILS used for Level 2 product processing is provided via an ADF and is not affected by the wrong retrievals.

OSCILLATING SPECTRA
Starting from middle November, spectra characterized by strong oscillations have been observed. That anomaly has corrupted a big amount of MIPAS Level 1 and Level 2. That problem was related to a bug in the MIPAS operating processor IPF 4.59 and it has been partially resolved with the new version of the MIPAS processor IPF 4.61. Remaining discrepancies have been resolved and will be implemented in another processor upgrade.

2.5 LEVEL 2 PRODUCT QUALITY MONITORING

2.5.1 Processor Configuration

2.5.1.1 Version

As already explained in Section 2.4.1.1, Tab. 3 lists the historical updates of the MIPAS processor. Version V4.59, operational since 23 July 2003, has introduced only Level 2 processing variations. The main improvements introduced via both the processor V4.59 and the installation of a new set of ADFs, have been: 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. The other updates are listed below:

- 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 ProductsMIPAS-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

V4.61 has solved the following problems:

- Inconsistency in number of profiles in MIPAS Level_2 (NO2 <-> p, T)
- Number of computed residual spectra not consistent with the number of observations
- Cloud-detection anomaly (partly closed)
- Exceeded time in processing offline products (partly closed)

The last two points will be discussed in Section 2.5.4 (Altitude Retrieval Performance)

2.5.1.2 Auxiliary Data Files

Table 5 lists the ADFs valid in March and Tab. 6 summarizes the historical (from January 2003) update of Level 2 ADFs.

Tab. 5 Level 2 ADFs valid in March (V3.7).

Auxiliary Data File	Start Validity	Stop Validity	Updated in March
MIP_IG2_AXVIEC20040227_081527_20040301_000000_20090301_000000	01-MAR-03	01-DEC-09	No
NRT MIP_MW2_AXVIEC20031021_145505_20020706_060000_20080706_060000 Off-line MIP_MW2_AXVIEC20031027_100858_20020706_060000_20080706_060000	06-JUL-02	06-JUL-08	No
NRT MIP_OM2_AXVIEC20040302_110723_20020706_000000_20080706_000000 Off-line MIP_OM2_AXVIEC20040302_110823_20020706_000000_20080706_000000	06-JUL-02	06-JUL-08	Yes
NRT MIP_PS2_AXVIEC20040302_110923_20040109_000000_20090209_000000 Off-line MIP_PS2_AXVIEC20040302_111023_20040109_000000_20090209_000000	09-JAN-04	09-JAN-09	Yes
NRT MIP_PI2_AXVIEC20031021_145745_20020706_060000_20080706_060000 Off-line MIP_PI2_AXVIEC20031027_101146_20020706_060000_20080706_060000	06-JUL-02	06-JUL-08	No
NRT MIP_CS2_AXVIEC20031021_145337_20020706_060000_20080706_060000 Off-line MIP_CS2_AXVIEC20031027_100559_20020706_060000_20080706_060000	06-JUL-02	06-JUL-08	No
NRT MIP_SP2_AXVIEC20031021_150016_20020706_060000_20080706_060000 Off-line MIP_SP2_AXVIEC20031027_101441_20020706_060000_20080706_060000	06-JUL-02	06-JUL-08	No

Tab. 6 Historical update of Level 2 ADFs.

Auxiliary Data File	Start Validity	Description
ADFs V3.1: MIP_MW2_AXVIEC20030722_134301_20030723_000000_20080722_000000 MIP_OM2_AXVIEC20030722_134602_20030723_000000_20080722_000000 MIP_PS2_AXVIEC20030722_102142_20030723_000000_20080722_000000 MIP_PI2_AXVIEC20030722_134848_20030723_000000_20080722_000000 MIP_CS2_AXVIEC20030722_133331_20030723_000000_20080722_000000 MIP_SP2_AXVIEC20030722_093046_20030723_000000_20080722_000000	23-JUL-03	Cloud detection enabled and improved validity mask range in Microwindows files; improved Occupation Matrices (no gaps between altitude validity ranges).
MIP_IG2_AXVIEC20030214_130918_20030301_000000_20080301_000000	01-MAR-03	Seasonal update of climatological initial guess: This auxiliary file turned out to be corrupt, and a corrected version has been disseminated on 10 March 2003.
MIP_IG2_AXVIEC20030307_142141_20030310_000000_20080301_000000	10-MAR-03	Seasonal update of climatological initial guess: This dissemination substitute the corrupt file disseminated previously.
MIP_IG2_AXVIEC20030522_104714_20030601_000000_20080601_000000	01-JUN-03	Seasonal update of climatological initial guess.
MIP_IG2_AXVIEC20030731_134035_20030901_000000_20080901_000000	01-SEP-03	Seasonal update of climatological initial guess.
ADFs V3.6: NRT MIP_MW2_AXVIEC20031021_145505_20020706_060000_20080706_060000 MIP_OM2_AXVIEC20031021_145630_20020706_060000_20080706_060000 MIP_PS2_AXVIEC20031021_145858_20020706_060000_20080706_060000 MIP_PI2_AXVIEC20031021_145745_20020706_060000_20080706_060000 MIP_CS2_AXVIEC20031021_145337_20020706_060000_20080706_060000 MIP_SP2_AXVIEC20031021_150016_20020706_060000_20080706_060000 Off-line MIP_MW2_AXVIEC20031027_100858_20020706_060000_20080706_060000 MIP_OM2_AXVIEC20031027_101029_20020706_060000_20080706_060000 MIP_PS2_AXVIEC20031027_101319_20020706_060000_20080706_060000 MIP_PI2_AXVIEC20031027_101146_20020706_060000_20080706_060000 MIP_CS2_AXVIEC20031027_100559_20020706_060000_20080706_060000 MIP_SP2_AXVIEC20031027_101441_20020706_060000_20080706_060000	06-JUL-02	Activation of cloud detection; removal of the gaps between the altitude validity ranges; altitudes margins fixed to +/- 4 km; short-term ILS bug fix. **NRT** Old convergence criteria; nominal altitude range. **Off-line**

		Improved convergence criteria; altitude range extended to 6-68 km.
MIP_IG2_AXVIEC20031118_151533_20031201_000000_20081201_000000	01-DEC-03	Seasonal update of climatological initial guess.
MIP_IG2_AXVIEC20040227_081527_20040301_000000_20090301_000000	01-MAR-04	Seasonal update of climatological initial guess.
ADFs V3.7: NRT MIP_MW2_AXVIEC20031021_145505_20020706_060000_20080706_060000 MIP_OM2_AXVIEC20040302_110723_20020706_000000_20080706_000000 MIP_PS2_AXVIEC20040302_110923_20040109_000000_20090209_000000 MIP_PI2_AXVIEC20031021_145745_20020706_060000_20080706_060000 MIP_CS2_AXVIEC20031021_145337_20020706_060000_20080706_060000 MIP_SP2_AXVIEC20031021_150016_20020706_060000_20080706_060000 Off-line MIP_MW2_AXVIEC20031027_100858_20020706_060000_20080706_060000 MIP_OM2_AXVIEC20040302_110823_20020706_000000_20080706_000000 MIP_PS2_AXVIEC20040302_111023_20040109_000000_20090209_000000 MIP_PI2_AXVIEC20031027_101146_20020706_060000_20080706_060000 MIP_CS2_AXVIEC20031027_100559_20020706_060000_20080706_060000 MIP_SP2_AXVIEC20031027_101441_20020706_060000_20080706_060000	06-JUL-02 and 09-JAN-04	With respect to V3.6: Eliminated scans with one or two altitude levels; adjusted the threshold to the new noise level.

2.5.2 REC Analysis

Residual spectra are the difference between spectra measured by the instrument and spectra generated by the retrieval forward model at the final iteration. Ideally, these should contain only random measurement noise but in practice a number of features are present indicating systematic errors either in the forward model or the instrument characterisation.

Residual and Error Correlation (REC) analysis is a statistical technique for analysing such data. The principle is to identify correlations between persistent features in the residual spectra and the signatures expected from different atmospheric species, other potential sources of forward model error and calibration errors represented by various derivatives of the spectrum with respect to wavenumber. This is now performed routinely as part of the monitoring of MIPAS data quality.

The following analysis refers only to NRT products.

Results:

1. **Pressure**
   Pressure and temperature microwindow residuals indicate an underestimate of a few % between 30-39 km. Other microwindow residuals indicate a similar bias at these altitudes, but +20% overestimates at higher and lower altitudes. Structures are similar to the previous month but approximately halved in magnitude.

2. CH4

CH4 microwindow residuals indicate a small overestimate of up to 0.1 ppmv. Other microwindow residuals indicate an underestimate of 0.2 ppmv at 20 km, but variable sign about 30 km. No significant change from previous month.

3. H2O

H2O microwindow residuals indicate an underestimate of up to 2 ppmv at 30 km, dropping to zero at 42 km, then rising again to 2 ppmv at 60 km, representing an enhancement of the structure of the previous month. Other microwindow residuals indicate the same underestimate below 30 km but continue to increase to 4 ppmv at 42 km and above. Structures are similar to the previous month but reduced in magnitude by approx 33%.

4. HNO3

HNO3 microwindow residuals indicate a slight underestimate of up to 0.5 ppbv at 27 km. Other microwindow residuals indicate a much larger overestimate varying from 2 ppbv at 12 km up to 8 ppbv at 33 km. The equatorial latitudes are an exception, indicating an underestimate of 5 ppbv at 12 and 15 km. No significant change from previous month.

5. N2O

N2O microwindow residuals indicate an underestimate of up to 30 ppbv at 30 km at equatorial latitudes, decreasing towards the poles, which is more symmetric about the equator than the previous month. Other microwindow residuals continue to indicate an overestimate of 40 ppbv at 47 km but no longer any clear structure at lower altitudes.

6. NO2

NO2 microwindow residuals indicate an overestimate of up to 1 ppbv from 33-36 km, approximately halved from the previous month. Other microwindow residuals no longer show any clear structure apart from a continued underestimate of 8 ppbv in the North Polar Region.

7. O3

O3 microwindow residuals indicate an overestimate reaching 0.5 ppmv at 30 km, approximately half the previous month's value, with a continued underestimate of 0.2 ppmv at 52 km. Other microwindow residuals continue to indicate an underestimate of up to 0.5 ppmv at 27 km for equatorial and southern mid-latitudes, but no clear signal for other latitude bands, and an overestimate of 0.5 ppmv at 47 km for all latitudes.

8. 0th Derivative

Apart from NO2, most microwindows show residual signatures of the original spectrum smaller than 2% of the original magnitude, very approximately related to the 2% radiometric gain error budget. NO2 residuals vary from +5 to +15%. Compared to the previous month, the magnitudes of the residuals have reduced and more closely resemble those of January.

9. 1st Derivative

Most microwindows show residual 1st derivative signatures corresponding to spectral shifts within the 0.001cm-1 spectral calibration error budget. The main departures are a for high altitude pT microwindows at long wavelengths and for high altitude NO2 microwindows, both of which show a negative shift. Results are very similar to the previous month except for a significant reduction in the amplitude in the NO2 microwindows.

10. 2nd Derivative

The assumed error budget for uncertainty in the width of the apodised instrument lineshape is 2%. Most microwindows show residual signatures within this range the main exceptions being the long wavelength, high altitude pT microwindows that indicate an underestimate, and the short wavelength H2O and NO2 microwindows that show no clear bias. The main change from the previous month is the general reduction in size of the residuals and the removal of the curvature, so that March results more closely resemble those of January.

Explanation of Plots:

Target Species (Fig. 12-18):
Spectral signatures of a large number of error sources are fitted simultaneously for each altitude and latitude band, but only those associated with pressure and the 6 retrieved species are plotted. Different colours/symbols indicate different latitude ranges. X-axis is an approximate conversion of residual signature to VMR or % pressure error based on a mid-latitude daytime profile. Black dashed line indicates +/- climatological 1sigma variability, dotted lines represent +/-10% and 100% of the profile value. Positive values indicate larger signature in atmospheric spectrum than forward model, indicating an underestimate of the `true' profile. Solid symbols represent the residuals fitted using only the target microwindows for each species (e.g., fitting H2O signature in H2O microwindows only) and open symbols represent the residuals fitted for all the other microwindows (e.g., fitting H2O signature in all the non-H2O microwindows).

Spectral Derivatives (Fig. 19-21):
0th, 1st and 2nd derivative signatures are fitted to each microwindow/altitude independently. Colours indicate microwindow target species and symbols indicate altitude range. Microwindow labels are listed in order of increasing wavenumber along the top but the set of small arrows indicates actual position along the x-axis. The y-axis represents a scaling of the signature in terms of some instrumental error. Following this analogy, positive y values indicate an underestimate of either the gain (0^{th} derivative), the wavenumber of atmospheric lines (1st derivative), or the AILS width (2nd derivative), in the sense of regarding the atmospheric spectra as `true' values compared to the forward model. Only points representing large numbers of residuals are plotted.

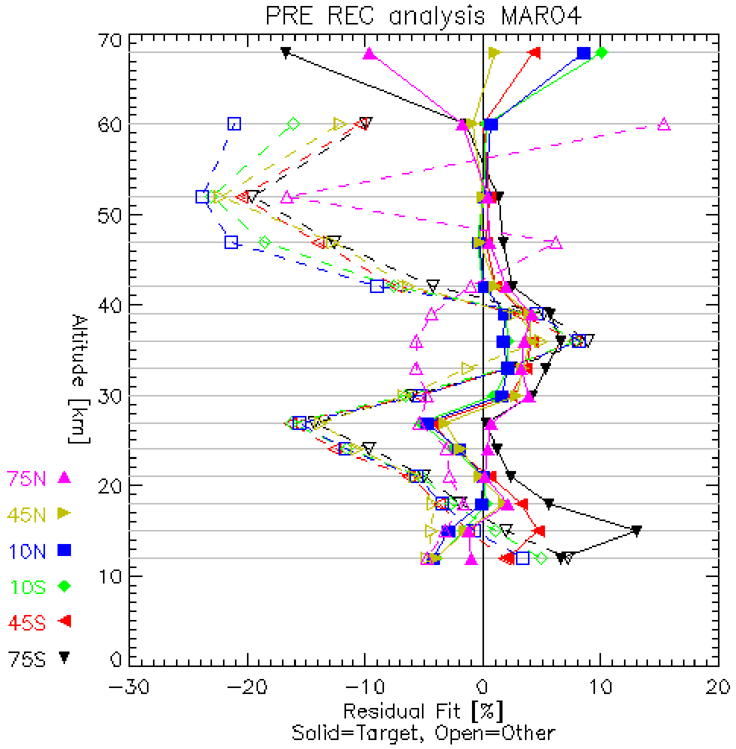

Fig. 12 Pressure REC analysis: March 2004.

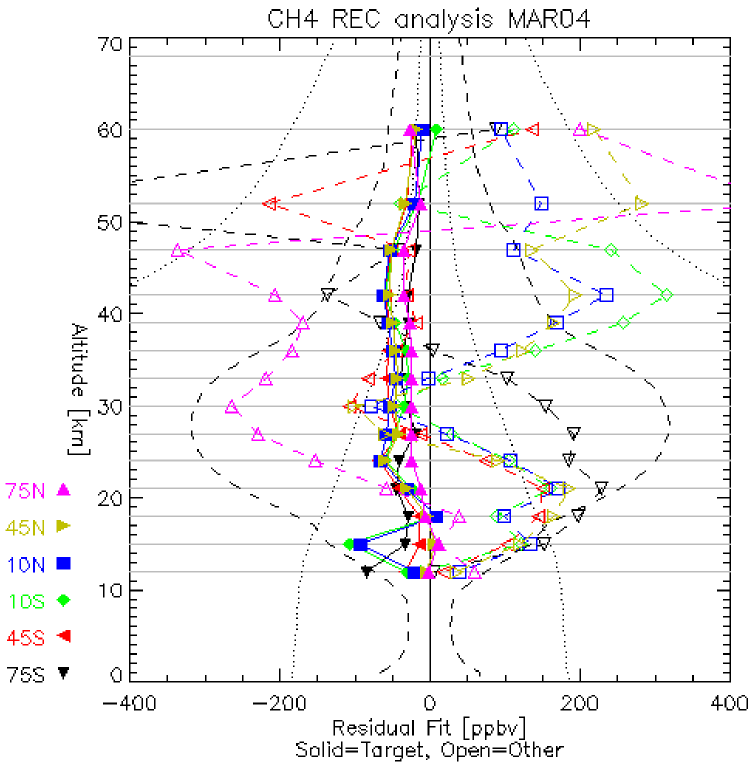

Fig. 13 CH4 REC analysis: March 2004.

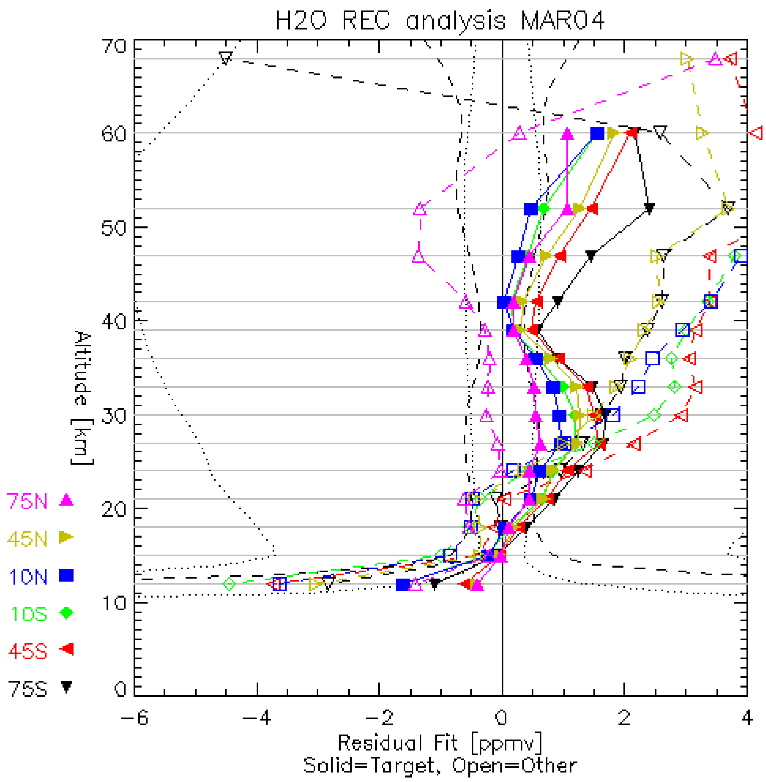

Fig. 14 H2O REC analysis: March 2004.

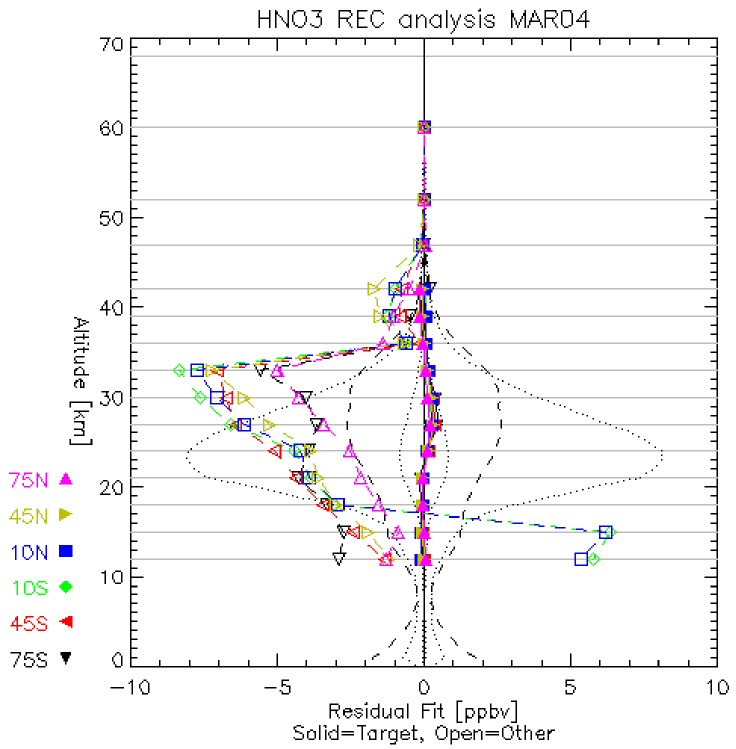

Fig. 15 HNO3 REC analysis: March 2004.

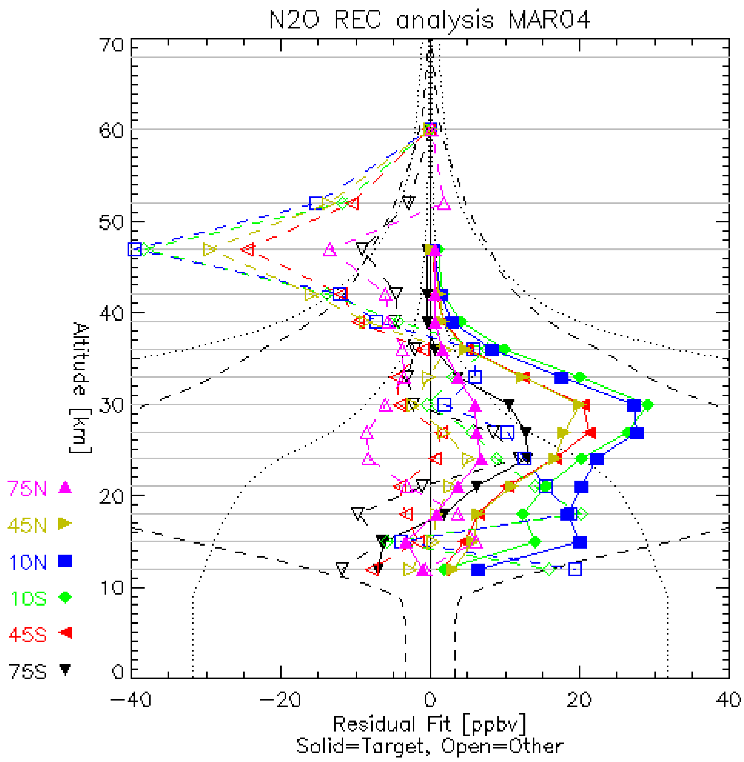

Fig. 16 N2O REC analysis: March 2004.

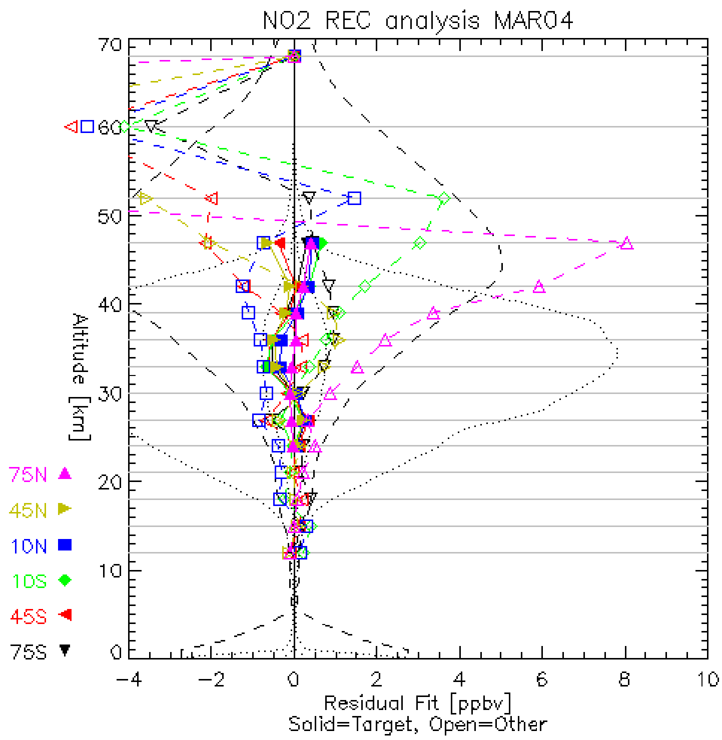

Fig. 17 NO2 REC analysis: March 2004.

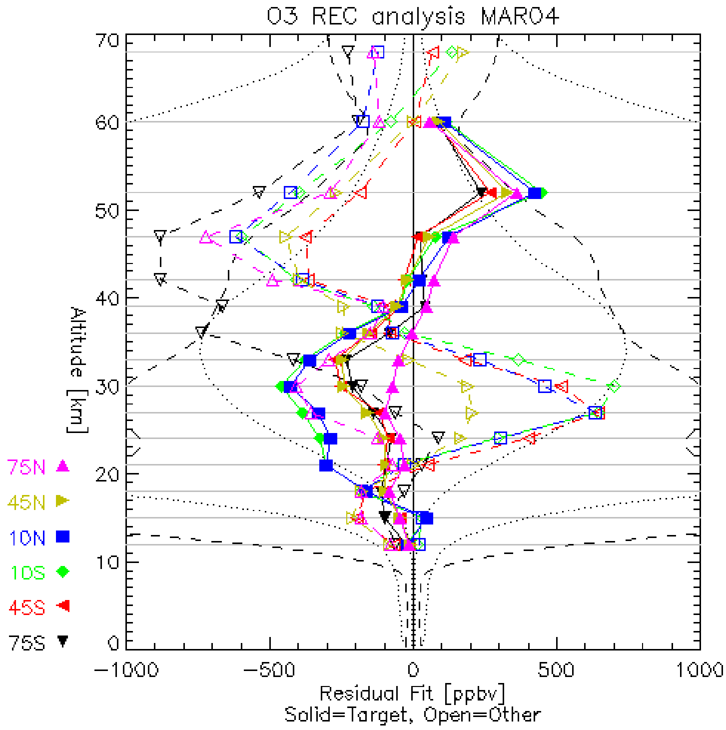

Fig. 18 O3 REC analysis: March 2004.

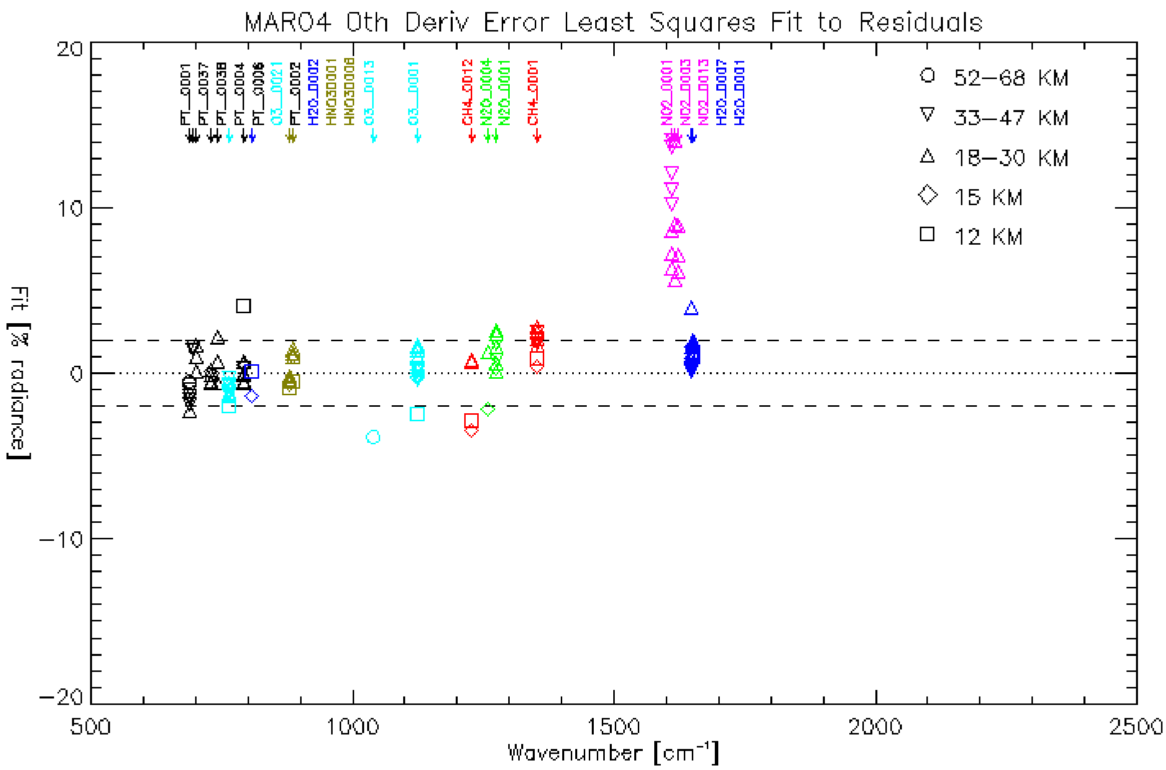

Fig. 19 0[th] order derivative error: March 2004.

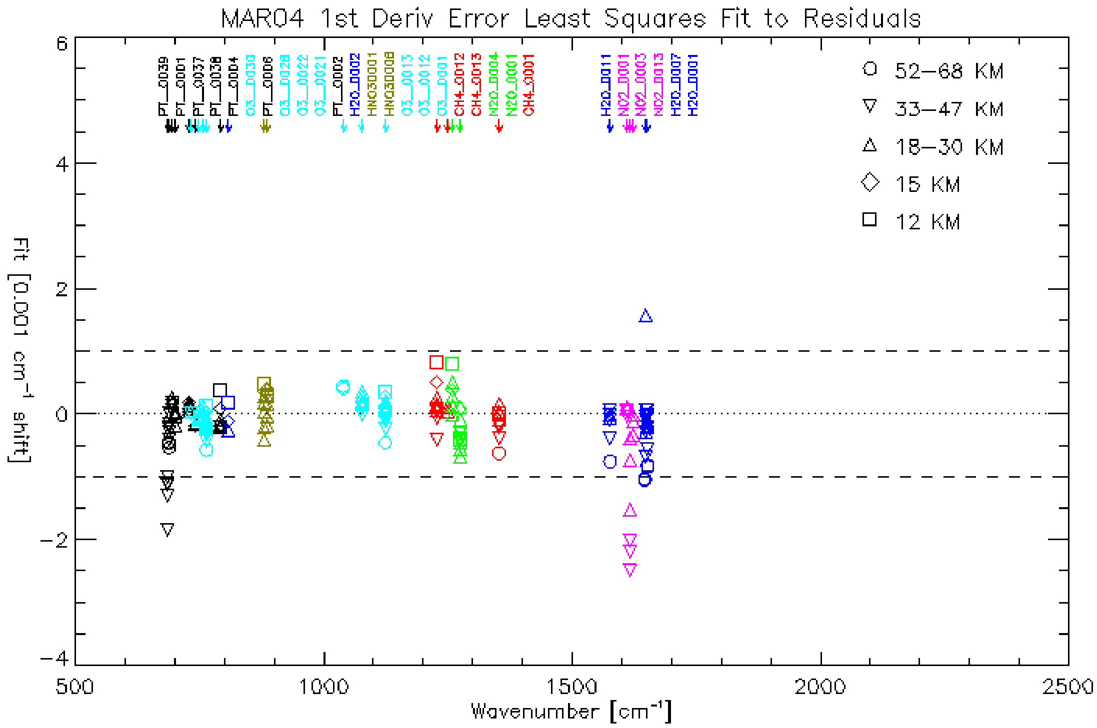

Fig. 20 1st order derivative error: March 2004.

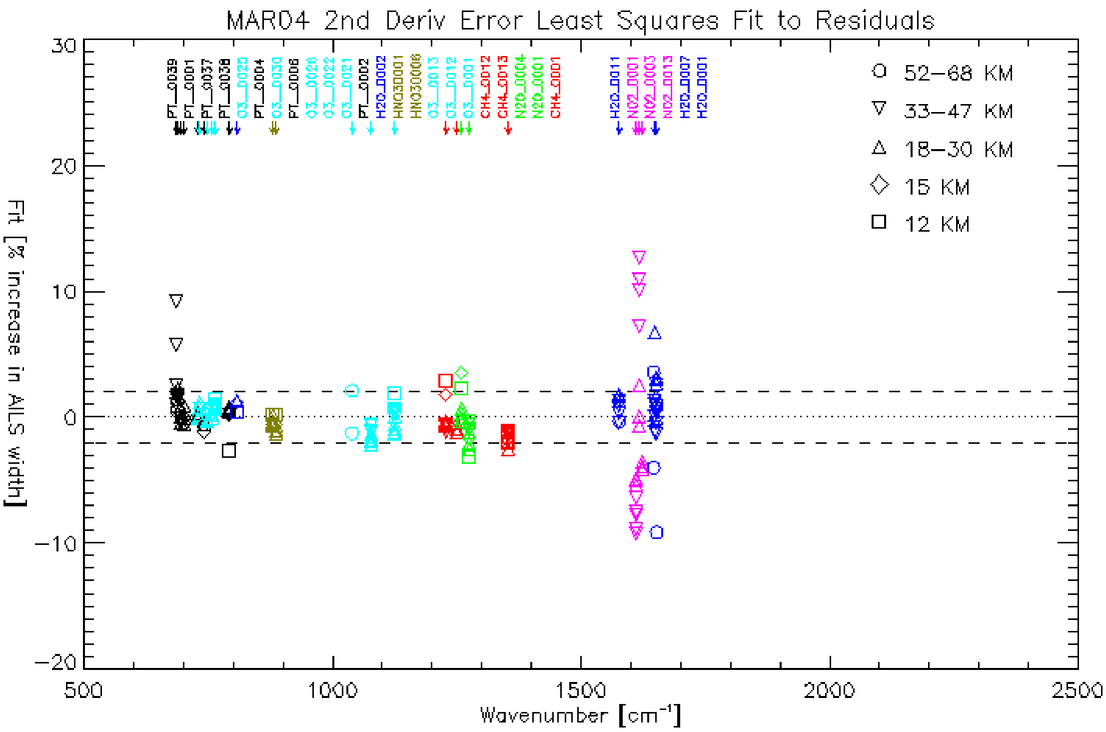

Fig. 21 2nd order derivative error: March 2004.

2.5.3 Occupation Matrix Statistics

An occupation matrix selects the set of microwindows and tangent altitudes used for each retrieval. When all L1B spectra are available for the retrieval, only the 'nominal' OMs #001-006 would be used, the different numbers just indicating different latitude bands. Given the width of these latitude bands and the MIPAS orbital coverage, the expected proportion of profiles within each latitude band are given in the Tab. 7.

Tab. 7 Expected proportion of profiles within each latitude band.

Occupation Matrix	Latitude Range	No. Profiles/orbit	Fraction of Profiles
006	65N-90N	10	14%
005	20N-65N	18	25%
004	EQU-20N	8	11%
003	20S-EQU	8	11%
002	65S-20S	18	25%
001	90S-65S	10	14%

Alternative OMs are also available to cope with situations where one or more spectra are unavailable, e.g. corrupt data or if cloud-contamination is detected in the field of view. These each have a 3-digit code, which can be used to identify the situation encountered, the second and third digits being one of the sweep altitudes. OMs with codes beginning with 6 use the same microwindows as the nominal OMs but with all sweeps up to and including a particular altitude excluded, e.g. 615 means that all spectra up to 15 km are excluded from the retrieval. These were specifically generated to cope with cloudy scenes. If the first digit is 1...5 then only one band at one altitude are excluded, (1=A band, 2=AB band, etc). For example code 421 is an occupation matrix, which excludes the C band at 21 km. If the first digit is 0 then all bands at the particular altitude are excluded. These OMs were generated to cope with corrupt data and, unlike the 600 OMs, often use different microwindows to the nominal OM.

The actual OM selected for retrieval is determined according to a priority list, the nominal OMs being always the first in the list. A check is made to see which bands are available and the priority list is searched sequentially until an OM is found which only requires the available bands. For example, if band A at 15 km is corrupt, OMs 015, 115, 615, 618, 621 ... etc could all be used but the one which is selected will be the highest in the priority list which, in theory, should be the one which allows most information to be retrieved from the remaining spectra.

The following analysis refers only to NRT products.

Results:
1. Valid retrievals only received up until March 26th when the instrument was switched off, approximately 450 valid pT profiles per day (compared to 670 the previous month).
2. VMR retrieved successfully from >98.5% pT profiles for all species, improvement of 0.3% compared to previous month.

3. 23% (OM002) and 23% (OM005) of retrievals are obtained using the nominal mid latitude OMs (expected 25% in the absence of clouds) – northern mid-latitudes (OM005) up by 1% compared to previous month.
4. 14% (OM001) and 15% (OM006) of retrievals are obtained using each of the nominal high latitude OMs (expected 14% in the absence of clouds) – an increase of 1% compared to previous month.
5. 10% (OM003) and 7% (OM004) of retrievals are obtained using the nominal low latitude OMs (expected 11% in the absence of clouds) - similar to previous month.
6. 2.5% retrievals correspond to OMs with 12 km sweep removed (medium level clouds detected): 612 for pT, O3, N2O; 015 for H2O; 115 for HNO3; 312 for CH4 - down by 2.2% compared to previous month.
7. 1.4% retrievals correspond to OMs with both 12 and 15 km sweeps removed (high cloud) : 615 for pT, 015 for H2O (again), O3; 615 for HNO3, CH4, N2O. - down by 1.3% compared to previous month.
8. 0.9% retrievals correspond to OMs with 12-18 km sweeps removed (very high cloud): 618 - down by 1.4% compared to previous month.
9. NO2, only retrieved from 24-47 km, uses no corrupt/missing OMs for more than 0.5% of the time in total.
10. Around 92% of all retrievals (expressed as total pT retrievals), apart from NO2, used the nominal occupation matrix, up 5% compared to previous month.

Table 8 summarises the results.

Tab. 8 Occupation matrix statistics.

PT		H2O		O3		HNO3		CH4		N2O		NO2	
No. Profiles		No. constituent profiles as % of No. pT profiles											
11757		98.6		98.6		98.6		98.5		98.5		98.6	
Occupation Matrix labels and frequency as % of pT ('etc.' = those contributing <0.1% each)													
OM	**%**	**OM**	**%**	**OM**	**%**	**OM**	**%**	**OM**	**%**	**OM**	**%**	**OM**	**%**
002	23.3	002	23.2	002	23.2	002	23.3	002	23.2	002	23.2	005	24.4
005	22.8	005	22.8	005	22.8	005	22.9	005	22.8	005	22.9	002	24.1
006	15.3	006	15.3	006	15.3	006	15.4	006	15.3	006	15.4	006	15.7
001	14.0	001	14.0	001	14.0	001	14.0	001	14.0	001	14.0	001	14.6
003	10.1	003	9.4	003	9.4	003	9.4	003	9.3	003	9.4	003	10.0
004	7.5	004	7.1	004	7.1	004	7.1	004	7.1	004	7.1	004	9.0
612	2.5	015	3.3	612	2.4	115	2.0	312	2.1	612	2.0	024	0.5
615	1.4	618	1.1	015	1.3	615	1.4	615	1.4	615	1.4	etc.	0.3
618	0.9	621	0.5	618	0.9	618	1.1	618	1.0	618	1.0		
621	0.4	112	0.4	621	0.5	621	0.5	621	0.5	621	0.5		
021	0.3	624	0.3	624	0.3	012	0.4	612	0.4	012	0.4		
624	0.2	021	0.2	018	0.3	624	0.3	624	0.3	624	0.3		
121	0.2	024	0.2	021	0.2	021	0.2	018	0.3	018	0.3		
024	0.1	615	0.1	024	0.1	024	0.1	021	0.2	021	0.2		

036	0.1	etc.	0.5	615	0.1	etc.	0.3	024	0.1	024	0.1		
etc.	0.7			etc.	0.3			etc.	0.3	etc.	0.2		
Profiles retrieved with nominal occupation matrix (OM001 ... OM006) as % of pT													
93.0		91.9		92.0		92.0		91.8		92.0		97.8	

2.5.4 Retrieval Performance

INCONSISTENCY IN COMPUTED RESIDUAL SPECTRA
The number of computed residual spectra with processor IPF 4.59 was not consistent with the number of observations. The problem has been fixed in IPF 4.61 installed in March.

NUMBER OF COMPUTED RESIDUAL NOT CONSISTENT WITH OBSERVATION
The problem affected IPF 4.59 and it has been fixed in IPF 4.61.

ANOMALOUS PROCESSING TIME
An excessive processing time for Level 2 off-line processing with IPF 4.59 characterized some MIPAS products. This has been tracked down to 2 causes:

- A discrepancy between processor and prototype processing time.
- A bug in the processor that is not able to process scans composed by one only altitude level.

In order to quickly remove the second problem, a new MIP_OM2_AX has been generated for both NRT and off-line processing in order to eliminate occupation matrix composed by scans with only one level. The new ADF has been disseminated in March after testing. The first problem is still affecting IPF 4.61, although the character of the timing discrepancy has changed.

INCREASED NOISE LEVEL
For the same reason explained in Section 2.4.5, a new MIP_PS2_AX has been generated and disseminated in March.

CLOUD-DETECTION ANOMALY
The cloud-detection performed by the MIPAS processor IPF 4.59 is different with respect to the detection done with the prototype. The problem has been partly removed in IPF 4.61, but remaining discrepancies are still under analysis in IPF 4.61.

2.5.5 Improvements

In order to conform the data processing to the new noise level introduced by the interferometer heating new MIP_PS1_AX and MIP_PS2_AX have been generated and disseminated in March after testing.

A new MIP_OM2_AX has been generated and disseminated in March in order to quickly resolve the problem related to processing of scans composed by one only altitude level.

2.6 VALIDATION ACTIVITIES AND RESULTS

2.6.1 Consistency Verification

The following figures show the comparison of the monthly mean vertical profiles (altitude, pressure, temperature, and species) with the ones obtained the previous month. The vertical axis in each case is the nominal tangent altitude and the averages are separated into 6 latitude bands.

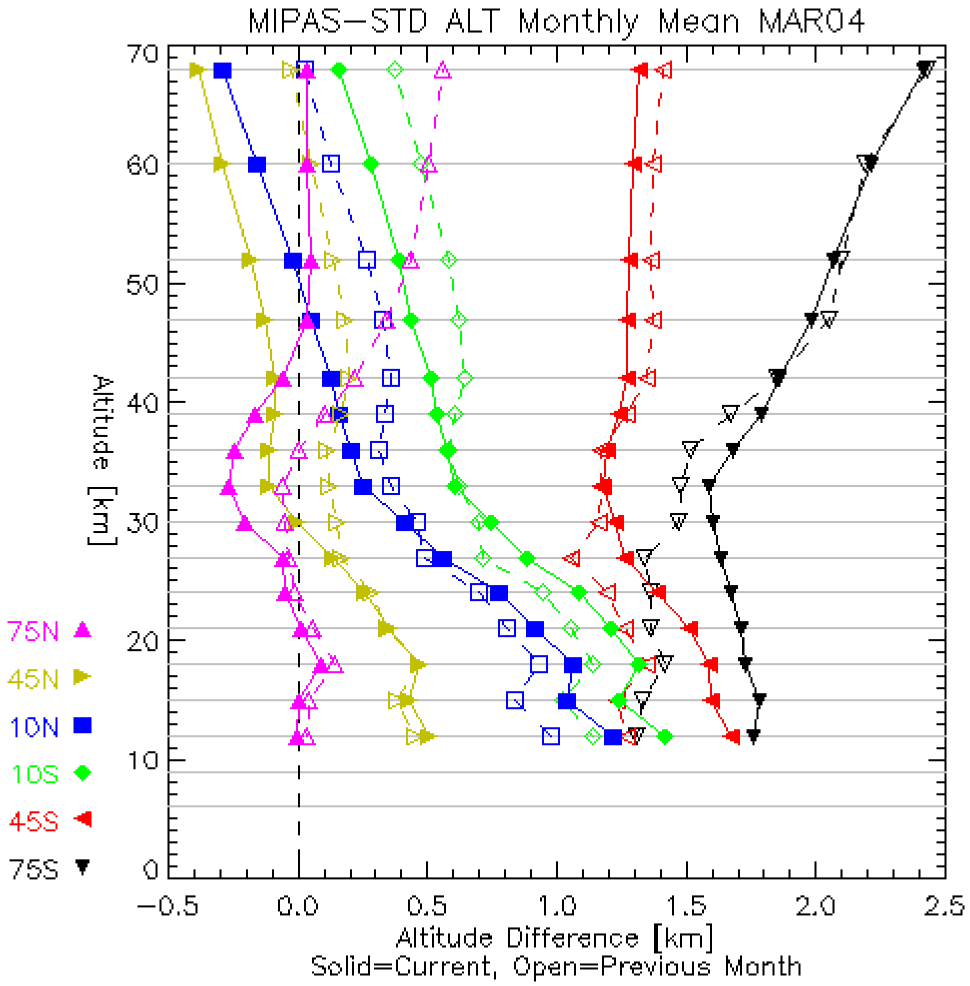

Fig. 22 Profile comparison between March and February: Altitude difference.

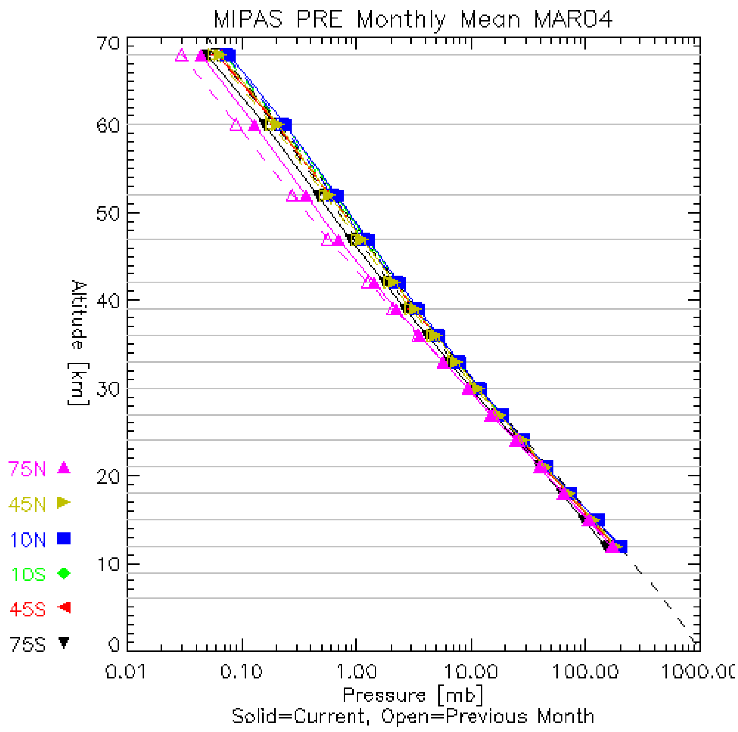

Fig. 23 Profile comparison between March and February: Pressure.

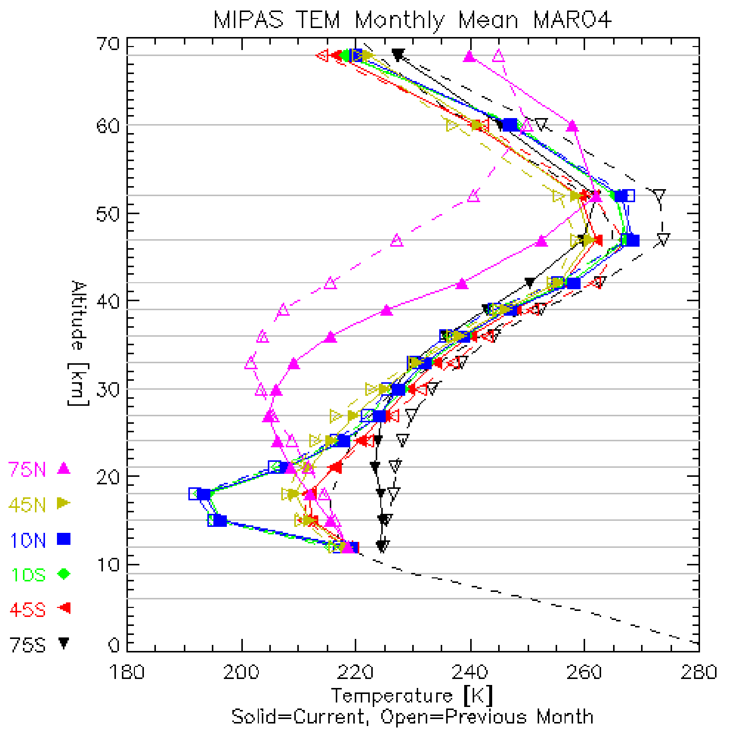

Fig. 24 Profile comparison between March and February: Temperature.

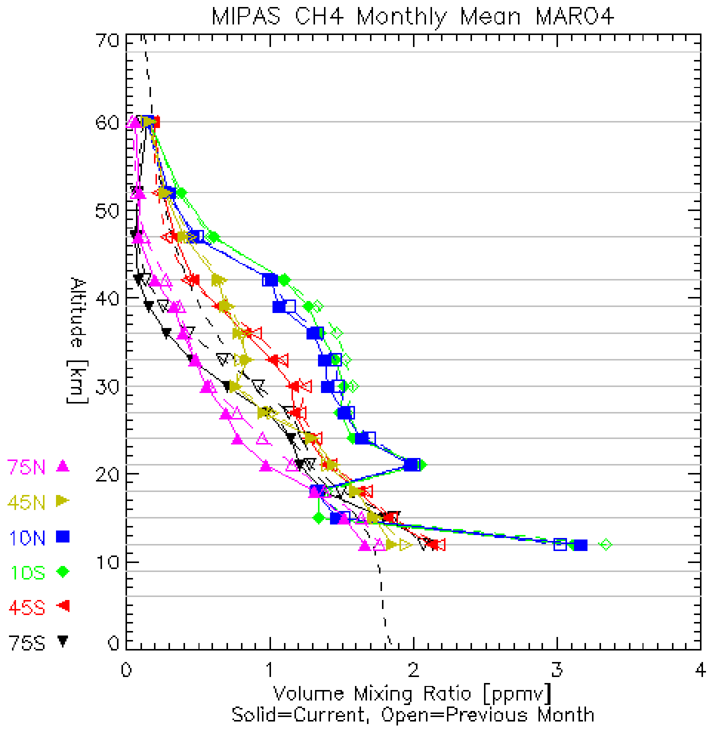

Fig. 25 Profile comparison between March and February: CH4.

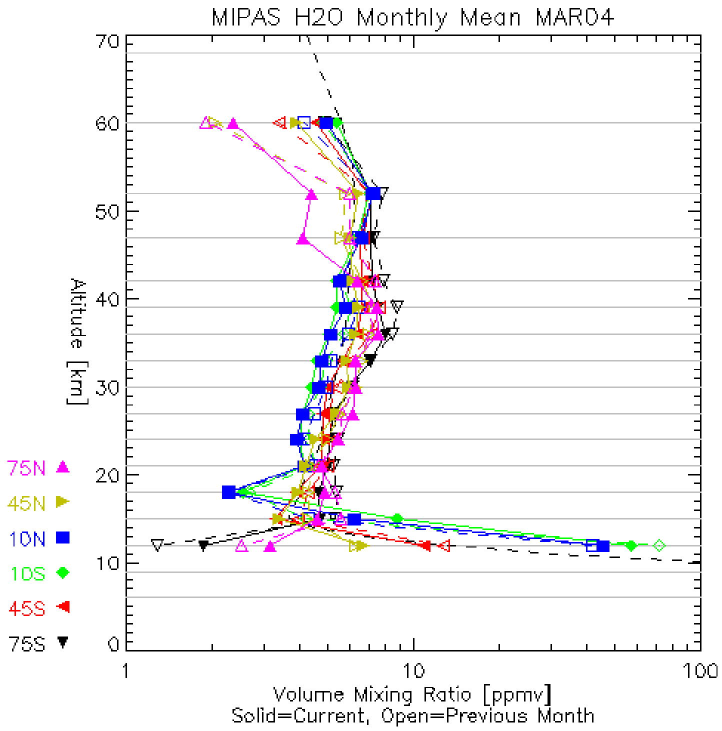

Fig. 26 Profile comparison between March and February: H2O.

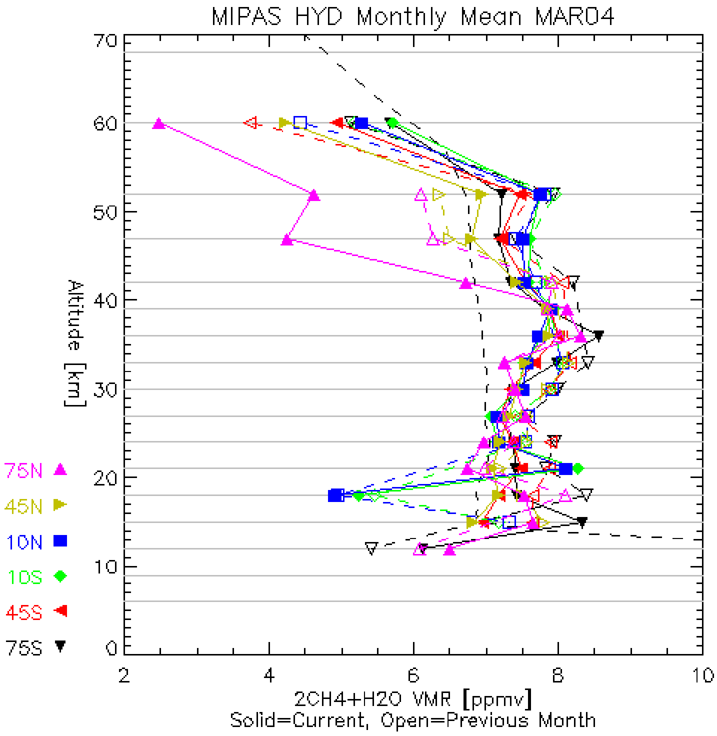

Fig. 27 Profile comparison between March and February: 2CH4+H2O.

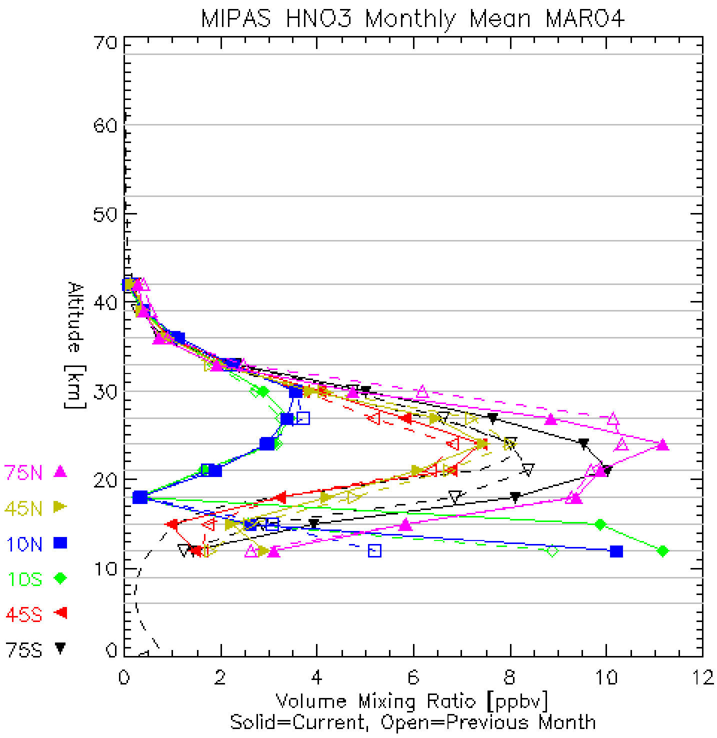

Fig. 28 Profile comparison between March and February: HNO3.

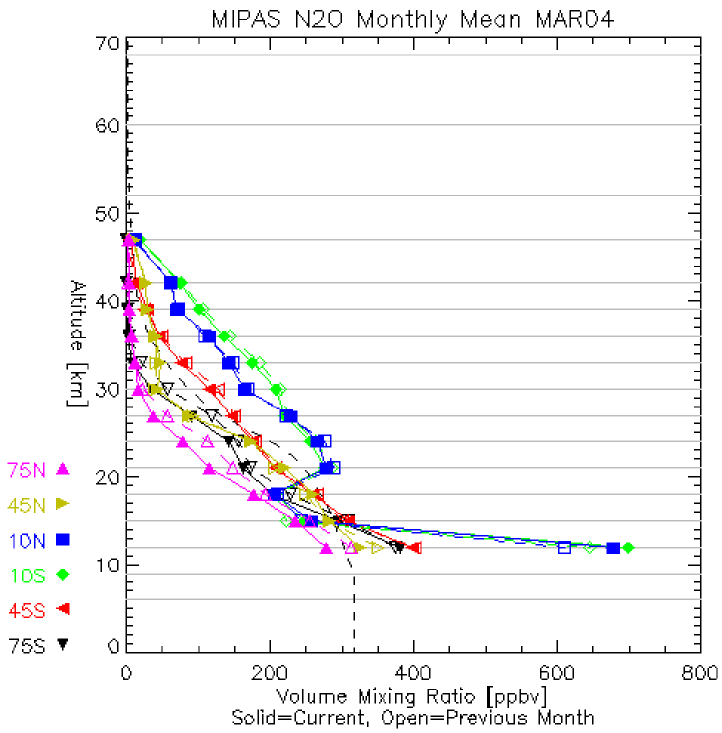

Fig. 29 Profile comparison between March and February: N2O.

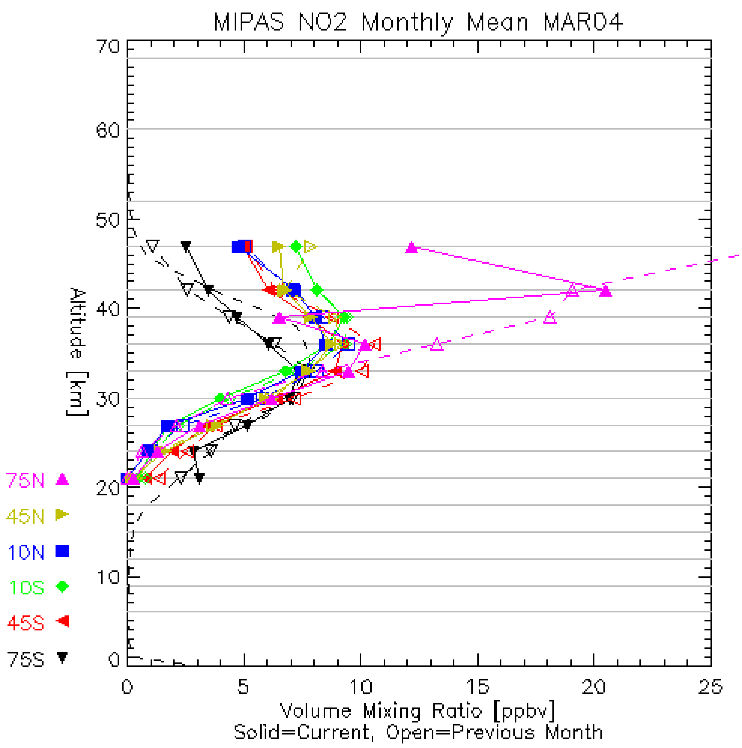

Fig. 30 Profile comparison between March and February: NO2.

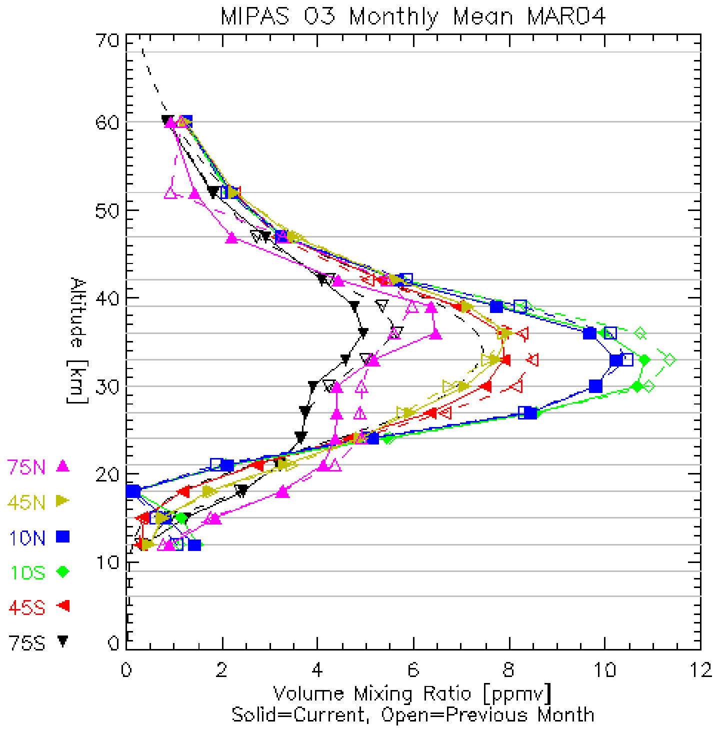

Fig. 31 Profile comparison between March and February: O3.

Comments:

Altitude Difference

For northern mid and polar latitudes reported tangent altitudes return to the January values but for other latitudes the altitudes below 30 km have increased by 300-400 m compared to previous months.

Temperature

Compared to the previous month there is the expected increase in north polar latitudes and decrease in south polar latitudes, although the north polar stratosphere is about 20K cooler than the previous year. Standard deviations of northern latitudes have decreased with respect to previous month.

Pressure

Tangent pressures compared to the previous month have generally increased in line with decreased tangent altitudes for most latitudes. In southern polar latitudes there has been a decrease in pressure at all altitudes although the tangent altitudes have only increased below 30 km. Southern hemisphere variability has increased significantly compared to the previous month.

CH4

Compared to the previous month there is a general small reduction in CH4 consistent with the higher tangent altitudes.

H2O

There are day/night differences of around 1 ppmv at 60 km due to the non-LTE enhancement of daytime radiances. There is something of a bump in the profiles at 39 km. This is particularly noticeable in the polar monthly means, which are around 2 ppmv higher at this altitude than would be expected from the climatology, and about 1 ppmv higher at this altitude than the March 2003 monthly mean profiles. The 75N profile is particularly dry at the highest 3 altitudes.

2CH4+H2O

The main difference compared to the previous month is the reduction in total hydrogen in the north polar latitudes at 47 km and above, mainly due to the reduction in H2O.

HNO3

South polar latitudes show a marked increase over last month, and the lowermost equatorial levels show a very large increase. Compared with last year, the low level equatorial values are also substantially larger and there is an enhancement of about 20% in north polar latitudes.

N2O

Apart from small decreases in polar latitudes the remaining profiles are almost exactly overlaid over last month. Compared with last year, the northern hemisphere shows a small reduction at most levels while there is not much change in the south. Variability is similar to the previous month, although significantly lower than the previous year.

NO2

Continued high nighttime values above 39 km, although slightly reduced from the previous month. The only clear peak in nighttime concentrations is for southern latitudes.

O3

General decrease of the peak (0.5-1 ppmv) compared to previous month. For the North Polar Region the peak is increasing at 36 km but decreasing at 30 km, almost developing a second maximum at lower altitudes (unlike the previous year when the peak was similar in shape to other latitudes). The South Polar Region shows a similar structure to the North Polar Region but with values 1-2 ppmv lower.

2.6.2 Statistics from Intercomparison with External Data

2.6.2.1 Comparison with ECMWF data

The ECMWF data have been obtained with the operational ECMWF model (CY26R3 and CY28R1). On 9 March the operational model changed from CY26R3 to CY28R1. No ozone changes were expected from the introduction of the new cycle. In CY28R1, MIPAS ozone data are actively assimilated, together with ozone layers from SBUV/2 from NOAA-16. All ozone values are in Dobson Units (DU), temperatures in K, and water vapour values in mg/m2.

TEMPERATURE

The profile plots shows that over most of the stratosphere the area averaged MIPAS temperatures are higher than ECMWF values, with departures less than 1%. In the mesosphere, the area averaged MIPAS temperatures are generally lower than ECMWF values with maximum departures up to -7% at the model top. The exception is the mesosphere in 90-65N, where departures are positive at the model top and reach values up to +6%. The ECMWF model is known to have a cold bias over the winter pole. The time series show a change in the MIPAS data around 26 February. MIPAS temperatures are higher after this change and agree better with the ECMWF analysis. This can also be seen in the Hovmoeller plots of temperature first-guess departures.

WATER VAPOUR

MIPAS water vapour values are larger than ECMWF values by 10-60% over much of the stratosphere. The largest departures are found below 100 hPa in the tropics. Like for temperature, the time series show a change in the MIPAS water vapour data around 26 February. MIPAS water vapour values are lower after this change and agree better with the ECMWF analysis. The scatter plots again show some unrealistically large MIPAS water vapour values in the tropics, possibly a sign of cloud contamination.

OZONE

MIPAS ozone data are actively assimilated in version CY26R3 of the ECMWF model. This means that the comparison with ECMWF ozone values does not give an independent validation of MIPAS ozone values any more. The profile plots show that the analysis is drawing to the MIPAS data. The scatter plots show that there are still unrealistically large MIPAS ozone values in the tropics below 60 hPa, possibly a sign of cloud contamination.