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ENVISAT CYCLIC ALTIMETRIC REPORT

CYCLE 37 from 02-05-2005 to 06-06-2005

Quality Assessment Report

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1 INTRODUCTION

This documents aims at reporting on the performances of the EnviSat Radar Altimeter, Microwave Radiometer and DORIS sensors, on the data quality of the corresponding Fast Delivery products as well as on the main events occurred during cycle 37.

This report covers the period from the 2nd of May and the 6th of June 2005.

2 DISTRIBUTION LIST

This report is available in PDF format at the internet address
http://earth.esa.int/pcs/envisat/ra2/reports/pcs_cyclic/

3 ACRONYMS

AGC	Automatic Gain Control
DORIS	Doppler Orbitography and Radiopositioning Integrated by Satellite
DSR	Data Set Record
EPC	Electronic Power Converter
ERS	European Remote Sensing satellite
ESRIN	European Space Research Institute
ESOC	European Space Operations Centre
FD	Fast Delivery products
GS	Ground Segment
GTS	Global Telecommunication System
HTL	Height Tracking Loop
ICU	Instrument Control Unit
IECF	Instrument Engineering Calibration Facility
IF	Intermediate Frequency
IE	Individual Echoes
IPF	Instrument Processing Facility
LUT	Look Up Table
MCMD	MacroCommand
MPH	Main Product Header
MSS	Mean Sea Surface
MWR	MicroWave Radiometer
MPS	Mission Planning System
NRT	Near Real Time
OBT	On-Board Time
OCM	Orbit Control Mode/Manoeuvres
PCS	ERS Products Control Service
PCF	EnviSat Product Control Facility
PDHS-E	ESRIN Processing and Data Handling Station

PDHS-K	Kiruna Processing and Data Handling Station
PLSOL	Payload Switch-Off Line
PMC	Payload Main Computer
PSO	On-orbit Position
PTR	Point Target Response
RA-2	EnviSat Radar Altimeter bi-frequency
RSL	Resolution Selection Logic
SAD	Static Auxiliary Files
SBT	Satellite Binary Time
SEU	Single Event
SFCM	Stellar Fine Control Mode
SPH	Specific Product header
SPSA	Signal Processing Sub-Assembly
SYSM	Stellar Yaw Steering Mode
S/W	Software
TM	Telemetry
TRP	Transponder
TWT	Traveling Wave Tube
UTC	Coordinated Universal Time
YSM	Yaw Stellar Mode

4 REFERENCE DOCUMENTS

[R – 1a] F-PAC MONTHLY REPORT, SALP-RP-M-OP-15379-CN, March 2005
[R – 1b] F-PAC MONTHLY REPORT, SALP-RP-M-OP-15387-CN, April 2005
[R – 2] ENVISAT Microwave Radiometer Assessment Report Cycle 035, CLS.DOS/05.032, http://earth.esa.int/pcs/envisat/mwr/reports/
[R – 3] Envisat RA-2 IF Mask weird behavior: Investigation Report
[R – 4] Instrument Performance Evaluation and Analysis Summary, PO-TR-ALS-RA-0042
[R – 5] Instrument Corrections Applied on RA-2 Level 1b products, Paper presented at the ENVISAT Calibration Review in September 2002
[R – 6] ENVISAT Phase E Cal/Val Acquisition Plan, ENVI-SPPA-EOPG-TN-03-0008
[R – 7] RA-2 S-Band Anomaly Investigation, PO-TN-ESA-RA-1341, http://earth.esa.int/pcs/envisat/ra2/articles/
[R – 8] RA-2 Performance Results, Paper presented at the ENVISAT Calibration Review in September 2002
[R – 9a] ECMWF Report on ENVISAT RA- 2 for March 2005, Report on ENVISAT Radar Altimeter - 2 (RA- 2), Wind/ Wave Product with Height Information (RA2_ WWV_ 2P),
[R – 9b] ECMWF Report on ENVISAT RA- 2 for April 2005, Report on ENVISAT Radar Altimeter - 2 (RA- 2), Wind/ Wave Product with Height Information (RA2_ WWV_ 2P), http://earth.esa.int/pcs/envisat/ra2/reports/ecmwf/
[R – 10] Envisat GDR Quality Assessment Report, SALP-RP-P2-EX-21121-CLS015
[R – 11] Envisat RA-2 Range Instrumental correction: USO clock period variations and associated auxiliary file, ENVI-GSEG-EOPG-TN-03-0009

[R – 12] Defining a Rain flag for the Envisat altimeter, G. Quartly, study presented to the final CCVT plenary meeting, http://earth.esa.int/pcs/envisat/ra2/articles/
[R – 13] ENVISAT Weekly Mission Operations Reports # 147-151, ENVI-ESOC-OPS-RP-1011-TOS-OF
[R – 14] Envisat validation and cross calibration activities during the verification phase. Synthesis Report ESTEC contract No. 16243/02/NL/FF WP6, http://earth.esa.int/pcs/envisat/ra2/articles/
[R – 15] ENVISAT-1 Products Specifications - Vol. 14: RA-2 Products Specifications, PO-RS-MDA-GS-2009, Iss 3, Rev. K, 24/05/2004
[R – 16] Algorithm for Flag identification and waveforms reconstruction of RA-2 data affected by “S-Band anomaly”, ENVI-GSEG-TN-04-0004, Issue 1.4

5 GENERAL QUALITY ASSESSMENT

5.1 Instruments status

The RA-2 instrument, during this cycle underwent two instrument anomalies as given in par. 6.1.

The two known causes of random on-board anomalies are still present. In particular we refer to the so-called S-Band anomaly and the IF mask weird behavior described respectively in [R – 7] and [R – 3]. Only the S-Band anomaly partially affects a low number of Envisat data products as given in par. 7.1.7.

MWR sensor assessment report: refer to [R – 2].

DORIS sensor assessment report: refer to [R – 1a] and [R-1b].

5.2 Cycle quality

The summary of the RA-2 data products availability for this cycle cannot be given due to technical problems. The following tables are going to be updated in the next ECAR.

Start orbit	Stop orbit	Time [sec] instrum. Unavail-ability	Time [sec] L0 gaps	Time [sec] L1b gaps	Time [sec] L2 (FGD) gaps	% instrum. avail.	% L0 avail.	% L1b avail.	% L2 (FGD) avail.

Table 1: RA-2 L0, L1b and L2 FGD Data products availability summary for cycle 37

The summary of the MWR L0 data products availability for this cycle is given in Table 2 (one line per week).

Start orbit	Stop orbit	Time [sec] instrum. unavailability	Time [sec] L0 gaps	% instrum. avail.	% L0 avail.

Table 2: MWR L0 Data products availability summary for cycle 37

The summary of the DORIS L0 data products availability for this cycle is given in Table 3 (one line per week).

Start orbit	Stop orbit	Time [sec] instrum. unavailability	Time [sec] L0 gaps	% instrum. avail.	% L0 avail.

Table 3: DORIS L0 Data products availability summary for cycle 37

5.3 Orbit quality

During cycle 37 one small manouvre was executed, whose details are given hereafter:

Manoeuvre on May 20, 2005 (DOY 140):

- Planned delta V size: 0.007 m/s (in the flight direction)
- Mid thrust time: 01:09:32 utc at PSO 82.74 degrees
- Thrust duration: 4 seconds
- Measured delta V: 0.0068 m/s (in the flight direction)

The orbit was maintained within the +/- 1km to the reference ground track during cycle 37.

5.4 Ground Segment Processing Chain Status

5.4.1 IPF PROCESSING CHAIN

Current version of the IPF processing chain is V4.58, installed in both PDHS-E and PDHS-K on July the 16th 2004. This is equivalent to the previous version for what regards all the algorithms and auxiliary files, only a new parameter has been added in the SPH that is the pass number which, for NRT data is nominally set to 0. This was done in order to be compliant with the off-line products version that indeed includes the pass number.

Previous IPF version V4.57 was operational at the Envisat PDHS-K and PDHS-E since April 29th and 28th 2004 respectively.

5.4.2 F-PAC PROCESSING CHAIN

Current version of CMA is V6.3 operational since Apr. 29, 2004.
F-PAC CMA anomalies: anomalies are detailed in the F-PAC Monthly Report [R – 1a] and [R-1b].

5.4.3 AUXILIARY DATA FILE

Hereafter all the Auxiliary files actually used by the IPF ground processing are listed:

```
RA2_CHD_AXVIEC20030402_094243_20030407_000000_20200101_000000
RA2_CON_AXVIEC20020606_164228_20020101_000000_20200101_000000
RA2_CST_AXVIEC20020621_135858_20020101_000000_20200101_000000
RA2_DIP_AXVIEC20020122_134206_20020101_000000_20200101_000000
RA2_GEO_AXVIEC20020314_093428_20020101_000000_20200101_000000
RA2_ICT_AXVIEC20031208_143628_20020101_000000_20200101_000000
RA2_IFA_AXVIEC20050216_125529_20020101_000000_20200101_000000
RA2_IFB_AXVIEC20050216_125738_20020101_000000_20200101_000000
RA2_IFF_AXVIEC20031208_151817_20030602_215929_20100101_000000
RA2_IOC_AXVIEC20020122_141121_20020101_000000_20200101_000000
RA2_MET_AXVIEC20020204_073357_20020101_000000_20200101_000000
RA2_MSS_AXVIEC20031208_145545_20020101_000000_20200101_000000
RA2_OT1_AXVIEC20040120_082051_20020101_000000_20200101_000000
RA2_OT2_AXVIEC20031208_150159_20020101_000000_20200101_000000
RA2_POL_AXVIEC20050428_180058_20020101_000000_20050528_235959
RA2_SET_AXVIEC20020122_150917_20020101_000000_20200101_000000
RA2_SL1_AXVIEC20030131_100228_20020101_000000_20200101_000000
RA2_SL2_AXVIEC20030131_101757_20020101_000000_20200101_000000
RA2_SOI_AXVIEC20031208_150608_20020101_000000_20200101_000000
RA2_SSB_AXVIEC20031208_150749_20020101_000000_20200101_000000
RA2_TLD_AXVIEC20031208_151137_20020101_000000_20200101_000000
RA2_USO_AXVIEC20020122_162920_20020101_000000_20200101_000000
```

The RA2_POL_AX, the RA2_SOL_AX and the RA2_PLA_AX have been regularly updated every week without problems.

The RA-2 Auxiliary Data Files (ADF) are accessible from the Envisat Web pages under http://www.envisat.esa.int/services/auxiliary_data/ra2mwr/ .

5.4.4 PLANNED UPGRADES

Evolution of the IPF Level 1B and Level 2 processing chain is intended to be operational by the end of 2005. The next IPF version release shall nominally contain the following:

1. USO instrumental correction within the RA-2 L1b processor.
2. New MWR Side Lobes correction algorithm within MWR L1b processor
3. Correction of the mispointing evaluation algorithm within the RA-2 L2 processor
4. Inclusion of the loading tide for the GOT2000.2 model.
5. Addition of the peakiness fields in Ku and S band to the RA-2 and MWR FD/I/MAR meteorological products
6. Inclusion of the square of the significant wave height in Ku and S band
7. Inclusion of an S-band anomaly flag, see [R – 16]
8. Upgrade of the Level 1B and Level 2 processing for DORIS NRT orbital information computation
9. New ADF for Digital Elevation Model (DEM): AUX_DEM_AX
10. Adjustment of the S Band computation for rain flag
11. Inclusion of nadir location not corrected for slope model
12. Inclusion of GPS Ionospheric correction
13. Addition of a field for Level 1B SW ID in Level 2 products
14. Inclusion of MOG2D Inverse Barometer Geophysical Correction in Level 2 products

Evolutions 3, 5, 6, 11, 12, 13 and 14 shall be reflected too in the F-PAC CMA processing chain.

6 ENVISAT PAYLOAD STATUS

6.1 Altimeter Events

The Radar Altimeter 2, during cycle 37, was switched twice to Suspend due to a SEU anomaly, with an RBI Status of 4047h.
This is a repeat of an expected anomaly which is under investigation (ref: AR ENV-614).

1. Start: 14 May 2005 23:56:37.000, orbit=16760
   Stop: 15 May 2005 10:53:45.000, orbit = 16767

   The instrument was recovered the following day, with measurement operations resuming at 135.10.53.45.

2. Start: 21 May 2005 00:10:45.000, orbit=16846
   Stop: 21 May 2005 10:55:35.000, orbit=16853

   The instrument was recovered the same day, with measurement operations resuming at 141.10.54.30.

6.1.1 RA-2 INSTRUMENT PLANNING

The RA-2 instrument planning was performed as follows:

- IF Calibration Mode according the nominal operational acquisition scheme: 100 seconds of data twice per day over Himalayan region (ascending and descending passes).
- Preset Loop Output mode for GAVDOS Range transponders, located in Creta.
- Preset Loop Output acquisition over ESA transponders, located near Rome; for both ascending and descending passes. The PLO planning has been updated to the High Chirp Resolution for the ESA TRP overpasses, starting from orbit #14790.
- Individual Echoes background planning: the buffering of 20 Data Blocks of Individual Echoes (1.114 sec.) transmitted every 160 Data Blocks starts after flying over Himalayan region (both ascending and descending passes) and prosecutes for half day.
- Individual Echoes acquisitions during PLO activity over the 4 ESA transponders near Rome (1 second length acquisition, 1 repetition)
- Individual Echoes acquisitions over Uyuni Salar zone, relative orbits #139 and 146 (1 second length acquisition, 2 repetitions)

Hereafter the map is reported showing the acquisition sites for both the Range and Sigma_0 transponders.

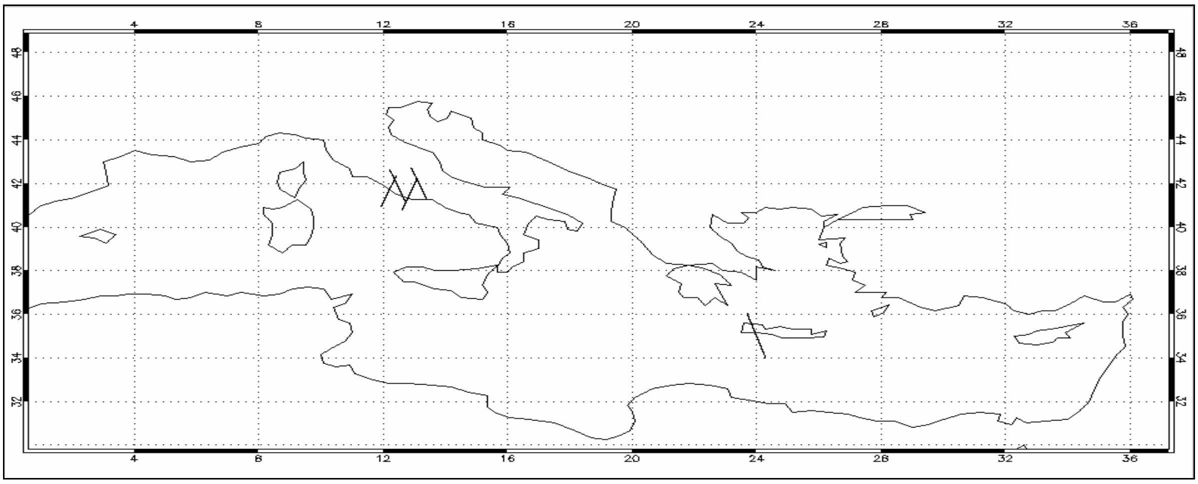

Figure 1: Transponder Acquisition sites for cycle 37

6.2 MWR Events

The MWR, during cycle 37 was never unavailable [R-13].

6.3 DORIS Events

The DORIS during cycle 37 was always available except during MVR switch OFF/ON to reset the HSM input shared with ASAR payload. The MVR switch OFF (Stabilisation mode) has been executed on Friday 20th of May (doy 140) at 12:10z and the MVR switch ON (Measurement mode) at 12:12z the same day.

7 INSTRUMENT PERFORMANCES

7.1 RA-2 Performances

7.1.1 IF FILTER MASK

In Figure 2 all valid IF masks retrieved by averaging the 100 seconds of data acquired daily during cycle 37 are plotted in the left panel. The on-ground measured IF mask (ref [R – 4]) is also plotted in that panel with a solid line. In the right panel the difference of each of the calculated IF masks with respect to the on-ground measured one is reported. During cycle 37 the number of valid IF masks have been of 16, representing about the 23% of the planned IF masks. Only valid IF masks are used to generate the final IF mask used in the Level 1B ground processing; the method used for editing the data is based on the comparison between each of the single IF masks and the reference one (on-ground).

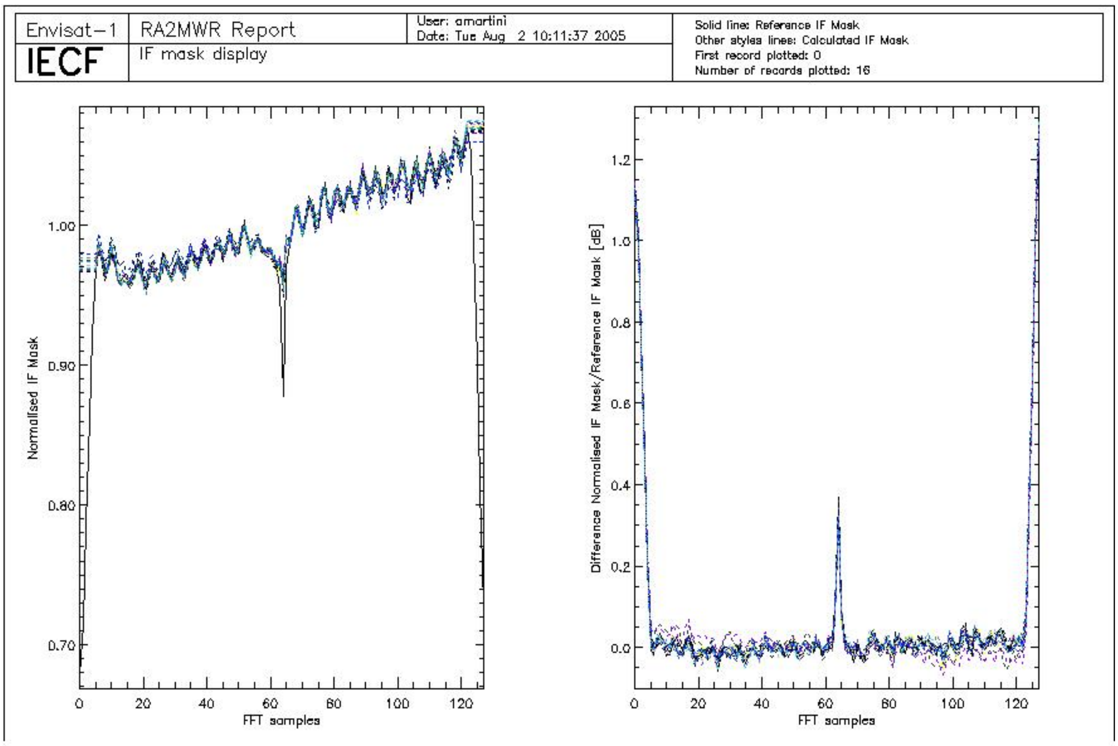

Figure 2: Valid IF masks retrieved daily during cycle 37 plotted together with the on-ground reference.

7.1.2 USO

In Figure 3 the USO clock period trend retrieved for cycle 37 is reported. The difference of the actual USO clock period with respect to the nominal one has been plotted in the upper panel. In the lower panel the Range error due to the USO clock variability has been reported taking a satellite altitude of 800 Km as a nominal value. The two peaks observed are due to the anomaly recoveries after the unavailability on May 14th and 21st.

Currently the nominal USO clock period (12500 ps) is used within the processing; this means that the data are not corrected for the bias and the drift correlated to the actual USO clock period.

A particular investigation has been performed regarding the USO clock trend and the associated auxiliary file; this is described in [R – 11]. The conclusion can be summarized as follows: the precision of 1 ps available in the current USO auxiliary file is not enough to appreciate its trend and it is too rough for any altimetric application. A suitable resolution is considered to be of 10^{-6} ps. This problem will be corrected with the following upgrade of the IPF as described in par. 5.4.4.

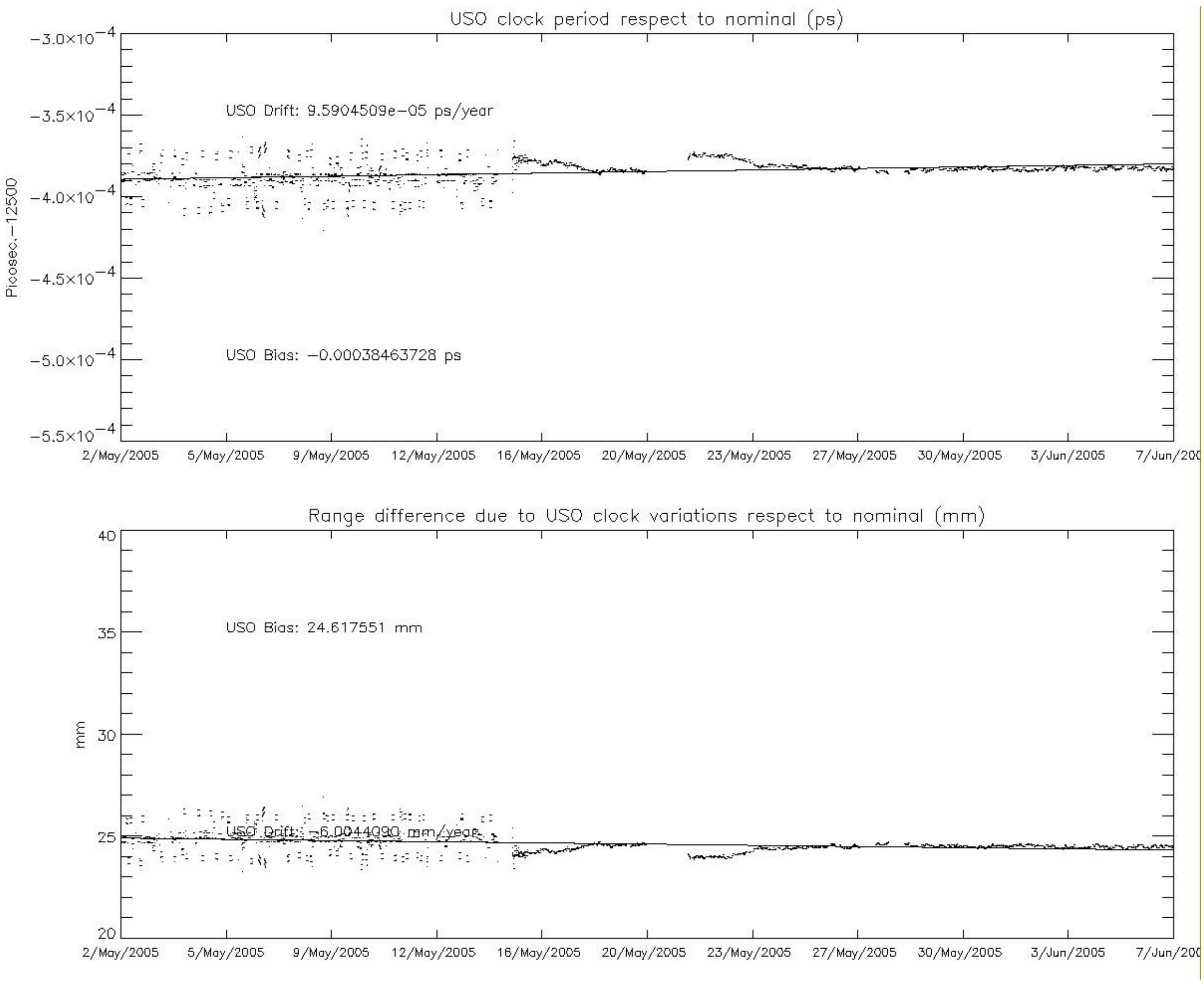

Figure 3: USO clock period for cycle 37

7.1.3 TRACKING CAPABILITY

The percentages of acquisition in the different resolutions subdivided by surface type are given in the Table bellow:

Surface type	320 MHz	80 MHz	20MHz
Open Ocean	99,87	0,05	0,02
Costal Water (ocean depth < 200 m)	96,54	2,84	0,62
Sea Ice	98,48	1,28	0,24
Ice Sheet	96,38	2,84	0,78
Land	82,89	13,21	3,91
All world	94,83	4,04	1,11

Table 4: RA-2 Tracking capability: Chirp ID percentages discriminated by surface type

The figures given for the RA-2 tracking performances during this cycle are very much in line with the ones recorded at the end of the Commissioning Phase and presented in [R – 8]. The slight differences are in part due to the different algorithms used to discriminate the surface types.
The objectives of the Commissioning Phase "RSL and Tracking optimization" are hereafter reported:
320MHz over Ocean > 99%
320 MHz within 15km of Land/Ocean boundary (Costal Water) – no specific requirement
320 MHz over Sea Ice > 95%
320/80 MHz Fixed resolution at Ice Sheet Crossovers > 95%
320MHz over Ice Shelves > 95%

7.1.4 SIGMA0 TRANSPONDER

The σ° absolute calibration of the RA-2 is performed using a reference target given by a transponder that has been developed at ESTEC. This has been exploited during the 6 month Commissioning phase to generate early calibration results. In order to consolidate this calibration results and to monitor the RA-2 calibration of σ° during the Envisat lifetime, a continuous monitoring is needed by operating the transponder as many as possible Envisat overpasses.
Two of the four planned Sigma_0 Transponder acquisitions for the cycle 37 have been positive. The operation planned on May 5th (Fiuggi site) has been regularly performed but the TPD signal has not been acquired by the RA2. The problem is related to the acquisition window time delay which has been set using a not accurate evaluation of the site altitude. A correction will be applied starting from the next cycle. As for the acquisition planned on 2nd of June the campaign has not been performed.
All the acquisitions were executed in High Resolution mode. The dates and times of the acquisitions are reported hereafter:

17-may-05, Maccarese, 09:42:06
24-may-05, Roma, 20:39:32

The results are reported in the following Table 5, including the tropospheric attenuation estimated from ECMWF data.

Orbit	Date	Location/Rel. Track	Coordinates	Resolution	Not Corrected Backscattering Bias [dB]	Tropospheric Correction (one way) [dB]
16795	17-may-05	Maccarese / 208	41.8605, 12.2385	High	0,84	0,084
16902	24-may-05	Rome / 315	41.8472, 12.4819	High	1,00	0,076

Table 5: Absolute backscattering calibration results obtained with Transponder measurements

7.1.5 DATATION

A significant part of an eventual error in the RA-2 products datation could be given by the not perfect synchronism between the Satellite Binary Time and the UTC Time due to a drift of the ICU clock period. A correlation between those two times is performed at every Kiruna orbit dump and then extrapolated for the four non-Kiruna orbits. In the upper panel of Figure 6, the differences between the extrapolated UTC values and the corresponding real UTC values measured at the next Kiruna dump, are reported. The variability observed during the previous cycles is not present for the current one, because the problem has been fixed at the end of the cycle 34.
In the lower panel the ICU clock step for the same period is shown.

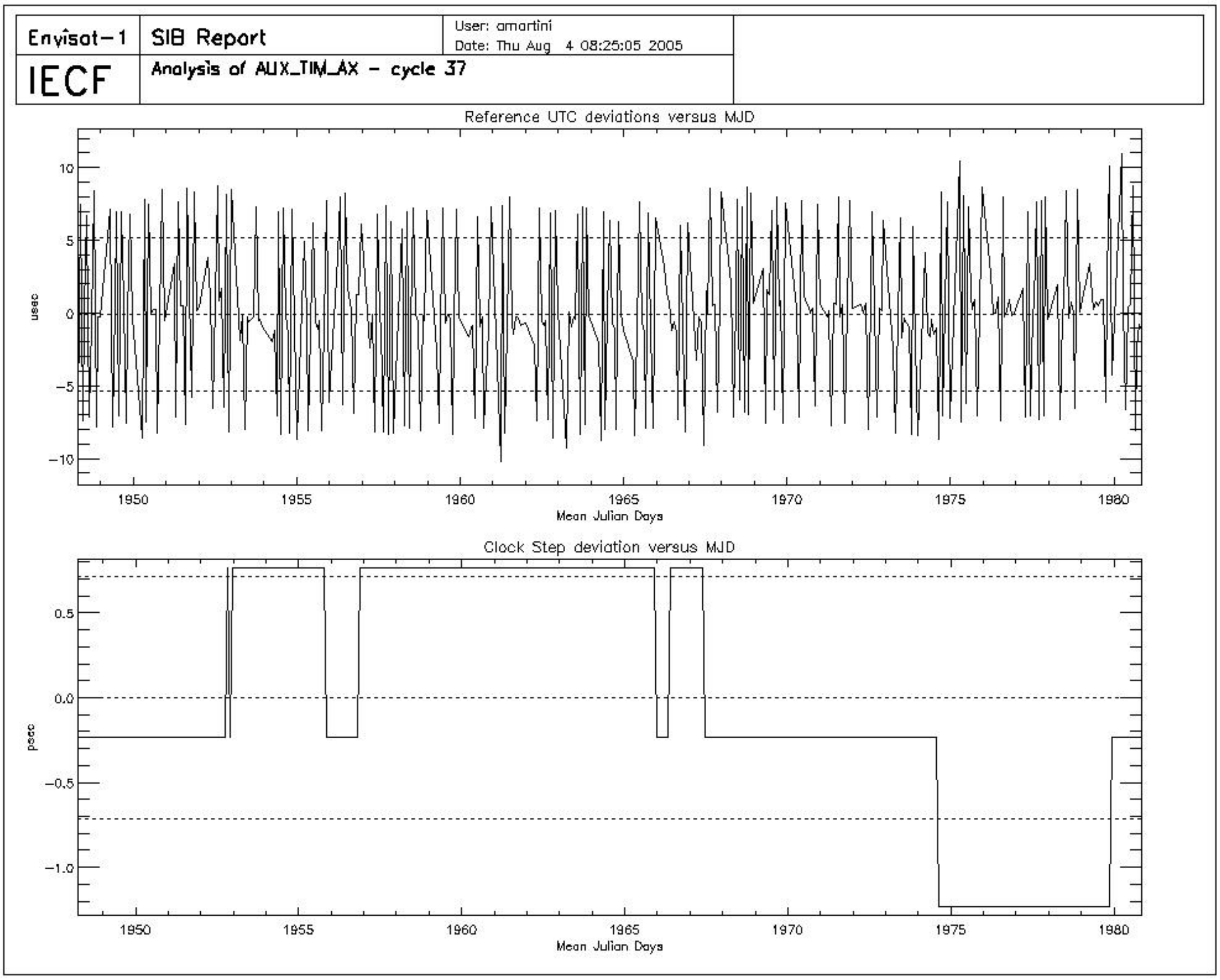

Figure 6: UTC deviations and ICU clock period for cycle 37

7.1.6 MISPOINTING

In Figure7 the trend of the mispointing squared (averaged every orbit) is reported in deg^2*10e-4
The average squared mispointing value, as extracted from the RA2_FGD_2P data products, is around 0.028 deg^2, is known to be higher than the one reported at platform level [R – 13]. This is due to a not perfect tuning of the algorithm currently used to retrieve the mispointing value from the RA-2 waveform data.
For this cycle two events of low mispointing values are present and visible in the plot of Figure 7. These events are in correspondence with the instrument anomalies occurred on 18 Apr 2005 and 23 Apr 2005, as reported in par. 6.1.

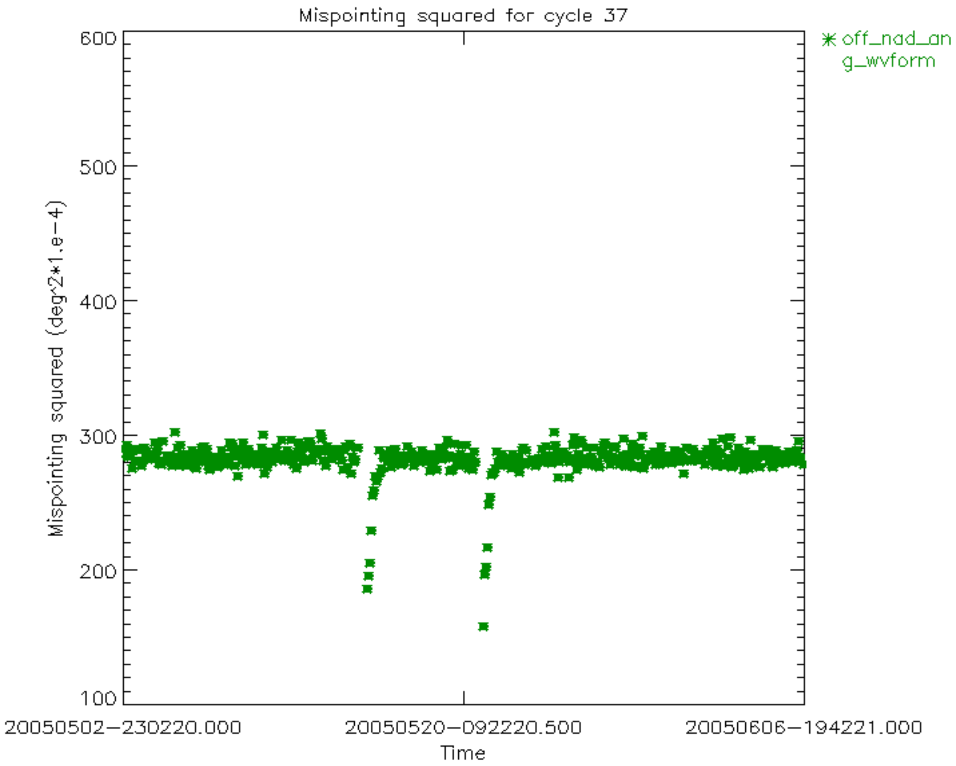

Figure 7: Smoothed mispointing squared trend for cycle 37 (deg^2*10^4)

7.1.7 S-BAND ANOMALY

The so-called "S-Band anomaly" affects the RA-2 data products quality. Hereafter, the table lists the product files affected by the S-band anomaly problem during cycle 37. This corresponds to a total percentage of about 1.64% of the acquired data.

Being the method used a statistical one working on ocean data, files containing less than 1000 seconds of data over ocean have not been considered. This choice is supported by the fact that the "S-Band anomaly" is associated to a particular instrumental behavior that cannot appear and disappear within a short time frame. (ref. [R – 7])

File name	Start date	Start time	Stop date	Stop time
RA2_FGD_2PNPDK20050524_172502_000059582037_00313_16900_4269.N1	24-MAY-2005	17:25:02.94	24-MAY-2005	19:04:20.56
RA2_FGD_2PNPDK20050524_190213_000058362037_00314_16901_4270.N1	24-MAY-2005	19:02:13.62	24-MAY-2005	20:39:29.54
RA2_FGD_2PNPDE20050531_202109_000045312037_00415_17002_4044.N1	31-MAY-2005	20:21:09.09	31-MAY-2005	21:36:39.67
RA2_FGD_2PNPDE20050531_213525_000060392037_00415_17002_4045.N1	31-MAY-2005	21:35:25.09	31-MAY-2005	23:16:04.03
RA2_FGD_2PNPDE20050531_231457_000062362037_00416_17003_4046.N1	31-MAY-2005	23:14:57.25	01-JUN-2005	00:58:53.36
RA2_FGD_2PNPDE20050601_005742_000042472037_00417_17004_4047.N1	01-JUN-2005	00:57:42.12	01-JUN-2005	02:08:28.63
RA2_FGD_2PNPDE20050601_020753_000061572037_00418_17005_4048.N1	01-JUN-2005	02:07:53.04	01-JUN-2005	03:50:30.06
RA2_FGD_2PNPDE20050601_034954_000048402037_00419_17006_4049.N1	01-JUN-2005	03:49:54.47	01-JUN-2005	05:10:34.75

Table 6: List of L2 FGD Files affected by S-Band anomaly during cycle 37

A valuable algorithm to detect the RA-2 DSRs affected by the S-Band anomaly within the L2 products can be found in [R- 12]. Note that the algorithm is only valid for data acquired over open-ocean.

7.1.8 IN-FLIGHT INTERNAL CALIBRATION

The RA-2 Range and Sigma0 measurements are corrected to take into account the internal path delay and attenuation, respectively. This is done by measuring those two variables in relation to the internal Point Target Response. The two correction factors are calculated during the L1b processing and directly applied. They are also continuously monitored and the results for cycle 37 (averaged per day) are reported in the next figures. A low value of the time delay calibration factor, occurred on 8th of May, is showed in Figure 8. It seems not to be related to any altimeter event, hence it will be monitored in the next cycles. The two high values of the Sigma0 calibration factor plotted in Figure 9 are related to the RA-2 anomaly recovery (see section 6.1). Despite these considerations the two calibration factors show a regular behaviour as observed on previous cycles.

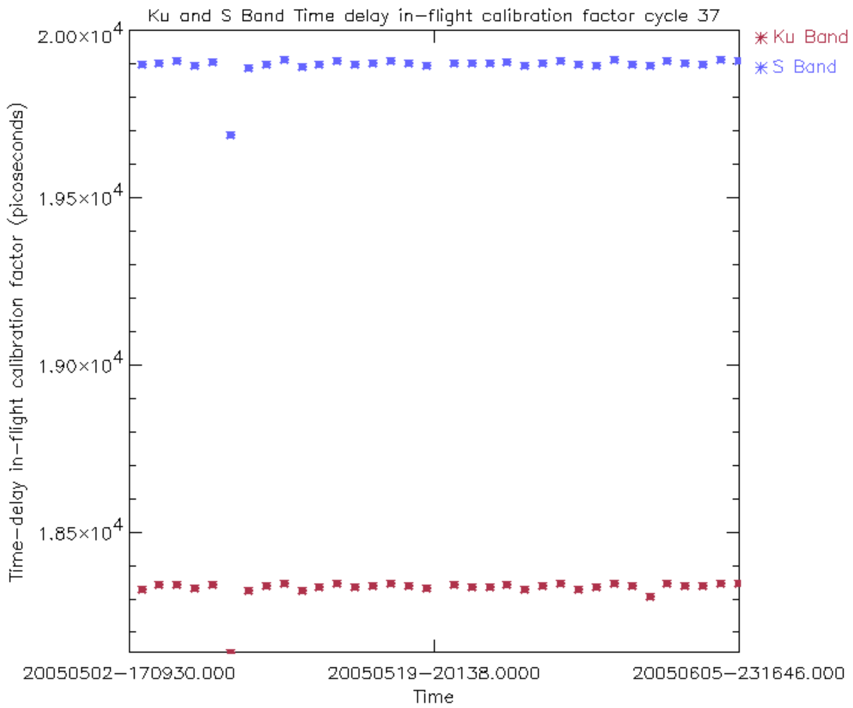

Figure 8: Ku and S Band in-flight time delay calibration factor for cycle 37

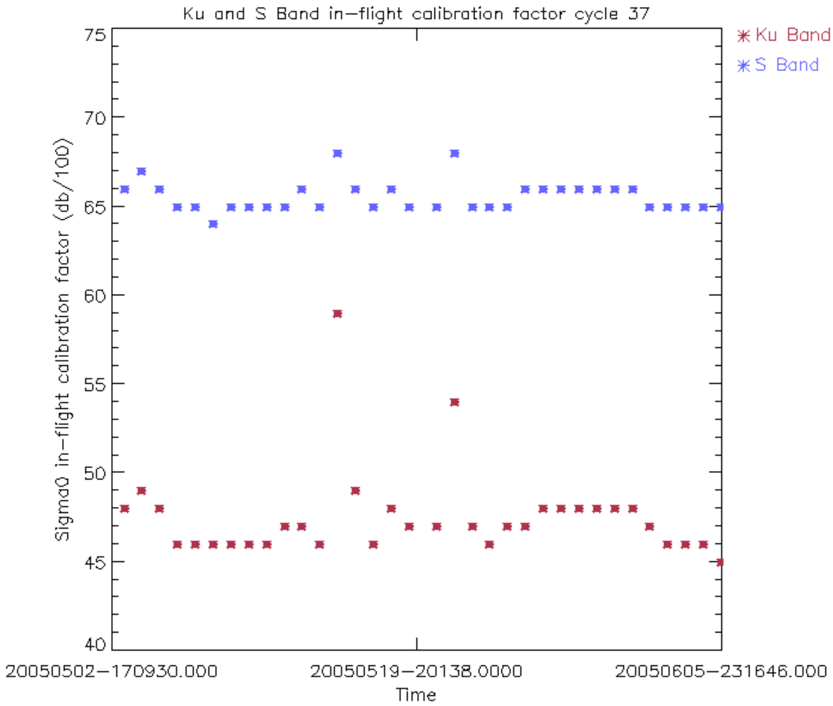

Figure 9: Ku and S Band in-flight Sigma0 calibration factor for cycle 37

7.2 MWR Performances

For MWR performances please refer to the Reference CLS Cyclic Report of the type of [R – 2].

7.3 DORIS Performances

For DORIS performances refer to the Reference F-PAC Monthly Report of the type of [R – 1a] and [R-1b].

8 PRODUCT PERFORMANCES

8.1 Availability of data

In Figure 10 and Table 7 the summary of unavailable RA-2 L0 products is given.
It is easy to notice that close to the Himalayan region two small gaps in the data are present. This is due to the daily instrument switch-offs (Heater 2 mode) performed to prevent the S-Band anomaly to last more than half a day when it occurs.

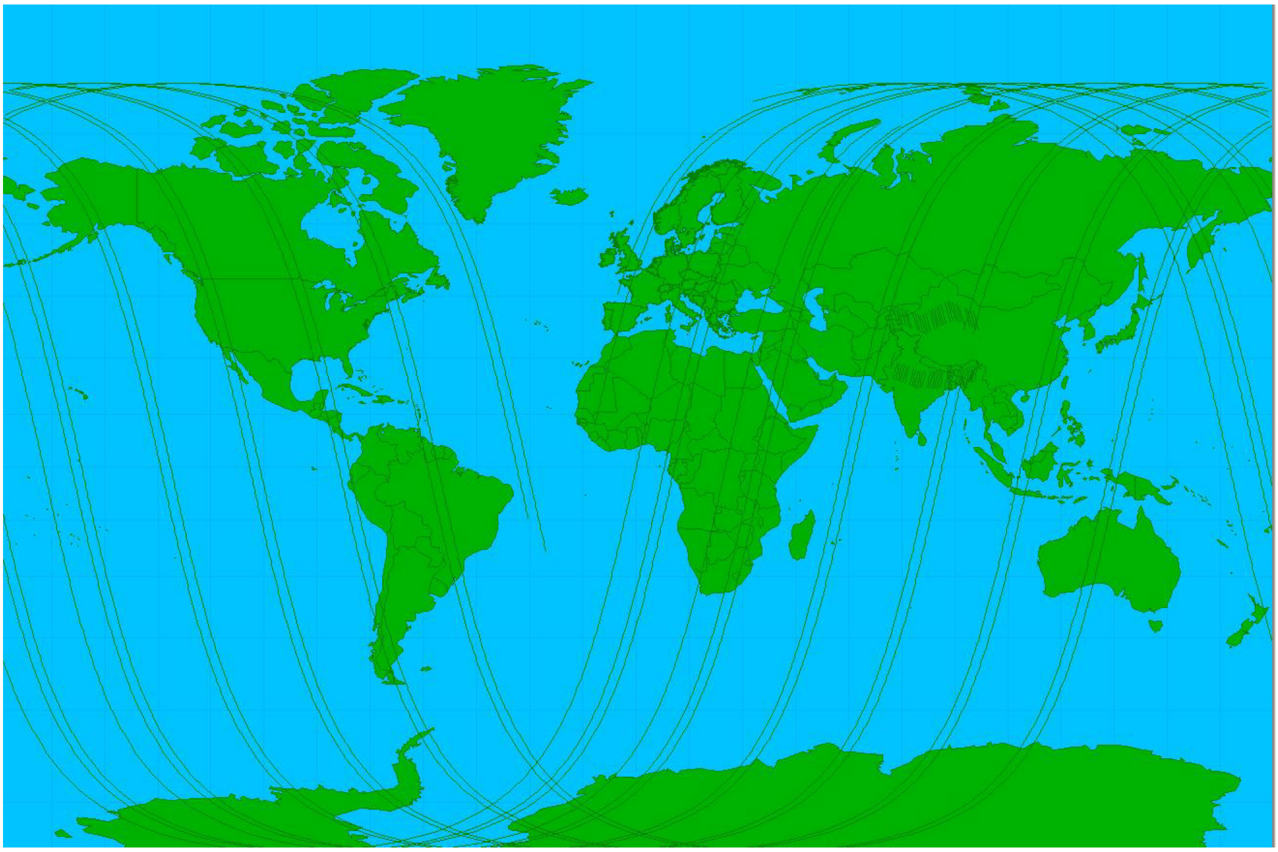

Figure 10: RA-2 L0 unavailable products for cycle 37

Start date	Start time	Stop date	Stop time	Duration [sec]	Start orbit	Stop orbit	Reason
02-MAY-2005	4.15.41	02-MAY-2005	4.16.59	78	16577	16577	PDS_UNKNOWN_FAILURE
02-MAY-2005	15.28.09	02-MAY-2005	15.29.26	77	16584	16584	PDS_UNKNOWN_FAILURE
07-MAY-2005	4.58.45	07-MAY-2005	5.00.02	77	16649	16649	PDS_UNKNOWN_FAILURE
07-MAY-2005	16.10.28	07-MAY-2005	16.11.46	78	16656	16656	PDS_UNKNOWN_FAILURE
03-MAY-2005	5.24.01	03-MAY-2005	5.25.19	78	16592	16592	PDS_UNKNOWN_FAILURE
03-MAY-2005	16.36.48	03-MAY-2005	16.38.06	78	16599	16599	PDS_UNKNOWN_FAILURE
04-MAY-2005	4.53.06	04-MAY-2005	4.54.24	78	16606	16606	PDS_UNKNOWN_FAILURE
04-MAY-2005	16.04.45	04-MAY-2005	16.06.03	78	16613	16613	PDS_UNKNOWN_FAILURE
05-MAY-2005	4.21.29	05-MAY-2005	4.22.47	78	16620	16620	PDS_UNKNOWN_FAILURE
05-MAY-2005	15.34.00	05-MAY-2005	15.35.18	78	16627	16627	PDS_UNKNOWN_FAILURE
06-MAY-2005	5.29.00	06-MAY-2005	5.30.18	78	16635	16635	PDS_UNKNOWN_FAILURE
06-MAY-2005	16.42.13	06-MAY-2005	16.43.30	77	16642	16642	PDS_UNKNOWN_FAILURE
09-MAY-2005	3.55.08	09-MAY-2005	3.56.26	78	16677	16677	PDS_UNKNOWN_FAILURE
09-MAY-2005	15.07.27	09-MAY-2005	15.08.45	78	16684	16684	PDS_UNKNOWN_FAILURE
13-MAY-2005	16.22.17	13-MAY-2005	16.23.35	78	16742	16742	PDS_UNKNOWN_FAILURE
14-MAY-2005	4.38.44	14-MAY-2005	4.40.01	77	16749	16749	PDS_UNKNOWN_FAILURE
14-MAY-2005	15.50.46	14-MAY-2005	15.52.04	78	16756	16756	PDS_UNKNOWN_FAILURE
14-MAY-2005	23.56.26	14-MAY-2005	23.56.37	11	16760	16760	PDS_UNKNOWN_FAILURE

10-MAY-2005	5.04.22	10-MAY-2005	5.05.39	77	16692	16692	PDS_UNKNOWN_FAILURE
10-MAY-2005	16.16.22	10-MAY-2005	16.17.40	78	16699	16699	PDS_UNKNOWN_FAILURE
11-MAY-2005	4.29.45	11-MAY-2005	4.29.48	3	16706	16706	PDS_UNKNOWN_FAILURE
11-MAY-2005	4.32.59	11-MAY-2005	4.34.17	78	16706	16706	PDS_UNKNOWN_FAILURE
11-MAY-2005	15.45.11	11-MAY-2005	15.46.29	78	16713	16713	PDS_UNKNOWN_FAILURE
12-MAY-2005	4.01.00	12-MAY-2005	4.02.18	78	16720	16720	PDS_UNKNOWN_FAILURE
12-MAY-2005	15.13.22	12-MAY-2005	15.14.40	78	16727	16727	PDS_UNKNOWN_FAILURE
13-MAY-2005	5.09.58	13-MAY-2005	5.11.16	78	16735	16735	PDS_UNKNOWN_FAILURE
14-MAY-2005	23.56.37	15-MAY-2005	4.04.23	14866	16760	16763	UNAV_RA2
15-MAY-2005	4.06.52	15-MAY-2005	10.53.45	24413	16763	16767	UNAV_RA2
16-MAY-2005	5.13.22	16-MAY-2005	5.13.25	3	16778	16778	PDS_UNKNOWN_FAILURE
16-MAY-2005	5.15.35	16-MAY-2005	5.16.53	78	16778	16778	PDS_UNKNOWN_FAILURE
20-MAY-2005	7.56.41	20-MAY-2005	11.16.45	12004	16837	16839	PDS_UNKNOWN_FAILURE
20-MAY-2005	16.01.57	20-MAY-2005	16.03.14	77	16842	16842	PDS_UNKNOWN_FAILURE
21-MAY-2005	0.10.31	21-MAY-2005	0.10.45	14	16846	16846	PDS_UNKNOWN_FAILURE
21-MAY-2005	15.28.05	21-MAY-2005	15.28.08	3	16856	16856	PDS_UNKNOWN_FAILURE
21-MAY-2005	15.31.05	21-MAY-2005	15.32.23	78	16856	16856	PDS_UNKNOWN_FAILURE
16-MAY-2005	16.28.11	16-MAY-2005	16.29.29	78	16785	16785	PDS_UNKNOWN_FAILURE
17-MAY-2005	4.44.28	17-MAY-2005	4.45.46	78	16792	16792	PDS_UNKNOWN_FAILURE
17-MAY-2005	15.56.21	17-MAY-2005	15.57.39	78	16799	16799	PDS_UNKNOWN_FAILURE
18-MAY-2005	4.12.44	18-MAY-2005	4.14.02	78	16806	16806	PDS_UNKNOWN_FAILURE
18-MAY-2005	15.25.10	18-MAY-2005	15.26.28	78	16813	16813	PDS_UNKNOWN_FAILURE
19-MAY-2005	5.21.12	19-MAY-2005	5.22.29	77	16821	16821	PDS_UNKNOWN_FAILURE
19-MAY-2005	16.34.05	19-MAY-2005	16.35.23	78	16828	16828	PDS_UNKNOWN_FAILURE
20-MAY-2005	4.50.13	20-MAY-2005	4.51.30	77	16835	16835	PDS_UNKNOWN_FAILURE
21-MAY-2005	0.10.45	21-MAY-2005	4.15.37	14692	16846	16849	UNAV_RA2
21-MAY-2005	4.18.36	21-MAY-2005	10.55.35	23819	16849	16853	UNAV_RA2
23-MAY-2005	4.55.55	23-MAY-2005	4.57.13	78	16878	16878	PDS_UNKNOWN_FAILURE
23-MAY-2005	16.07.32	23-MAY-2005	16.08.50	78	16885	16885	PDS_UNKNOWN_FAILURE
26-MAY-2005	5.01.32	26-MAY-2005	5.02.50	78	16921	16921	PDS_UNKNOWN_FAILURE
26-MAY-2005	16.13.24	26-MAY-2005	16.14.42	78	16928	16928	PDS_UNKNOWN_FAILURE
27-MAY-2005	4.30.05	27-MAY-2005	4.31.23	78	16935	16935	PDS_UNKNOWN_FAILURE
27-MAY-2005	15.39.23	27-MAY-2005	15.39.26	3	16942	16942	PDS_UNKNOWN_FAILURE
27-MAY-2005	15.42.22	27-MAY-2005	15.43.40	78	16942	16942	PDS_UNKNOWN_FAILURE
28-MAY-2005	3.56.01	28-MAY-2005	3.56.03	2	16949	16949	PDS_UNKNOWN_FAILURE
28-MAY-2005	3.58.03	28-MAY-2005	3.59.21	78	16949	16949	PDS_UNKNOWN_FAILURE
28-MAY-2005	15.10.23	28-MAY-2005	15.11.41	78	16956	16956	PDS_UNKNOWN_FAILURE
24-MAY-2005	4.24.21	24-MAY-2005	4.25.38	77	16892	16892	PDS_UNKNOWN_FAILURE
24-MAY-2005	7.30.55	24-MAY-2005	7.38.25	450	16894	16894	PDS_UNKNOWN_FAILURE
24-MAY-2005	15.33.44	24-MAY-2005	15.33.47	3	16899	16899	PDS_UNKNOWN_FAILURE
24-MAY-2005	15.36.47	24-MAY-2005	15.38.05	78	16899	16899	PDS_UNKNOWN_FAILURE
25-MAY-2005	3.50.55	25-MAY-2005	3.50.58	3	16906	16906	PDS_UNKNOWN_FAILURE
25-MAY-2005	3.52.11	25-MAY-2005	3.53.29	78	16906	16906	PDS_UNKNOWN_FAILURE
25-MAY-2005	16.44.54	25-MAY-2005	16.46.11	77	16914	16914	PDS_UNKNOWN_FAILURE

26-MAY-2005	4.59.19	26-MAY-2005	4.59.22	3	16921	16921	PDS_UNKNOWN_FAILURE
30-MAY-2005	4.35.50	30-MAY-2005	4.37.08	78	16978	16978	PDS_UNKNOWN_FAILURE
30-MAY-2005	15.45.05	30-MAY-2005	15.45.07	2	16985	16985	PDS_UNKNOWN_FAILURE
02-JUN-2005	15.50.49	02-JUN-2005	15.50.52	3	17028	17028	PDS_UNKNOWN_FAILURE
02-JUN-2005	15.53.33	02-JUN-2005	15.54.51	78	17028	17028	PDS_UNKNOWN_FAILURE
03-JUN-2005	4.09.47	03-JUN-2005	4.11.05	78	17035	17035	PDS_UNKNOWN_FAILURE
03-JUN-2005	15.19.37	03-JUN-2005	15.19.40	3	17042	17042	PDS_UNKNOWN_FAILURE
03-JUN-2005	15.22.12	03-JUN-2005	15.23.30	78	17042	17042	PDS_UNKNOWN_FAILURE
04-JUN-2005	5.16.10	04-JUN-2005	5.16.13	3	17050	17050	PDS_UNKNOWN_FAILURE
04-JUN-2005	5.18.23	04-JUN-2005	5.19.40	77	17050	17050	PDS_UNKNOWN_FAILURE
04-JUN-2005	16.31.08	04-JUN-2005	16.32.25	77	17057	17057	PDS_UNKNOWN_FAILURE
30-MAY-2005	15.47.58	30-MAY-2005	15.49.15	77	16985	16985	PDS_UNKNOWN_FAILURE
31-MAY-2005	4.03.55	31-MAY-2005	4.05.13	78	16992	16992	PDS_UNKNOWN_FAILURE
31-MAY-2005	15.16.18	31-MAY-2005	15.17.36	78	16999	16999	PDS_UNKNOWN_FAILURE
01-JUN-2005	5.10.33	01-JUN-2005	5.10.36	3	17007	17007	PDS_UNKNOWN_FAILURE
01-JUN-2005	5.12.46	01-JUN-2005	5.14.04	78	17007	17007	PDS_UNKNOWN_FAILURE
01-JUN-2005	16.25.13	01-JUN-2005	16.26.31	78	17014	17014	PDS_UNKNOWN_FAILURE
02-JUN-2005	4.38.40	02-JUN-2005	4.38.43	3	17021	17021	PDS_UNKNOWN_FAILURE
02-JUN-2005	4.41.35	02-JUN-2005	4.42.53	78	17021	17021	PDS_UNKNOWN_FAILURE

Table 7: List of gaps for RA-2 L0 products during cycle 37

In Figure 11 and Table 8 the summary of unavailable MWR L0 products is given.

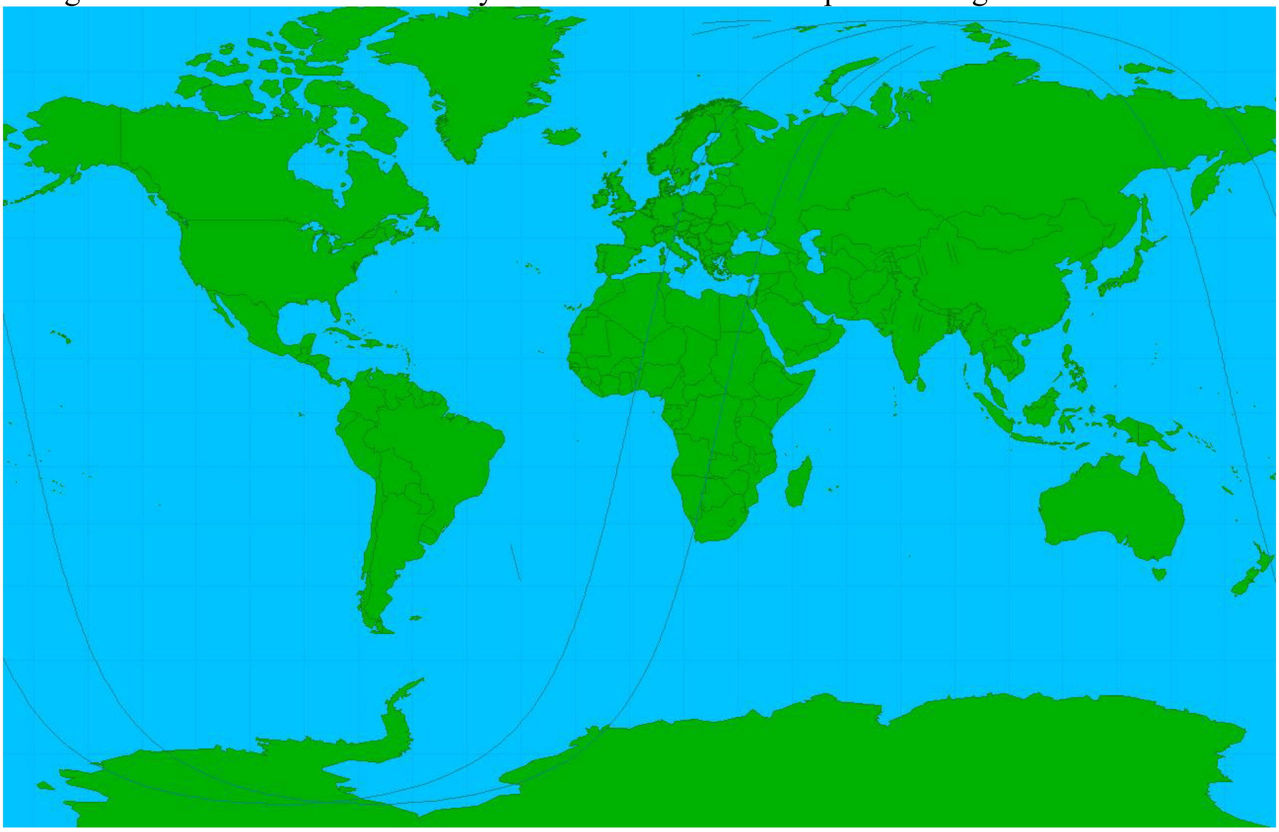

Figure 11: MWR L0 unavailable products for cycle 37

Start date	Start time	Stop date	Stop time	Duration [sec]	Start orbit	Stop orbit	Reason
02-MAY-2005	15.28.09	02-MAY-2005	15.29.26	77	16584	16584	PDS_UNKNOWN_FAILURE
07-MAY-2005	4.58.45	07-MAY-2005	5.00.02	77	16649	16649	PDS_UNKNOWN_FAILURE
07-MAY-2005	16.10.28	07-MAY-2005	16.11.46	78	16656	16656	PDS_UNKNOWN_FAILURE
03-MAY-2005	5.24.01	03-MAY-2005	5.25.19	78	16592	16592	PDS_UNKNOWN_FAILURE
03-MAY-2005	16.36.48	03-MAY-2005	16.38.06	78	16599	16599	PDS_UNKNOWN_FAILURE
04-MAY-2005	4.53.06	04-MAY-2005	4.54.24	78	16606	16606	PDS_UNKNOWN_FAILURE
04-MAY-2005	16.04.45	04-MAY-2005	16.06.03	78	16613	16613	PDS_UNKNOWN_FAILURE
05-MAY-2005	4.21.29	05-MAY-2005	4.22.47	78	16620	16620	PDS_UNKNOWN_FAILURE
05-MAY-2005	15.34.00	05-MAY-2005	15.35.18	78	16627	16627	PDS_UNKNOWN_FAILURE
06-MAY-2005	5.29.00	06-MAY-2005	5.30.18	78	16635	16635	PDS_UNKNOWN_FAILURE
06-MAY-2005	16.42.13	06-MAY-2005	16.43.30	77	16642	16642	PDS_UNKNOWN_FAILURE
20-MAY-2005	0.33.52	20-MAY-2005	0.36.16	144	16832	16832	PDS_UNKNOWN_FAILURE
20-MAY-2005	7.55.53	20-MAY-2005	11.16.41	12048	16837	16839	PDS_UNKNOWN_FAILURE
24-MAY-2005	7.30.02	24-MAY-2005	7.38.02	480	16894	16894	PDS_UNKNOWN_FAILURE
25-MAY-2005	13.38.28	25-MAY-2005	13.39.16	48	16912	16912	PDS_UNKNOWN_FAILURE
27-MAY-2005	12.36.09	27-MAY-2005	12.36.57	48	16940	16940	PDS_UNKNOWN_FAILURE
02-JUN-2005	12.46.46	02-JUN-2005	12.47.34	48	17026	17026	PDS_UNKNOWN_FAILURE

Table 8: List of gaps for MWR L0 products during cycle 37

In Figure 12 and Table 9 the summary of unavailable RA-2 L1b products is given. Please note that in this case, only the gaps due to problems with the PDS are reported.

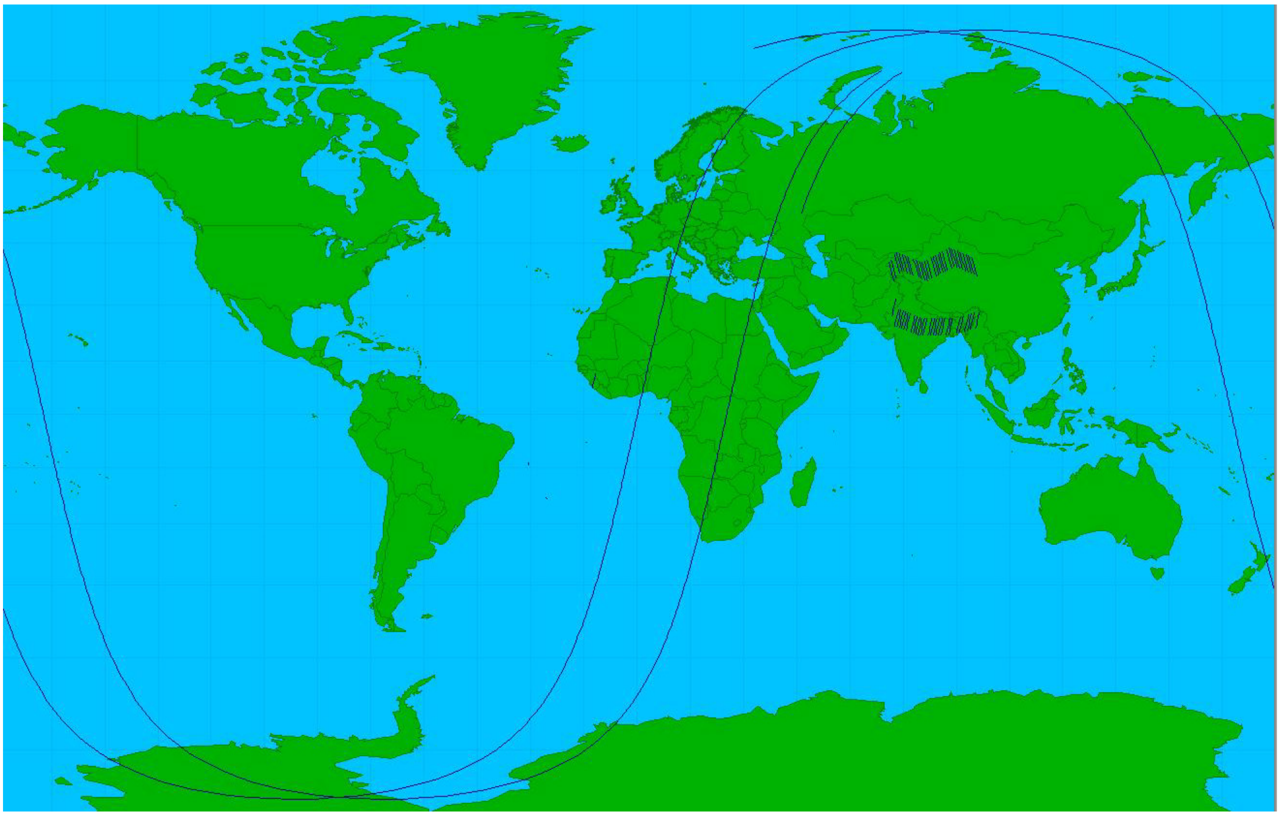

Figure 12: RA-2 L1b unavailable products for cycle 37

Start date	Start time	Stop date	Stop time	Duration [sec]	Start orbit	Stop orbit	Reason
02-MAY-2005	4.15.41	02-MAY-2005	4.16.59	78	16577	16577	PDS_UNKNOWN_FAILURE
02-MAY-2005	15.28.09	02-MAY-2005	15.29.26	77	16584	16584	PDS_UNKNOWN_FAILURE
07-MAY-2005	4.58.45	07-MAY-2005	5.00.02	77	16649	16649	PDS_UNKNOWN_FAILURE
07-MAY-2005	16.10.28	07-MAY-2005	16.11.46	78	16656	16656	PDS_UNKNOWN_FAILURE
03-MAY-2005	5.24.01	03-MAY-2005	5.25.19	78	16592	16592	PDS_UNKNOWN_FAILURE
03-MAY-2005	16.36.48	03-MAY-2005	16.38.06	78	16599	16599	PDS_UNKNOWN_FAILURE
04-MAY-2005	4.53.06	04-MAY-2005	4.54.24	78	16606	16606	PDS_UNKNOWN_FAILURE
04-MAY-2005	16.04.45	04-MAY-2005	16.06.03	78	16613	16613	PDS_UNKNOWN_FAILURE
05-MAY-2005	4.21.29	05-MAY-2005	4.22.47	78	16620	16620	PDS_UNKNOWN_FAILURE
05-MAY-2005	15.34.00	05-MAY-2005	15.35.18	78	16627	16627	PDS_UNKNOWN_FAILURE
06-MAY-2005	5.29.00	06-MAY-2005	5.30.18	78	16635	16635	PDS_UNKNOWN_FAILURE
06-MAY-2005	16.42.13	06-MAY-2005	16.43.30	77	16642	16642	PDS_UNKNOWN_FAILURE
14-MAY-2005	4.38.44	14-MAY-2005	4.40.01	77	16749	16749	PDS_UNKNOWN_FAILURE
14-MAY-2005	15.50.46	14-MAY-2005	15.52.04	78	16756	16756	PDS_UNKNOWN_FAILURE
14-MAY-2005	23.56.27	14-MAY-2005	23.56.37	10	16760	16760	PDS_UNKNOWN_FAILURE
15-MAY-2005	10.53.45	15-MAY-2005	10.54.50	65	16767	16767	PDS_UNKNOWN_FAILURE
15-MAY-2005	15.19.16	15-MAY-2005	15.20.34	78	16770	16770	PDS_UNKNOWN_FAILURE
10-MAY-2005	5.04.22	10-MAY-2005	5.05.39	77	16692	16692	PDS_UNKNOWN_FAILURE
10-MAY-2005	16.16.22	10-MAY-2005	16.17.40	78	16699	16699	PDS_UNKNOWN_FAILURE

11-MAY-2005	4.32.59	11-MAY-2005	4.34.17	78	16706	16706	PDS_UNKNOWN_FAILURE
11-MAY-2005	15.45.11	11-MAY-2005	15.46.29	78	16713	16713	PDS_UNKNOWN_FAILURE
12-MAY-2005	4.01.00	12-MAY-2005	4.02.18	78	16720	16720	PDS_UNKNOWN_FAILURE
12-MAY-2005	15.13.22	12-MAY-2005	15.14.40	78	16727	16727	PDS_UNKNOWN_FAILURE
13-MAY-2005	5.09.58	13-MAY-2005	5.11.16	78	16735	16735	PDS_UNKNOWN_FAILURE
13-MAY-2005	16.22.17	13-MAY-2005	16.23.35	78	16742	16742	PDS_UNKNOWN_FAILURE
16-MAY-2005	5.13.23	16-MAY-2005	5.13.25	2	16778	16778	PDS_UNKNOWN_FAILURE
16-MAY-2005	5.15.35	16-MAY-2005	5.16.53	78	16778	16778	PDS_UNKNOWN_FAILURE
20-MAY-2005	7.56.42	20-MAY-2005	11.16.45	12003	16837	16839	PDS_UNKNOWN_FAILURE
20-MAY-2005	16.01.57	20-MAY-2005	16.03.14	77	16842	16842	PDS_UNKNOWN_FAILURE
21-MAY-2005	0.10.32	21-MAY-2005	0.10.45	13	16846	16846	PDS_UNKNOWN_FAILURE
21-MAY-2005	15.28.06	21-MAY-2005	15.28.08	2	16856	16856	PDS_UNKNOWN_FAILURE
21-MAY-2005	15.31.05	21-MAY-2005	15.32.23	78	16856	16856	PDS_UNKNOWN_FAILURE
16-MAY-2005	16.28.11	16-MAY-2005	16.29.29	78	16785	16785	PDS_UNKNOWN_FAILURE
17-MAY-2005	4.44.28	17-MAY-2005	4.45.46	78	16792	16792	PDS_UNKNOWN_FAILURE
17-MAY-2005	15.56.21	17-MAY-2005	15.57.39	78	16799	16799	PDS_UNKNOWN_FAILURE
18-MAY-2005	4.12.44	18-MAY-2005	4.14.02	78	16806	16806	PDS_UNKNOWN_FAILURE
18-MAY-2005	15.25.10	18-MAY-2005	15.26.28	78	16813	16813	PDS_UNKNOWN_FAILURE
19-MAY-2005	5.21.12	19-MAY-2005	5.22.29	77	16821	16821	PDS_UNKNOWN_FAILURE
19-MAY-2005	16.34.05	19-MAY-2005	16.35.23	78	16828	16828	PDS_UNKNOWN_FAILURE
20-MAY-2005	4.50.13	20-MAY-2005	4.51.30	77	16835	16835	PDS_UNKNOWN_FAILURE
23-MAY-2005	4.55.55	23-MAY-2005	4.57.13	78	16878	16878	PDS_UNKNOWN_FAILURE
23-MAY-2005	16.07.32	23-MAY-2005	16.08.50	78	16885	16885	PDS_UNKNOWN_FAILURE
27-MAY-2005	15.42.22	27-MAY-2005	15.43.40	78	16942	16942	PDS_UNKNOWN_FAILURE
28-MAY-2005	3.58.03	28-MAY-2005	3.59.21	78	16949	16949	PDS_UNKNOWN_FAILURE
28-MAY-2005	15.10.23	28-MAY-2005	15.11.41	78	16956	16956	PDS_UNKNOWN_FAILURE
24-MAY-2005	4.24.21	24-MAY-2005	4.25.38	77	16892	16892	PDS_UNKNOWN_FAILURE
24-MAY-2005	7.30.56	24-MAY-2005	7.38.25	449	16894	16894	PDS_UNKNOWN_FAILURE
24-MAY-2005	15.36.47	24-MAY-2005	15.38.05	78	16899	16899	PDS_UNKNOWN_FAILURE
25-MAY-2005	3.52.11	25-MAY-2005	3.53.29	78	16906	16906	PDS_UNKNOWN_FAILURE
25-MAY-2005	16.44.54	25-MAY-2005	16.46.11	77	16914	16914	PDS_UNKNOWN_FAILURE
26-MAY-2005	5.01.32	26-MAY-2005	5.02.50	78	16921	16921	PDS_UNKNOWN_FAILURE
26-MAY-2005	16.13.24	26-MAY-2005	16.14.42	78	16928	16928	PDS_UNKNOWN_FAILURE
27-MAY-2005	4.30.05	27-MAY-2005	4.31.23	78	16935	16935	PDS_UNKNOWN_FAILURE
30-MAY-2005	4.35.50	30-MAY-2005	4.37.08	78	16978	16978	PDS_UNKNOWN_FAILURE
30-MAY-2005	15.47.58	30-MAY-2005	15.49.15	77	16985	16985	PDS_UNKNOWN_FAILURE
03-JUN-2005	15.19.38	03-JUN-2005	15.19.40	2	17042	17042	PDS_UNKNOWN_FAILURE
03-JUN-2005	15.22.12	03-JUN-2005	15.23.30	78	17042	17042	PDS_UNKNOWN_FAILURE
04-JUN-2005	5.18.23	04-JUN-2005	5.19.40	77	17050	17050	PDS_UNKNOWN_FAILURE
04-JUN-2005	16.31.08	04-JUN-2005	16.32.25	77	17057	17057	PDS_UNKNOWN_FAILURE
30-MAY-2005	15.49.15	30-MAY-2005	15.49.16	1	16985	16985	PDS_UNKNOWN_FAILURE
31-MAY-2005	4.03.55	31-MAY-2005	4.05.13	78	16992	16992	PDS_UNKNOWN_FAILURE
31-MAY-2005	15.16.18	31-MAY-2005	15.17.36	78	16999	16999	PDS_UNKNOWN_FAILURE
01-JUN-2005	5.12.46	01-JUN-2005	5.14.04	78	17007	17007	PDS_UNKNOWN_FAILURE

01-JUN-2005	16.25.13	01-JUN-2005	16.26.31	78	17014	17014	PDS_UNKNOWN_FAILURE
02-JUN-2005	4.41.35	02-JUN-2005	4.42.53	78	17021	17021	PDS_UNKNOWN_FAILURE
02-JUN-2005	15.53.33	02-JUN-2005	15.54.51	78	17028	17028	PDS_UNKNOWN_FAILURE
03-JUN-2005	4.09.47	03-JUN-2005	4.11.05	78	17035	17035	PDS_UNKNOWN_FAILURE

Table 9: List of gaps for RA-2 L1b products during cycle 37

8.2 RA-2 Altimeter Parameters

Hereafter a summary of the main Altimetric parameters performances is reported; these results have been obtained with the editing criteria mentioned in par. 8.3.

8.2.1 ALTIMETER RANGE

The monitoring of the RA-2 FD altimetric range shall be done once the NRT products shall be upgraded with the DORIS navigator NRT orbital information. For NRT products there are no current results for the time being.

8.2.2 SIGNIFICANT WAVE HEIGHT

The histogram of the SWH, reported in Figure 13, shows a nominal behavior for this cycle. The trend goes on following the behavior shown in the cycle 34 and 35, where the peaks of Ku and S bands SWH histograms are closer to each other.
Figure 14 shows the SWH daily mean. The possible high values, sometimes plotted outside the figure range, reported for the S-Band data are due to the so-called S-Band anomaly (ref. par.7.1.7).

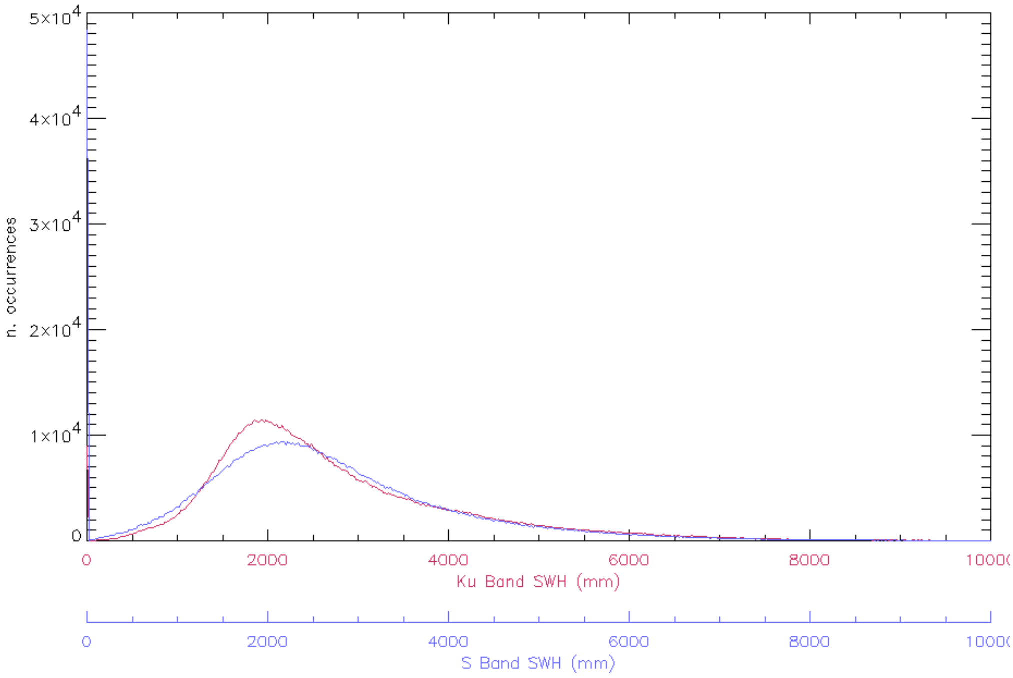

Figure 13: Histogram of Ku and S Band SWH for cycle 37 (mm)

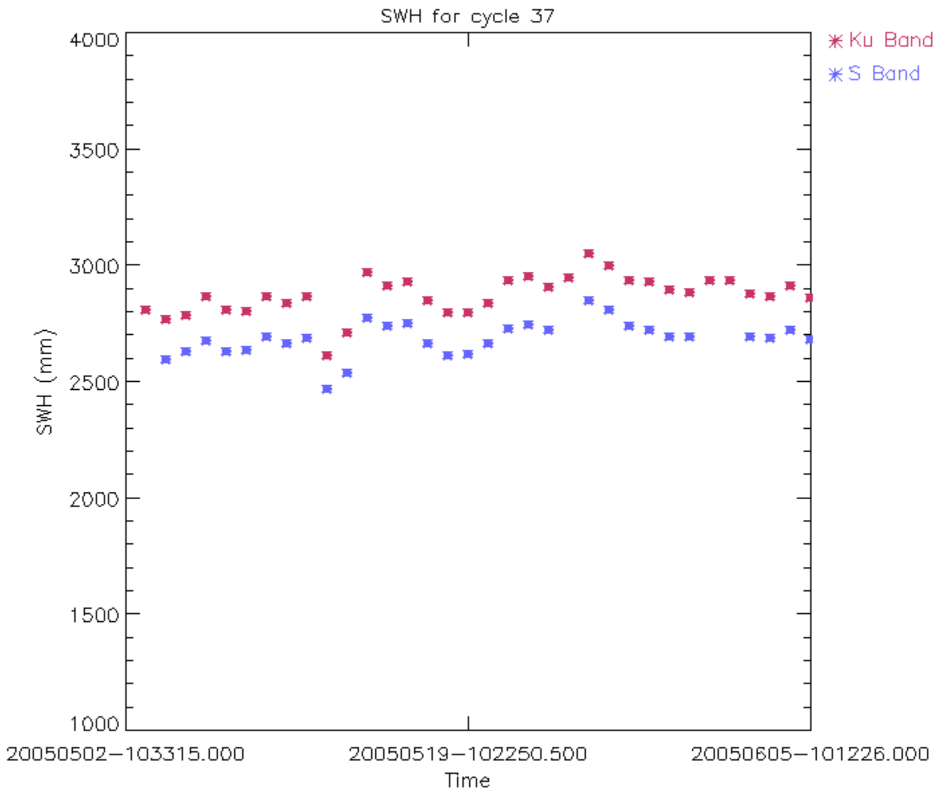

Figure 14: Ku and S SWH daily average for cycle 37 (mm)

8.2.3 BACKSCATTER COEFFICIENT – WIND SPEED

The Sigma_0 histogram both in Ku and S Band shows secondary peaks. A small investigation on this problem, performed on the data of cycle 28, demonstrated that the backscattering distribution assumes a different behavior for different sea conditions. Indeed, for both bands, the majority of the data is concentrated on lower values for rough sea state (southern hemisphere, winter conditions) and on higher values for calm sea state (northern hemisphere, summer conditions).
For this cycle the left secondary peaks are higher then the previous cycles. This behavior is due to a seasonal effect. In fact it is visible for the corresponding cycles of 2004 (cycles 24 and 25).

In Figure 16, the backscattering coefficient daily average trend is reported. The trend shows a nominal behavior for both bands. The high daily means (sometimes plotted outside the figure range) reported for the S-Band Sigma_0 are due to the so-called S-Band anomaly (ref. par. 7.1.7).

The histogram of Wind Speed computed for the Ku-band and the time behavior during cycle 37 are reported in Figure 17 and Figure 18, respectively. They are similar to the previous cycle.

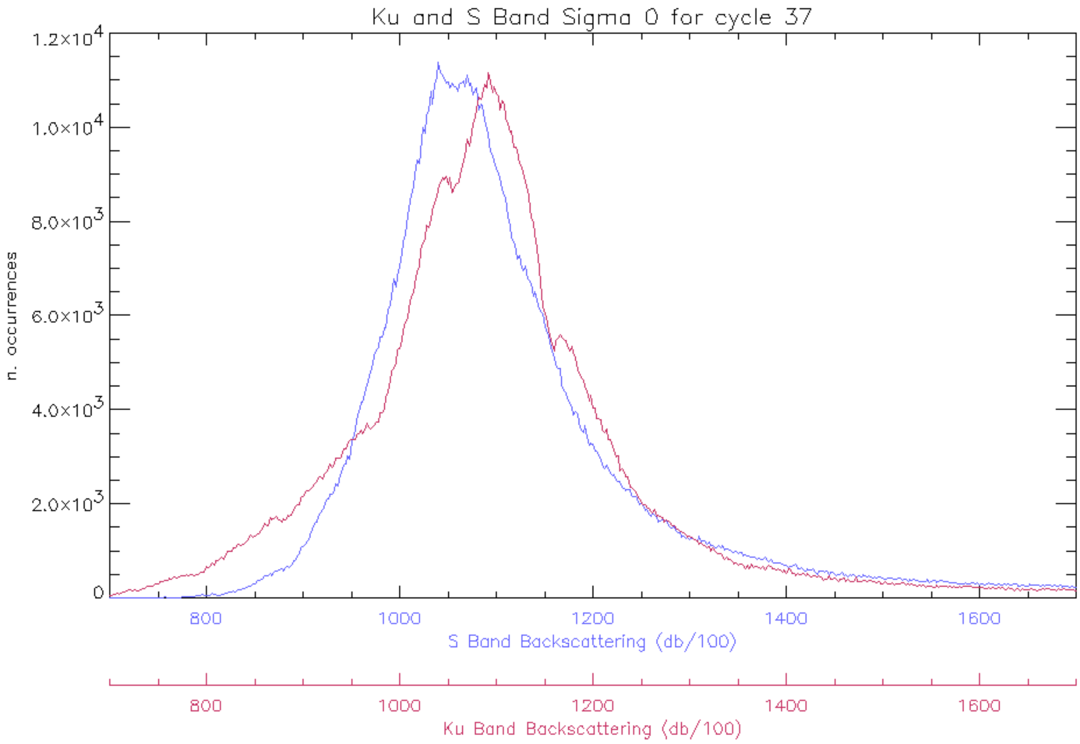

Figure 15: Histogram of Ku and S Band Backscattering Coefficient for cycle 37 (dB/100)

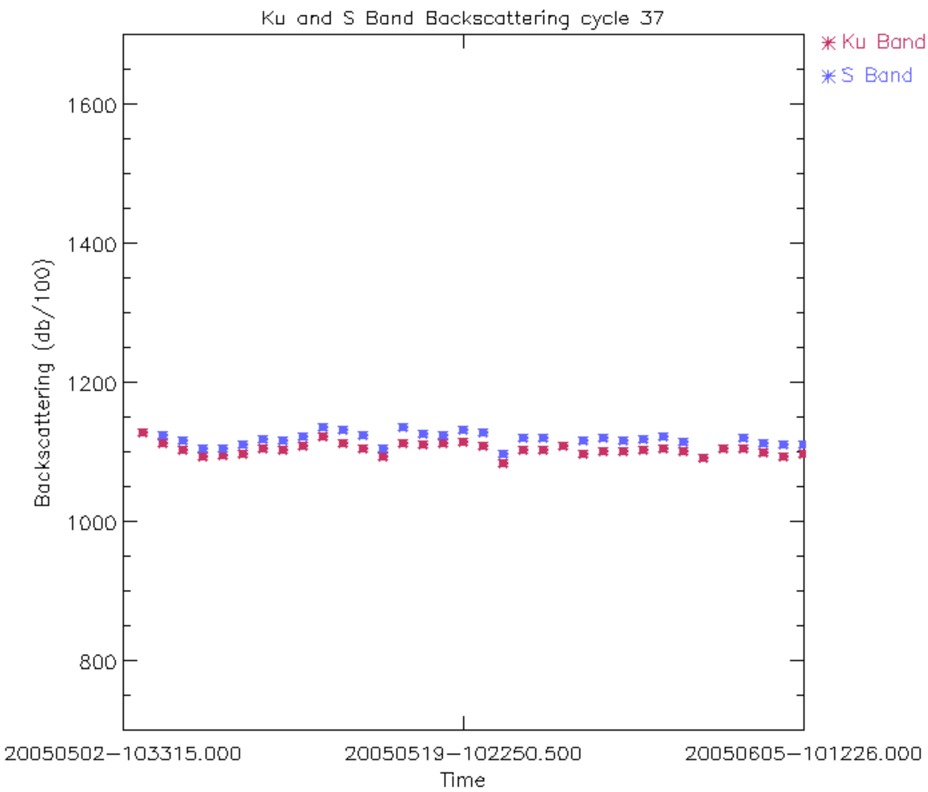

Figure 16: Ku and S Sigma_0 daily average for cycle 37 (dB/100)

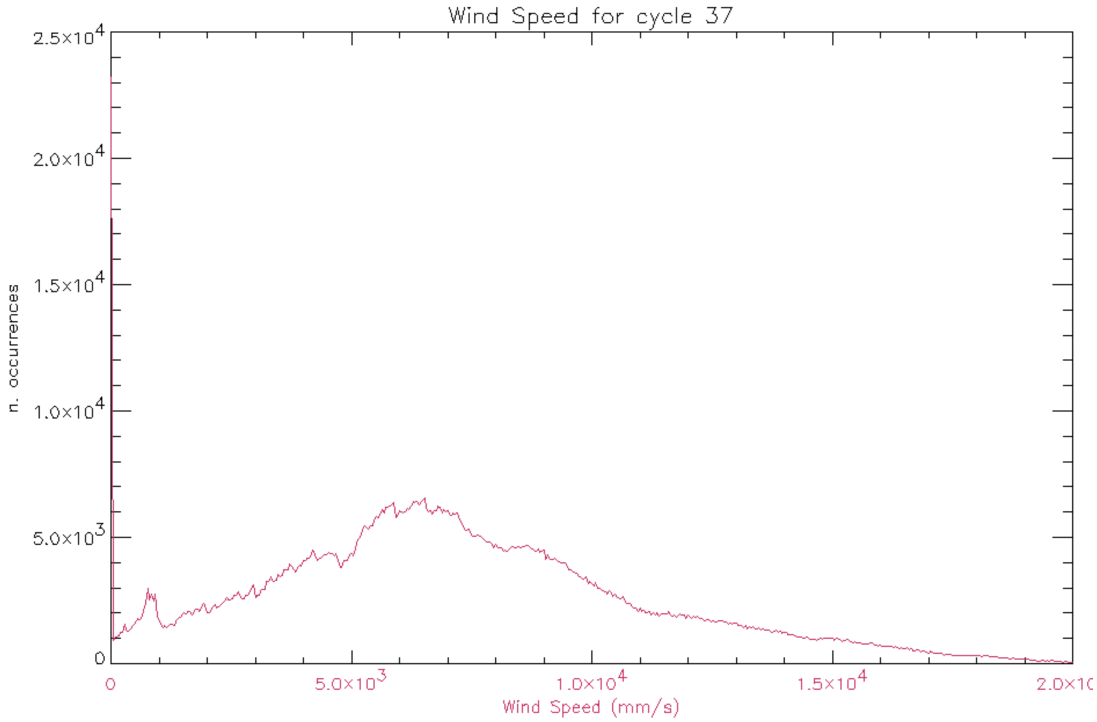

Figure 17: Histogram of Ku Wind Speed for cycle 37 (mm/s)

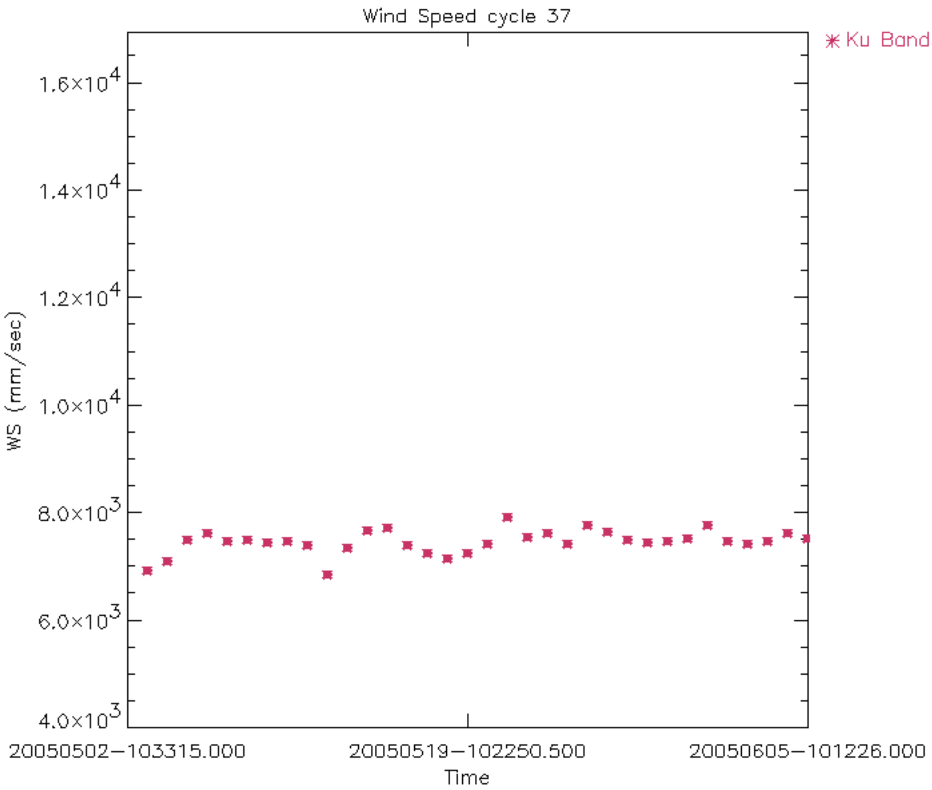

Figure 18: Ku Band Wind Speed daily average for cycle 37 (mm/s)

8.3 Edited measurements

In order to produce the statistics reported in 8.2 the following editing criteria have been used before using RA2_FGD products:

Parameter	Surface type	Zone	Range
Ku SWH	Open Ocean	All world	[0, 10] (m)
Ku Backscattering Coeff.	Open ocean	All world	[7, 17] (dBs)
Ku Wind Speed	Open ocean	All world	[0, 20] (m/s)

Table 10: Editing criteria for RA-2 parameters statistics

8.4 Product disclaimer

For the product disclaimers please refer to the following web link:
http://envisat.esa.int/dataproducts/availability/

8.5 Data handling recommendations

8.5.1 SEA-ICE FLAG

The following algorithm is proposed for the determination of a sea-ice flag, presently missing in the Level 2 Ra-2 and MWR data products. (See [R – 14]):

|Latitude *(lat: field#4 of L2 data)*| >50 deg
AND
The number of 20Hz valid data *(num_18hz_ku_ocean: field#23 of L2 data)* < 17
OR
|MWR Wet Tropospheric Correction *(mwr_wet_tropo_corr: field#42 of L2 data)*–ECMWF Wet Tropospheric Correction *(mod_wet_tropo_corr: field#41 of L2 data)*| > 10 cm
OR
Peakiness *(Ku_peak: field#139 of L2 data)* >2

8.5.2 OCEAN S-BAND ANOMALIES DETECTION

A valuable algorithm to detect the Level 2 DSR affected by the RA-2 S-Band anomaly is proposed in [R- 12]. Note that its validity is limited to the data acquired over open-ocean.

8.5.3 WARNING ON IPF 4.56 VERSION IDENTIFICATION FIELD

All RA-2 and MWR level 1B and NRT Level 2 products generated after November 26, 2003 report a software version as being 4.54 (available in MPH field 8).

Nevertheless those products have been generated with the IPF V4.56 operational since November 26, 2003. The first nominal generated product, using the new SW version, will be the one relevant to the absolute orbit number 9094.
The software version ID is correct since December 4, 2003.

8.5.4 S-BAND BACKSCATTERING COEFFICIENT

For the data processed with IPF version 4.56 on, the S-Band Backscattering coefficient has been demonstrated to be in average about 0.65 dBs higher than for the previous versions of the processor. This is due to the algorithm used for the retrieval of the AGC in S-Band, corrected in IPF version 4.56 to be more coherent with the real functioning of the instrument.

An average value of 0.65 dBs is suggested to be added to the old software versions S-Band Sigma0 in order to be in line with the new IPF V4.56 version.

8.5.5 USO RANGE CORRECTION

The actual data of cycle 37 have to be corrected to compensate for the Ultra Stable Oscillator drift shown in Figure 3. The measured Range shall be corrected considering a drift of –6.00 mm per year. Eventually it could also be corrected for the cyclic average given bias of 24.61 mm.

Warning: bias and drift have to be **SUBTRACTED** to the original altimetric range, according to the following equation:

Rtrue=Roriginal-dR

where Roriginal is the range in the GDR products and Rtrue is the true (corrected) range

8.5.6 KU-BAND BACKSCATTERING COEFFICIENT CALIBRATION

The results of the Ku-Band Sigma0 absolute calibration performed with a transponder have been presented in par. 7.1.4. Those results are going to be consolidated and are summarized on chapter 9.1.4. In order to absolutely calibrate the backscattering coefficient given in the RA2 L2 products the following shall be used by the end user to get to the real Sigma0 measurement:

Sigma_0_true = Sigma_0_prod + G_tx_rx_prod - G_tx_rx_real - Bias [dB]

Where:
Bias: Bias retrieved from the Sigma0 Absolute Calibration (see 9.1.4)
G_tx_rx_prod: Current effective Tx-Rx Gain value used in the operational ground processing chain (ADF file RA2_CHD_AX). The value nominally used since IPF V4.54 is (for configuration RFSS=A and HPA=A) is 170.70 dB
G_tx_rx_real: Pre-launch characterization value (configuration value RFSS=A and HPA=A is 167.46 dB)

8.5.7 ABNORMAL RA-2 RANGE BEHAVIOR AFTER ANOMALY RECOVERY

An un-expected behavior of the Envisat RA-2 sensor was observed in the period from 2004/09/27 at ~16:00 and ending on 2004/09/29 at ~12:00 AM. This directly happened after the recovery of a RA-2 on-board anomaly occurred on the 2004/09/26 at ~13:40. The altimetric range jumped by several meters w.r.t. the Mean Sea Surface; on the other hand everything came back to normal as from the 29th of September around noon. RA-2 data from the above period have to be considered with caution.

8.6 Wind & Wave quality assessment

Refer to the ECMWF report given in [R – 9a] and [R-9b].

9 LONG TERM MONITORING

9.1 RA-2 Instrument monitoring

9.1.1 IF FILTER MASK

In Figure 19 the evolution of the IF mask quality parameters evaluated as in [R – 4] is reported only for valid data. It can be observed that the difference with respect to the on-ground reference stays quite constant around 0.07 dBs but a small increase is visible on the plot for the last three cycles.

Three peaks are visible on the plot that correspond to the data acquired on September the 27th 2003 at 15:48, on October the 29th 2003 at 15:42 and on May the 10th 2004 at 15:45. The reason of this could be found in the instrument warming up considering that the IF Cal acquisition has been made, in all the cases, only a couple of hours after an anomaly recovery. The residual noise and the accuracy show a very constant behavior over the whole period.

A weird behavior has been observed during the validation of several newly created IF mask correction auxiliary files. After an investigation, it has been recently found out that the phenomenon was due to an error done by the operator while manually creating the auxiliary files.

During cycle 37 the IF Calibration Mode still shows the weird behavior described in [R – 3]. This problem, present since the beginning of the mission, is under investigation. The anomaly directly affects the number of valid RA-2 IF masks obtained per cycle, but does not refrain from the generation of the IF mask correction file, used in input to the Level 1B ground processing.

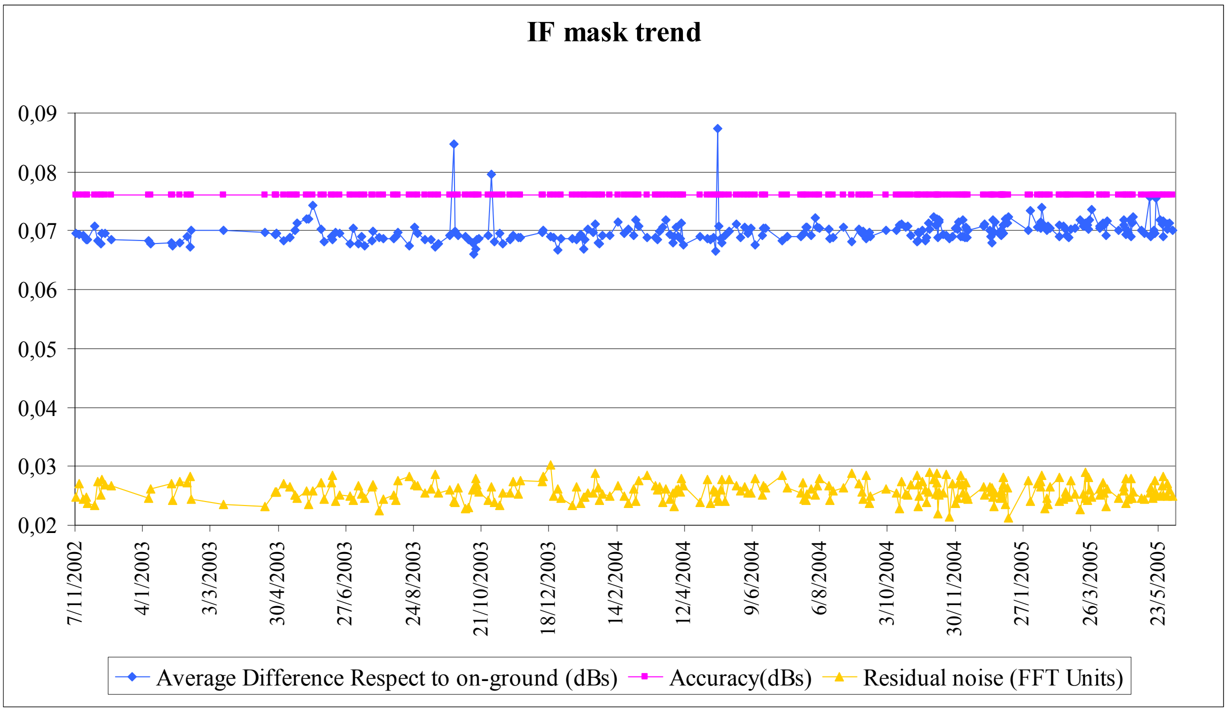

Figure 19: Evolution of the IF mask related parameters for valid IF masks retrieved up to cycle 37

In Figure 19A the percentages of valid IF masks from cycle 20 up to cycle 37 are reported.

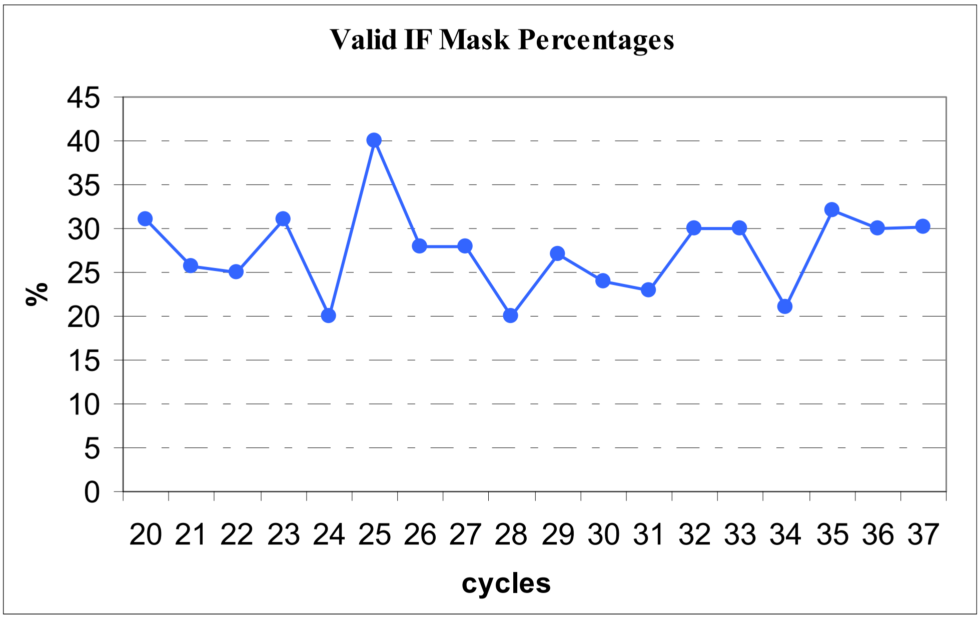

Figure 19A: Percentages of valid IF Mask up to cycle 37

9.1.2 USO

In Figure 20 the USO clock period trend retrieved until the end of cycle 37 is reported. In order to make the variability visible, the difference of the actual USO clock period with respect to the nominal one has been plotted, in the upper panel. In the lower panel the Range error due to the USO clock variability has been reported taking a satellite altitude of 800 Km as a nominal value.

Currently the nominal USO clock period (12500 ps) is used within the processing; this means that the data are not corrected for the bias and the drift correlated to the actual USO clock period. Those values, translated into altimetric range figures, are respectively of 28.47 mm and –4.68 mm/year as calculated with data covering the period 4 August 2004 to 6 June 2005 (the data covering the anomalous period between 2004/09/27 at ~16:00 and 2004/09/29 at ~12:00 AM have not been used to evaluate these figures).

WARNING: the given bias and drift have to be **SUBTRACTED** to the original altimetric range, according to the definition reported in par. 8.5.5.

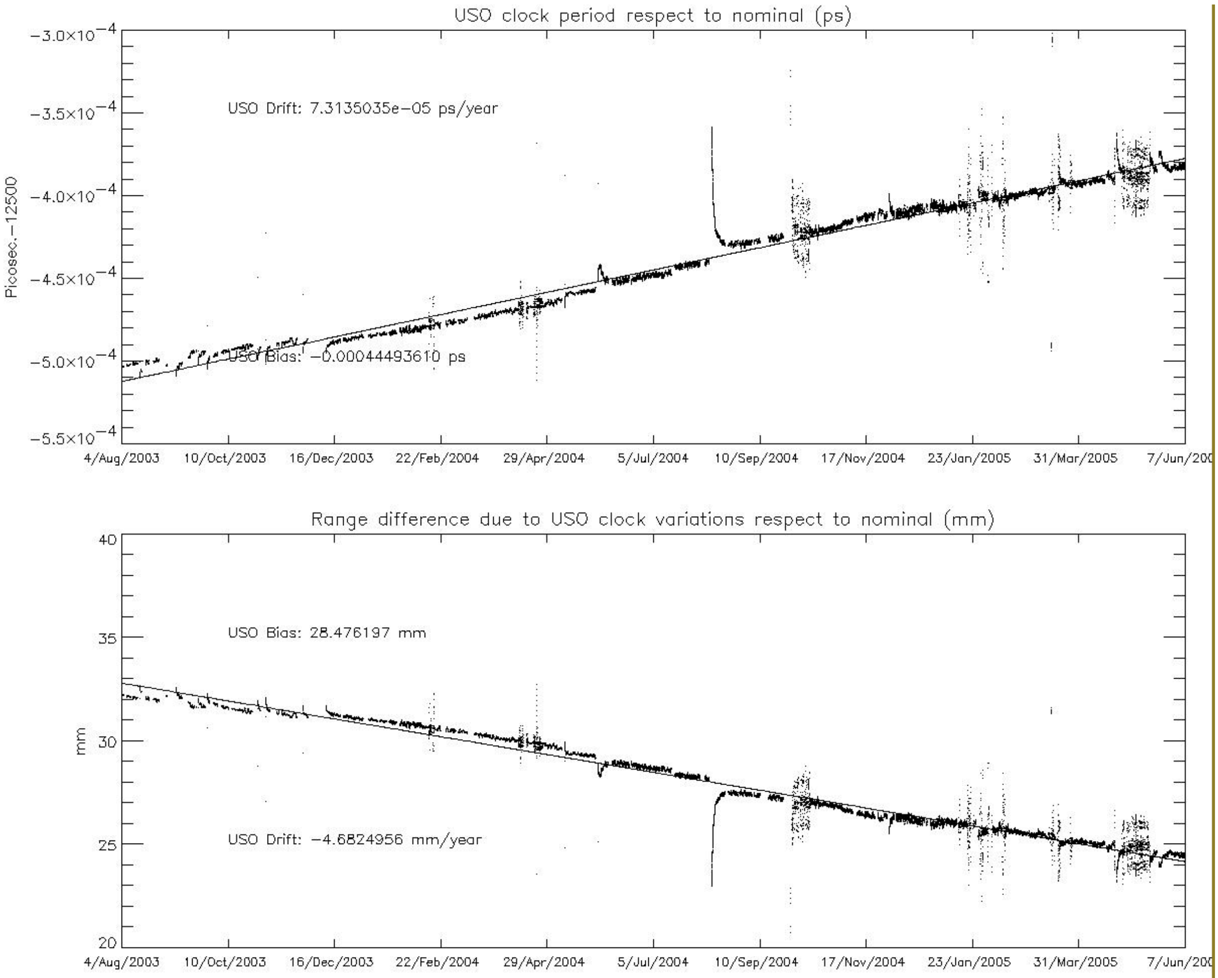

Figure 20: USO clock period until end of cycle 37

9.1.3 TRACKING CAPABILITY

In Figure 21, Figure 22 and Figure 23 the cyclic tracking percentages for the three RA-2 bandwidths are reported.
The worsening in performances noticeable for cycle 20 was due to the up-load of wrong on-board software parameters for the lasted for about three days.

In general, even if a tiny evolution can be observed, the tracking performances are well in line with the output figures and objectives of the Commissioning Phase as given in par. 7.1.3.

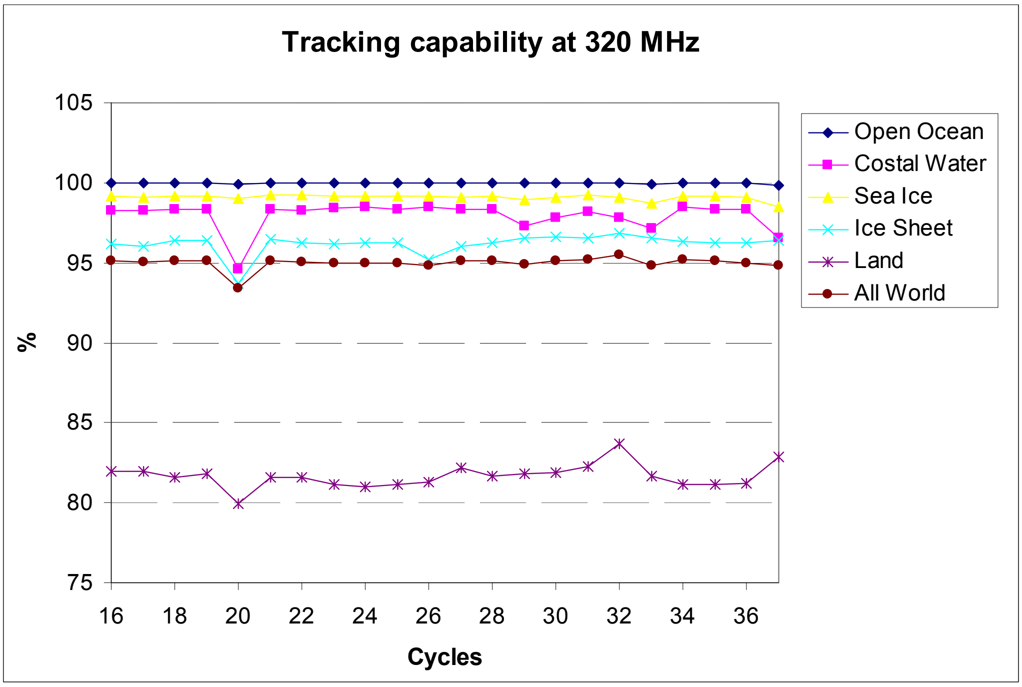

Figure 21: RA-2 Tracking percentage at 320MHz for different surfaces

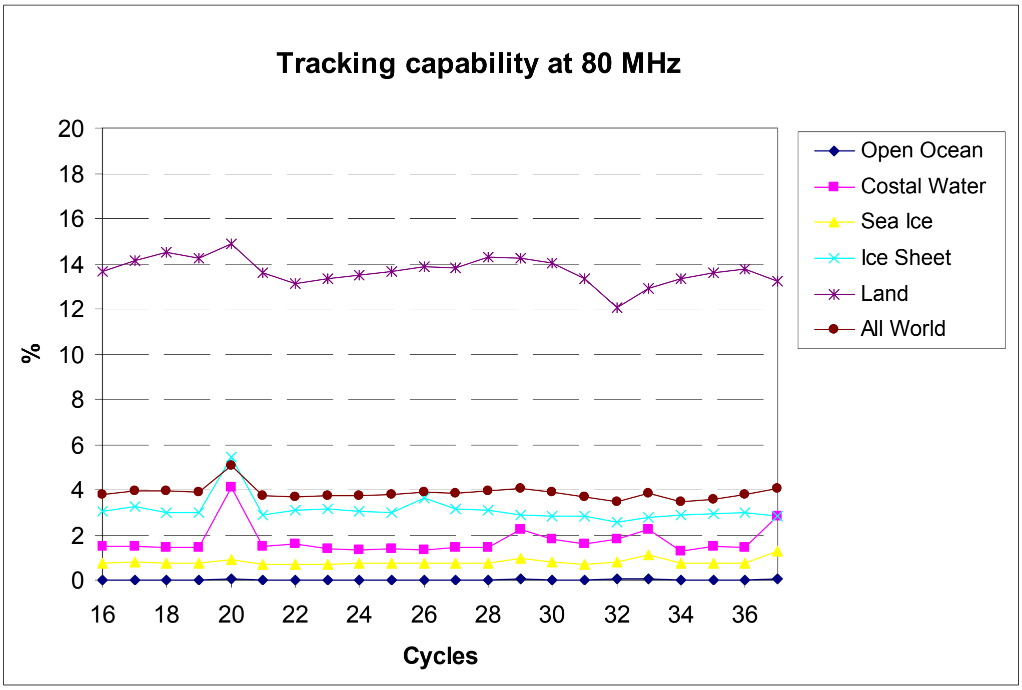

Figure 22: RA-2 Tracking percentage at 80MHz for different surfaces

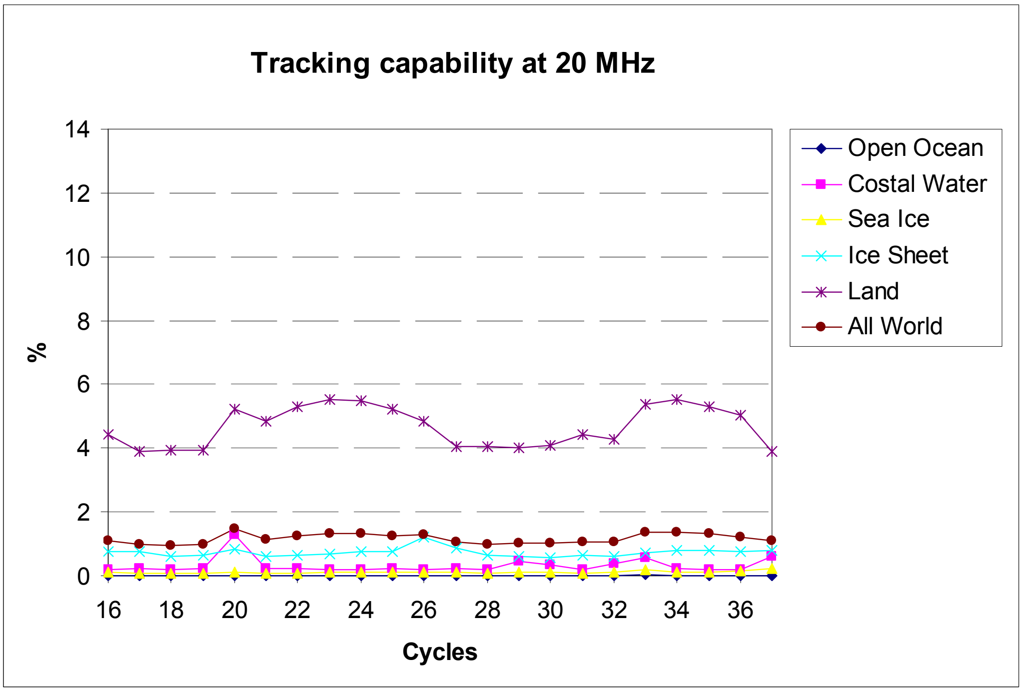

Figure 23: RA-2 Tracking percentage at 20MHz for different surfaces

9.1.4 SIGMA0 ABSOLUTE CALIBRATION

Table 11 reports the transponder measurement from cycle 24 up to cycle 37. Since December 2004 all the acquisitions have been performed in High Resolution Mode (320 MHz). The mean value of the estimated bias at High Resolution is 0.955 dB with a standard deviation of 0.047 dB. It is possible to notice that the Low Resolution measurement are coherent among themselves but there is a bias with respect to the High Resolution ones. This is probably due to a processing problem with the internal calibration factor not taken into account in Low Resolution Mode. The problem shall be investigated.

Absolute Orbit nb	Date of Measurement	Location / Rel. track	RA-2 resolution	Transponder Bias [dB]	ECMWF Wet Tropo. Corr. [dB]
10389	24-feb-04	Rome / 315	Low	1,552	0,120
10511	04-mar-04	Valmontone / 437	Low	1,542	0,102
10618	11-mar-04	Fiuggi / 43	Low	1,447	0,135
10783	23-mar-04	Maccarese / 208	Low	1,540	0,141
10890	30-mar-04	Rome / 315	Low	1,442	0,152
11119	15-apr-04	Fiuggi / 43	High	0,963	0,122
11513	13-mag-04	Valmontone / 437	Low	1,353	0,133
11620	20-mag-04	Fiuggi / 43	Low	1,417	0,139
11892	08-giu-04	Rome / 315	Low	1,504	0,154
12014	17-giu-04	Valmontone / 437	Low	1,448	0,348
12121	24-giu-04	Fiuggi / 43	Low	1,576	0,149

14290	23-nov-04	Maccarese / 208	Low	1,43	0,164
14397	30-nov-04	Rome / 315	Low	1,11	0,142
14519	9-dic-04	Valmontone / 437	Low	1,26	0,248
14791	28-dic-04	Maccarese / 208	High	0,97	0,134
14898	4-gen-05	Rome / 315	High	0,95	0,114
15020	13-gen-05	Valmontone / 437	High	0,88	0,118
15127	20-gen-05	Fiuggi / 43	High	1,01	0,108
15292	1-feb-05	Maccarese / 208	High	0,95	0,132
15399	8-feb-05	Rome / 315	High	1,05	0,124
15521	17-feb-05	Valmontone / 437	High	0,94	0,115
15793	8-mar-05	Maccarese / 208	High	0,93	0,116
15900	15-mar-05	Rome / 315	High	0,93	0,128
16022	24-mar-05	Valmontone / 437	High	0,94	0,154
16294	12-apr-05	Maccarese / 208	High	0,97	0,140
16401	19-apr-05	Rome / 315	High	0,99	0,134
16523	28-apr-05	Valmontone / 437	High	0,97	0,114
16795	17-may-05	Maccarese / 208	High	0,84	0,168
16902	24-may-05	Rome / 315	High	1,00	0,152

Table 11: Transponder measurement results up to cycle 37

In Figure 24 the time behavior of the bias is plotted for both Low and High Resolution. The green line represents the corrected bias for the internal calibration factor (only for the Low Resolution data) and the tropospheric attenuation. The latter is estimated by using the ECMWF meteorological data. The low value of the corrected bias for the orbit 14397 is due to the dew air condition and a probable underestimation of the tropo-attenuation.

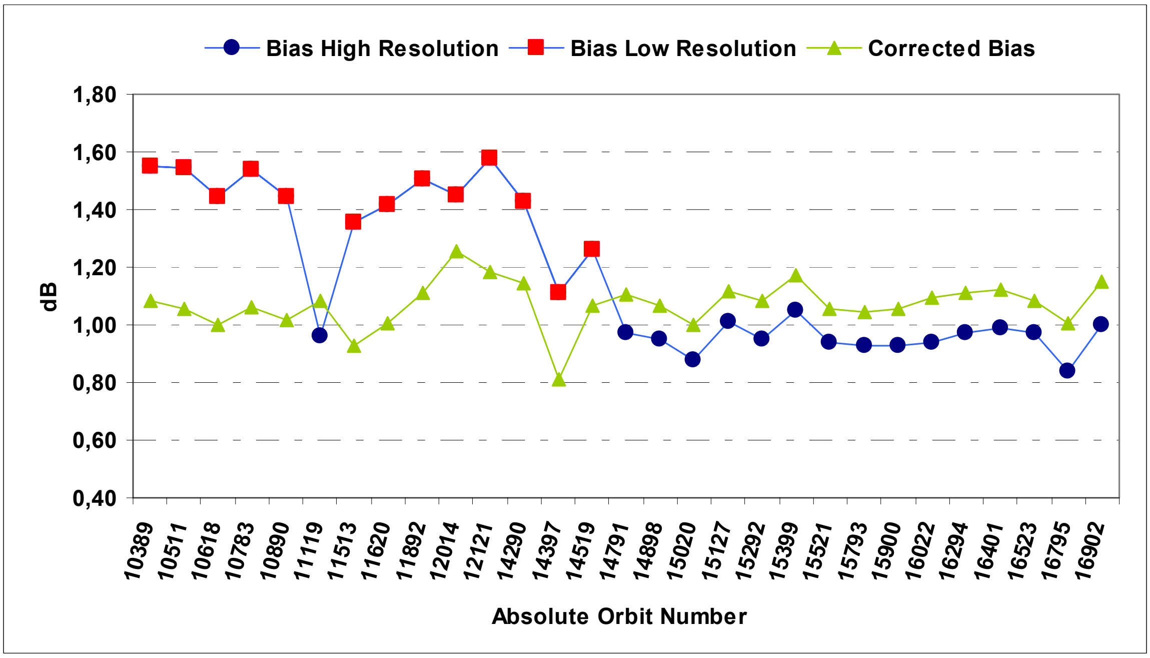

Figure 24: Time behavior of the transponder bias

9.1.5 DATATION

In Figure 25 (upper panel) the differences between the extrapolated UTC values and the corresponding real UTC values measured at the next Kiruna dump, are reported.
The plots are only related to the data collected up to cycle 32. The UTC deviation for the cycle 33 and cycle 37 have been not added. The datation plots and comments pertinent to the cycle 37 are reported in par. 7.1.5.
Only few anomalous events can be observed at the beginning of the period (cycles 16/17) for which the difference rises above the 20 microseconds warning threshold. However, starting from cycles 22/23, the number of small differences (10 microseconds plus or minus) has increased a lot. Furthermore, during the last ten days of the cycle 32 and for all cycle 33 and 34, the variability of the deviations has increased reporting many peaks just over the 20 microseconds threshold; this phenomenon is now fixed. In the lower panel the ICU clock step for the same period is shown where big variations are reported. This is however not a problem because the ICU clock period variations are included in the algorithm for the SBT/UTC correlation evaluation.

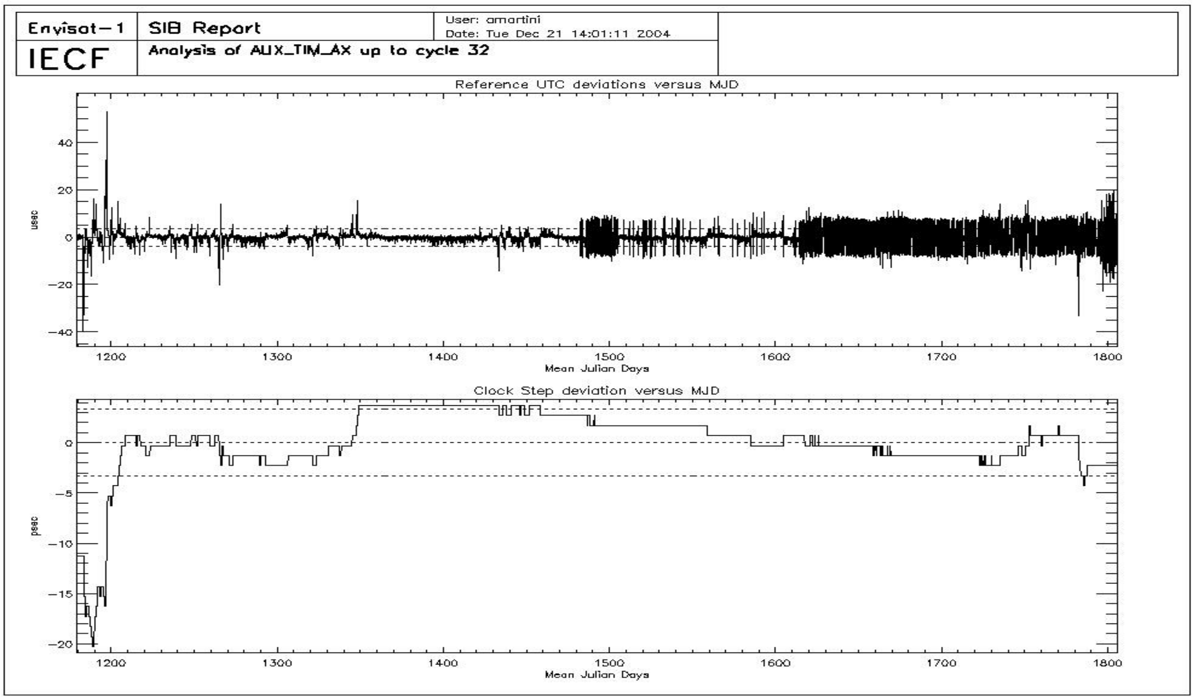

Figure 25: UTC deviations and ICU clock period up to cycle 32

9.1.6 MISPOINTING

In Figure 26 the overall mispointing squared trend (averaged over each orbit) is plotted for cycles 16 to 36. The jump occurred on November the 26th 2003 is correlated to the upload of IPF version 4.56; the abrupt decreasing of the mispointing squared value is due to the usage of a new RA2_IFF_AX IF mask auxiliary file. After the drop a very tiny increase of the mispointing squared could eventually be detectable. The most probable cause of this phenomenon could be a change in the Intermediate Frequency Filter slope due to ageing effects.

On the other hand, it can be noticed that the mispointing squared assumes lower values just after an instrument anomaly, showing an increasing trend until it reaches back a standard mispointing value. This particular behavior can be explained by the different shape that the over-ocean average waveform has before and after an anomalous event as visible in Figure 27. Observe, in particular, the disappearance of the small dip in the waveforms acquired after the anomaly. This problem will be solved with the introduction of an updated mispointing retrieval algorithm with the next version of the processing software as described in par. 5.4.4.

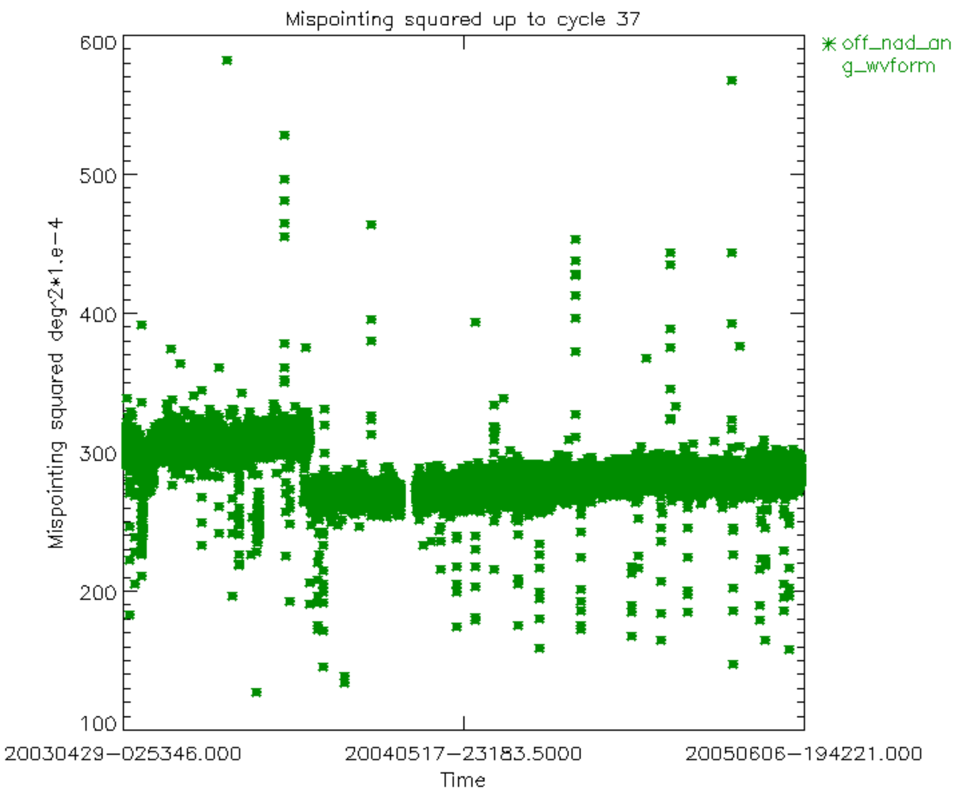

Figure 26: Smoothed mispointing squared trend until end of cycle 37 (deg^2*10e-4)

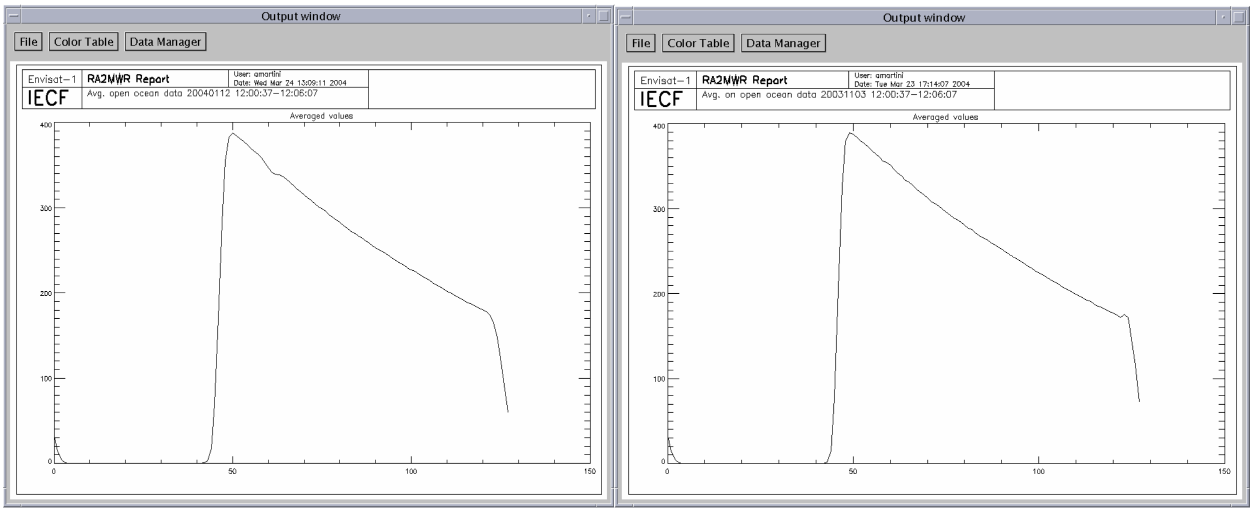

Figure 27: Open Ocean average waveforms before (left) and after an anomaly (right)

9.1.7 S-BAND ANOMALY

In Figure 28 the percentage of data per cycle that are affected by the so-called “S-Band” anomaly is reported. The figures are variable between 0% and 8.1%.
The number of occurrences of S Band anomaly decreased from a mean value of 4% to 2% since the beginning of cycle 31 due to the implementation of IF CAL procedure (including Heater 2 for S Band anomaly suppression) twice per day over the Himalayan region.
The relatively high value recorded for cycle 27 is due to the fact that on the day 1st of June 2004, the S-band anomaly started at around 14:30 while the instrument didn’t switch to mode Heater 2 when foreseen (at about 15:50). For this reason the S-Band anomaly continued for the next 24 hours until the next Heater 2 mode on June the 2nd.

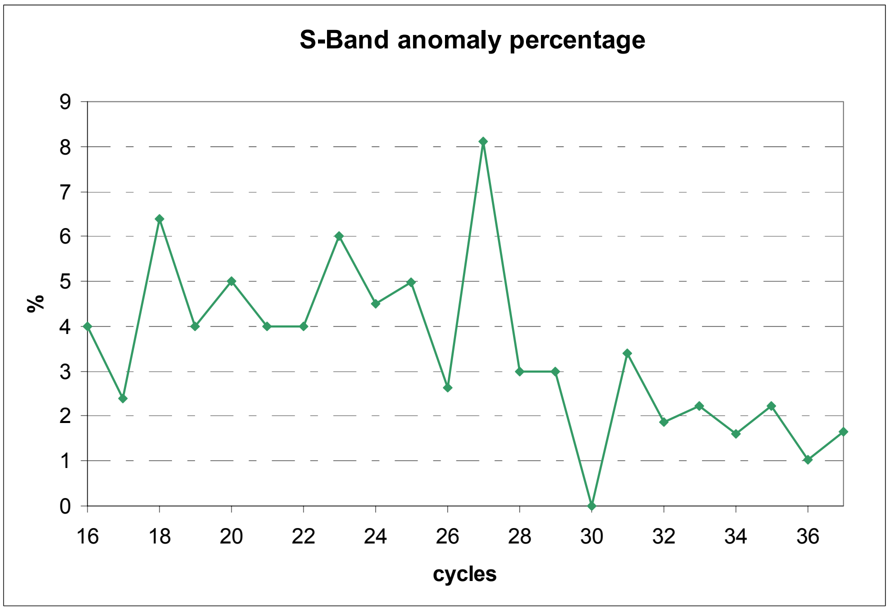

Figure 28: Percentage of data affected by the "S-Band Anomaly" for cycles 16-36

9.1.8 IN-FLIGHT INTERNAL CALIBRATION

Figure 29 and Figure 30 report Ku and S Band in-flight calibration factors for Time Delay and Sigma0 respectively, daily averaged, up to the current cycle. The Time Delay factor shows to be very stable for both the working frequencies. The Ku band Sigma0 factor reveals a decrease of about 0.2 dBs over the period starting from cycle 16. Being the factor instability quite small this is not being considered a problem, for the moment, since the calibration factor is indeed introduced especially to correct for eventual instrumental changes. However a special eye is kept on the monitoring of this parameter.

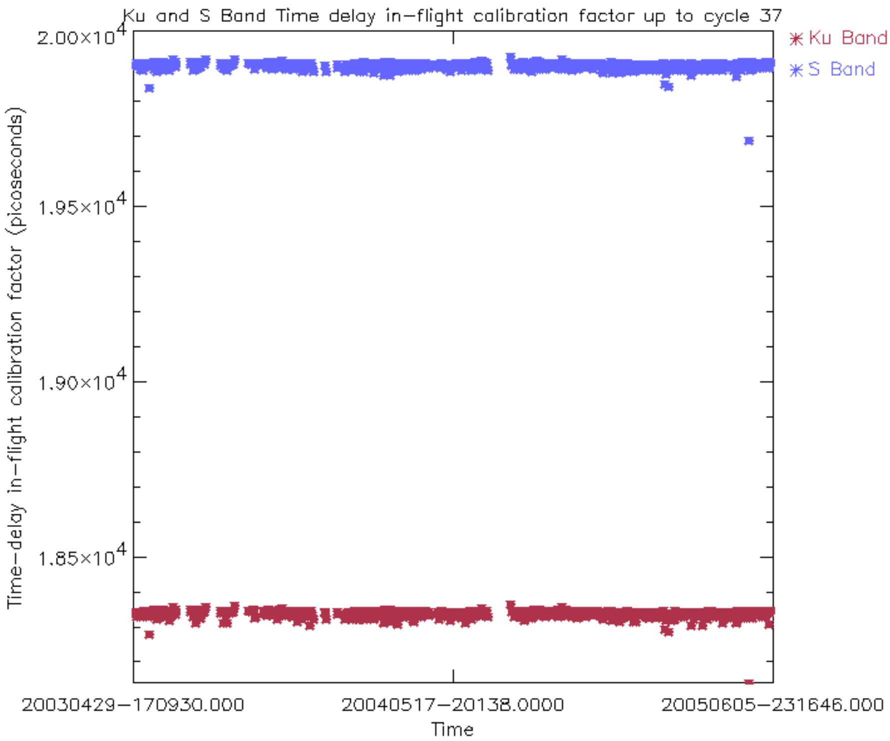

Figure 29: Ku and S Band in-flight time delay calibration factor up to cycle 37

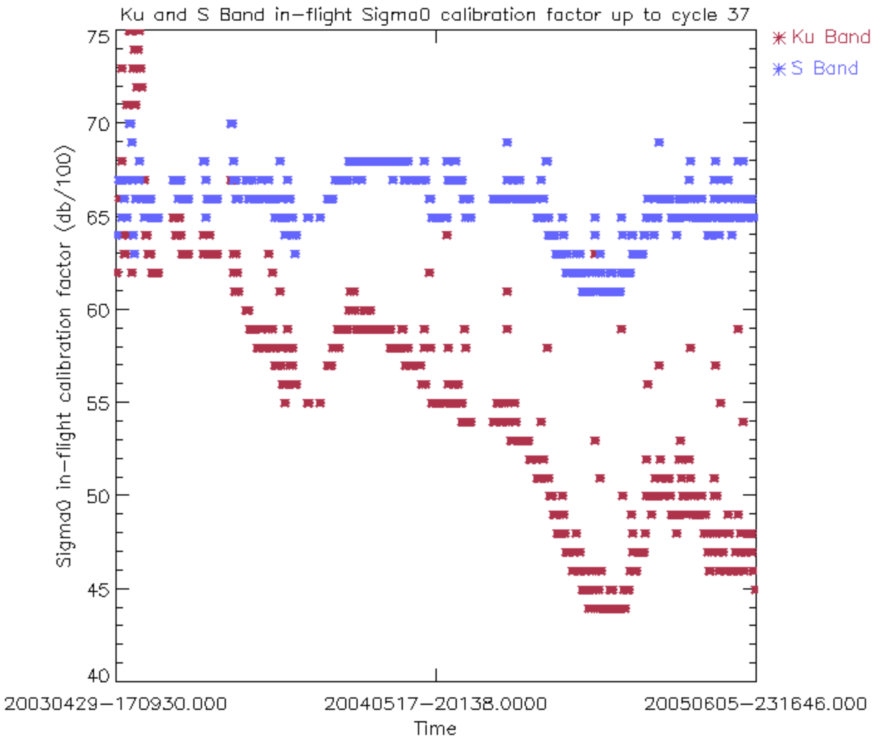

Figure 30: Ku and S Band in-flight Sigma0 calibration factor up to cycle 37

9.2 Products Monitoring

9.2.1 AVAILABILITY OF DATA

Hereafter the percentage of the different levels of products availability is reported up to the cycle 35. Considering as reference the instrument unavailability, it is possible to notice that in the last three cycles the situation is slightly improved for all levels of products.

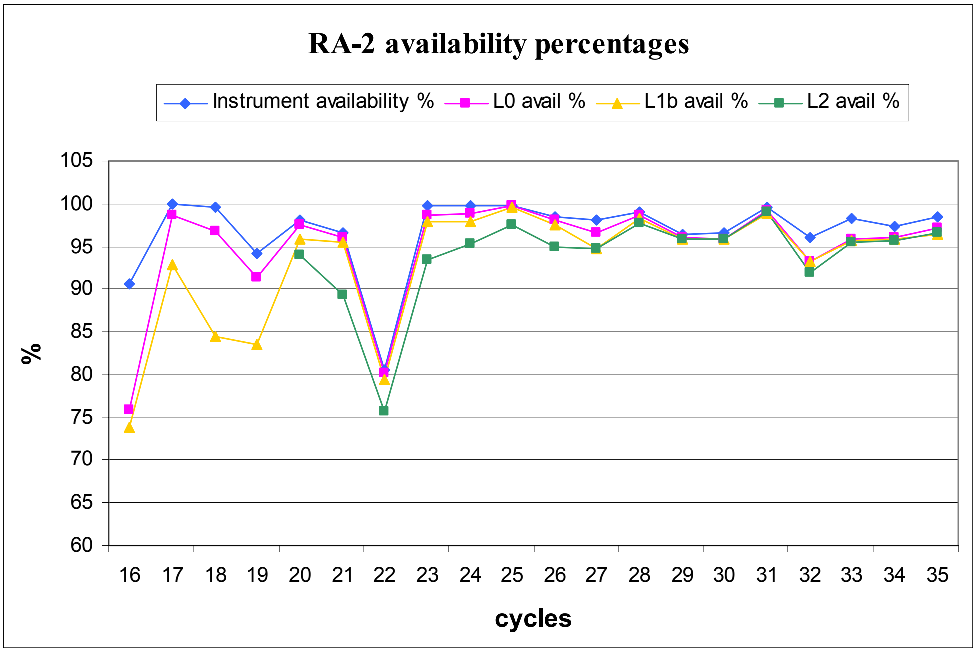

Figure 31: Percentage of Products unavailability up to cycle 37

9.2.2 RA-2 ALTIMETER PARAMETERS

Hereafter a summary of the main altimetric parameters performances is reported; these results have been obtained with the editing criteria mentioned in par. 8.3.

9.2.2.1 Altimeter range

The monitoring of the RA-2 FD altimetric range shall be done once the NRT products shall be upgraded with the DORIS navigator NRT orbital information. For NRT products there are no current results for the time being.

9.2.2.2 Significant Wave Height

The SWH in both bands shows a small drop, of about 10 cm, on the July the 2nd 2004. After a detailed analysis that drop can be now interpreted more like a smoother decrease which can be correlated to a seasonal variability as it could be observed during the year 2003.
On the other hand, the S-Band SWH shows a drop on April the 9th 2003 corresponding to the operational up-load of IPF version 4.54; furthermore the high daily means reported (sometimes plotted outside the figure range) are due to the so-called S-Band anomaly (ref. par.7.1.7).

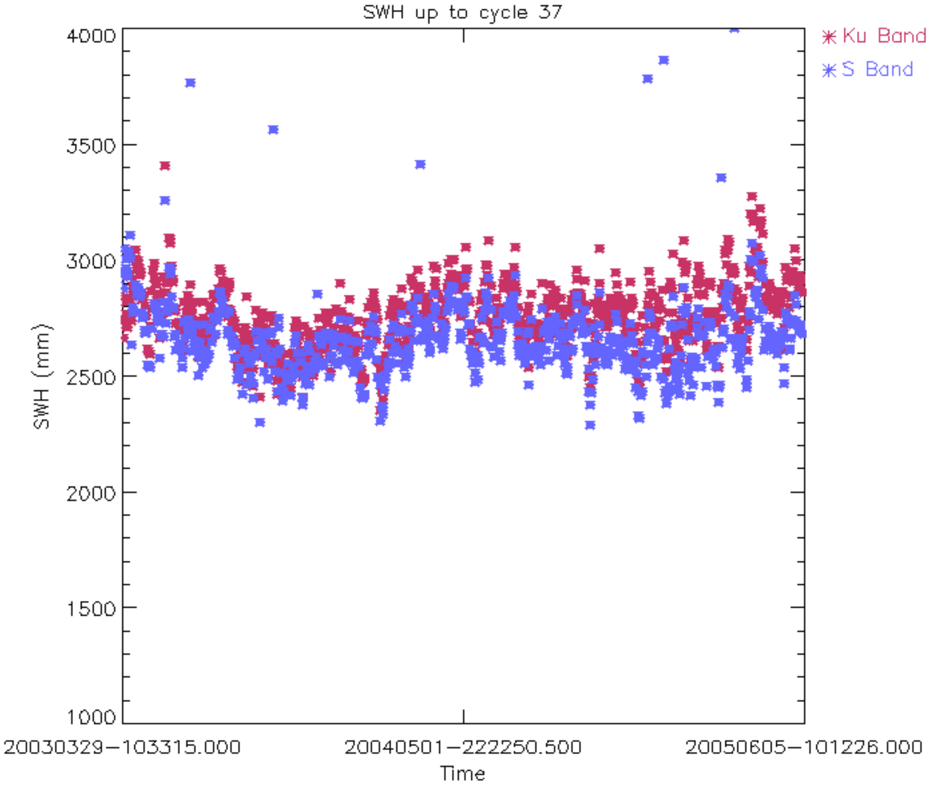

Figure 32: Ku and S SWH daily average up to cycle 37 (mm)

9.2.2.3 Backscatter coefficient – Wind Speed

The Ku-Band Sigma_0 trend, reported hereafter, is characterized by a jump of in average 3.24 dBs concomitant with the operational up-load of IPF version 4.54 occurred on the 9th of April 2003. To be said that this change is due to the upload of a new RA2_CHD_AX ADF file that artificially shifted the RA-2 real Sigma_0 in order to align it with ERS-2 Sigma_0 and make it coherent with the Witter and Chelton empirical wind model. A similar change in trend, but in the opposite direction, is also visible in the Wind Speed trend reported afterwards.
Beyond the huge jump occurred in April 2003, the S-Band Sigma_0 reports a smaller jump occurring on November the 26th 2003. Following the installation of the IPF processing chain V4.56, the average values of the RA-2 S-Band backscattering parameter, shows an increase of ~0.65 dBs, the new S-band sigma0 being higher with respect to the previous versions. See chapter 8.5.4.

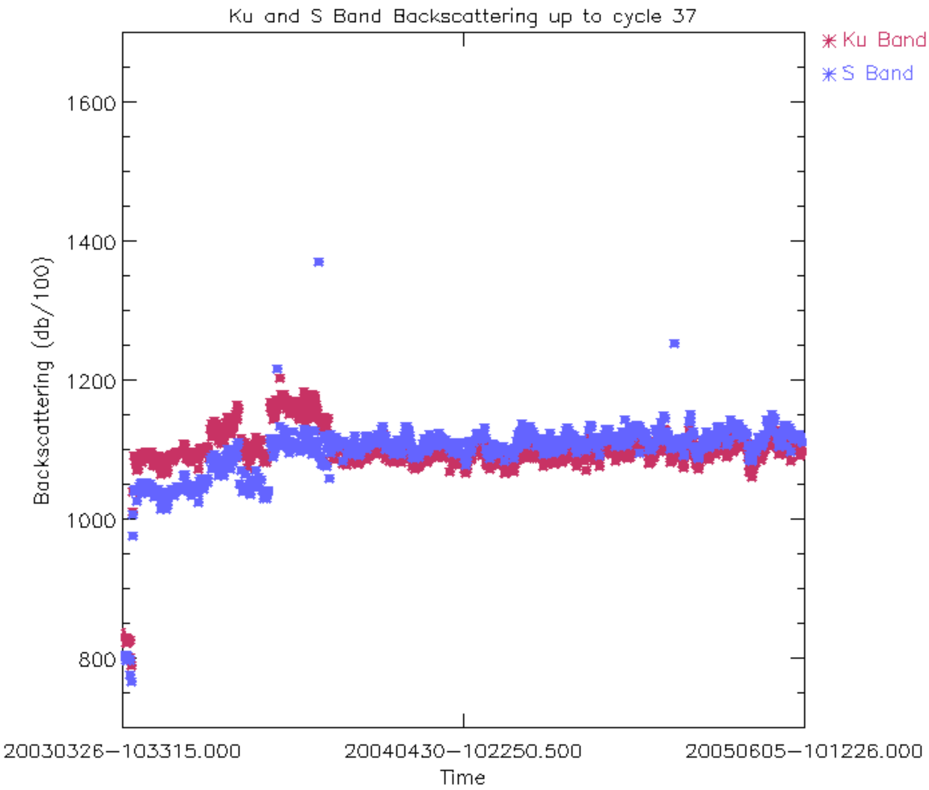

Figure 33: Ku and S band Backscattering daily averages up to cycle 37 (dB/100)

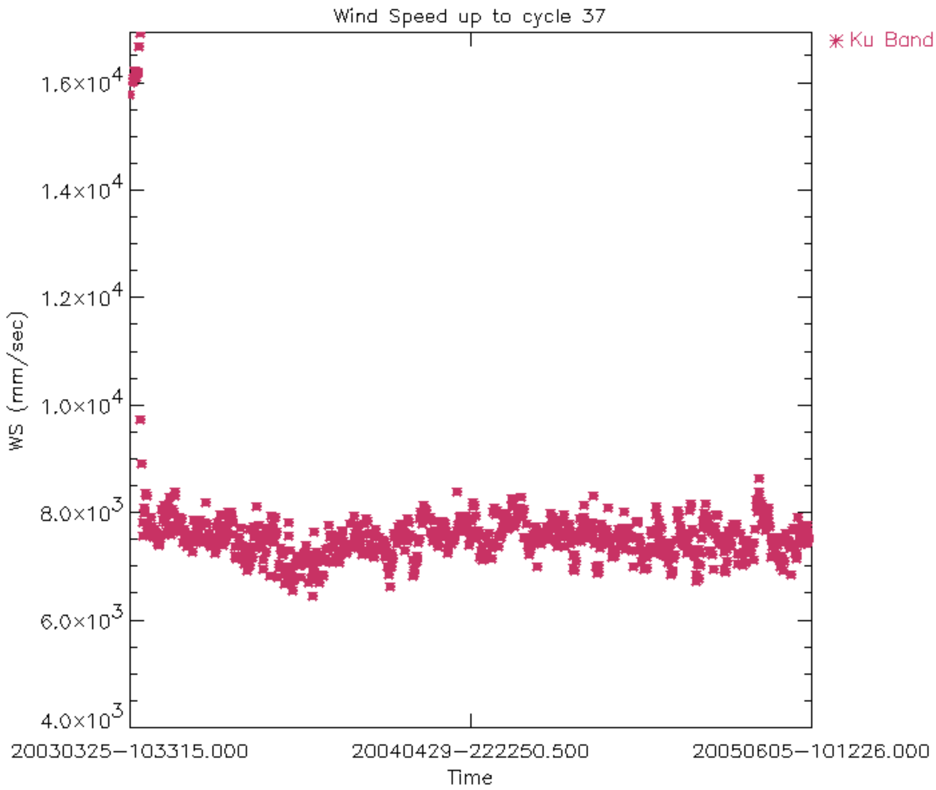

Figure 34: Wind Speed daily averages up to cycle 37 (mm/s)

10 PARTICULAR INVESTIGATIONS

During cycle 37 no special investigation has been performed.