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ENVISAT CYCLIC ALTIMETRIC REPORT

CYCLE 34 from 17-01-2005 to 21-02-2005

Quality Assessment Report

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TABLE OF CONTENTS

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 34.

This report covers the period from the 17th of January 2005 and the 21st of February 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, January 2005
[R – 1b] F-PAC MONTHLY REPORT, SALP-RP-M-OP-15387-CN, February 2005
[R – 2] ENVISAT Microwave Radiometer Assessment Report Cycle 034, 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 January 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 February 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 # 136-140, 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 one instrument anomaly 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 is given in Table 1 (one line per week).

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.
15085	15185.2	1974.430	1089.703	1086.707	1105.556	99.6735	99.4934	99.4939	99.4907
15185.2	15285.4	107278.673	105260.637	109401.709	109422.511	82.2621	64.8579	64.1732	64.1698
15285.4	15385.6	2115.158	139526.889	151246.578	151269.489	99.6503	76.5803	74.6426	74.6388
15385.6	15485.8	2067.748	35934.090	40529.461	46565.819	99.6581	93.7166	92.9568	91.9587
15485.8	15586	2152.522	1095.333	1092.259	1104.524	99.6441	99.4630	99.4635	99.4615

Table 1: RA-2 L0, L1b and L2 FGD Data products availability summary for cycle 34

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.
15085	15185.2	0	0	100	100
15185.2	15285.4	0	103811.653	100	82.8354
15285.4	15385.6	0	150571.346	100	75.1039
15385.6	15485.8	0	35185	100	94.1824
15485.8	15586	0	0	100	100

Table 2: MWR L0 Data products availability summary for cycle 34

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.
15085	15185.2	0	1532.999	100	99.8733
15185.2	15285.4	0	221382.306	100	81.6979
15285.4	15385.6	0	289131.692	100	76.0969
15385.6	15485.8	0	75621	100	93.7483
15485.8	15586	0	2042.999	100	99.8311

Table 3: DORIS L0 Data products availability summary for cycle 34

5.3 Orbit quality

During cycle 34 the orbit was maintained within the +/- 1km to the reference ground track.
One manoeuvre over the period:

On February 18th, 2005 an in-plane correction manoeuvre (SFCM) took place, in order to start a new ground track control cycle:
- Planned delta V size: 0.0085 m/s, increasing orbit semi major axis by approximately 15 metres
- Mid thrust time: 02:22:52.5 utc at PSO 129.8 degrees
- Thrust duration: 4 seconds
- Measured delta V: 0.0083 m/s (towards flight direction).

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. Patches 1, 2, 3 and 4 have been installed until known with no impacts on ENVISAT products.

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 used 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_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 currently planned. 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.

Evolutions 3, 5 and 6 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 34, was unavailable once in the following time frames:

Start: 26 Jan 2005 15:50:14 Orbit = 15210
Stop: 26 Jan 2005 21:07:30 Orbit = 15213

cause: RA-2 was unavailable due to pending repeated telemetry anomalies preceding a Platform PMC intervention. ARB pending.

The Envisat Weekly Mission Operations Reports related to the cycle 34 do not make reference to the HSU1 fuse problem [R-13]. However this problem does not affect nominal operations since the RA-2 instrument is heated by the nearby hardware.

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.

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

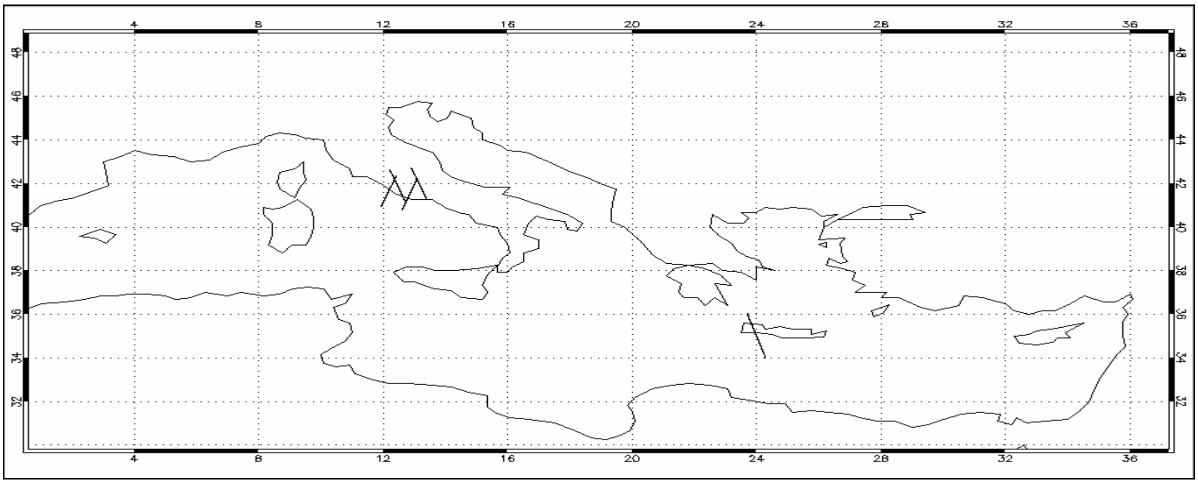

Figure 1: Transponder Acquisition sites for cycle 34

6.2 MWR Events

The MWR, during cycle 34 was never unavailable [R-13].

6.3 DORIS Events

The DORIS during cycle 34 was never unavailable [R-13].
Starting from June the 14th 2004 the DORIS USO was switched to the redundancy component and it is now working correctly.

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 34 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 34 the number of valid IF masks have been of 10, representing about the 14.3% of the total available 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).

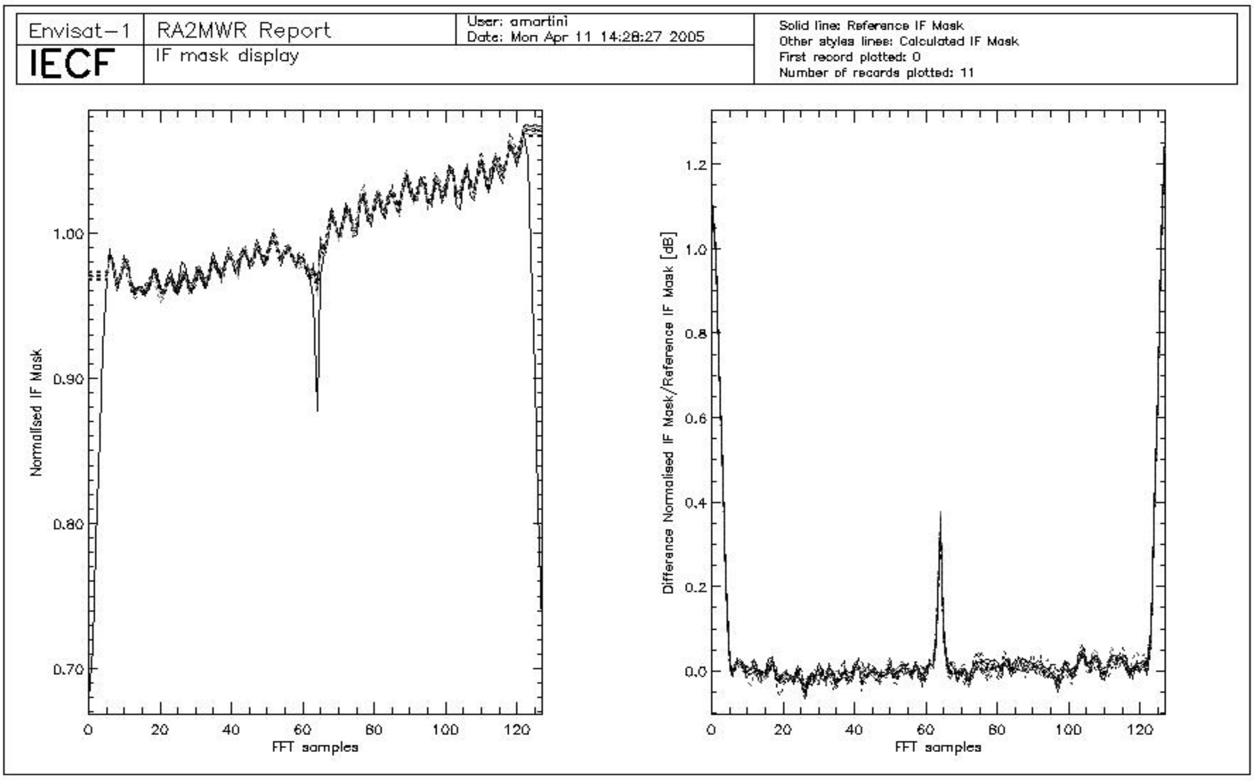

Figure 2: Valid IF masks retrieved daily during cycle 34 plotted together with the on-ground reference.

7.1.2 USO

In Figure 3 the USO clock period trend retrieved for cycle 34 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.

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.

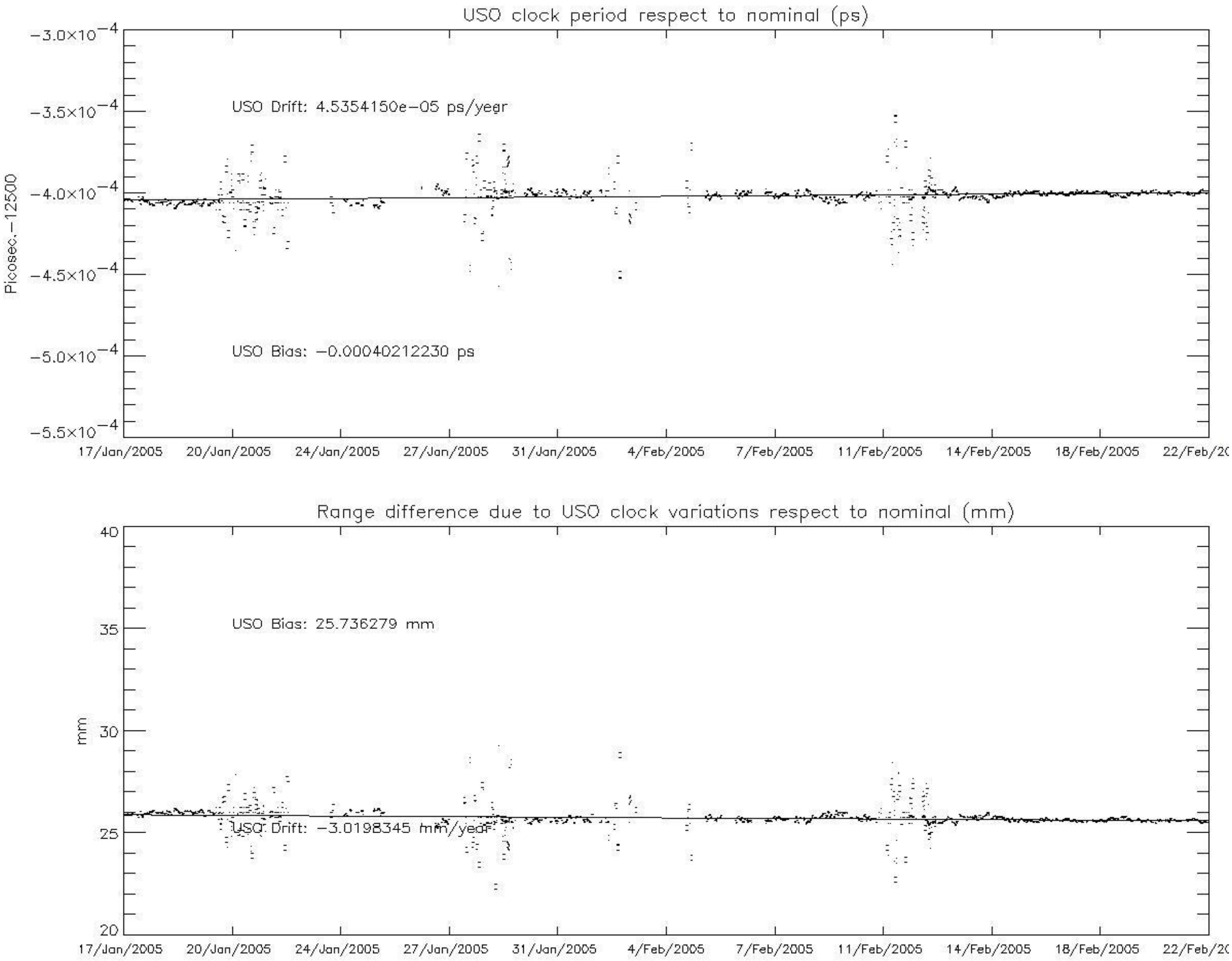

Figure 3: USO clock period for cycle 34

7.1.3 TRACKING CAPABILITY

In Figure 4 and Figure 5, the Chirp ID is plotted respectively for ascending and descending passes of cycle 34. The MDSRs acquired with 320MHz bandwidth are plotted in light gray (Chirp ID equal to 0), the ones acquired with 80MHz bandwidth are plotted in violet (Chirp ID equal to 1) and the ones acquired with the 20MHz bandwidth are plotted in dark green (Chirp ID equal to 2).

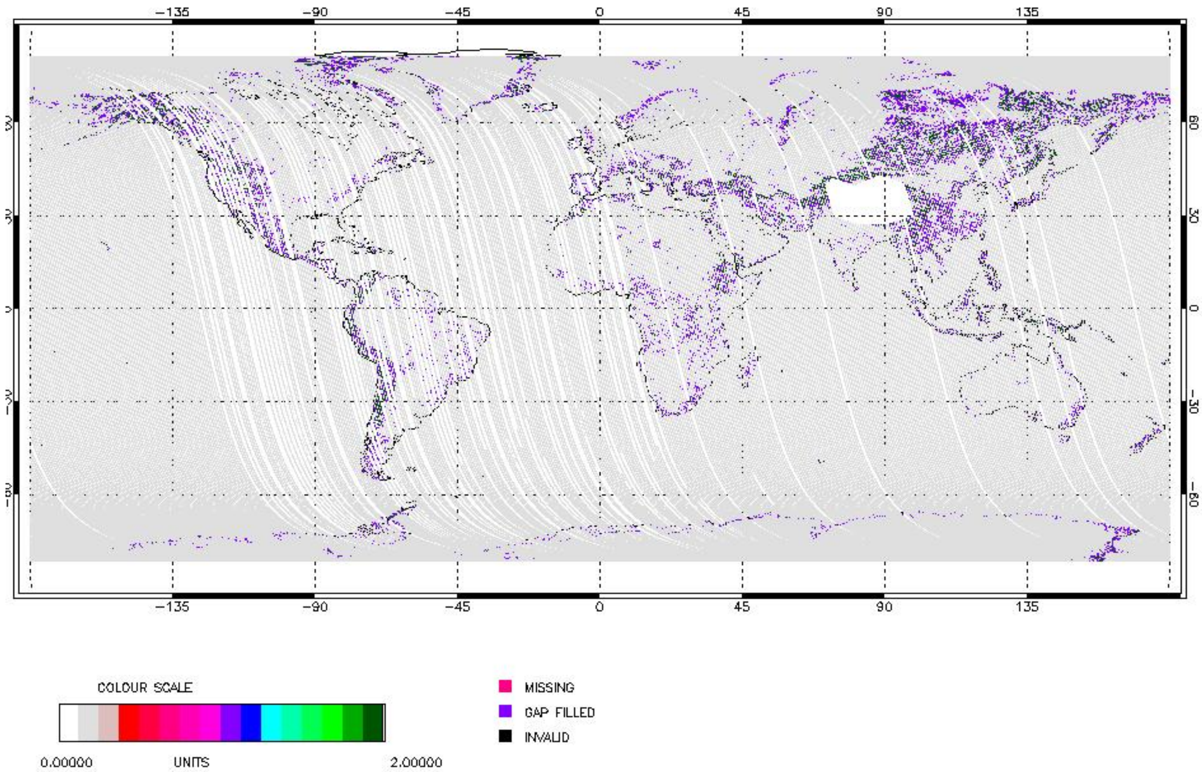

Figure 4: RA-2 Chirp ID for ascending passes during cycle 34

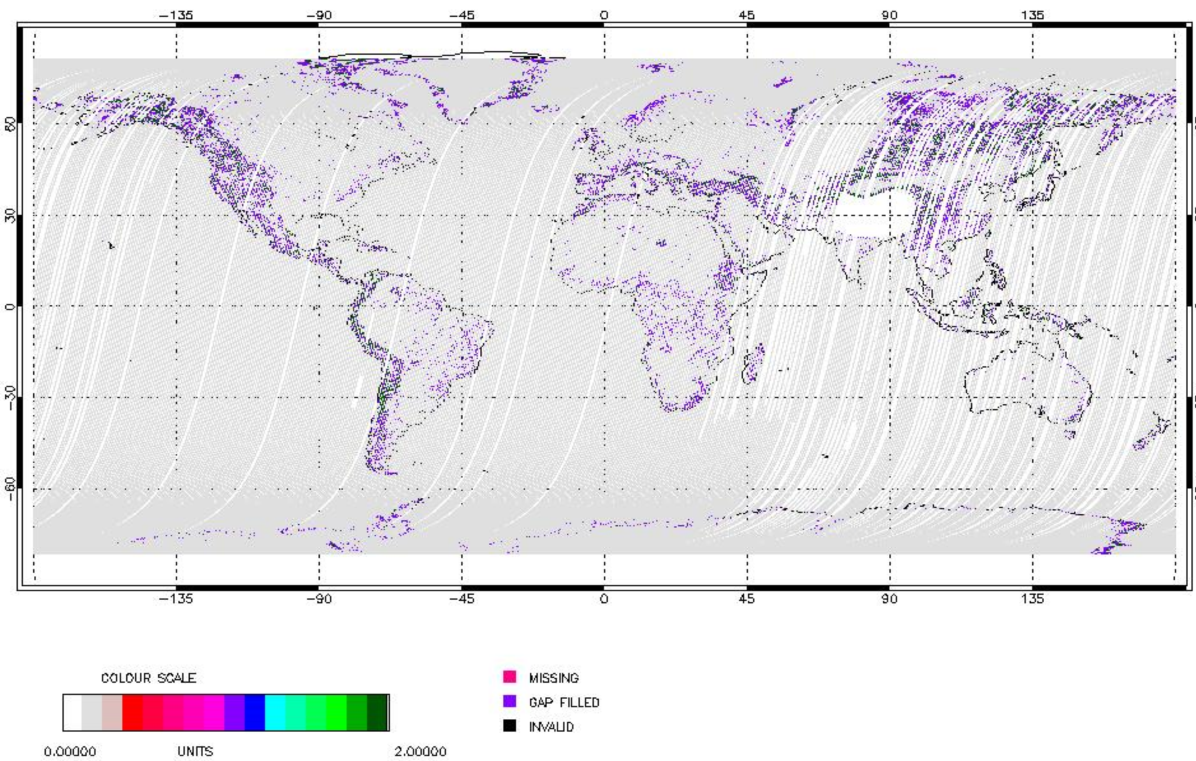

Figure 5: RA-2 Chirp ID for descending passes during cycle 34

The corresponding percentages of acquisition in the different resolutions subdivided by surface type are given in Table 4:

Surface type	320 MHz	80 MHz	20MHz
Open Ocean	99.99 %	0.01 %	0 %
Costal Water (ocean depth < 200 m)	98.50 %	1.28 %	0.21 %
Sea Ice	99.13 %	0.76 %	0.10 %
Ice Sheet	96.33 %	2.87%	0.80 %
Land	81.16 %	13.32 %	5.52 %
All world	95.19 %	3.46 %	1.35 %

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)
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

During cycle 34 all the planned Sigma_0 Transponder acquisitions were performed. All of them were executed in High Resolution mode. The dates and times of the acquisitions are reported hereafter:

20-January-2005, Fiuggi, 20:36:33
1-February-2005, Maccarese, 09:42:01
8-February-2005, Rome, 20:39:27
17-February-2005, Valmontone, 09:39:09

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]
15127	20-gen-05	Fiuggi / 43	41.7875, 13.2212	High	1.01	0.054
15292	1-feb-05	Maccarese / 208	41.8605, 12.2385	High	0.95	0.066
15399	8-feb-05	Rome / 315	41.8472, 12.4819	High	1.05	0.062
15521	17-feb-05	Valmontone / 437	41.7673, 12.9247	High	0.94	0.058

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. For the whole cycle, twenty times they overcome the 20 microseconds (absolute value) warning threshold; this reflects an increased variability of the deviations already observed during the last ten days of the cycle 32 and for the whole previous cycle (cycle 33). The problem is under investigation.

In the lower panel the ICU clock step for the same period is shown. It is possible to notice that there is a certain degree of correspondence of the peak reported in the higher panel with the clock step value changes. This allows one to compensate for the extrapolation deviations and to go back to a nominal situation.

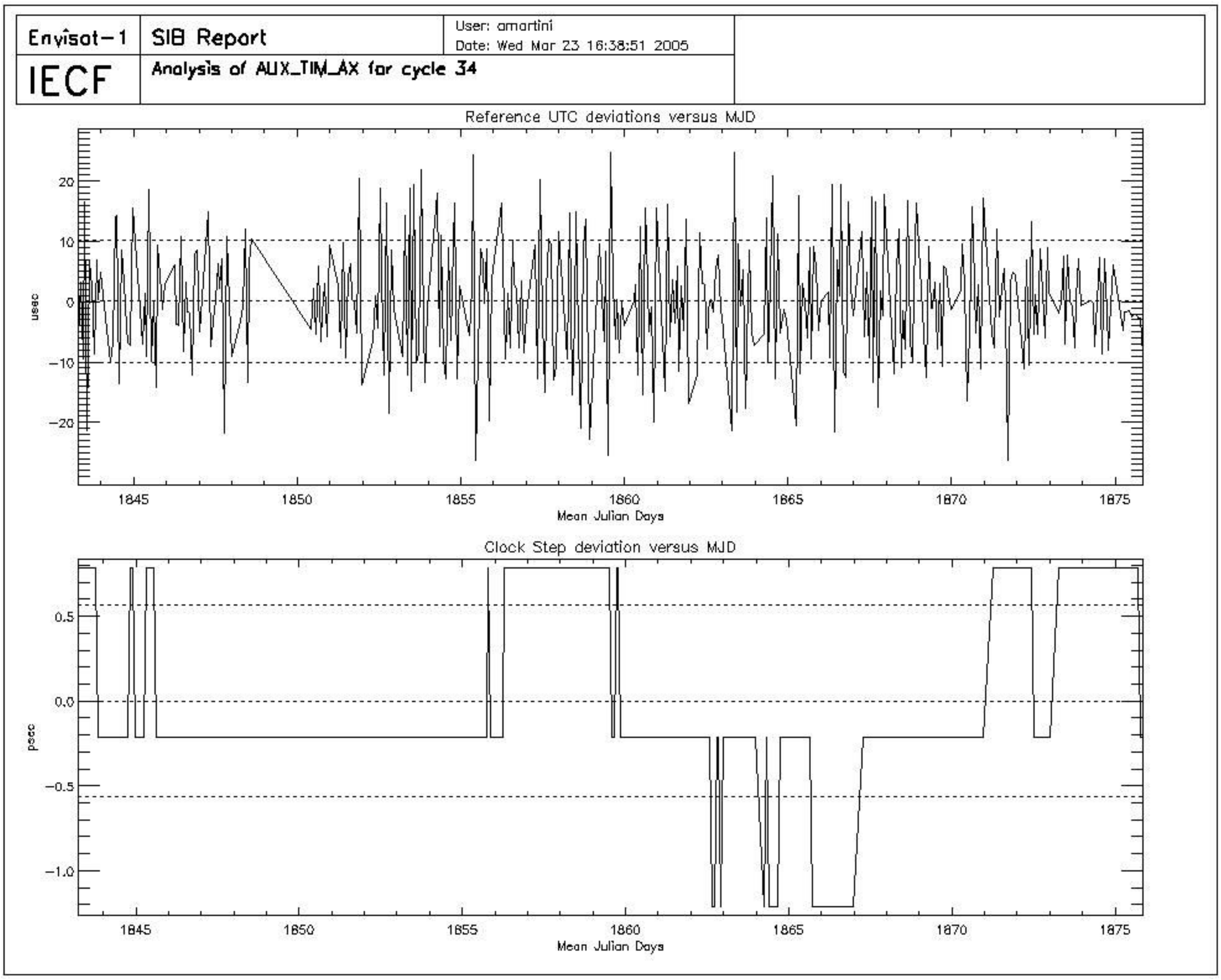

Figure 6: UTC deviations and ICU clock period for cycle 34

7.1.6 MISPOINTING

In Figure7 the trend of the mispointing squared (averaged every orbit) is reported in deg^2*10e-4
The average 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. An optimization of this algorithm shall be part of the next Level 2 processors upgrade, planned for mid-2005 (ref. 5.4.4).
For this cycle only one event of low mispointing values is present and visible in the plot of Figure 7. The low mispointing event is in correspondence with the instrument anomaly occurred on January 26th 2005, as reported in par. 6.1.

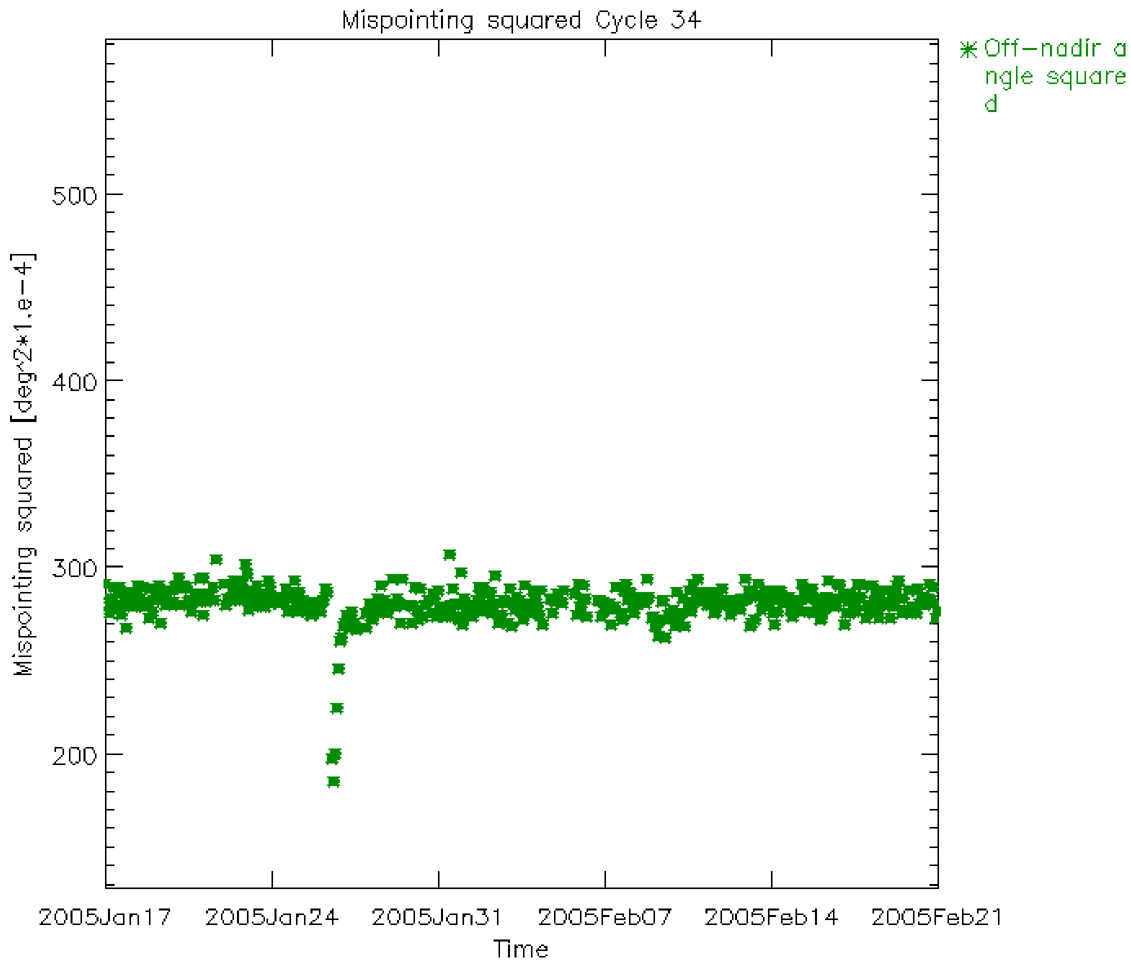

Figure 7: Smoothed mispointing squared trend for cycle 34 (deg^2*10^4)

7.1.7 S-BAND ANOMALY

The so-called "S-Band anomaly" affects the RA-2 data products quality. Hereafter, the table lists the products files affected by the S-band anomaly problem during cycle 34. This corresponds to a total percentage of about 1.6% 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_2PNPDK20050203_082701_000061302034_00236_15320_2896.N1	03-feb-05	27:01.6	03-feb-05	09:11.9
RA2_FGD_2PNPDK20050203_100733_000059262034_00237_15321_2903.N1	03-feb-05	07:33.9	03-feb-05	46:20.3
RA2_FGD_2PNPDK20050203_132641_000000062034_00239_15323_2932.N1	03-feb-05	26:41.6	03-feb-05	26:47.1
RA2_FGD_2PNPDE20050208_215336_000061092034_00315_15399_2729.N1	08-feb-05	53:36.2	08-feb-05	35:25.3
RA2_FGD_2PNPDE20050208_233404_000060892034_00316_15400_2730.N1	08-feb-05	34:04.1	09-feb-05	15:33.1
RA2_FGD_2PNPDE20050209_011411_000044682034_00317_15401_2731.N1	09-feb-05	14:11.9	09-feb-05	28:40.1
RA2_FGD_2PNPDE20050209_022803_000049682034_00318_15402_2732.N1	09-feb-05	28:03.4	09-feb-05	50:51.7
RA2_FGD_2PNPDE20050211_030516_000048872034_00347_15431_2760.N1	11-feb-05	05:16.3	11-feb-05	26:43.3

Table 6: List of L2 FGD Files affected by S-Band anomaly during cycle 34

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 34 (averaged per day) are reported in Figure 8 and Figure 9. It can be noticed that the time delay calibration factor shows a very stable behaviour while the Sigma0 reports a small increasing trend of few hundreds of a dB over the cycle as observed in the cycle 33. The trend showed on the last two cycles is in contrast with the behaviour observed on the previous cycles (see 9.1.7).

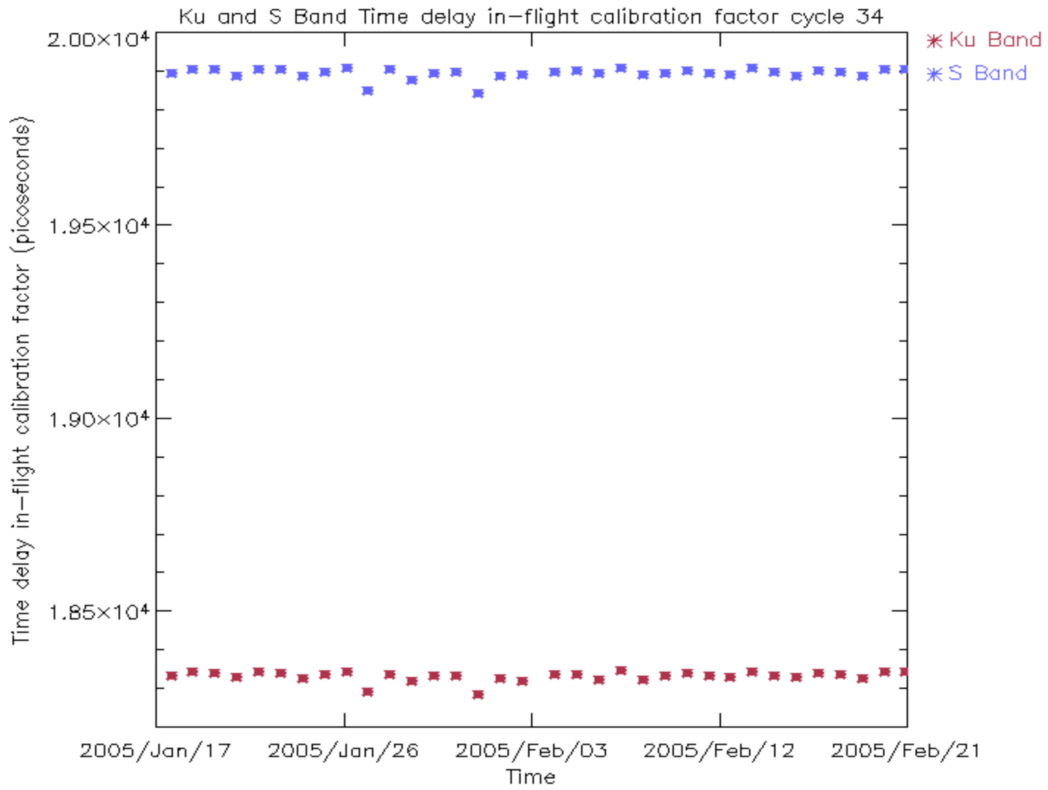

Figure 8: Ku and S Band in-flight time delay calibration factor for cycle 34

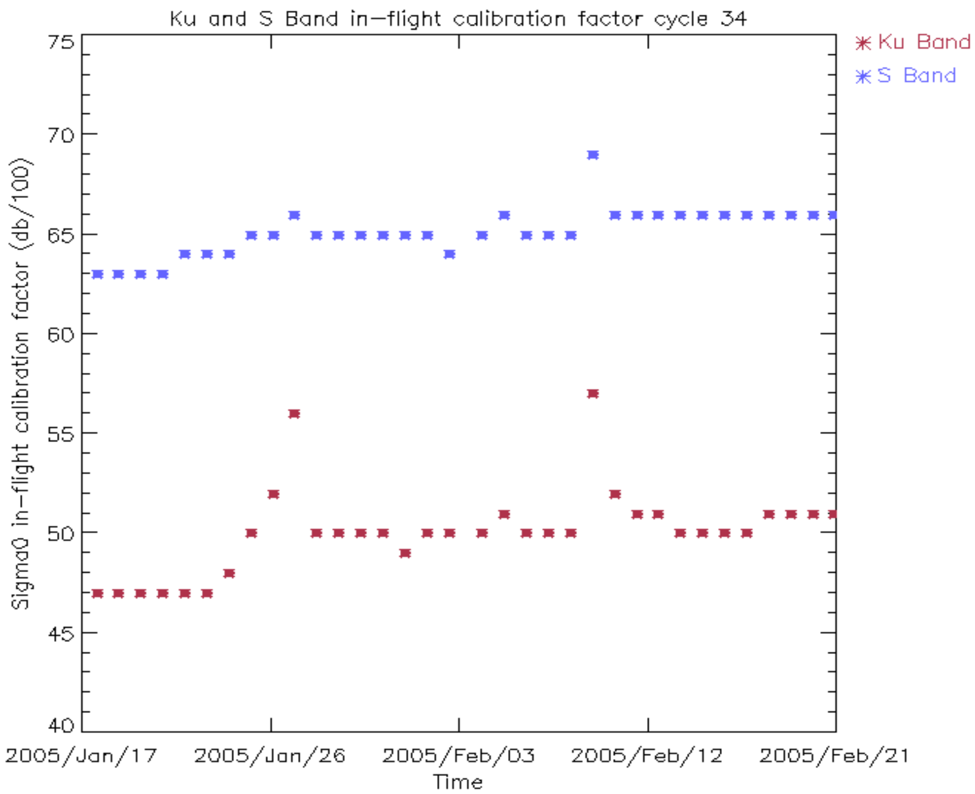

Figure 9: Ku and S Band in-flight Sigma0 calibration factor for cycle 34

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.

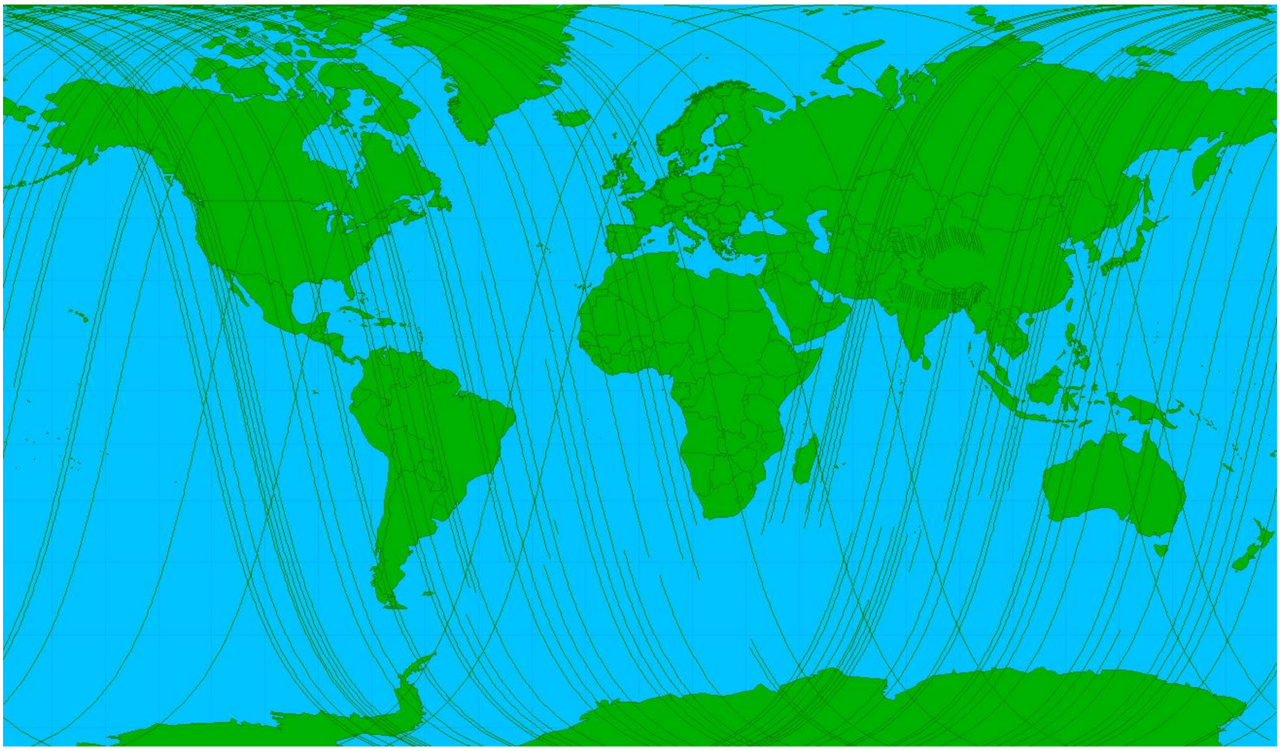

Figure 10: RA-2 L0 unavailable products for cycle 34

Start date	Start time	Stop date	Stop time	Duration [sec]	Start orbit	Stop orbit	Reason

17-gen-05	04:15:33	17-gen-05	04:16:51	78	15074	15074	PDS_UNKNOWN_FAILURE
17-gen-05	15:28:01	17-gen-05	15:29:19	78	15081	15081	PDS_UNKNOWN_FAILURE
22-gen-05	04:58:37	22-gen-05	04:59:55	78	15146	15146	PDS_UNKNOWN_FAILURE
22-gen-05	16:10:21	22-gen-05	16:11:38	77	15153	15153	PDS_UNKNOWN_FAILURE
18-gen-05	05:23:53	18-gen-05	05:25:11	78	15089	15089	PDS_UNKNOWN_FAILURE
18-gen-05	16:36:40	18-gen-05	16:37:58	78	15096	15096	PDS_UNKNOWN_FAILURE
19-gen-05	04:52:58	19-gen-05	04:54:16	78	15103	15103	PDS_UNKNOWN_FAILURE
19-gen-05	16:04:38	19-gen-05	16:05:55	77	15110	15110	PDS_UNKNOWN_FAILURE
20-gen-05	04:21:22	20-gen-05	04:22:39	77	15117	15117	PDS_UNKNOWN_FAILURE
20-gen-05	15:33:53	20-gen-05	15:35:10	77	15124	15124	PDS_UNKNOWN_FAILURE
21-gen-05	05:28:53	21-gen-05	05:30:10	77	15132	15132	PDS_UNKNOWN_FAILURE
21-gen-05	16:42:05	21-gen-05	16:43:23	78	15139	15139	PDS_UNKNOWN_FAILURE
24-gen-05	03:55:01	24-gen-05	03:56:19	78	15174	15174	PDS_UNKNOWN_FAILURE
24-gen-05	15:07:20	24-gen-05	15:08:38	78	15181	15181	PDS_UNKNOWN_FAILURE
28-gen-05	20:05:25	28-gen-05	20:56:17	3052	15241	15241	SSR
28-gen-05	22:50:19	28-gen-05	22:50:23	4	15242	15242	PDS_UNKNOWN_FAILURE
29-gen-05	00:01:11	29-gen-05	00:21:53	1242	15243	15243	SSR
29-gen-05	04:38:37	29-gen-05	04:39:55	78	15246	15246	PDS_UNKNOWN_FAILURE
29-gen-05	11:06:53	29-gen-05	12:45:59	5946	15250	15251	SSR
29-gen-05	15:47:51	29-gen-05	15:47:54	3	15253	15253	PDS_UNKNOWN_FAILURE
29-gen-05	15:50:40	29-gen-05	15:51:58	78	15253	15253	PDS_UNKNOWN_FAILURE
25-gen-05	05:04:15	25-gen-05	05:05:32	77	15189	15189	PDS_UNKNOWN_FAILURE
25-gen-05	16:16:15	25-gen-05	16:17:33	78	15196	15196	PDS_UNKNOWN_FAILURE
26-gen-05	04:32:52	26-gen-05	04:34:10	78	15203	15203	PDS_UNKNOWN_FAILURE
26-gen-05	04:55:32	26-gen-05	06:30:29	5697	15203	15204	SSR
26-gen-05	15:45:04	26-gen-05	15:50:30	326	15210	15210	PDS_UNKNOWN_FAILURE
27-gen-05	21:31:19	28-gen-05	05:07:42	27383	15227	15232	SSR
28-gen-05	05:09:52	28-gen-05	07:08:31	7119	15232	15233	SSR
28-gen-05	16:22:10	28-gen-05	16:23:28	78	15239	15239	PDS_UNKNOWN_FAILURE
26-gen-05	15:50:30	26-gen-05	21:07:30	19020	15210	15213	SSR
26-gen-05	15:50:30	26-gen-05	21:08:35	19085	15210	15213	SSR
27-gen-05	03:58:21	27-gen-05	03:58:40	19	15217	15217	UNAV_RA2
27-gen-05	04:00:54	27-gen-05	04:02:36	102	15217	15217	UNAV_RA2
27-gen-05	04:19:08	27-gen-05	04:19:15	7	15217	15217	UNAV_RA2
27-gen-05	15:11:05	27-gen-05	15:11:07	2	15224	15224	UNAV_RA2
27-gen-05	15:13:15	27-gen-05	15:14:33	78	15224	15224	UNAV_RA2
31-gen-05	00:59:21	31-gen-05	03:52:57	10416	15272	15274	SSR
31-gen-05	05:15:29	31-gen-05	05:16:46	77	15275	15275	PDS_UNKNOWN_FAILURE
01-feb-05	15:56:15	01-feb-05	15:57:33	78	15296	15296	PDS_UNKNOWN_FAILURE
01-feb-05	21:03:15	01-feb-05	22:14:41	4286	15299	15299	SSR
01-feb-05	23:58:00	01-feb-05	23:59:00	60	15300	15300	PDS_UNKNOWN_FAILURE
02-feb-05	02:15:21	02-feb-05	02:47:33	1932	15302	15302	SSR
02-feb-05	04:12:38	02-feb-05	04:13:56	78	15303	15303	PDS_UNKNOWN_FAILURE
02-feb-05	04:31:13	02-feb-05	06:11:21	6008	15303	15304	SSR

02-feb-05	15:25:04	02-feb-05	15:26:22	78	15310	15310	PDS_UNKNOWN_FAILURE
02-feb-05	21:44:08	02-feb-05	23:39:45	6937	15313	15315	SSR
03-feb-05	05:21:06	03-feb-05	05:22:23	77	15318	15318	PDS_UNKNOWN_FAILURE
03-feb-05	16:33:59	03-feb-05	16:35:17	78	15325	15325	PDS_UNKNOWN_FAILURE
31-gen-05	05:34:19	31-gen-05	07:15:08	6049	15275	15276	SSR
04-feb-05	04:50:07	04-feb-05	04:51:25	78	15332	15332	PDS_UNKNOWN_FAILURE
04-feb-05	16:01:51	04-feb-05	16:03:08	77	15339	15339	PDS_UNKNOWN_FAILURE
04-feb-05	21:09:47	04-feb-05	21:43:25	2018	15342	15342	SSR
04-feb-05	22:21:35	05-feb-05	04:15:31	21236	15342	15346	SSR
05-feb-05	04:18:30	05-feb-05	06:15:58	7048	15346	15347	SSR
05-feb-05	15:30:59	05-feb-05	15:32:17	78	15353	15353	PDS_UNKNOWN_FAILURE
31-gen-05	16:28:05	31-gen-05	16:29:23	78	15282	15282	PDS_UNKNOWN_FAILURE
31-gen-05	20:00:42	31-gen-05	21:01:33	3651	15284	15284	SSR
31-gen-05	21:22:37	31-gen-05	22:47:57	5120	15285	15285	SSR
01-feb-05	01:04:18	01-feb-05	02:05:10	3652	15287	15287	SSR
01-feb-05	02:13:07	01-feb-05	03:19:27	3980	15287	15288	SSR
01-feb-05	04:44:22	01-feb-05	04:45:40	78	15289	15289	PDS_UNKNOWN_FAILURE
01-feb-05	05:02:17	01-feb-05	05:17:01	884	15289	15289	PDS_UNKNOWN_FAILURE
06-feb-05	21:20:30	07-feb-05	04:53:30	27180	15370	15375	SSR
07-feb-05	04:55:49	07-feb-05	06:54:11	7102	15375	15376	SSR
09-feb-05	16:44:47	09-feb-05	16:46:05	78	15411	15411	PDS_UNKNOWN_FAILURE
10-feb-05	05:01:26	10-feb-05	05:02:44	78	15418	15418	PDS_UNKNOWN_FAILURE
10-feb-05	16:13:18	10-feb-05	16:14:36	78	15425	15425	PDS_UNKNOWN_FAILURE
11-feb-05	00:13:33	11-feb-05	00:35:15	1302	15429	15430	SSR
11-feb-05	01:52:22	11-feb-05	03:05:16	4374	15430	15431	SSR
11-feb-05	04:26:42	11-feb-05	04:26:44	2	15432	15432	PDS_UNKNOWN_FAILURE
11-feb-05	04:29:59	11-feb-05	04:31:17	78	15432	15432	PDS_UNKNOWN_FAILURE
11-feb-05	04:47:54	11-feb-05	06:28:39	6045	15432	15433	SSR
11-feb-05	15:39:16	11-feb-05	15:39:19	3	15439	15439	PDS_UNKNOWN_FAILURE
11-feb-05	15:42:16	11-feb-05	15:43:34	78	15439	15439	PDS_UNKNOWN_FAILURE
07-feb-05	16:07:26	07-feb-05	16:08:44	78	15382	15382	PDS_UNKNOWN_FAILURE
12-feb-05	03:55:54	12-feb-05	03:55:57	3	15446	15446	PDS_UNKNOWN_FAILURE
12-feb-05	03:57:57	12-feb-05	03:59:15	78	15446	15446	PDS_UNKNOWN_FAILURE
12-feb-05	04:16:31	12-feb-05	04:19:22	171	15446	15446	PDS_UNKNOWN_FAILURE
12-feb-05	15:10:17	12-feb-05	15:11:35	78	15453	15453	PDS_UNKNOWN_FAILURE
08-feb-05	01:46:20	08-feb-05	04:21:08	9288	15387	15389	SSR
08-feb-05	04:24:15	08-feb-05	06:19:37	6922	15389	15390	SSR
08-feb-05	15:33:38	08-feb-05	15:33:41	3	15396	15396	PDS_UNKNOWN_FAILURE
08-feb-05	15:36:41	08-feb-05	15:37:59	78	15396	15396	PDS_UNKNOWN_FAILURE
08-feb-05	20:42:30	08-feb-05	20:59:50	1040	15399	15399	SSR
09-feb-05	03:52:05	09-feb-05	03:53:23	78	15403	15403	PDS_UNKNOWN_FAILURE
09-feb-05	11:58:03	09-feb-05	13:34:08	5765	15408	15409	SSR
14-feb-05	04:35:44	14-feb-05	04:37:02	78	15475	15475	PDS_UNKNOWN_FAILURE
14-feb-05	15:44:58	14-feb-05	15:45:01	3	15482	15482	PDS_UNKNOWN_FAILURE

17-feb-05	15:53:26	17-feb-05	15:54:44	78	15525	15525	PDS_UNKNOWN_FAILURE
18-feb-05	04:09:41	18-feb-05	04:10:58	77	15532	15532	PDS_UNKNOWN_FAILURE
18-feb-05	15:22:06	18-feb-05	15:23:24	78	15539	15539	PDS_UNKNOWN_FAILURE
19-feb-05	05:18:16	19-feb-05	05:19:34	78	15547	15547	PDS_UNKNOWN_FAILURE
19-feb-05	16:31:01	19-feb-05	16:32:19	78	15554	15554	PDS_UNKNOWN_FAILURE
14-feb-05	15:47:51	14-feb-05	15:49:09	78	15482	15482	PDS_UNKNOWN_FAILURE
15-feb-05	04:03:49	15-feb-05	04:05:07	78	15489	15489	PDS_UNKNOWN_FAILURE
15-feb-05	15:16:11	15-feb-05	15:17:29	78	15496	15496	PDS_UNKNOWN_FAILURE
16-feb-05	05:10:27	16-feb-05	05:10:29	2	15504	15504	PDS_UNKNOWN_FAILURE
16-feb-05	05:12:39	16-feb-05	05:13:57	78	15504	15504	PDS_UNKNOWN_FAILURE
16-feb-05	16:25:06	16-feb-05	16:26:24	78	15511	15511	PDS_UNKNOWN_FAILURE
17-feb-05	04:41:28	17-feb-05	04:42:46	78	15518	15518	PDS_UNKNOWN_FAILURE
17-feb-05	15:50:42	17-feb-05	15:50:45	3	15525	15525	PDS_UNKNOWN_FAILURE

Table 7: List of gaps for RA-2 L0 products during cycle 34

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

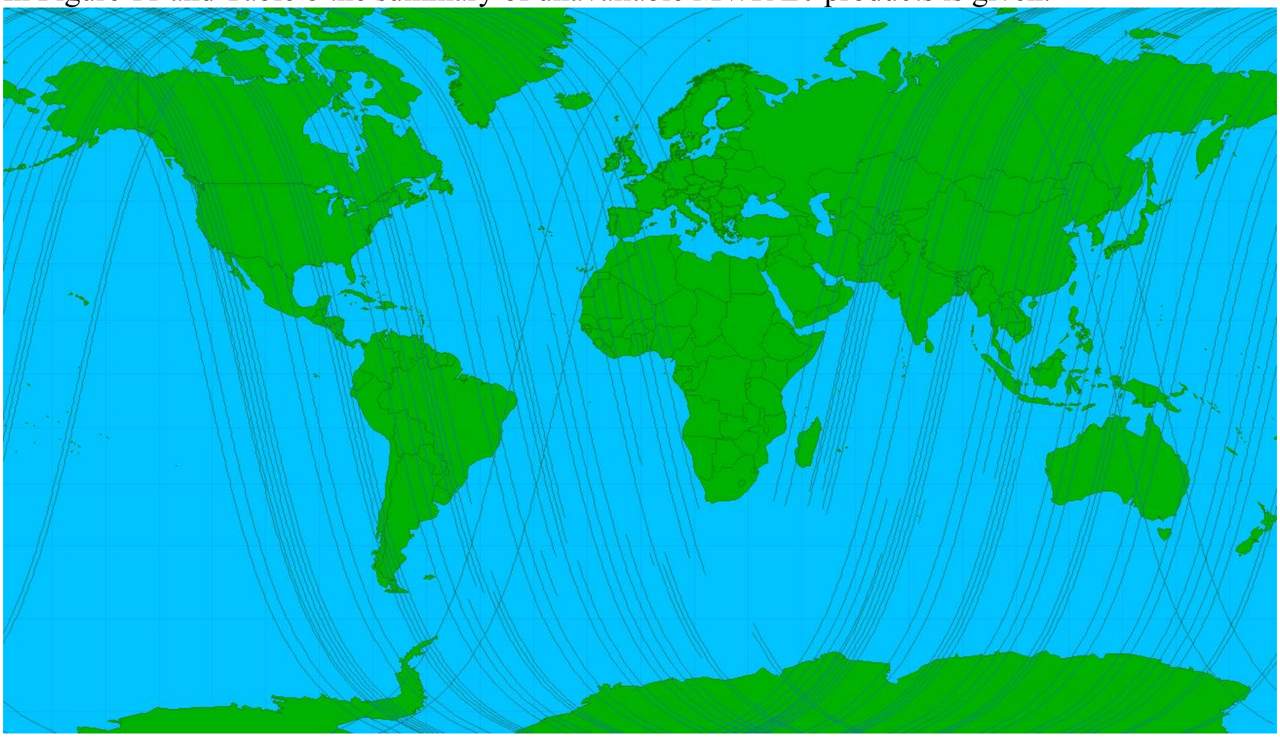

Figure 11: MWR L0 unavailable products for cycle 34

Start date	Start time	Stop date	Stop time	Duration [sec]	Start orbit	Stop orbit	Reason
26-gen-05	04:53:41	26-gen-05	06:30:05	5784	15203	15204	PDS_UNKNOWN_FAILURE
27-gen-05	04:18:31	27-gen-05	04:20:07	96	15217	15217	PDS_UNKNOWN_FAILURE
27-gen-05	21:30:33	28-gen-05	07:08:10	34657	15227	15233	PDS_UNKNOWN_FAILURE
28-gen-05	20:04:11	28-gen-05	20:56:11	3120	15241	15241	PDS_UNKNOWN_FAILURE
29-gen-05	11:05:48	29-gen-05	12:45:49	6001	15250	15251	PDS_UNKNOWN_FAILURE
29-gen-05	21:06:37	29-gen-05	22:09:25	3768	15256	15256	PDS_UNKNOWN_FAILURE

29-gen-05	22:15:25	29-gen-05	23:49:26	5641	15256	15257	PDS_UNKNOWN_FAILURE
29-gen-05	23:52:14	30-gen-05	01:29:26	5832	15257	15258	PDS_UNKNOWN_FAILURE
30-gen-05	01:33:50	30-gen-05	06:05:50	16320	15258	15261	PDS_UNKNOWN_FAILURE
31-gen-05	00:58:16	31-gen-05	03:52:40	10464	15272	15274	PDS_UNKNOWN_FAILURE
31-gen-05	05:33:28	31-gen-05	07:15:04	6096	15275	15276	PDS_UNKNOWN_FAILURE
02-feb-05	02:46:20	02-feb-05	06:11:09	12289	15302	15304	PDS_UNKNOWN_FAILURE
02-feb-05	21:43:10	02-feb-05	23:39:34	6984	15313	15315	PDS_UNKNOWN_FAILURE
04-feb-05	21:08:50	04-feb-05	21:48:51	2401	15342	15342	PDS_UNKNOWN_FAILURE
04-feb-05	22:14:51	05-feb-05	06:15:39	28848	15342	15347	PDS_UNKNOWN_FAILURE
31-gen-05	19:59:30	31-gen-05	21:01:30	3720	15284	15284	PDS_UNKNOWN_FAILURE
31-gen-05	21:21:06	31-gen-05	22:47:54	5208	15285	15285	PDS_UNKNOWN_FAILURE
01-feb-05	00:24:42	01-feb-05	00:27:30	168	15286	15286	PDS_UNKNOWN_FAILURE
01-feb-05	01:03:06	01-feb-05	02:05:06	3720	15287	15287	PDS_UNKNOWN_FAILURE
01-feb-05	02:12:18	01-feb-05	03:19:06	4008	15287	15288	PDS_UNKNOWN_FAILURE
01-feb-05	05:01:30	01-feb-05	05:17:54	984	15289	15289	PDS_UNKNOWN_FAILURE
01-feb-05	21:02:20	01-feb-05	22:14:20	4320	15299	15299	PDS_UNKNOWN_FAILURE
01-feb-05	23:56:20	02-feb-05	01:33:56	5856	15300	15301	PDS_UNKNOWN_FAILURE
06-feb-05	21:20:30	07-feb-05	06:54:08	34418	15370	15376	PDS_UNKNOWN_FAILURE
07-feb-05	22:25:45	07-feb-05	22:26:33	48	15385	15385	PDS_UNKNOWN_FAILURE
08-feb-05	01:45:21	08-feb-05	06:19:22	16441	15387	15390	PDS_UNKNOWN_FAILURE
08-feb-05	20:41:23	08-feb-05	20:59:47	1104	15399	15399	PDS_UNKNOWN_FAILURE
09-feb-05	11:57:01	09-feb-05	13:33:49	5808	15408	15409	PDS_UNKNOWN_FAILURE
11-feb-05	00:12:40	11-feb-05	00:30:40	1080	15429	15430	PDS_UNKNOWN_FAILURE
11-feb-05	01:51:28	11-feb-05	03:05:04	4416	15430	15431	PDS_UNKNOWN_FAILURE
11-feb-05	04:47:04	11-feb-05	06:28:16	6072	15432	15433	PDS_UNKNOWN_FAILURE
12-feb-05	04:15:30	12-feb-05	04:19:06	216	15446	15446	PDS_UNKNOWN_FAILURE

Table 8: List of gaps for MWR L0 products during cycle 34

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.

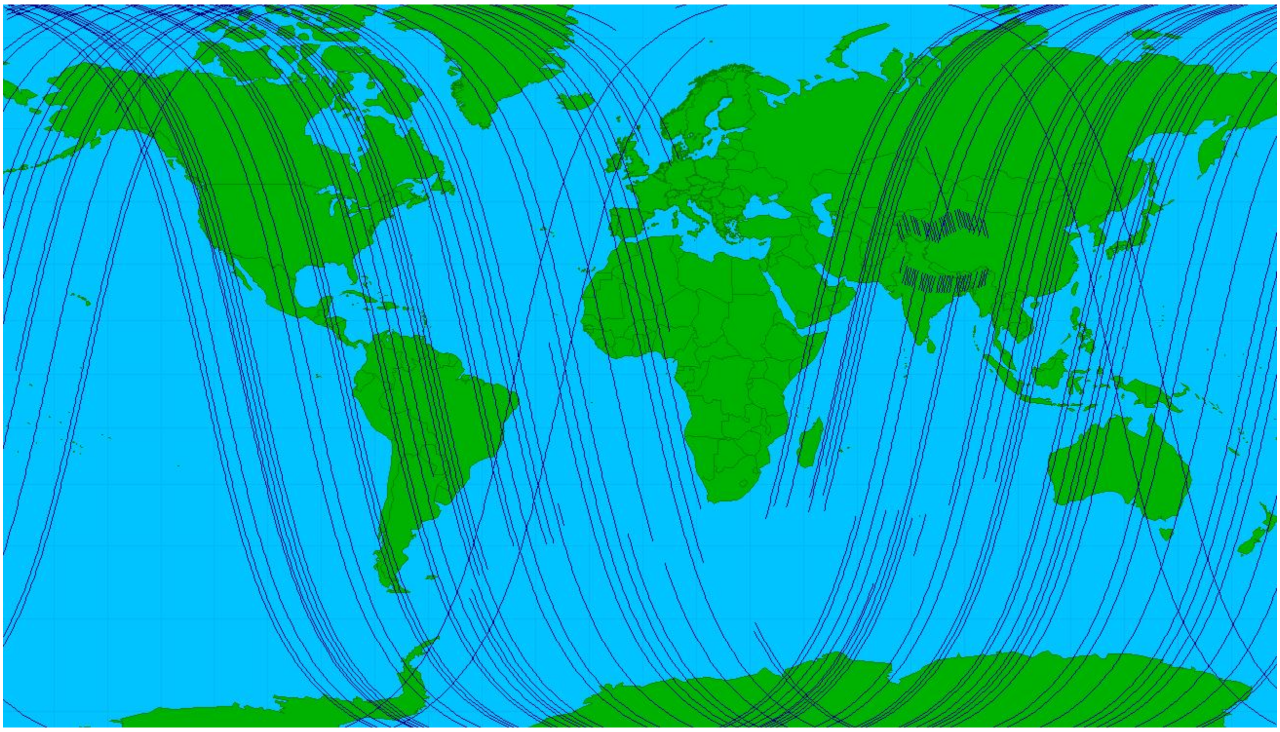

Figure 12: RA-2 L1b unavailable products for cycle 34

Start date	Start time	Stop date	Stop time	Duration [sec]	Start orbit	Stop orbit	Reason
17-gen-05	04:15:33	17-gen-05	04:16:51	78	15074	15074	PDS_UNKNOWN_FAILURE
17-gen-05	15:28:01	17-gen-05	15:29:19	78	15081	15081	PDS_UNKNOWN_FAILURE
22-gen-05	04:58:37	22-gen-05	04:59:55	78	15146	15146	PDS_UNKNOWN_FAILURE
22-gen-05	16:10:21	22-gen-05	16:11:38	77	15153	15153	PDS_UNKNOWN_FAILURE
18-gen-05	05:23:53	18-gen-05	05:25:11	78	15089	15089	PDS_UNKNOWN_FAILURE
18-gen-05	16:36:40	18-gen-05	16:37:58	78	15096	15096	PDS_UNKNOWN_FAILURE
19-gen-05	04:52:58	19-gen-05	04:54:16	78	15103	15103	PDS_UNKNOWN_FAILURE
19-gen-05	16:04:38	19-gen-05	16:05:55	77	15110	15110	PDS_UNKNOWN_FAILURE
20-gen-05	04:21:22	20-gen-05	04:22:39	77	15117	15117	PDS_UNKNOWN_FAILURE
20-gen-05	15:33:53	20-gen-05	15:35:10	77	15124	15124	PDS_UNKNOWN_FAILURE
21-gen-05	05:28:53	21-gen-05	05:30:10	77	15132	15132	PDS_UNKNOWN_FAILURE
21-gen-05	16:42:05	21-gen-05	16:43:23	78	15139	15139	PDS_UNKNOWN_FAILURE
24-gen-05	03:55:01	24-gen-05	03:56:19	78	15174	15174	PDS_UNKNOWN_FAILURE
24-gen-05	15:07:20	24-gen-05	15:08:38	78	15181	15181	PDS_UNKNOWN_FAILURE
28-gen-05	20:05:27	28-gen-05	20:56:17	3050	15241	15241	PDS_UNKNOWN_FAILURE
29-gen-05	00:22:07	29-gen-05	01:59:57	5870	15243	15244	PDS_UNKNOWN_FAILURE
29-gen-05	04:38:37	29-gen-05	04:39:55	78	15246	15246	PDS_UNKNOWN_FAILURE
29-gen-05	11:06:54	29-gen-05	12:45:59	5945	15250	15251	PDS_UNKNOWN_FAILURE
29-gen-05	15:50:40	29-gen-05	15:51:58	78	15253	15253	PDS_UNKNOWN_FAILURE
25-gen-05	05:04:15	25-gen-05	05:05:32	77	15189	15189	PDS_UNKNOWN_FAILURE
25-gen-05	16:16:15	25-gen-05	16:17:33	78	15196	15196	PDS_UNKNOWN_FAILURE
26-gen-05	04:32:52	26-gen-05	04:34:10	78	15203	15203	PDS_UNKNOWN_FAILURE

26-gen-05	04:55:33	26-gen-05	06:30:29	5696	15203	15204	PDS_UNKNOWN_FAILURE
26-gen-05	15:45:04	26-gen-05	15:50:30	326	15210	15210	PDS_UNKNOWN_FAILURE
27-gen-05	21:31:20	28-gen-05	05:07:42	27382	15227	15232	PDS_UNKNOWN_FAILURE
28-gen-05	05:09:52	28-gen-05	07:08:31	7119	15232	15233	PDS_UNKNOWN_FAILURE
28-gen-05	16:22:10	28-gen-05	16:23:28	78	15239	15239	PDS_UNKNOWN_FAILURE
31-gen-05	00:59:22	31-gen-05	03:52:57	10415	15272	15274	PDS_UNKNOWN_FAILURE
31-gen-05	05:15:29	31-gen-05	05:16:46	77	15275	15275	PDS_UNKNOWN_FAILURE
01-feb-05	15:56:15	01-feb-05	15:57:33	78	15296	15296	PDS_UNKNOWN_FAILURE
01-feb-05	21:03:16	01-feb-05	22:14:29	4273	15299	15299	PDS_UNKNOWN_FAILURE
01-feb-05	23:57:28	01-feb-05	23:58:00	32	15300	15300	PDS_UNKNOWN_FAILURE
01-feb-05	23:58:00	01-feb-05	23:59:00	60	15300	15300	PDS_UNKNOWN_FAILURE
02-feb-05	01:35:16	02-feb-05	02:15:21	2405	15301	15302	PDS_UNKNOWN_FAILURE
02-feb-05	02:15:21	02-feb-05	02:47:33	1932	15302	15302	PDS_UNKNOWN_FAILURE
02-feb-05	02:47:33	02-feb-05	04:09:54	4941	15302	15303	PDS_UNKNOWN_FAILURE
02-feb-05	04:12:38	02-feb-05	04:13:56	78	15303	15303	PDS_UNKNOWN_FAILURE
02-feb-05	04:31:14	02-feb-05	06:11:21	6007	15303	15304	PDS_UNKNOWN_FAILURE
02-feb-05	15:25:04	02-feb-05	15:26:22	78	15310	15310	PDS_UNKNOWN_FAILURE
31-gen-05	05:34:21	31-gen-05	07:15:08	6047	15275	15276	PDS_UNKNOWN_FAILURE
02-feb-05	20:31:24	02-feb-05	21:44:08	4364	15313	15313	PDS_UNKNOWN_FAILURE
02-feb-05	21:44:08	02-feb-05	23:39:45	6937	15313	15315	PDS_UNKNOWN_FAILURE
03-feb-05	05:21:06	03-feb-05	05:22:23	77	15318	15318	PDS_UNKNOWN_FAILURE
03-feb-05	16:33:59	03-feb-05	16:35:17	78	15325	15325	PDS_UNKNOWN_FAILURE
04-feb-05	04:50:07	04-feb-05	04:51:25	78	15332	15332	PDS_UNKNOWN_FAILURE
04-feb-05	16:01:51	04-feb-05	16:03:08	77	15339	15339	PDS_UNKNOWN_FAILURE
04-feb-05	21:09:48	04-feb-05	21:43:25	2017	15342	15342	PDS_UNKNOWN_FAILURE
04-feb-05	22:21:36	05-feb-05	04:15:31	21235	15342	15346	PDS_UNKNOWN_FAILURE
05-feb-05	04:18:30	05-feb-05	06:15:58	7048	15346	15347	PDS_UNKNOWN_FAILURE
05-feb-05	15:30:59	05-feb-05	15:32:17	78	15353	15353	PDS_UNKNOWN_FAILURE
31-gen-05	16:28:05	31-gen-05	16:29:23	78	15282	15282	PDS_UNKNOWN_FAILURE
31-gen-05	20:00:43	31-gen-05	21:01:33	3650	15284	15284	PDS_UNKNOWN_FAILURE
31-gen-05	21:22:38	31-gen-05	22:47:57	5119	15285	15285	PDS_UNKNOWN_FAILURE
01-feb-05	01:04:19	01-feb-05	02:05:10	3651	15287	15287	PDS_UNKNOWN_FAILURE
01-feb-05	02:13:08	01-feb-05	03:19:27	3979	15287	15288	PDS_UNKNOWN_FAILURE
01-feb-05	04:44:22	01-feb-05	04:45:40	78	15289	15289	PDS_UNKNOWN_FAILURE
01-feb-05	05:02:18	01-feb-05	05:17:01	883	15289	15289	PDS_UNKNOWN_FAILURE
06-feb-05	21:20:30	07-feb-05	04:53:30	27180	15370	15375	PDS_UNKNOWN_FAILURE
07-feb-05	04:55:49	07-feb-05	06:54:11	7102	15375	15376	PDS_UNKNOWN_FAILURE
10-feb-05	05:01:26	10-feb-05	05:02:44	78	15418	15418	PDS_UNKNOWN_FAILURE
10-feb-05	16:13:18	10-feb-05	16:14:36	78	15425	15425	PDS_UNKNOWN_FAILURE
11-feb-05	00:13:35	11-feb-05	00:35:15	1300	15429	15430	PDS_UNKNOWN_FAILURE
11-feb-05	00:35:15	11-feb-05	01:52:22	4627	15430	15430	PDS_UNKNOWN_FAILURE
11-feb-05	01:52:22	11-feb-05	03:05:16	4374	15430	15431	PDS_UNKNOWN_FAILURE
11-feb-05	04:29:59	11-feb-05	04:31:17	78	15432	15432	PDS_UNKNOWN_FAILURE
11-feb-05	04:47:55	11-feb-05	06:28:39	6044	15432	15433	PDS_UNKNOWN_FAILURE

11-feb-05	15:42:16	11-feb-05	15:43:34	78	15439	15439	PDS_UNKNOWN_FAILURE
12-feb-05	03:57:57	12-feb-05	03:59:15	78	15446	15446	PDS_UNKNOWN_FAILURE
12-feb-05	04:16:32	12-feb-05	04:19:22	170	15446	15446	PDS_UNKNOWN_FAILURE
07-feb-05	16:07:26	07-feb-05	16:08:44	78	15382	15382	PDS_UNKNOWN_FAILURE
12-feb-05	15:10:17	12-feb-05	15:11:35	78	15453	15453	PDS_UNKNOWN_FAILURE
08-feb-05	01:46:21	08-feb-05	04:21:08	9287	15387	15389	PDS_UNKNOWN_FAILURE
08-feb-05	04:24:15	08-feb-05	06:19:37	6922	15389	15390	PDS_UNKNOWN_FAILURE
08-feb-05	15:36:41	08-feb-05	15:37:59	78	15396	15396	PDS_UNKNOWN_FAILURE
08-feb-05	20:42:31	08-feb-05	20:59:50	1039	15399	15399	PDS_UNKNOWN_FAILURE
09-feb-05	03:52:05	09-feb-05	03:53:23	78	15403	15403	PDS_UNKNOWN_FAILURE
09-feb-05	11:58:04	09-feb-05	13:33:58	5754	15408	15409	PDS_UNKNOWN_FAILURE
09-feb-05	16:44:47	09-feb-05	16:46:05	78	15411	15411	PDS_UNKNOWN_FAILURE
14-feb-05	04:35:44	14-feb-05	04:37:02	78	15475	15475	PDS_UNKNOWN_FAILURE
14-feb-05	15:47:51	14-feb-05	15:49:09	78	15482	15482	PDS_UNKNOWN_FAILURE
18-feb-05	15:22:06	18-feb-05	15:23:24	78	15539	15539	PDS_UNKNOWN_FAILURE
19-feb-05	05:18:16	19-feb-05	05:19:34	78	15547	15547	PDS_UNKNOWN_FAILURE
19-feb-05	16:31:01	19-feb-05	16:32:19	78	15554	15554	PDS_UNKNOWN_FAILURE
15-feb-05	04:03:49	15-feb-05	04:05:07	78	15489	15489	PDS_UNKNOWN_FAILURE
15-feb-05	15:16:11	15-feb-05	15:17:29	78	15496	15496	PDS_UNKNOWN_FAILURE
16-feb-05	05:12:39	16-feb-05	05:13:57	78	15504	15504	PDS_UNKNOWN_FAILURE
16-feb-05	16:25:06	16-feb-05	16:26:24	78	15511	15511	PDS_UNKNOWN_FAILURE
17-feb-05	04:41:28	17-feb-05	04:42:46	78	15518	15518	PDS_UNKNOWN_FAILURE
17-feb-05	15:50:43	17-feb-05	15:50:45	2	15525	15525	PDS_UNKNOWN_FAILURE
17-feb-05	15:53:26	17-feb-05	15:54:44	78	15525	15525	PDS_UNKNOWN_FAILURE
18-feb-05	04:09:41	18-feb-05	04:10:58	77	15532	15532	PDS_UNKNOWN_FAILURE

Table 9: List of gaps for RA-2 L1b products during cycle 34

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

No current results for the time being. 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.

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 33, where the peaks of Ku and S bands SWH histograms are closer 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).

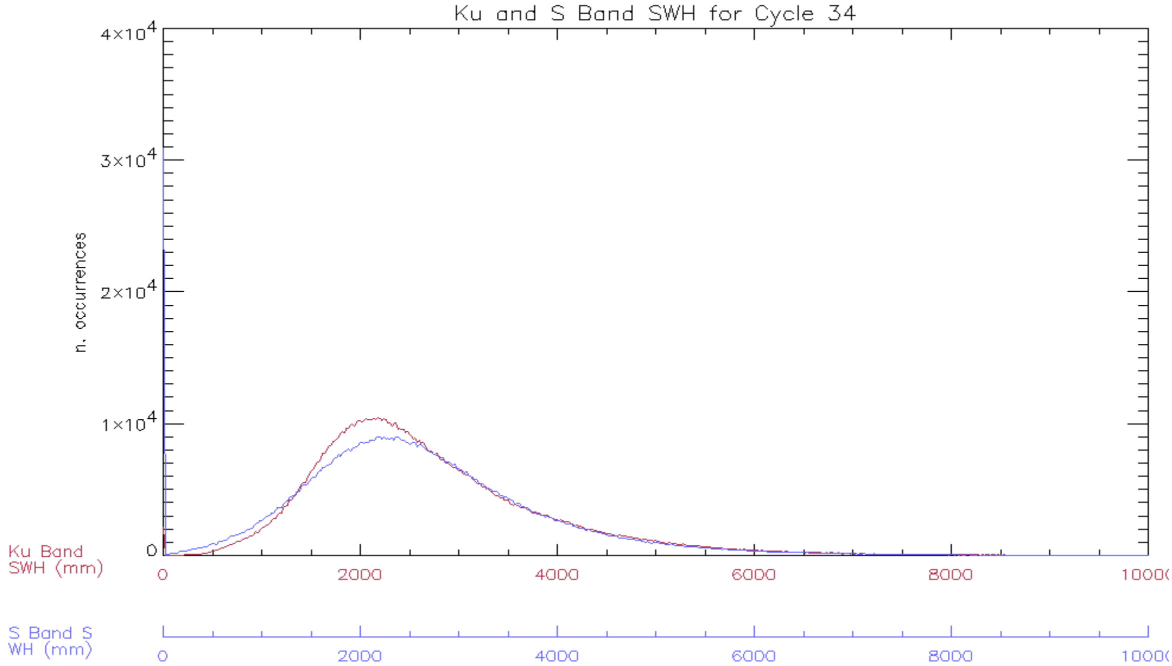

Figure 13: Histogram of Ku and S Band SWH for cycle 34 (mm)

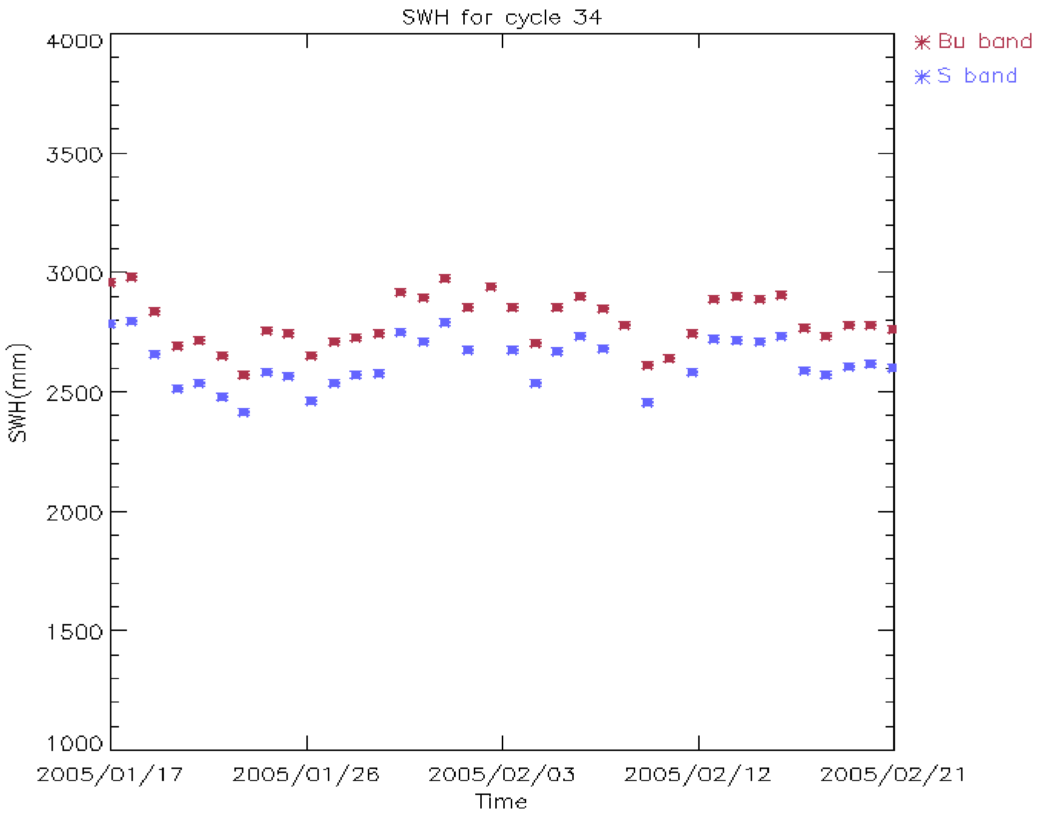

Figure 14: Ku and S SWH daily average for cycle 34 (mm)

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).

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 34 are reported in Figure 17 and Figure 18, respectively. They are similar to the previous cycle.

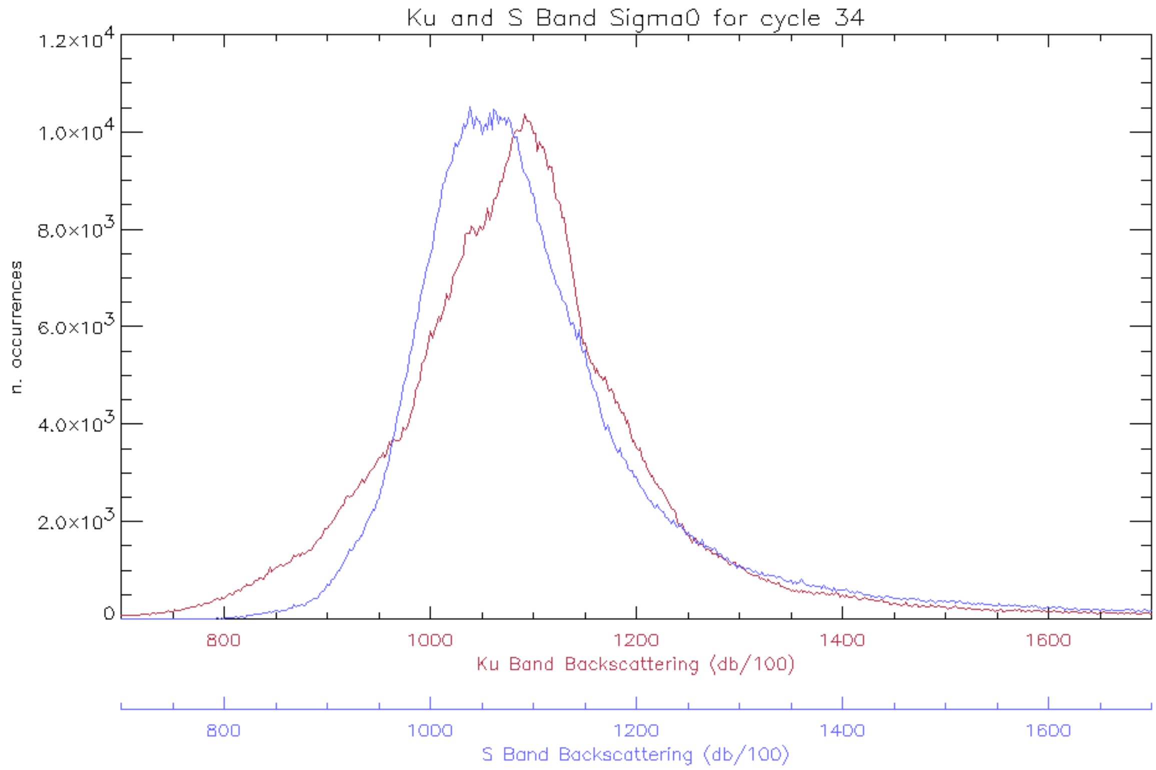

Figure 15: Histogram of Ku and S Band Backscattering Coefficient for cycle 34 (dB/100)

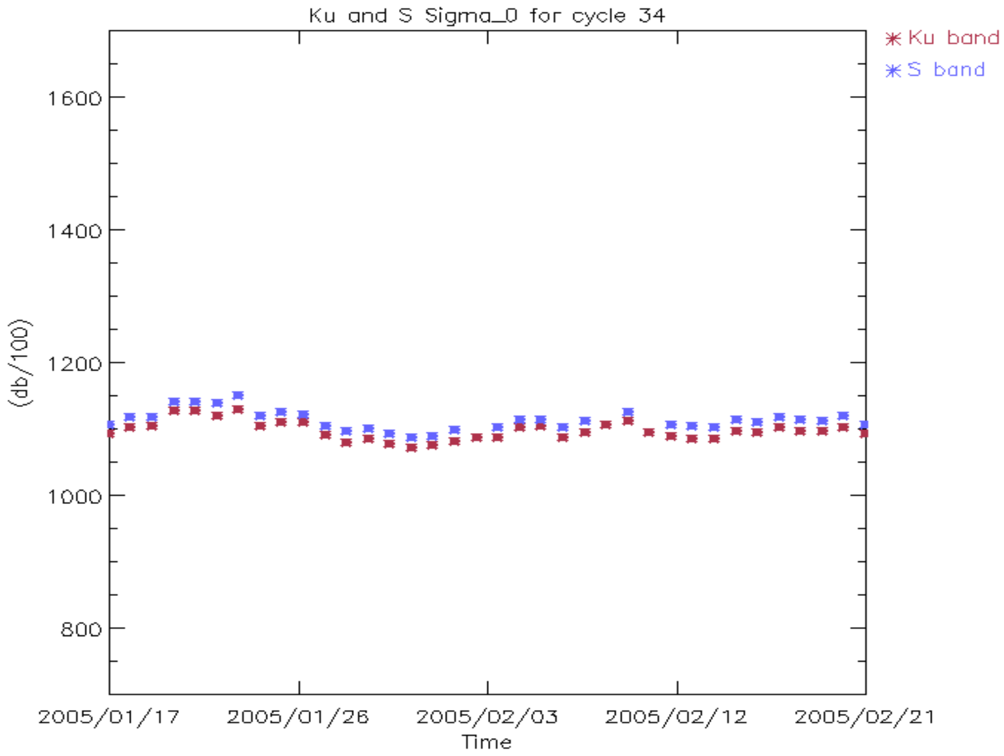

Figure 16: Ku and S Sigma_0 daily average for cycle 34 (dB/100)

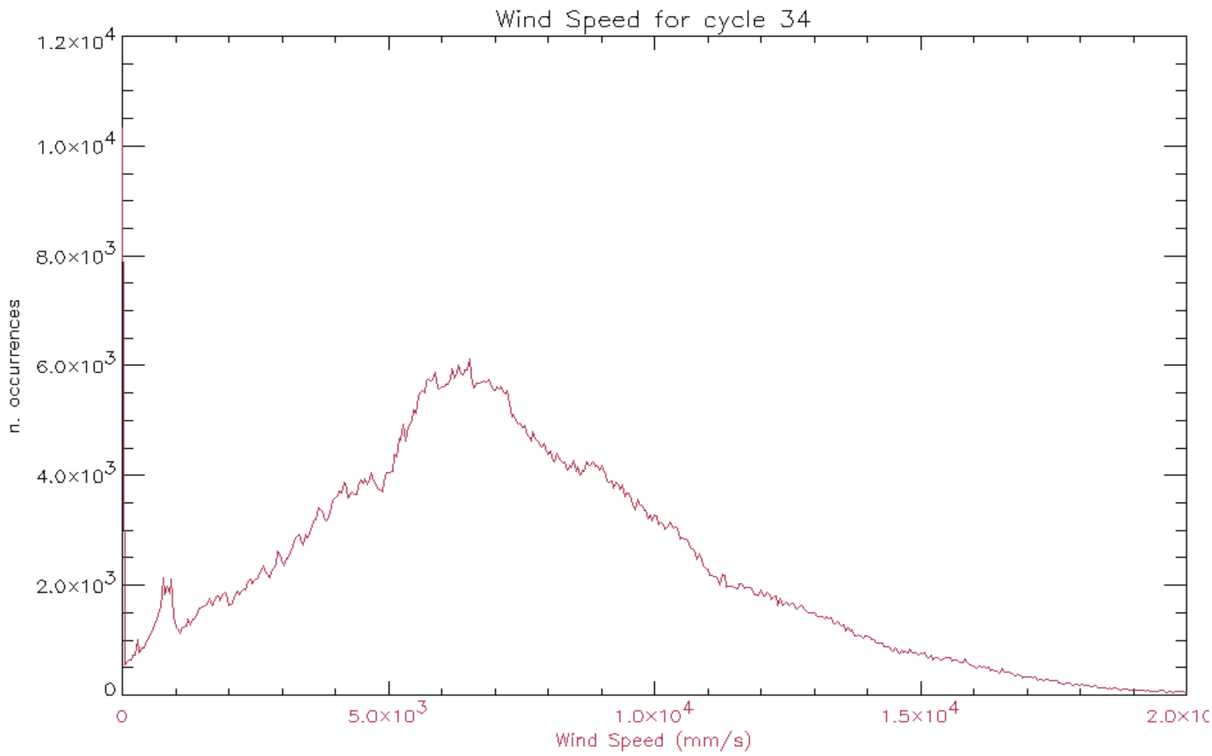

Figure 17: Histogram of Ku Wind Speed for cycle 34 (mm/s)

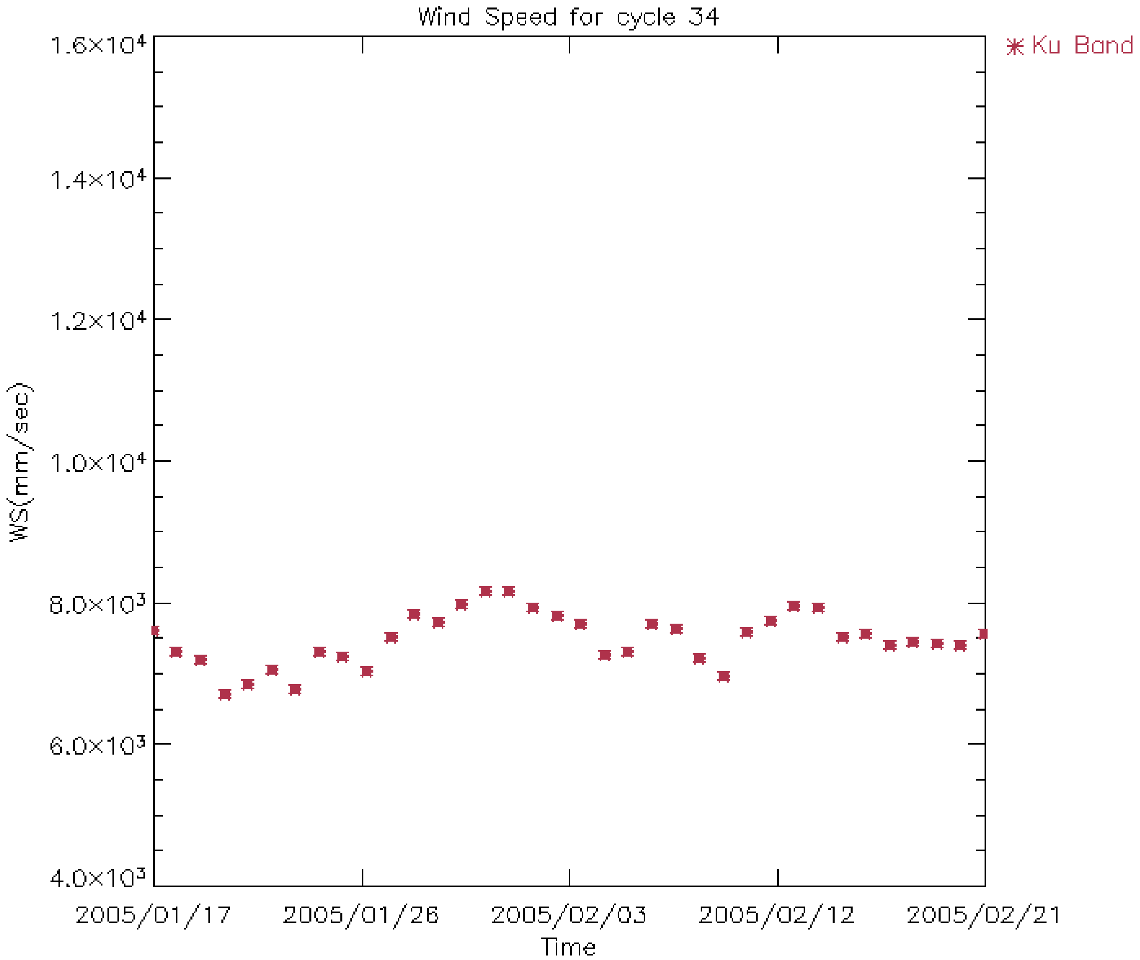

Figure 18: Ku Band Wind Speed daily average for cycle 34 (mm/s)

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 34 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 –3.02 mm per year. Eventually it could also be corrected for the cyclic average given bias (25.74 mm) that has to be added to the measured value.

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 still not conclusive since some problems have still to be solved, in any case, 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 7.1.4)
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 two 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 34 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.

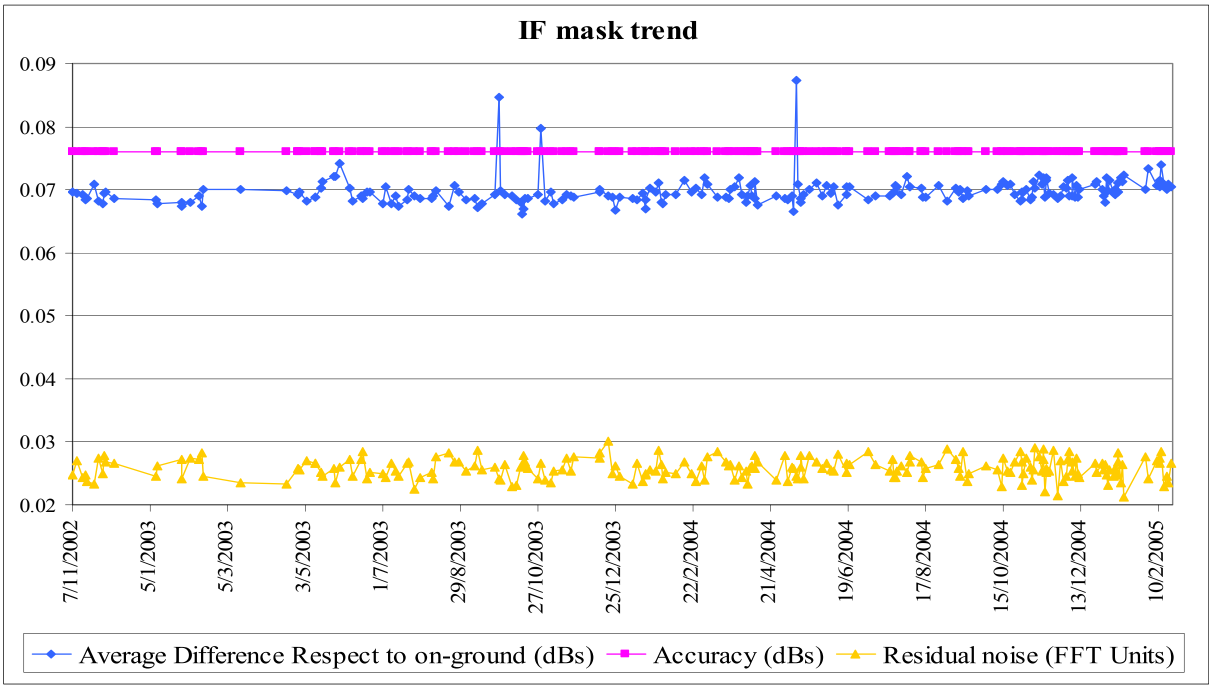

Figure 19: Evolution of the IF mask related parameters for valid IF masks retrieved up to cycle 34

9.1.2 USO

In Figure 20 the USO clock period trend retrieved until the end of cycle 34 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 31.23 mm and –4.697 mm/year as calculated with data covering the period 13 June 2003 to 21 February 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). The given bias and drift have to be added to the original altimetric range.

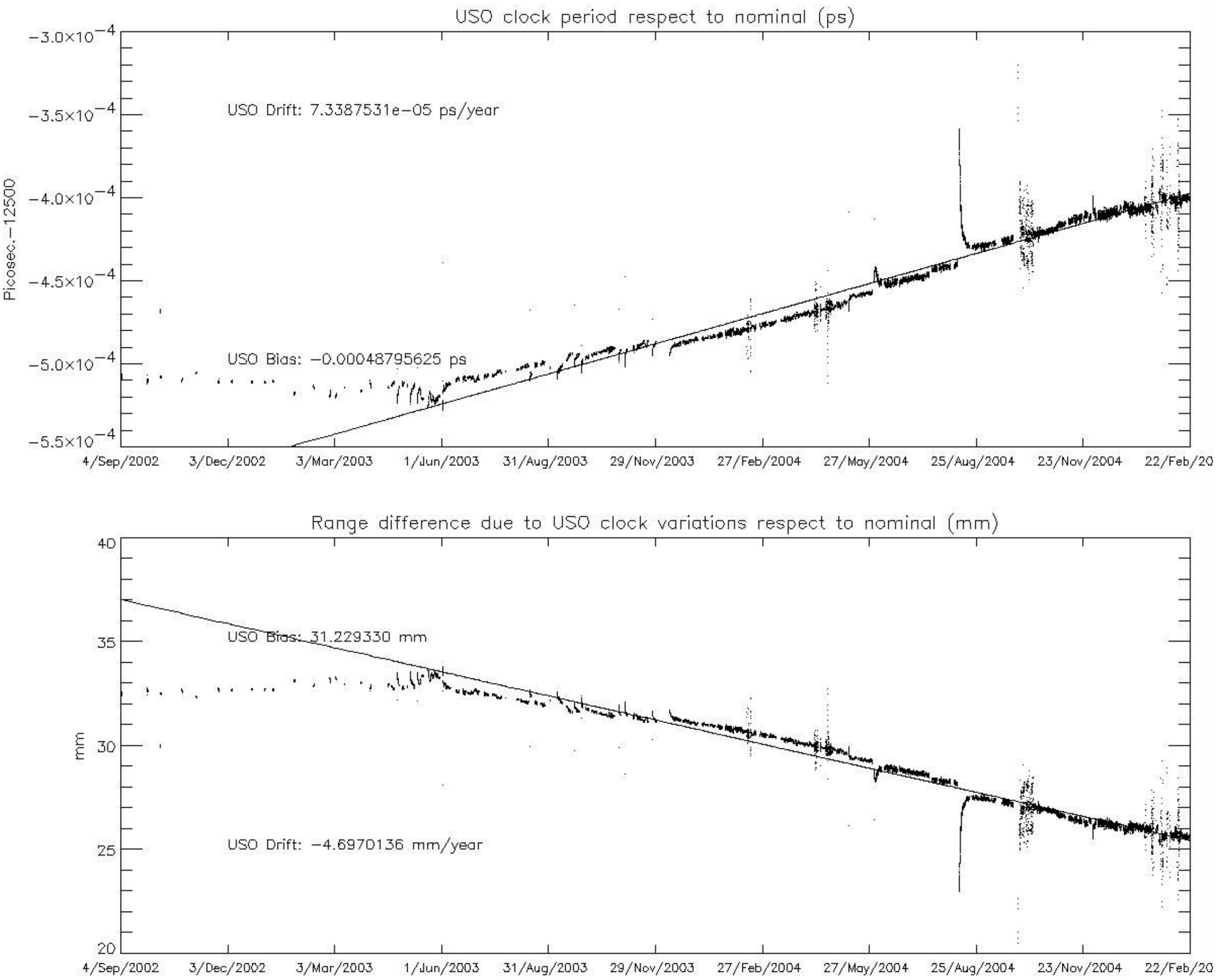

Figure 20: USO clock period until end of cycle 34

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.

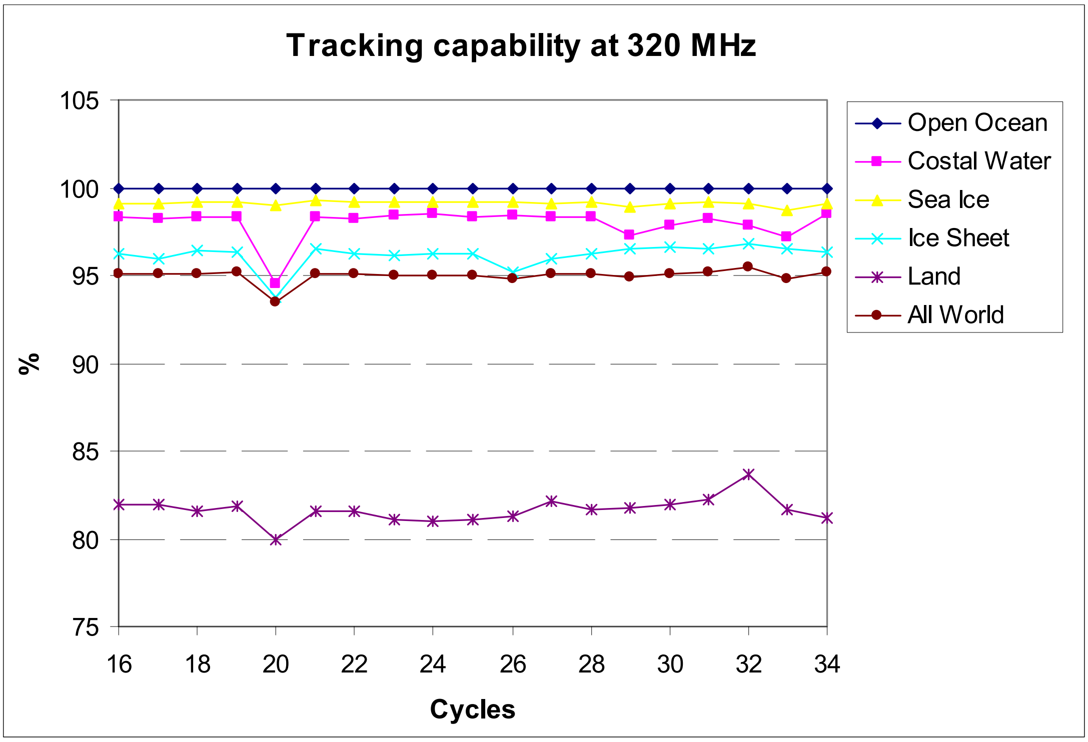

Figure 21: RA-2 Tracking percentage at 320MHz for different surfaces

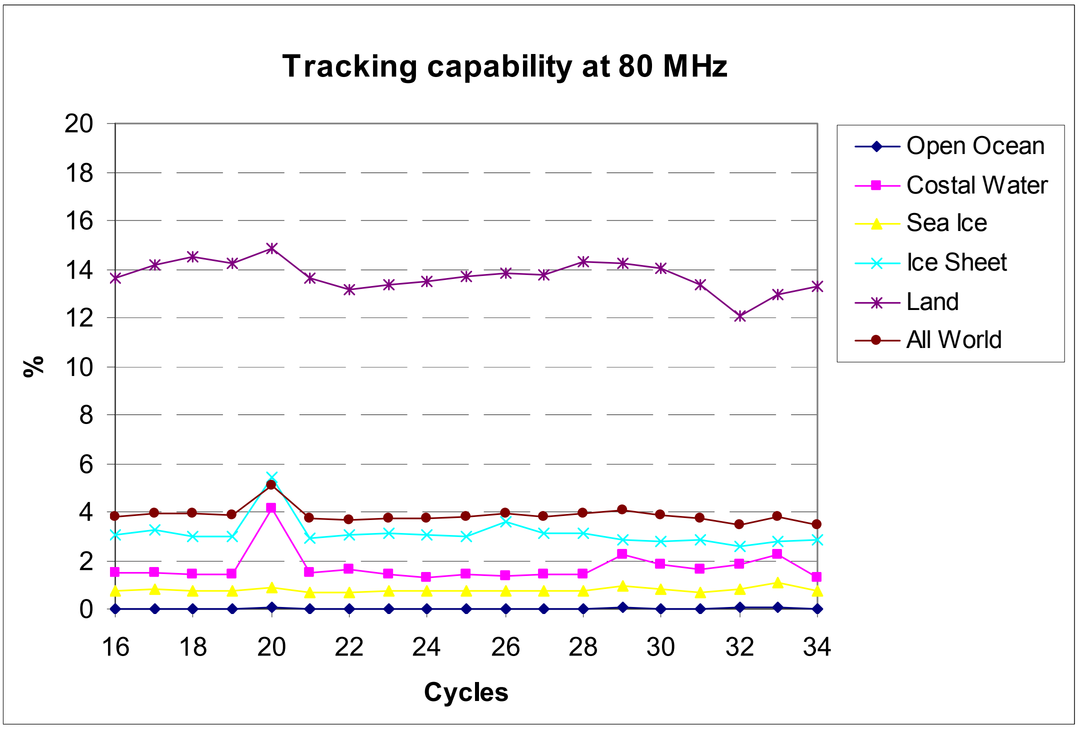

Figure 22: RA-2 Tracking percentage at 80MHz for different surfaces

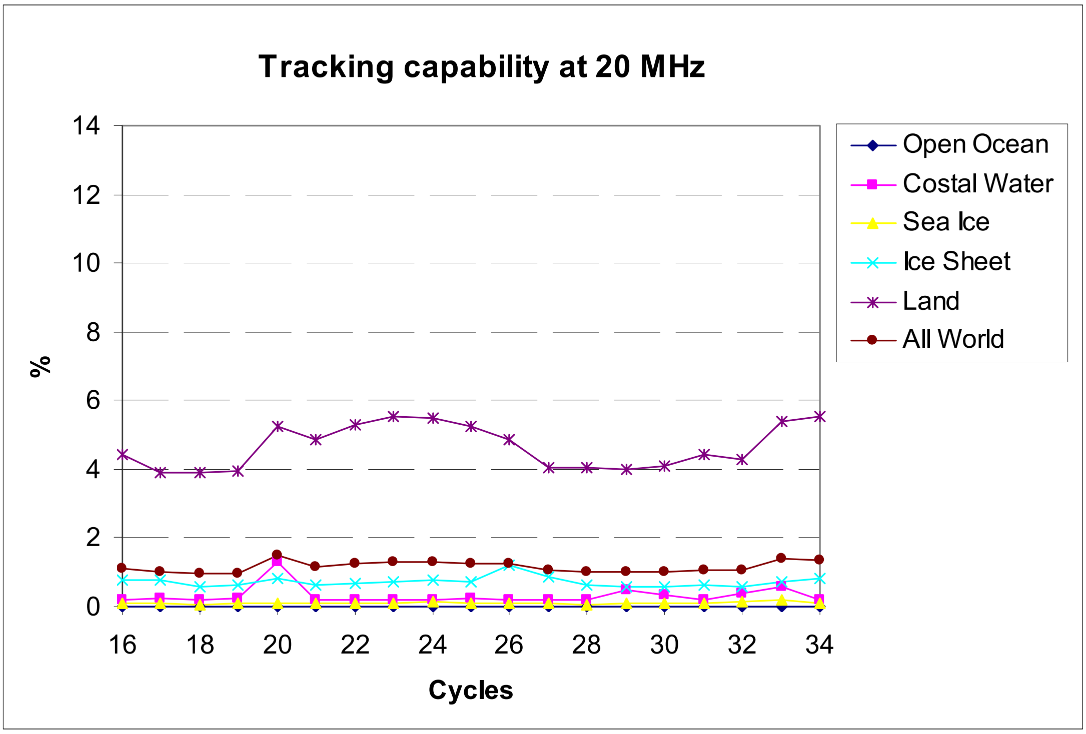

Figure 23: RA-2 Tracking percentage at 20MHz for different surfaces

9.1.4 DATATION

In Figure 24 (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 34 have been not added . The datation plots and comments pertinent to the cylce 34 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; this problem is currently under investigation. 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 will also be part of the investigation.

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.

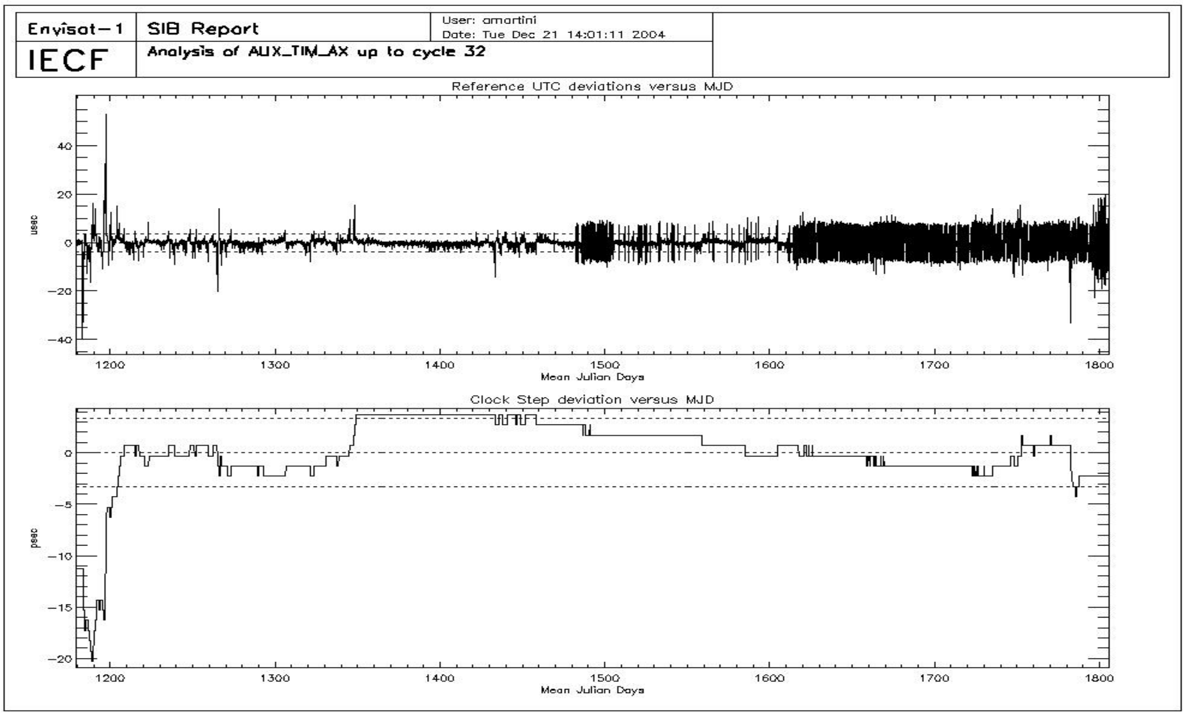

Figure 24: UTC deviations and ICU clock period up to cycle 32

9.1.5 MISPOINTING

In Figure 25 the overall mispointing squared trend (averaged over each orbit) is plotted for cycles 16 to 32. 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 26. 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.

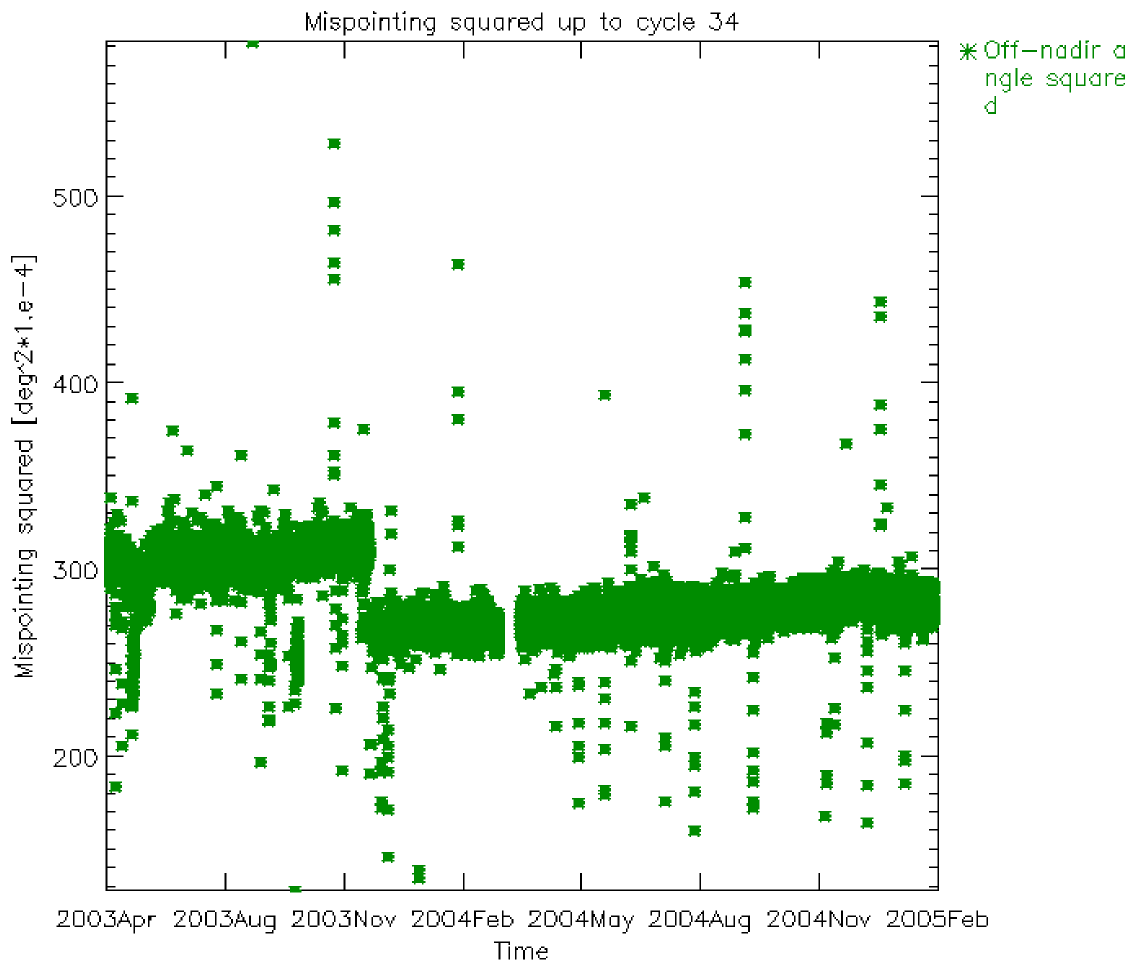

Figure 25: Smoothed mispointing squared trend until end of cycle 34 (deg^2*10e-4)

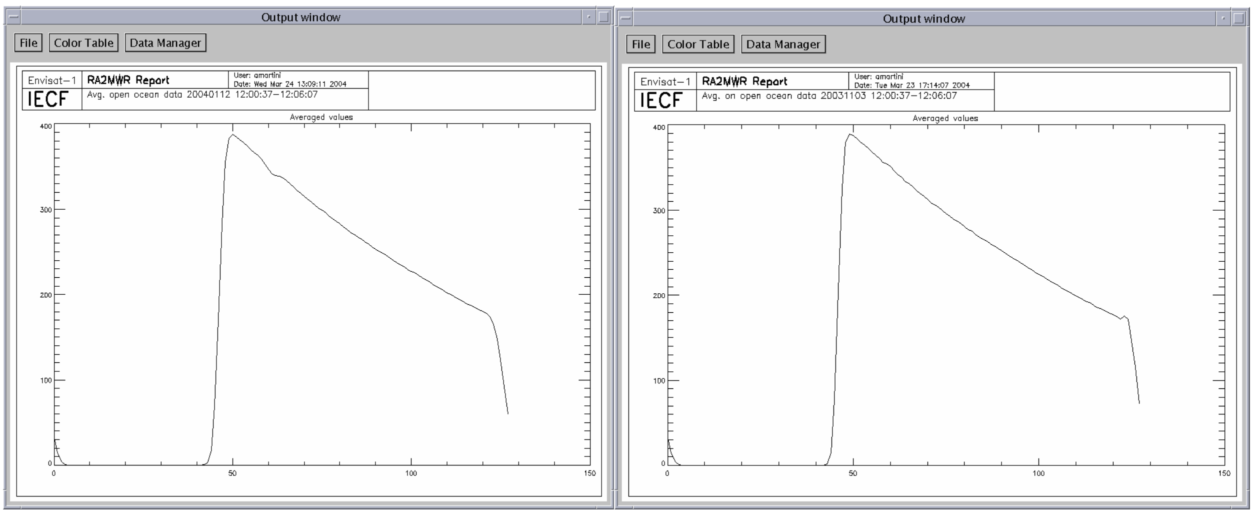

Figure 26: Open Ocean average waveforms before (left) and after an anomaly (right)

9.1.6 S-BAND ANOMALY

In Figure 27 the percentage of data per cycle that are affected by the so-called "S-Band" anomaly is reported. The figures are quite stable between 0% and 8.1%.
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.

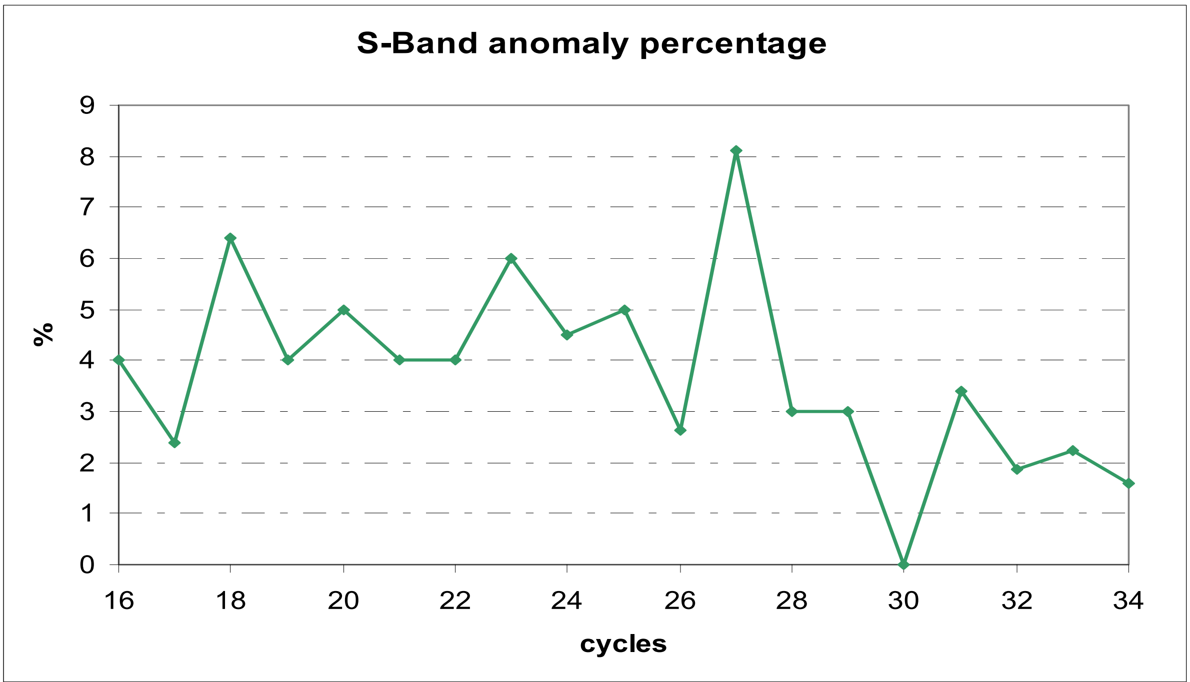

Figure 27: Percentage of data affected by the "S-Band Anomaly" for cycles 16-34

9.1.7 IN-FLIGHT INTERNAL CALIBRATION

Figure 28 and Figure 29 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, but a light increase is visible for the last two months. It seems that the overall internal gain has been continuously decreasing, having demonstrated that the transmitted power did not decrease during the same time span. 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.

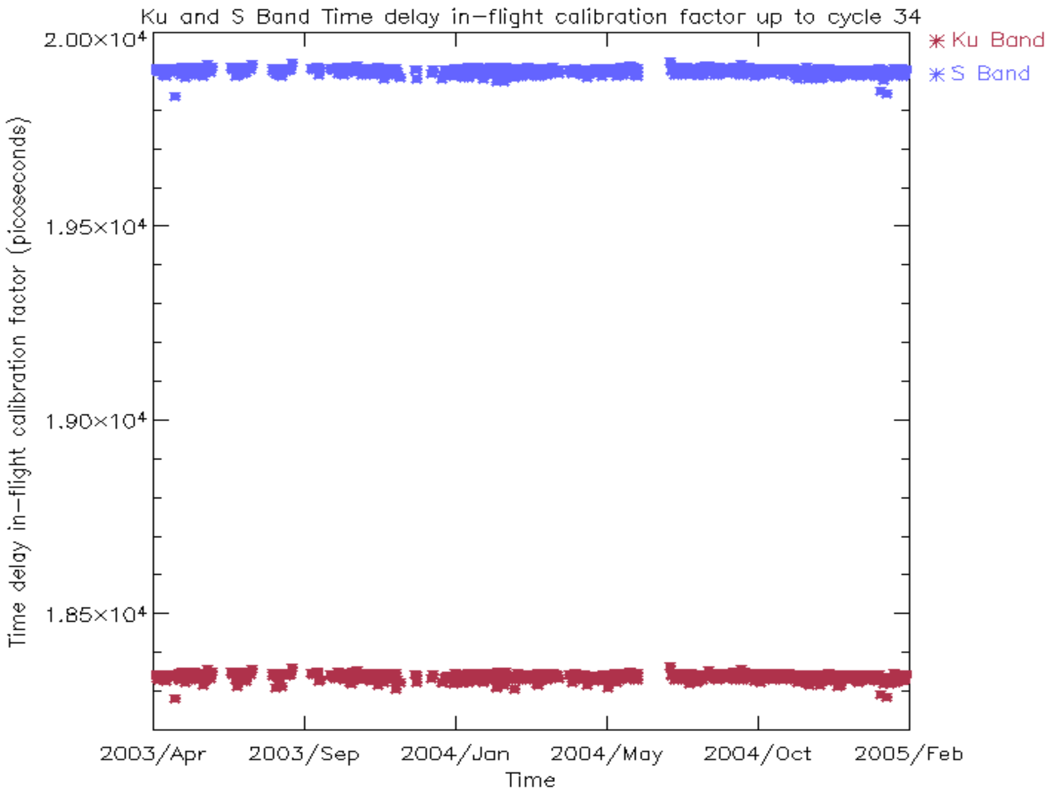

Figure 28: Ku and S Band in-flight time delay calibration factor up to cycle 34

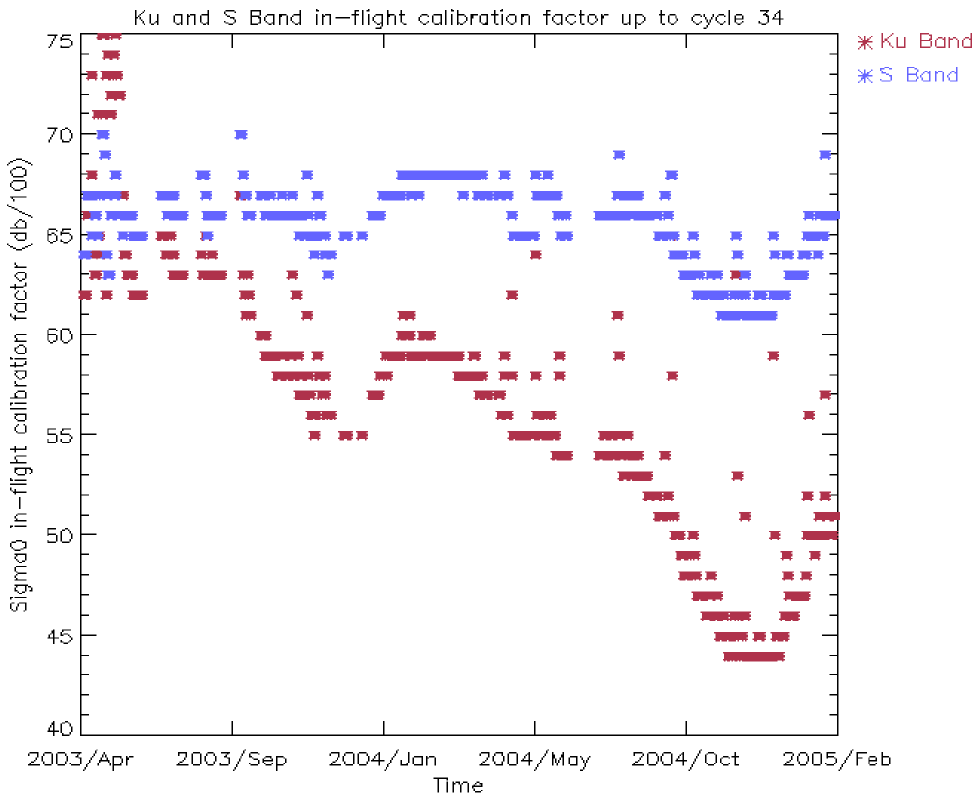

Figure 29: Ku and S Band in-flight Sigma0 calibration factor up to cycle 34

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 34. Considering as reference the instrument unavailability, it is possible to notice that in the last two cycles the situation is slightly improved for all levels of products.

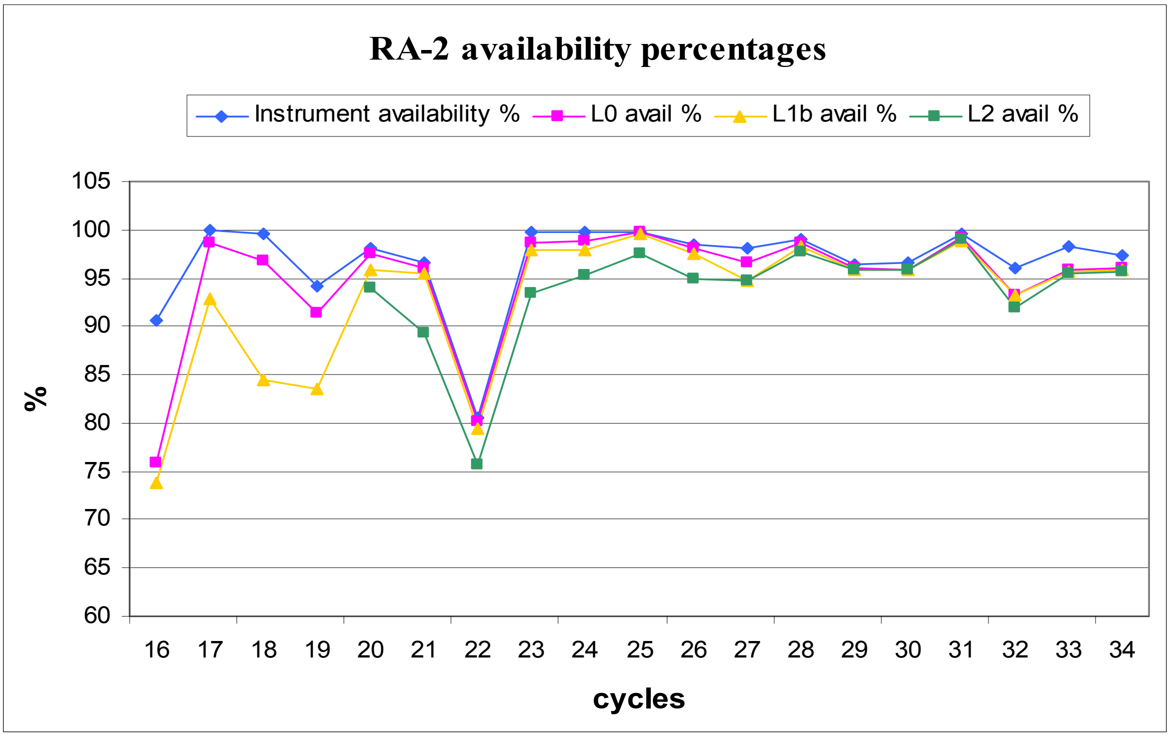

Figure 30: Percentage of Products unavailability up to cycle 34

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

No current results for the time being. 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.

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).

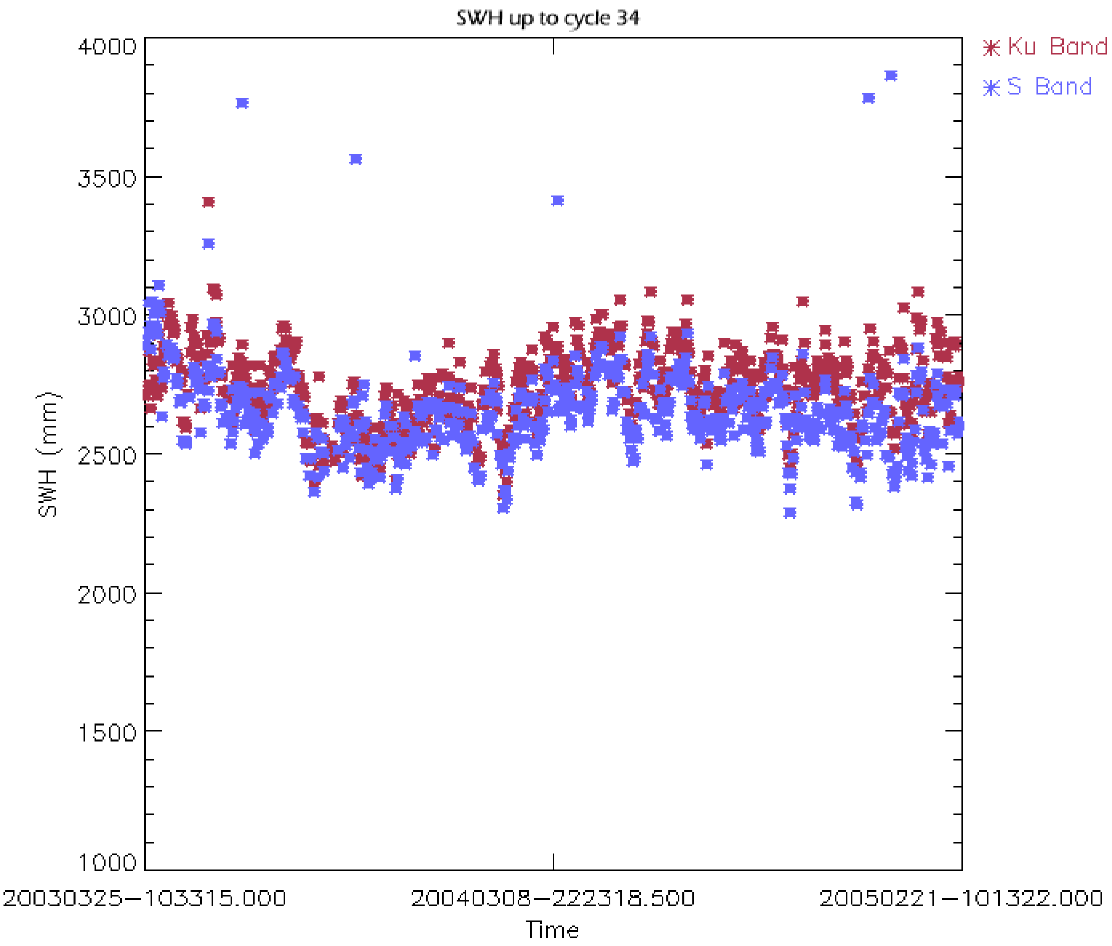

Figure 31: Ku and S SWH daily average up to cycle 34 (mm)

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.

When looking carefully a tiny increasing trend can be noticed that causes a change in the Ku-Band backscattering coefficient of about 0.2 dBs over the whole reported period. This could be due to the Ku-Band Sigma0 in-flight calibration factor behaviour which shows a decrease of 0.2 dBs over the same time frame. However, despite the jump, the same increasing trend can eventually be detected for the S-band backscattering coefficient while the S-Band Sigma0 in-flight calibration does not show a decreasing trend as the Ku-band one.

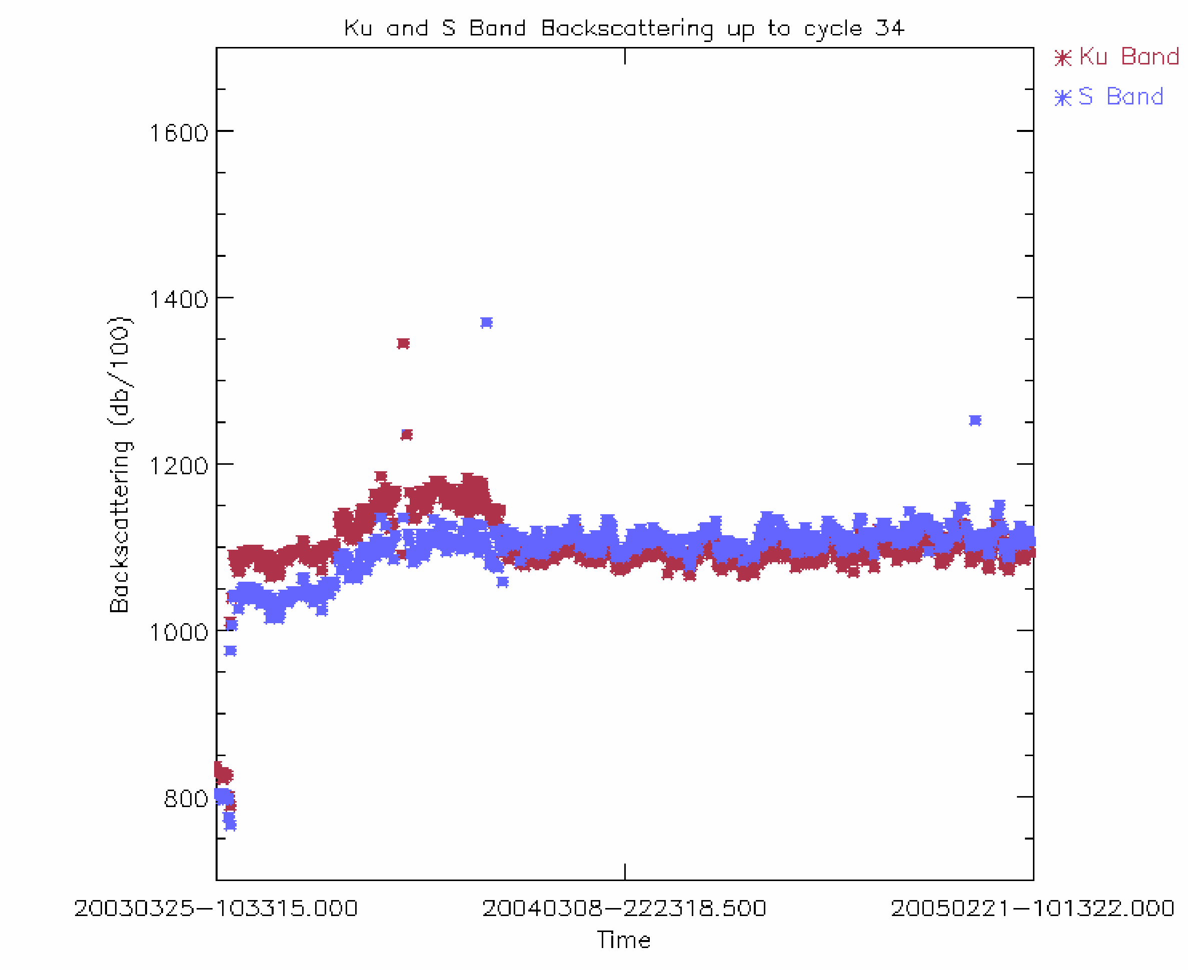

Figure 32: Ku and S band Backscattering daily averages up to cycle 34 (dB/100)

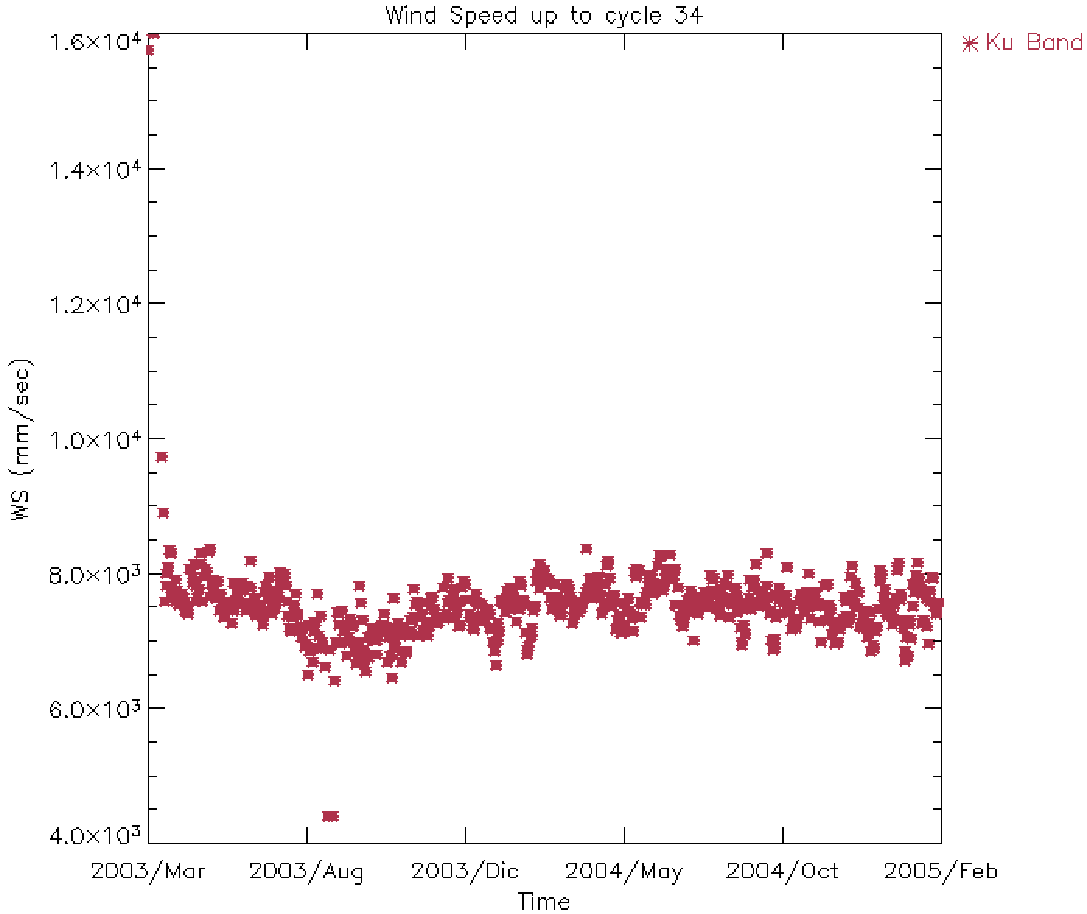

Figure 33: Wind Speed daily averages up to cycle 34 (mm/s)

10 PARTICULAR INVESTIGATIONS

During cycle 34 no special investigation has been performed.