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ENVISAT CYCLIC ALTIMETRIC REPORT

CYCLE 38 from 06-06-2005 to 11-07-2005

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 38.

This report covers the period from the 6th of June 2005 and the 11th of July.

2 DISTRIBUTION LIST

This report is available in PDF format at the internet address
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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-15389-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 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 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 38

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 38

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 38

5.3 Orbit quality

During cycle 38 one small manouvre was executed, whose details are given hereafter:

Manoeuvre on June 8, 2005 (DOY 159):

- Planned delta V size: 0.01137 m/s (in the flight direction)
- Mid thrust time: 20:06:11 UTC at PSO 180.27 degrees
- Thrust duration: 6 seconds
- Measured delta V: 0.01130 m/s (in the flight direction)

This manoeuvre, together with the previous one executed on May 20, 2005 (see ECAR Cycle 37), had a twofold objective:

- start a new ground track control cycle around the reference orbit
- overfly on June 11th, 2005 at 03:25:03 UTC a reference point on the Earth surface

overflown 105 days earlier (February 26, 2005, 03:24:57.0 UTC, coordinates: 96.28 degrees East, 3.62 degrees North).

The combined effect of both manoeuvres and the actual air drag conditions brought the ground track to circa 14 metres West (+/-0.5 metre) of the reference point at the targeted overfly time.

The orbit was maintained within the +/- 1km to the reference ground track during cycle 38.

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_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 38, was once switched to Suspend due to an uncontrolled Software action, with an RBI Status of 4082h. This is a repeat of an expected anomaly which is under investigation (ref: AR ENV-774).

Start: 4 Jul 2005 04:41:10.000, orbit= 17479
Stop: 4 Jul 2005 11:19:39.000, orbit = 17483

The instrument was recovered the same day, with measurement operations resuming at 185.11.19.40.

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)

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

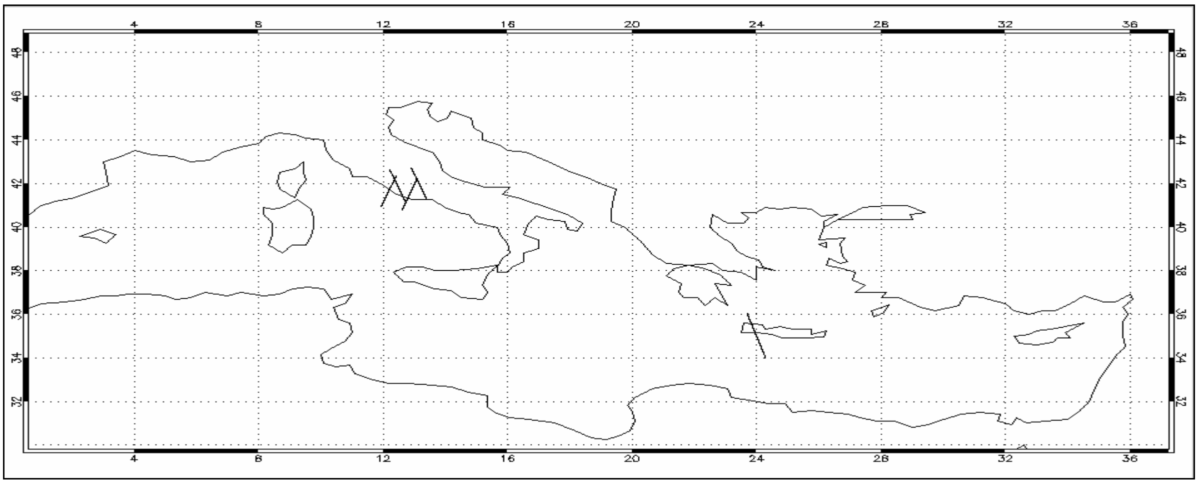

Figure 1: Transponder Acquisition sites for cycle 38

6.2 MWR Events

The MWR, during cycle 38 was never unavailable [R-13].

6.3 DORIS Events

The DORIS during cycle 38 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 38 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 38 the number of valid IF masks have been of 14, representing about the 20% 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).

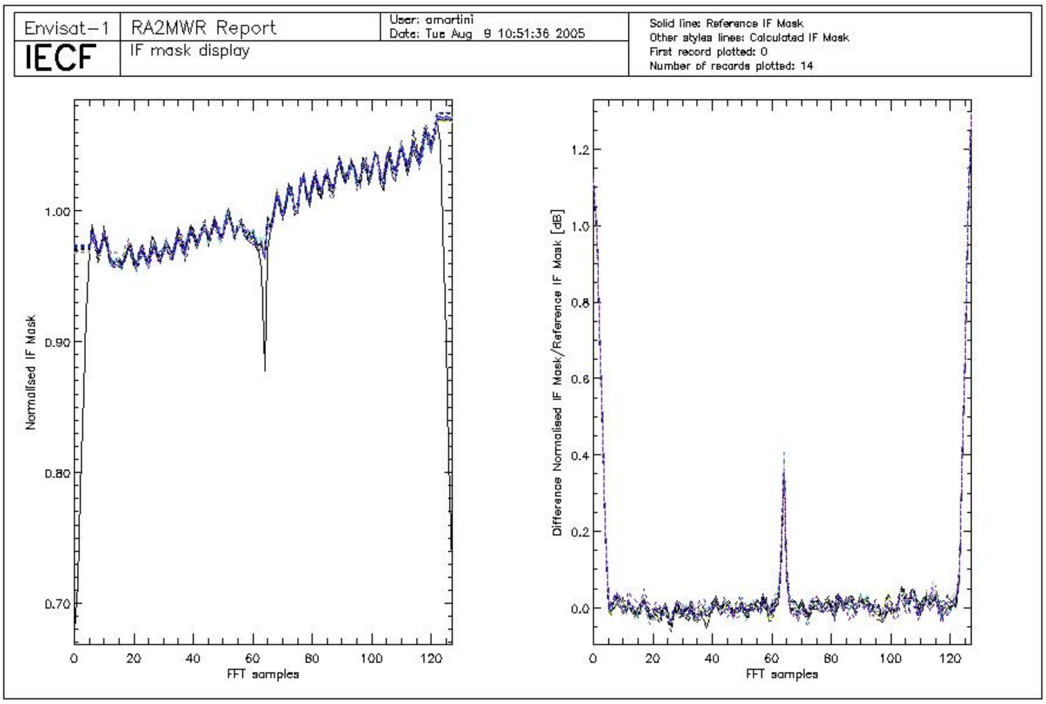

Figure 2: Valid IF masks retrieved daily during cycle 38 plotted together with the on-ground reference.

7.1.2 USO

In Figure 3 the USO clock period trend retrieved for cycle 38 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 peak observed is due to the anomaly recovery after the unavailability on July 4th.

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.

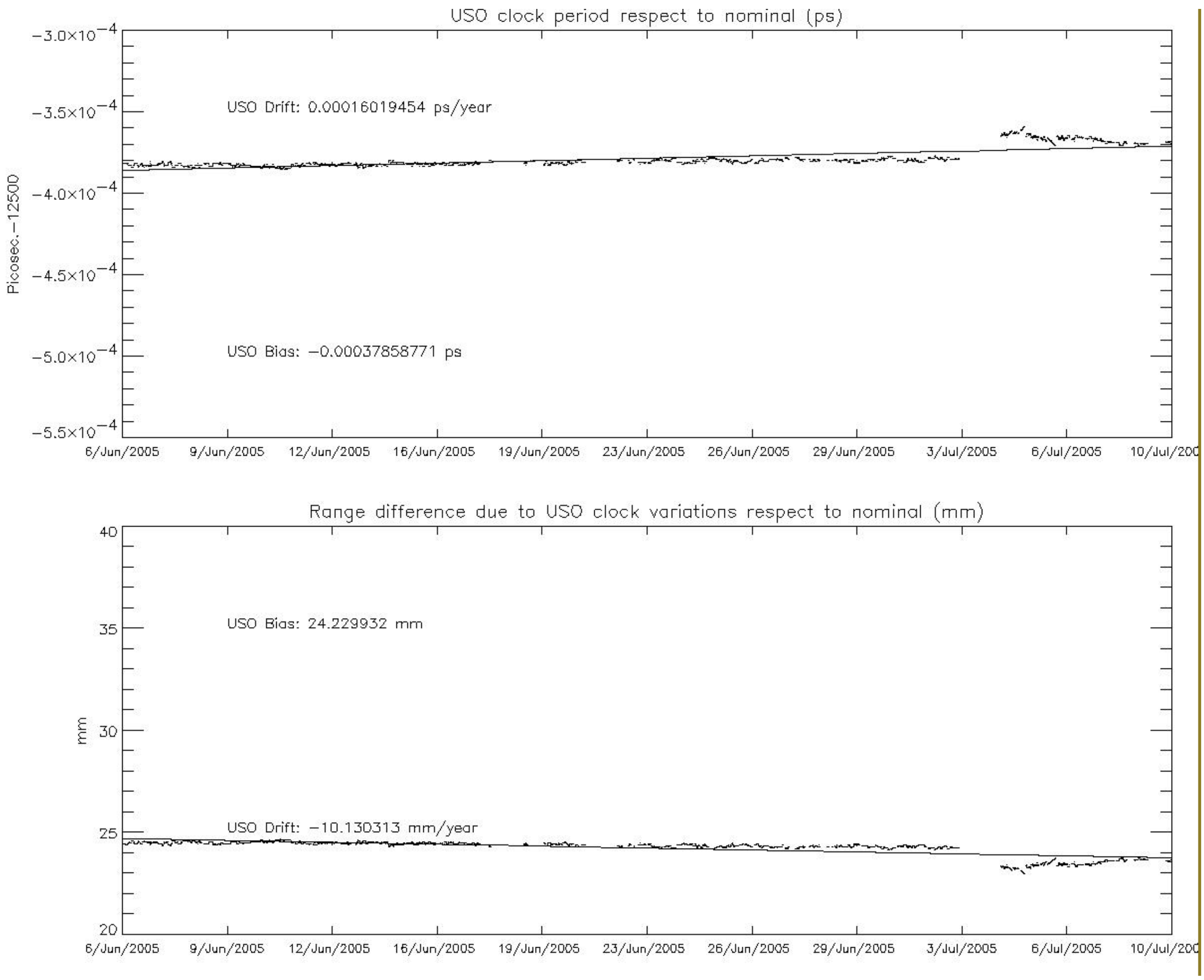

Figure 3: USO clock period for cycle 38

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	99,99	0,00	0,00
Costal Water (ocean depth < 200 m)	98,45	1,37	0,18
Sea Ice	99,15	0,78	0,07
Ice Sheet	96,09	3,18	0,73
Land	81,94	14,19	3,87
All world	95,12	3,90	0,97

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 38 have been positive. The operation planned on June 9th (Fiuggi site) has been regularly performed but the TPD signal has only partially 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 cycle 41.
An anomaly occurred during the calibration campaign on 21st of June. At the Envisat overpass, the attenuator setting of the transponder was too high (about 17.8 dB) with respect to the typical values of 1.6-2.5 dB. This anomaly didn't occur during the following two acquisitions.

The acquisitions were executed in High Resolution mode. The dates and times of the acquisitions are reported hereafter:

28-Jun-05, Roma, 20:39:25
07-Jul-05, Valmontone, 09:39:08

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]
17403	28-jun-05	Rome / 315	41.8472, 12.4819	High	1.13	0.08
17525	07-jul-05	Valmontone/437	41.7673, 12.9247	High	1.04	0.065

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 high UTC residuals shown in the plot on mjd 213(-30 usec) was due to a problem occurred in data availability for time correlation on the 6^{th} of July. The problem only lasted for 24 hours.

In the lower panel the ICU clock step for the same period is shown.

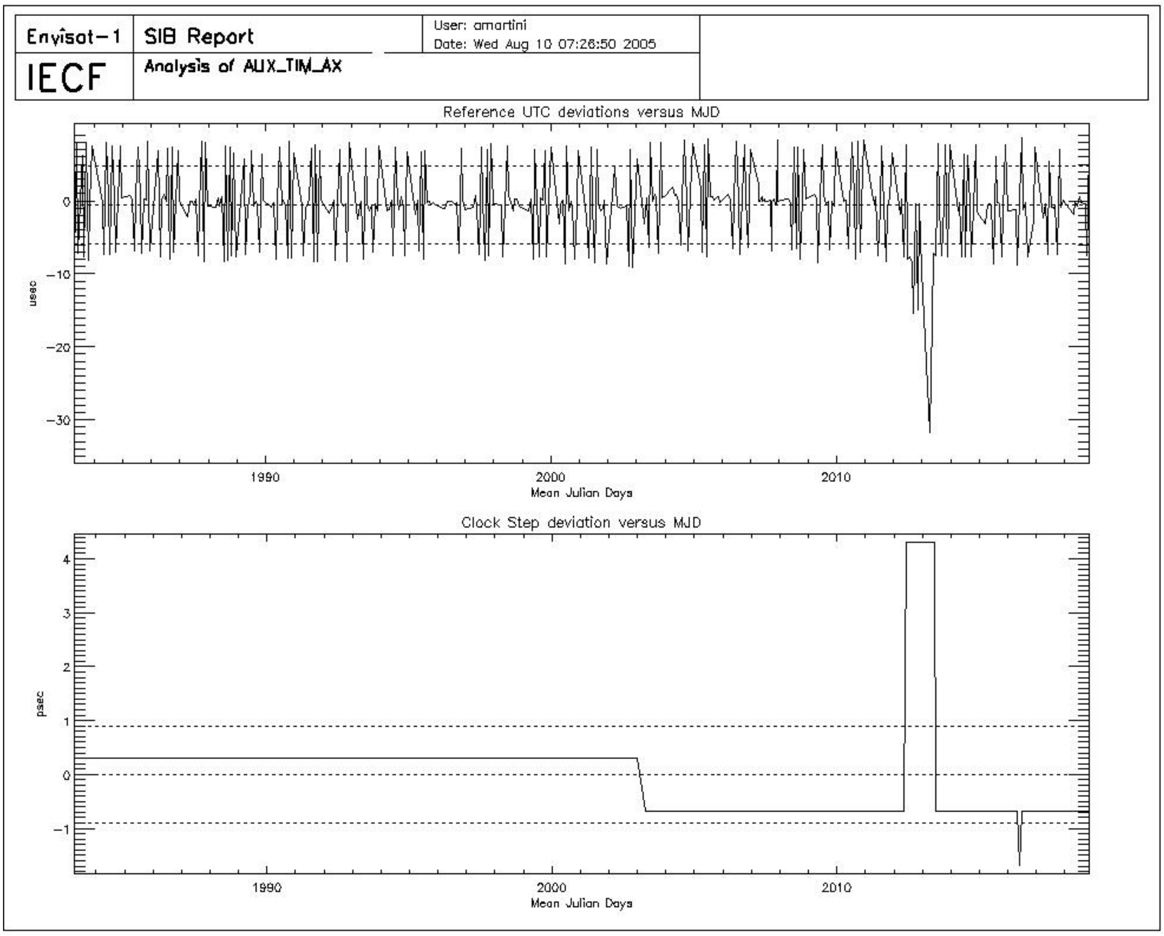

Figure 6: UTC deviations and ICU clock period for cycle 38

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 one event of low mispointing value is present and visible in the plot of Figure 7. This event is in correspondence with the instrument anomaly occurred on July 4th, as reported in par. 6.1.

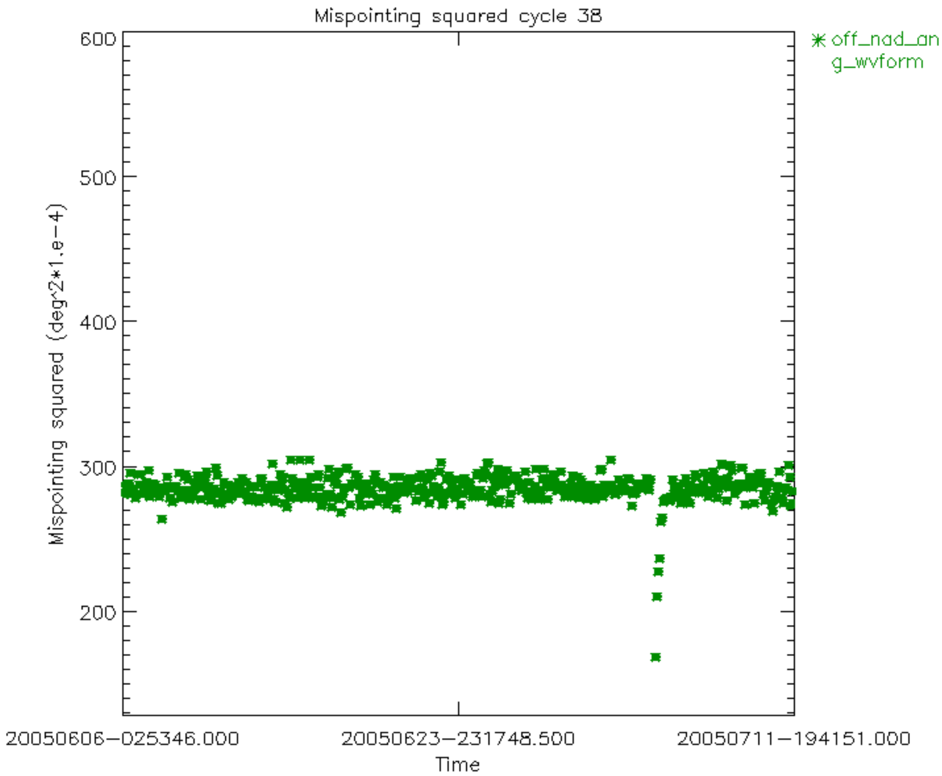

Figure 7: Smoothed mispointing squared trend for cycle 38 (deg^2*10^4)

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 38. This corresponds to a total percentage of about 1.81% 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_2PNPDK20050620_150057_000050782038_00197_17285_0164.N1	20-JUN-2005	15:00:57.87	20-JUN-2005	16:25:35.43
RA2_FGD_2PNPDK20050622_171455_000057942038_00227_17315_0190.N1	22-JUN-2005	17:14:55.51	22-JUN-2005	18:51:29.37
RA2_FGD_2PNPDK20050622_185027_000060612038_00228_17316_0191.N1	22-JUN-2005	18:50:27.04	22-JUN-2005	20:31:28.26
RA2_FGD_2PNPDE20050622_202928_000044972038_00229_17317_0148.N1	22-JUN-2005	20:29:28.00	22-JUN-2005	21:44:25.17
RA2_FGD_2PNPDE20050622_214321_000062182038_00229_17317_0149.N1	22-JUN-2005	21:43:21.72	22-JUN-2005	23:27:00.02
RA2_FGD_2PNPDE20050622_232601_000061222038_00230_17318_0150.N1	22-JUN-2005	23:26:01.03	23-JUN-2005	01:08:03.52
RA2_FGD_2PNPDE20050623_010658_000042422038_00231_17319_0151.N1	23-JUN-2005	01:06:58.96	23-JUN-2005	02:17:41.02
RA2_FGD_2PNPDE20050623_021708_000061682038_00232_17320_0152.N1	23-JUN-2005	02:17:08.77	23-JUN-2005	03:59:56.93
RA2_FGD_2PNPDE20050623_035924_000047782038_00233_17321_0153.N1	23-JUN-2005	03:59:24.68	23-JUN-2005	05:19:02.57

Table 6: List of L2 FGD Files affected by S-Band anomaly during cycle 38

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 38 (averaged per day) are reported in the next figures. The high values of the Sigma0 calibration factor plotted in Figure 9 is related to the RA-2 anomaly recovery (see section 6.1). The two calibration factors show a regular behaviour as observed on previous cycles.

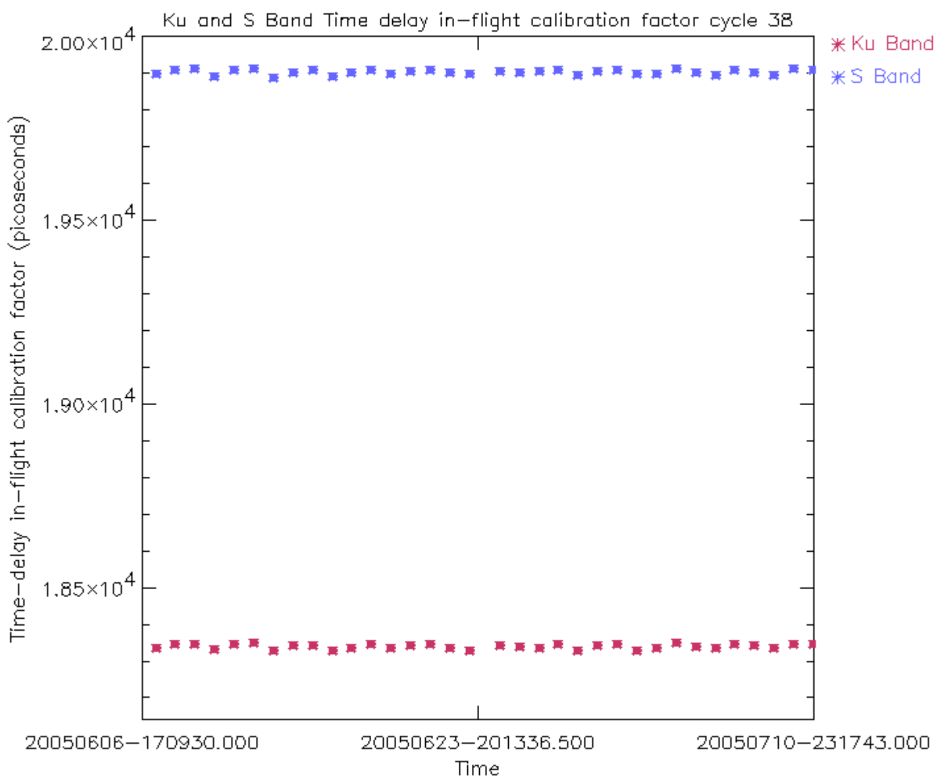

Figure 8: Ku and S Band in-flight time delay calibration factor for cycle 38

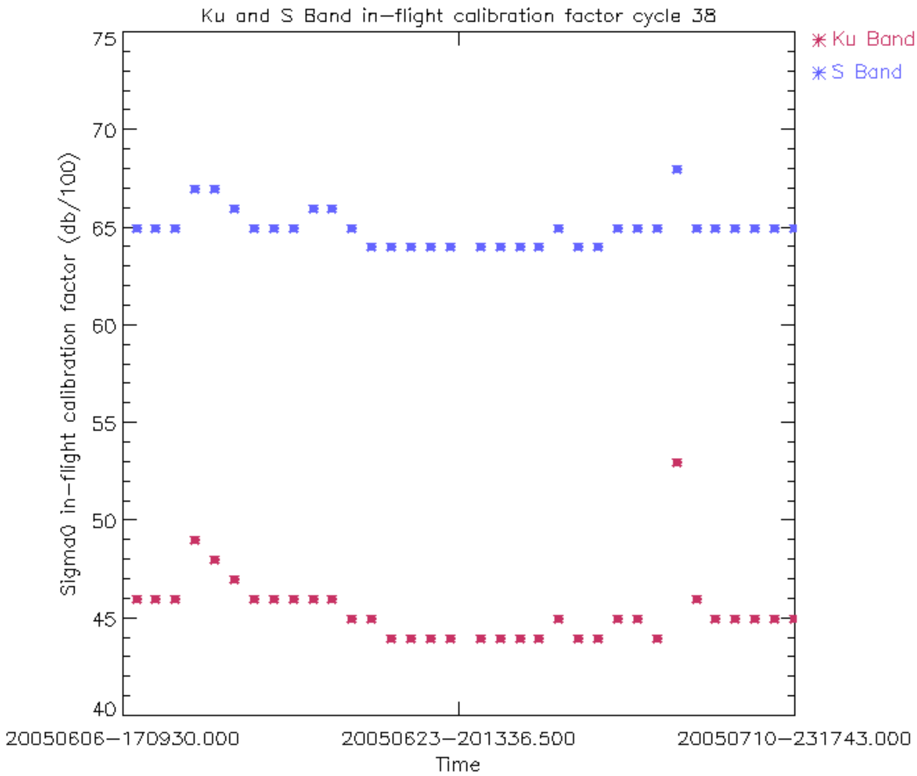

Figure 9: Ku and S Band in-flight Sigma0 calibration factor for cycle 38

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.

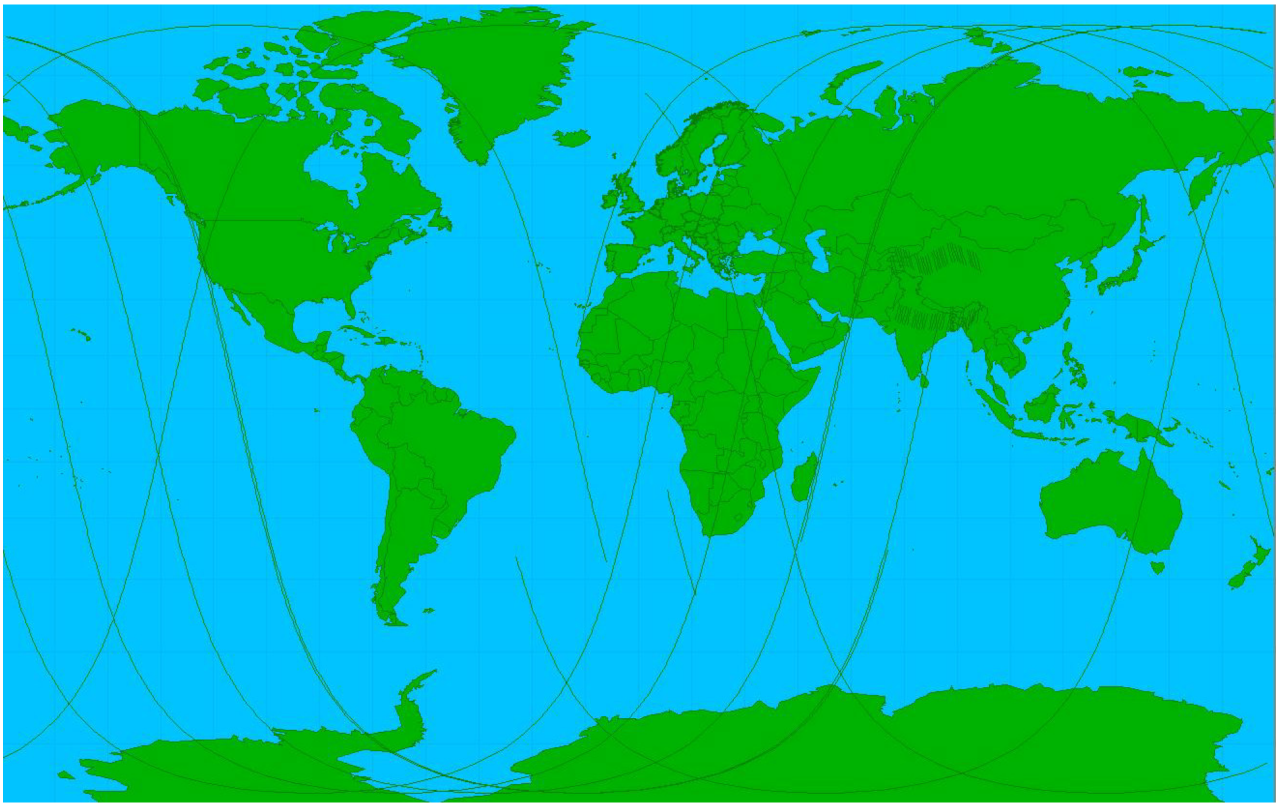

Figure 10: RA-2 L0 unavailable products for cycle 38

Start date	Start time	Stop date	Stop time	Duration [sec]	Start orbit	Stop orbit	Reason
06-JUN-2005	4.15.39	06-JUN-2005	4.16.57	78	17078	17078	PDS_UNKNOWN_FAILURE
06-JUN-2005	15.28.07	06-JUN-2005	15.29.25	78	17085	17085	PDS_UNKNOWN_FAILURE
10-JUN-2005	16.42.11	10-JUN-2005	16.43.28	77	17143	17143	PDS_UNKNOWN_FAILURE
11-JUN-2005	4.58.43	11-JUN-2005	5.00.01	78	17150	17150	PDS_UNKNOWN_FAILURE
11-JUN-2005	16.10.26	11-JUN-2005	16.11.44	78	17157	17157	PDS_UNKNOWN_FAILURE
07-JUN-2005	5.23.59	07-JUN-2005	5.25.17	78	17093	17093	PDS_UNKNOWN_FAILURE
07-JUN-2005	16.36.46	07-JUN-2005	16.38.04	78	17100	17100	PDS_UNKNOWN_FAILURE
08-JUN-2005	4.53.04	08-JUN-2005	4.54.22	78	17107	17107	PDS_UNKNOWN_FAILURE
08-JUN-2005	16.04.43	08-JUN-2005	16.06.01	78	17114	17114	PDS_UNKNOWN_FAILURE
09-JUN-2005	4.21.27	09-JUN-2005	4.22.45	78	17121	17121	PDS_UNKNOWN_FAILURE
09-JUN-2005	15.30.54	09-JUN-2005	15.30.57	3	17128	17128	PDS_UNKNOWN_FAILURE
09-JUN-2005	15.33.58	09-JUN-2005	15.35.16	78	17128	17128	PDS_UNKNOWN_FAILURE
10-JUN-2005	5.28.58	10-JUN-2005	5.30.16	78	17136	17136	PDS_UNKNOWN_FAILURE
13-JUN-2005	3.53.28	13-JUN-2005	3.53.30	2	17178	17178	PDS_UNKNOWN_FAILURE
13-JUN-2005	3.55.07	13-JUN-2005	3.56.25	78	17178	17178	PDS_UNKNOWN_FAILURE
17-JUN-2005	5.07.45	17-JUN-2005	5.07.48	3	17236	17236	PDS_UNKNOWN_FAILURE
17-JUN-2005	5.09.58	17-JUN-2005	5.11.16	78	17236	17236	PDS_UNKNOWN_FAILURE
17-JUN-2005	16.22.17	17-JUN-2005	16.23.34	77	17243	17243	PDS_UNKNOWN_FAILURE
18-JUN-2005	4.38.43	18-JUN-2005	4.40.01	78	17250	17250	PDS_UNKNOWN_FAILURE

18-JUN-2005	15.50.46	18-JUN-2005	15.52.04	78	17257	17257	PDS_UNKNOWN_FAILURE
13-JUN-2005	15.07.26	13-JUN-2005	15.08.44	78	17185	17185	PDS_UNKNOWN_FAILURE
14-JUN-2005	5.04.21	14-JUN-2005	5.05.38	77	17193	17193	PDS_UNKNOWN_FAILURE
14-JUN-2005	16.16.21	14-JUN-2005	16.17.39	78	17200	17200	PDS_UNKNOWN_FAILURE
15-JUN-2005	4.32.58	15-JUN-2005	4.34.16	78	17207	17207	PDS_UNKNOWN_FAILURE
15-JUN-2005	4.51.08	15-JUN-2005	6.31.12	6004	17207	17208	PDS_UNKNOWN_FAILURE
15-JUN-2005	15.45.10	15-JUN-2005	15.46.28	78	17214	17214	PDS_UNKNOWN_FAILURE
16-JUN-2005	4.01.00	16-JUN-2005	4.02.18	78	17221	17221	PDS_UNKNOWN_FAILURE
16-JUN-2005	15.13.21	16-JUN-2005	15.14.39	78	17228	17228	PDS_UNKNOWN_FAILURE
20-JUN-2005	5.13.23	20-JUN-2005	5.13.25	2	17279	17279	PDS_UNKNOWN_FAILURE
20-JUN-2005	5.15.35	20-JUN-2005	5.16.53	78	17279	17279	PDS_UNKNOWN_FAILURE
23-JUN-2005	16.34.06	23-JUN-2005	16.35.24	78	17329	17329	PDS_UNKNOWN_FAILURE
24-JUN-2005	4.47.38	24-JUN-2005	4.47.40	2	17336	17336	PDS_UNKNOWN_FAILURE
24-JUN-2005	4.50.14	24-JUN-2005	4.51.32	78	17336	17336	PDS_UNKNOWN_FAILURE
24-JUN-2005	16.01.58	24-JUN-2005	16.03.16	78	17343	17343	PDS_UNKNOWN_FAILURE
25-JUN-2005	4.18.37	25-JUN-2005	4.19.55	78	17350	17350	PDS_UNKNOWN_FAILURE
25-JUN-2005	15.31.07	25-JUN-2005	15.32.24	77	17357	17357	PDS_UNKNOWN_FAILURE
20-JUN-2005	16.28.12	20-JUN-2005	16.29.29	77	17286	17286	PDS_UNKNOWN_FAILURE
20-JUN-2005	19.55.10	20-JUN-2005	19.59.27	257	17288	17288	PDS_UNKNOWN_FAILURE
21-JUN-2005	4.44.29	21-JUN-2005	4.45.46	77	17293	17293	PDS_UNKNOWN_FAILURE
21-JUN-2005	15.56.22	21-JUN-2005	15.57.40	78	17300	17300	PDS_UNKNOWN_FAILURE
22-JUN-2005	4.12.45	22-JUN-2005	4.14.03	78	17307	17307	PDS_UNKNOWN_FAILURE
22-JUN-2005	15.22.29	22-JUN-2005	15.22.31	2	17314	17314	PDS_UNKNOWN_FAILURE
22-JUN-2005	15.25.12	22-JUN-2005	15.26.29	77	17314	17314	PDS_UNKNOWN_FAILURE
23-JUN-2005	5.21.13	23-JUN-2005	5.22.31	78	17322	17322	PDS_UNKNOWN_FAILURE
27-JUN-2005	4.55.57	27-JUN-2005	4.57.14	77	17379	17379	PDS_UNKNOWN_FAILURE
27-JUN-2005	16.07.34	27-JUN-2005	16.08.51	77	17386	17386	PDS_UNKNOWN_FAILURE
01-JUL-2005	15.42.24	01-JUL-2005	15.43.42	78	17443	17443	PDS_UNKNOWN_FAILURE
02-JUL-2005	3.58.05	02-JUL-2005	3.59.23	78	17450	17450	PDS_UNKNOWN_FAILURE
02-JUL-2005	15.10.25	02-JUL-2005	15.11.43	78	17457	17457	PDS_UNKNOWN_FAILURE
28-JUN-2005	4.24.22	28-JUN-2005	4.25.40	78	17393	17393	PDS_UNKNOWN_FAILURE
28-JUN-2005	15.36.49	28-JUN-2005	15.38.06	77	17400	17400	PDS_UNKNOWN_FAILURE
29-JUN-2005	3.52.13	29-JUN-2005	3.53.31	78	17407	17407	PDS_UNKNOWN_FAILURE
29-JUN-2005	16.44.55	29-JUN-2005	16.46.13	78	17415	17415	PDS_UNKNOWN_FAILURE
29-JUN-2005	23.05.30	30-JUN-2005	0.22.01	4591	17418	17419	PDS_UNKNOWN_FAILURE
30-JUN-2005	5.01.34	30-JUN-2005	5.02.52	78	17422	17422	PDS_UNKNOWN_FAILURE
30-JUN-2005	16.13.26	30-JUN-2005	16.14.44	78	17429	17429	PDS_UNKNOWN_FAILURE
01-JUL-2005	4.30.07	01-JUL-2005	4.31.25	78	17436	17436	PDS_UNKNOWN_FAILURE
30-JUN-2005	0.22.01	30-JUN-2005	0.46.31	1470	17419	17419	UNAV_ARTEMIS
04-JUL-2005	4.35.52	04-JUL-2005	4.41.10	318	17479	17479	PDS_UNKNOWN_FAILURE
04-JUL-2005	11.19.39	04-JUL-2005	11.20.46	67	17483	17483	PDS_UNKNOWN_FAILURE
07-JUL-2005	4.41.37	07-JUL-2005	4.42.55	78	17522	17522	PDS_UNKNOWN_FAILURE
07-JUL-2005	15.50.52	07-JUL-2005	15.50.54	2	17529	17529	PDS_UNKNOWN_FAILURE
07-JUL-2005	15.53.35	07-JUL-2005	15.54.53	78	17529	17529	PDS_UNKNOWN_FAILURE

08-JUL-2005	4.09.50	08-JUL-2005	4.11.07	77	17536	17536	PDS_UNKNOWN_FAILURE
08-JUL-2005	15.22.15	08-JUL-2005	15.23.33	78	17543	17543	PDS_UNKNOWN_FAILURE
09-JUL-2005	5.18.25	09-JUL-2005	5.19.43	78	17551	17551	PDS_UNKNOWN_FAILURE
09-JUL-2005	16.31.10	09-JUL-2005	16.32.28	78	17558	17558	PDS_UNKNOWN_FAILURE
09-JUL-2005	18.16.07	09-JUL-2005	19.55.33	5966	17559	17560	PDS_UNKNOWN_FAILURE
04-JUL-2005	15.45.06	04-JUL-2005	15.45.09	3	17486	17486	PDS_UNKNOWN_FAILURE
04-JUL-2005	15.48.00	04-JUL-2005	15.49.18	78	17486	17486	PDS_UNKNOWN_FAILURE
05-JUL-2005	4.03.58	05-JUL-2005	4.05.15	77	17493	17493	PDS_UNKNOWN_FAILURE
05-JUL-2005	15.16.20	05-JUL-2005	15.17.38	78	17500	17500	PDS_UNKNOWN_FAILURE
05-JUL-2005	21.34.15	05-JUL-2005	21.41.40	445	17503	17503	PDS_UNKNOWN_FAILURE
06-JUL-2005	5.10.35	06-JUL-2005	5.10.38	3	17508	17508	PDS_UNKNOWN_FAILURE
06-JUL-2005	5.12.48	06-JUL-2005	5.14.06	78	17508	17508	PDS_UNKNOWN_FAILURE
06-JUL-2005	16.25.15	06-JUL-2005	16.26.33	78	17515	17515	PDS_UNKNOWN_FAILURE
04-JUL-2005	4.41.10	04-JUL-2005	11.19.39	23909	17479	17483	UNAV_RA2

Table 7: List of gaps for RA-2 L0 products during cycle 38

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

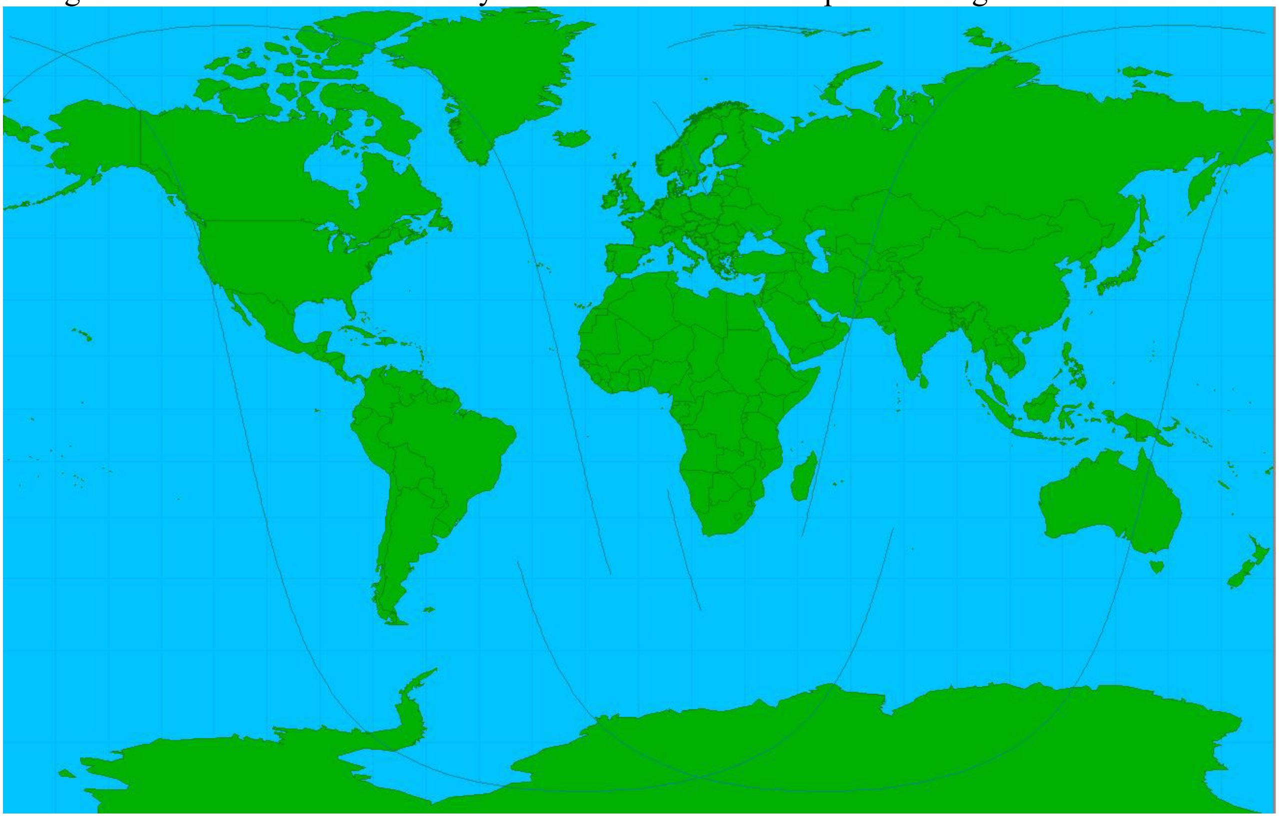

Figure 11: MWR L0 unavailable products for cycle 38

Start date	Start time	Stop date	Stop time	Duration [sec]	Start orbit	Stop orbit	Reason
06-JUN-2005	14.00.55	06-JUN-2005	14.01.43	48	17084	17084	PDS_UNKNOWN_FAILURE
15-JUN-2005	4.49.39	15-JUN-2005	6.30.51	6072	17207	17208	PDS_UNKNOWN_FAILURE
20-JUN-2005	16.37.51	20-JUN-2005	16.38.39	48	17286	17286	PDS_UNKNOWN_FAILURE
20-JUN-2005	19.53.52	20-JUN-2005	19.59.04	312	17288	17288	PDS_UNKNOWN_FAILURE
24-JUN-2005	12.56.00	24-JUN-2005	12.56.48	48	17341	17341	PDS_UNKNOWN_FAILURE
25-JUN-2005	14.03.38	25-JUN-2005	14.04.26	48	17356	17356	PDS_UNKNOWN_FAILURE
27-JUN-2005	14.40.31	27-JUN-2005	14.41.19	48	17385	17385	PDS_UNKNOWN_FAILURE
29-JUN-2005	23.04.36	30-JUN-2005	0.22.01	4645	17418	17419	PDS_UNKNOWN_FAILURE
30-JUN-2005	0.22.01	30-JUN-2005	0.46.12	1451	17419	17419	UNAV_ARTEMIS
04-JUL-2005	12.42.23	04-JUL-2005	12.43.10	47	17484	17484	PDS_UNKNOWN_FAILURE
05-JUL-2005	21.33.14	05-JUL-2005	21.41.38	504	17503	17503	PDS_UNKNOWN_FAILURE
08-JUL-2005	13.54.32	08-JUL-2005	13.55.20	48	17542	17542	PDS_UNKNOWN_FAILURE
09-JUL-2005	18.15.22	09-JUL-2005	19.55.22	6000	17559	17560	PDS_UNKNOWN_FAILURE

Table 8: List of gaps for MWR L0 products during cycle 38

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.

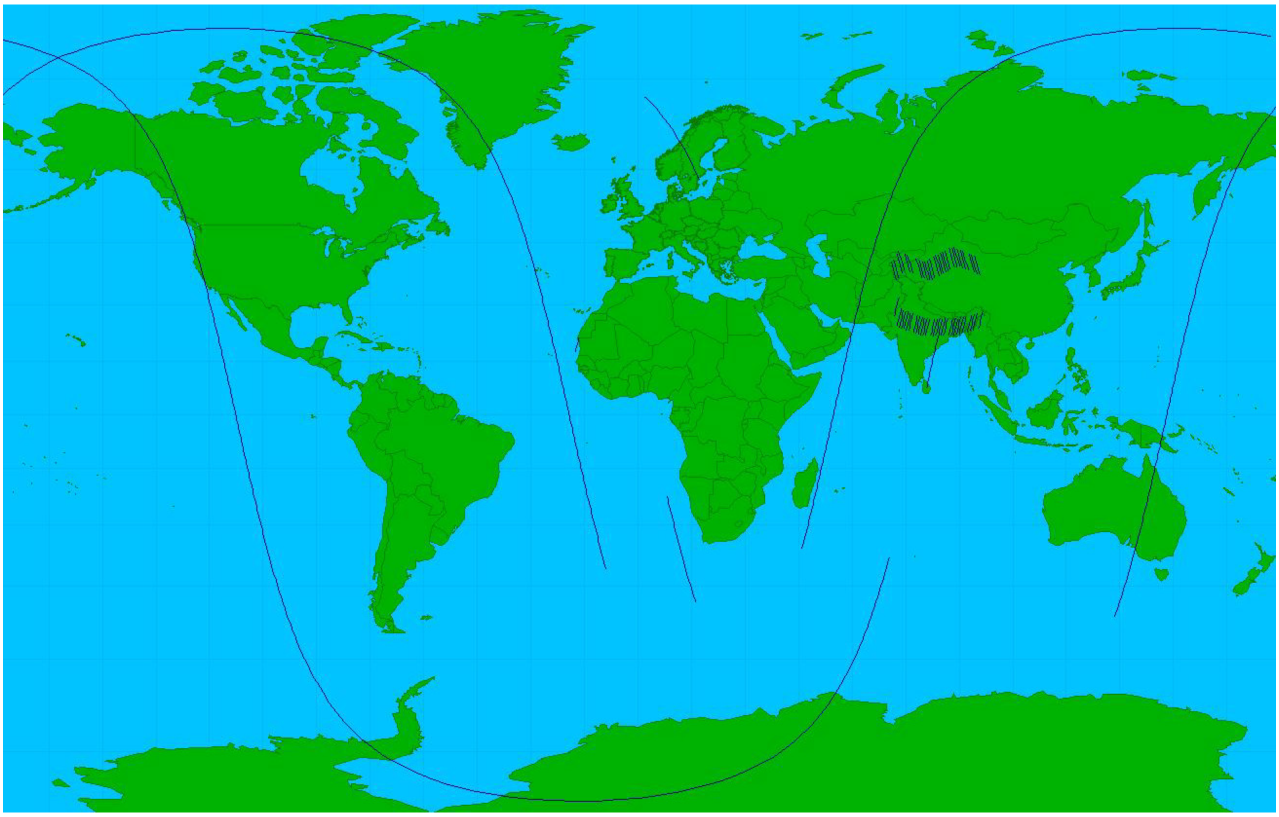

Figure 12: RA-2 L1b unavailable products for cycle 38

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

20-JUN-2005	16.28.12	20-JUN-2005	16.29.29	77	17286	17286	PDS_UNKNOWN_FAILURE
24-JUN-2005	16.01.58	24-JUN-2005	16.03.16	78	17343	17343	PDS_UNKNOWN_FAILURE
25-JUN-2005	4.18.37	25-JUN-2005	4.19.55	78	17350	17350	PDS_UNKNOWN_FAILURE
25-JUN-2005	15.31.07	25-JUN-2005	15.32.24	77	17357	17357	PDS_UNKNOWN_FAILURE
20-JUN-2005	19.55.11	20-JUN-2005	19.59.27	256	17288	17288	PDS_UNKNOWN_FAILURE
21-JUN-2005	4.44.29	21-JUN-2005	4.45.46	77	17293	17293	PDS_UNKNOWN_FAILURE
21-JUN-2005	15.56.22	21-JUN-2005	15.57.40	78	17300	17300	PDS_UNKNOWN_FAILURE
22-JUN-2005	4.12.45	22-JUN-2005	4.14.03	78	17307	17307	PDS_UNKNOWN_FAILURE
22-JUN-2005	15.25.12	22-JUN-2005	15.26.29	77	17314	17314	PDS_UNKNOWN_FAILURE
23-JUN-2005	5.21.13	23-JUN-2005	5.22.31	78	17322	17322	PDS_UNKNOWN_FAILURE
23-JUN-2005	16.34.06	23-JUN-2005	16.35.24	78	17329	17329	PDS_UNKNOWN_FAILURE
24-JUN-2005	4.50.14	24-JUN-2005	4.51.32	78	17336	17336	PDS_UNKNOWN_FAILURE
27-JUN-2005	4.55.57	27-JUN-2005	4.57.14	77	17379	17379	PDS_UNKNOWN_FAILURE
27-JUN-2005	16.07.34	27-JUN-2005	16.08.51	77	17386	17386	PDS_UNKNOWN_FAILURE
01-JUL-2005	15.42.24	01-JUL-2005	15.43.42	78	17443	17443	PDS_UNKNOWN_FAILURE
02-JUL-2005	3.58.05	02-JUL-2005	3.59.23	78	17450	17450	PDS_UNKNOWN_FAILURE
02-JUL-2005	15.10.25	02-JUL-2005	15.11.43	78	17457	17457	PDS_UNKNOWN_FAILURE
28-JUN-2005	4.24.22	28-JUN-2005	4.25.40	78	17393	17393	PDS_UNKNOWN_FAILURE
28-JUN-2005	15.36.49	28-JUN-2005	15.38.06	77	17400	17400	PDS_UNKNOWN_FAILURE
29-JUN-2005	3.52.13	29-JUN-2005	3.53.31	78	17407	17407	PDS_UNKNOWN_FAILURE
29-JUN-2005	16.44.55	29-JUN-2005	16.46.13	78	17415	17415	PDS_UNKNOWN_FAILURE
29-JUN-2005	23.05.31	30-JUN-2005	0.22.01	4590	17418	17419	PDS_UNKNOWN_FAILURE
30-JUN-2005	5.01.34	30-JUN-2005	5.02.52	78	17422	17422	PDS_UNKNOWN_FAILURE
30-JUN-2005	16.13.26	30-JUN-2005	16.14.44	78	17429	17429	PDS_UNKNOWN_FAILURE
01-JUL-2005	4.30.07	01-JUL-2005	4.31.25	78	17436	17436	PDS_UNKNOWN_FAILURE
04-JUL-2005	4.35.52	04-JUL-2005	4.41.10	318	17479	17479	PDS_UNKNOWN_FAILURE
04-JUL-2005	11.19.39	04-JUL-2005	11.20.46	67	17483	17483	PDS_UNKNOWN_FAILURE
07-JUL-2005	15.53.35	07-JUL-2005	15.54.53	78	17529	17529	PDS_UNKNOWN_FAILURE
08-JUL-2005	4.09.50	08-JUL-2005	4.11.07	77	17536	17536	PDS_UNKNOWN_FAILURE
08-JUL-2005	15.22.15	08-JUL-2005	15.23.33	78	17543	17543	PDS_UNKNOWN_FAILURE
09-JUL-2005	5.18.25	09-JUL-2005	5.19.43	78	17551	17551	PDS_UNKNOWN_FAILURE
09-JUL-2005	16.31.10	09-JUL-2005	16.32.28	78	17558	17558	PDS_UNKNOWN_FAILURE
09-JUL-2005	18.16.08	09-JUL-2005	19.55.33	5965	17559	17560	PDS_UNKNOWN_FAILURE
04-JUL-2005	15.45.07	04-JUL-2005	15.45.09	2	17486	17486	PDS_UNKNOWN_FAILURE
04-JUL-2005	15.48.00	04-JUL-2005	15.49.18	78	17486	17486	PDS_UNKNOWN_FAILURE
05-JUL-2005	4.03.58	05-JUL-2005	4.05.15	77	17493	17493	PDS_UNKNOWN_FAILURE
05-JUL-2005	15.16.20	05-JUL-2005	15.17.38	78	17500	17500	PDS_UNKNOWN_FAILURE
05-JUL-2005	21.34.16	05-JUL-2005	21.41.40	444	17503	17503	PDS_UNKNOWN_FAILURE
06-JUL-2005	5.12.48	06-JUL-2005	5.14.06	78	17508	17508	PDS_UNKNOWN_FAILURE
06-JUL-2005	16.25.15	06-JUL-2005	16.26.33	78	17515	17515	PDS_UNKNOWN_FAILURE
07-JUL-2005	4.41.37	07-JUL-2005	4.42.55	78	17522	17522	PDS_UNKNOWN_FAILURE

Table 9: List of gaps for RA-2 L1b products during cycle 38

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 as detected for the previous cycle.
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).

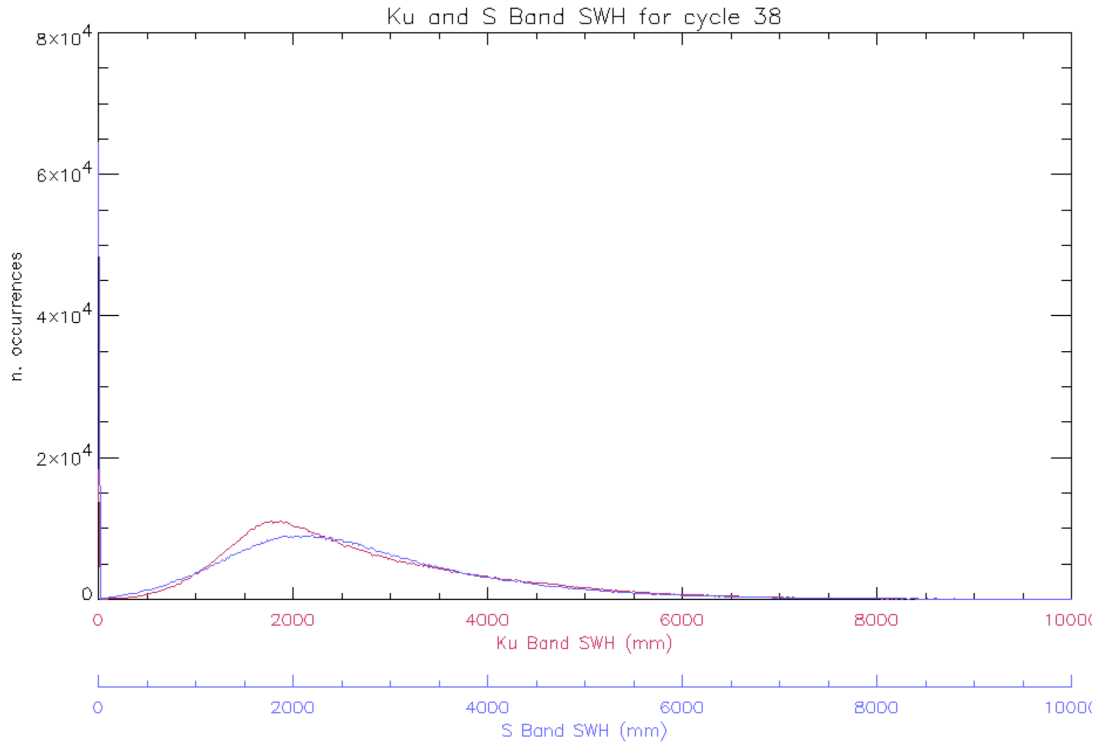

Figure 13: Histogram of Ku and S Band SWH for cycle 38 (mm)

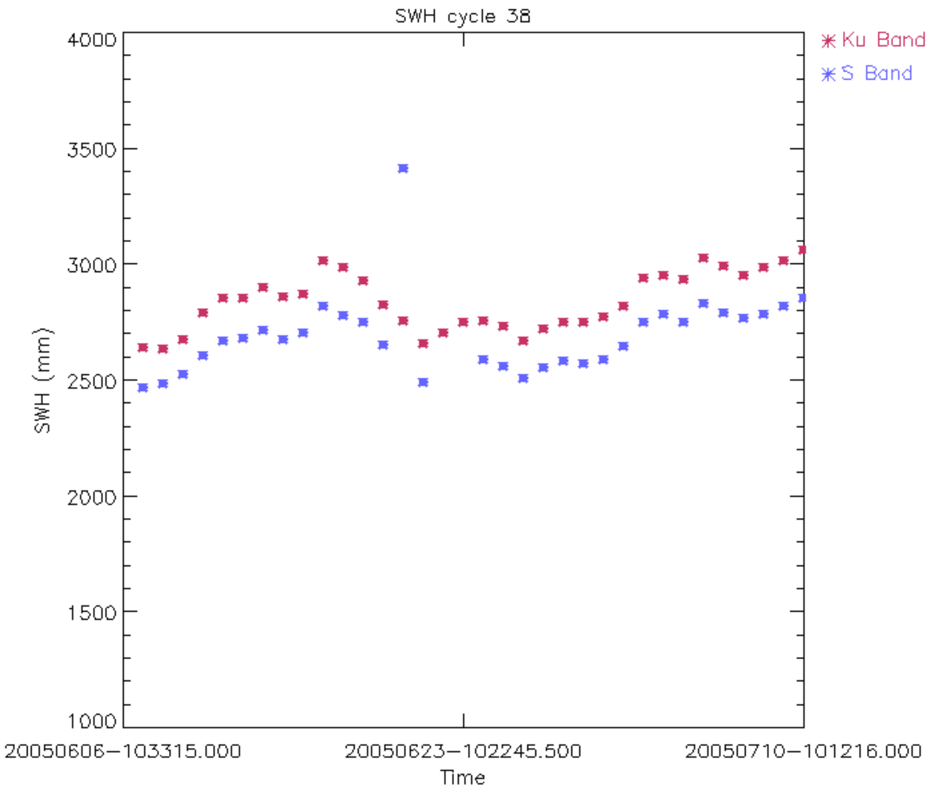

Figure 14: Ku and S SWH daily average for cycle 38 (mm)

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

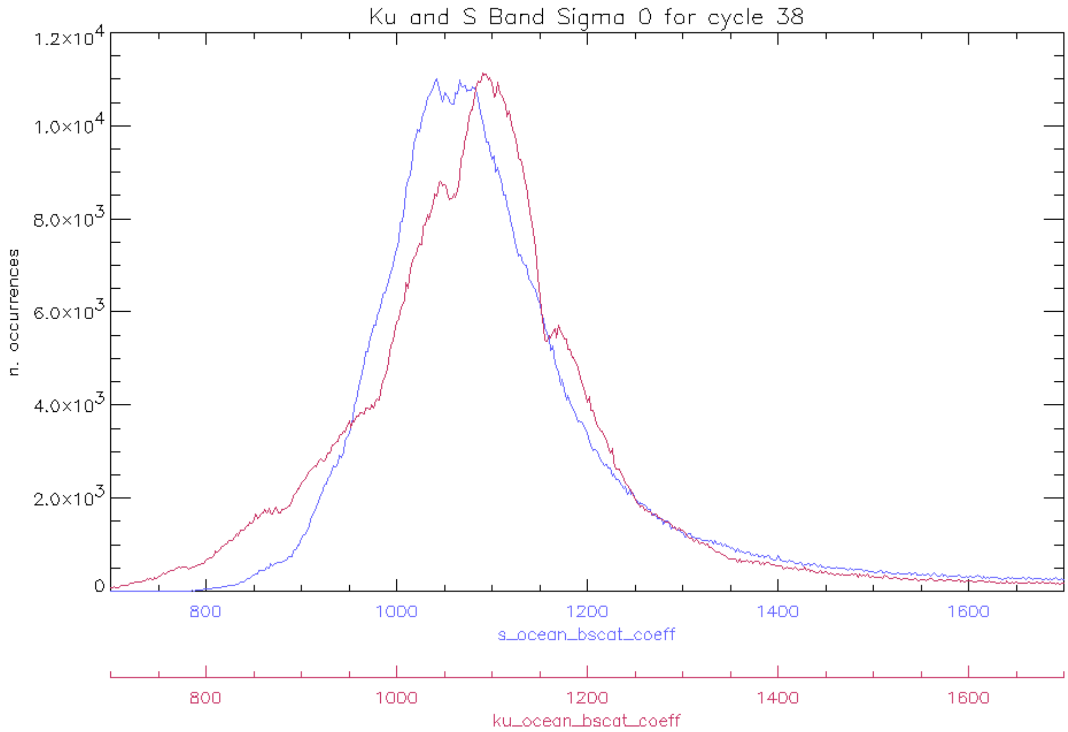

Figure 15: Histogram of Ku and S Band Backscattering Coefficient for cycle 38 (dB/100)

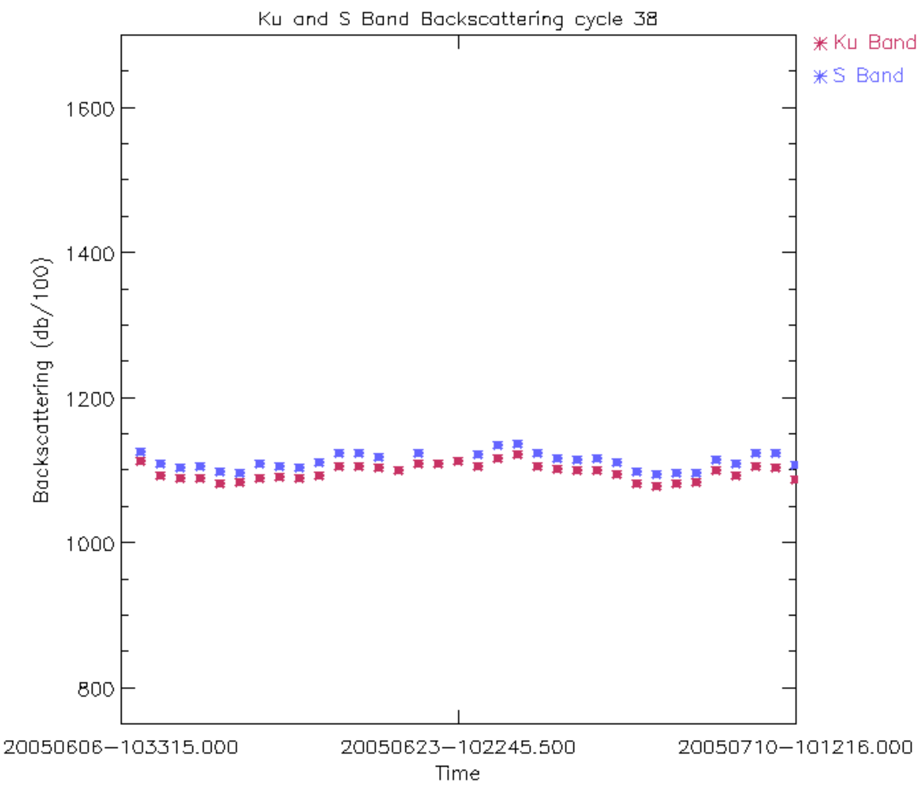

Figure 16: Ku and S Sigma_0 daily average for cycle 38 (dB/100)

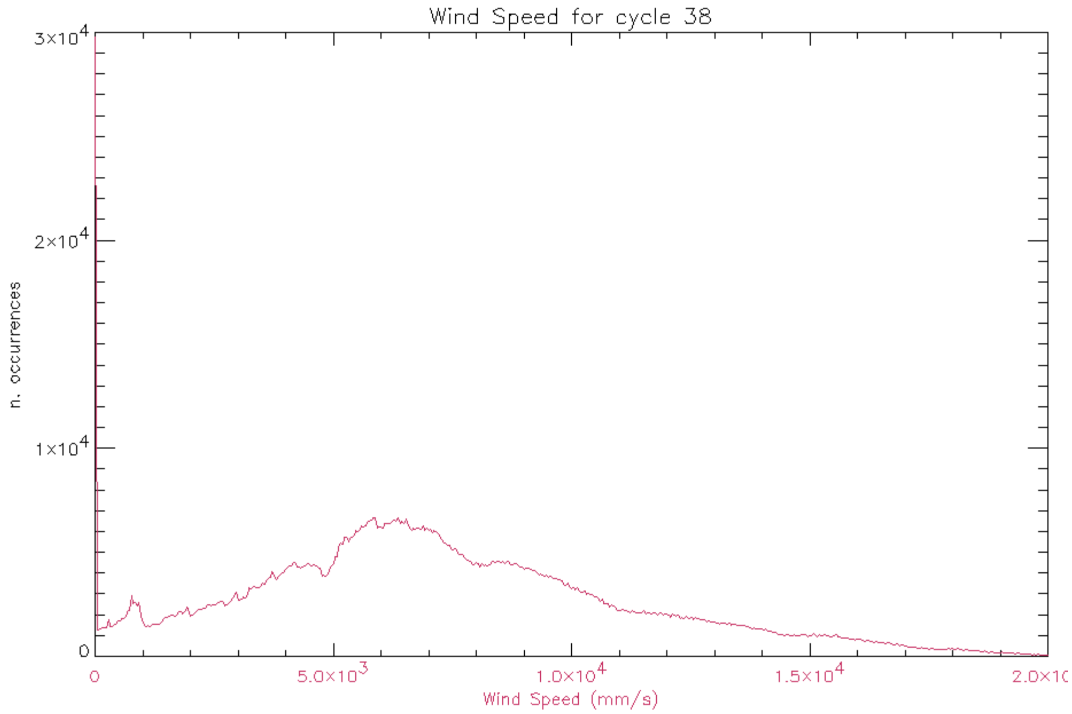

Figure 17: Histogram of Ku Wind Speed for cycle 38 (mm/s)

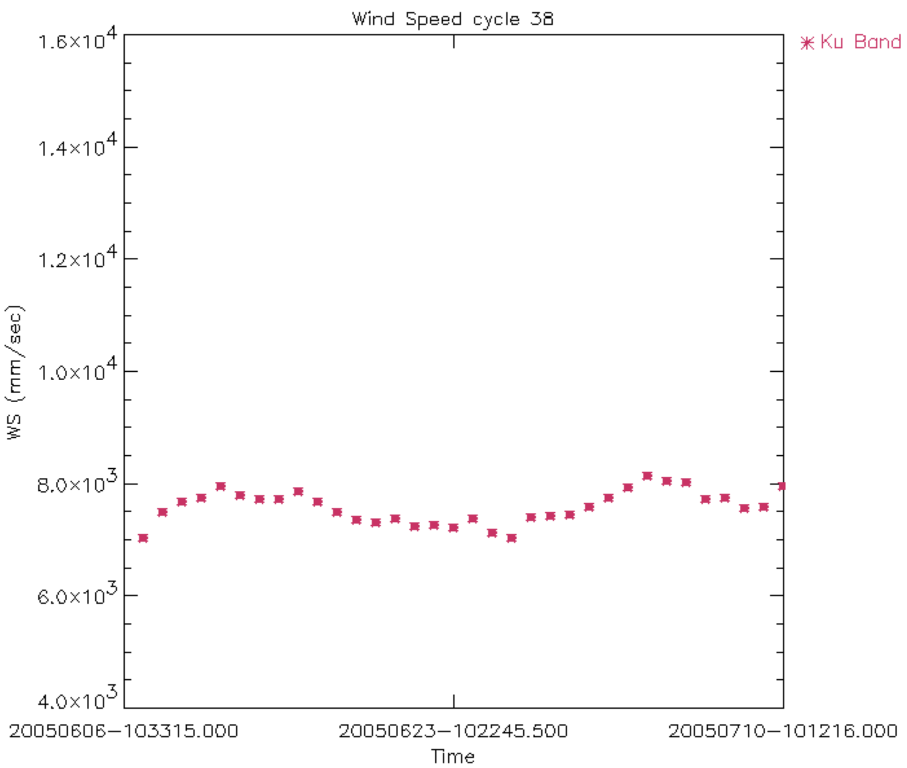

Figure 18: Ku Band Wind Speed daily average for cycle 38 (mm/s)

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 38 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 –10.13 mm per year. Eventually it could also be corrected for the cyclic average given bias of 24.23 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 38 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.

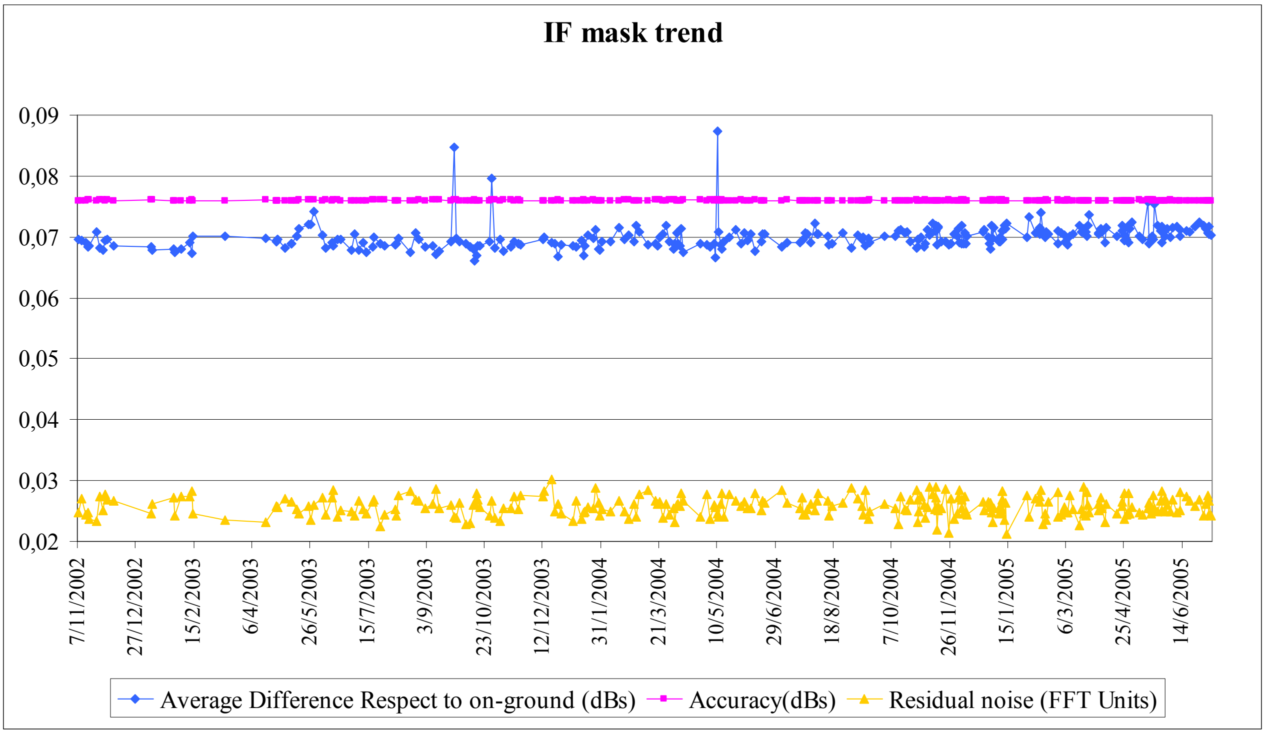

Figure 19: Evolution of the IF mask related parameters for valid IF masks retrieved up to cycle 38

In Figure 19A the percentages of valid IF masks from cycle 20 up to cycle 38 are reported.

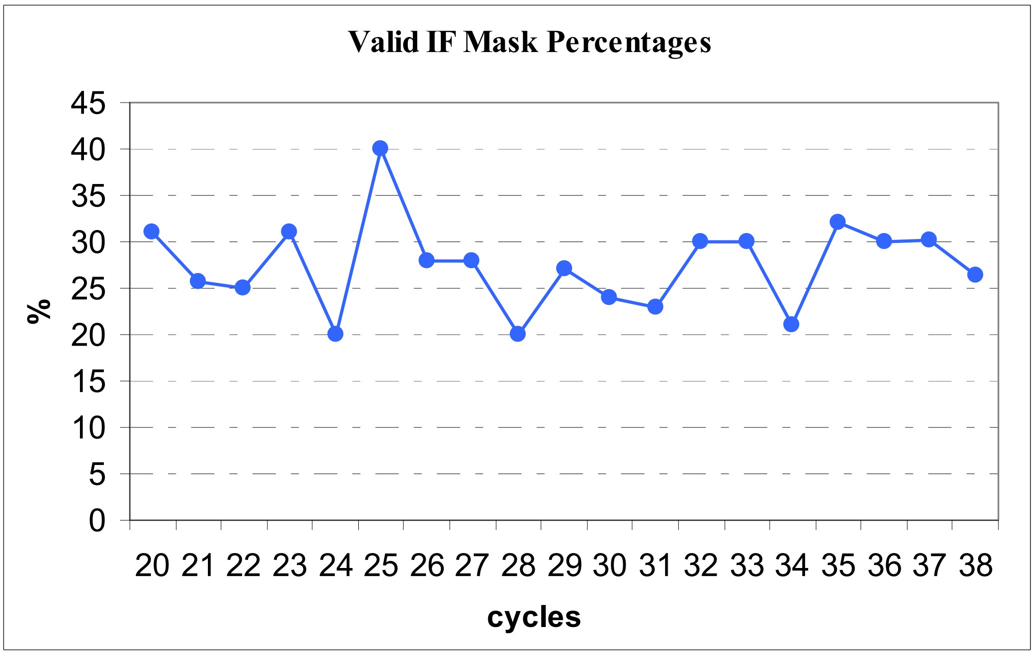

Figure 19A: Percentages of valid IF Mask up to cycle 38

9.1.2 USO

In Figure 20 the USO clock period trend retrieved until the end of cycle 37 is reported. The USO clock period trend for cycle 38 is reported in par. 7.1.2.
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.

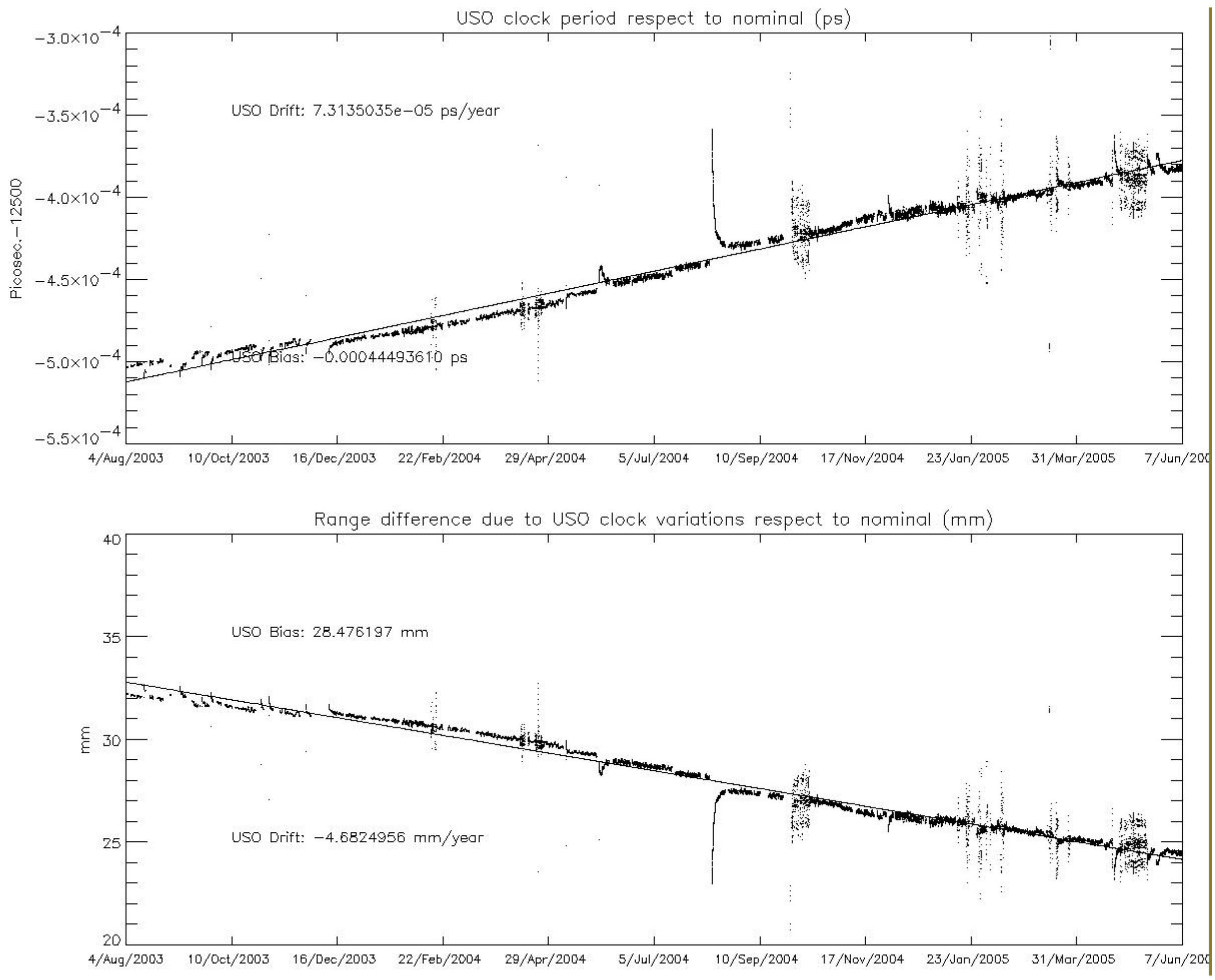

Figure 20: USO clock period until end of cycle 37

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.

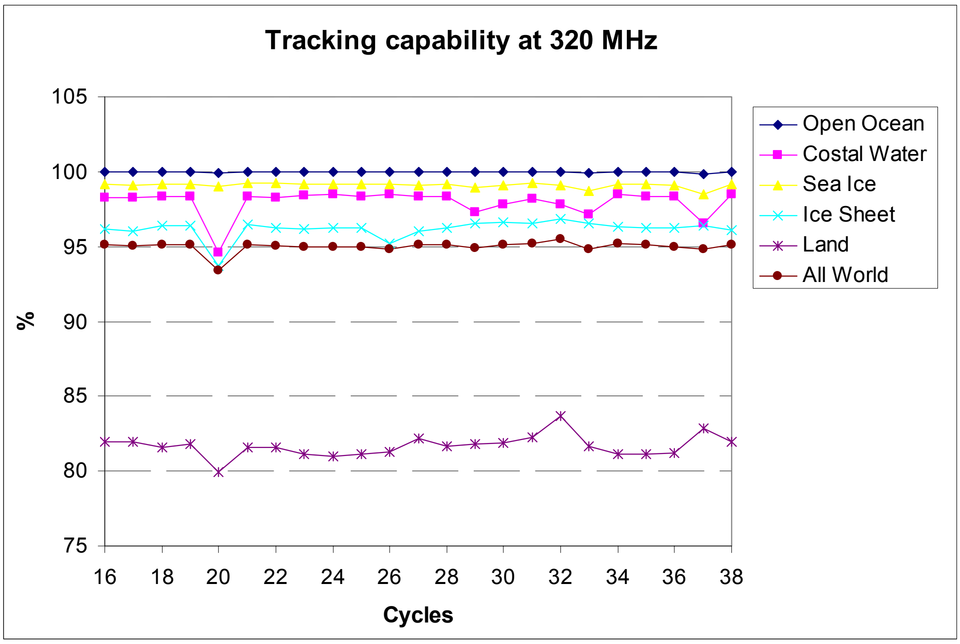

Figure 21: RA-2 Tracking percentage at 320MHz for different surfaces

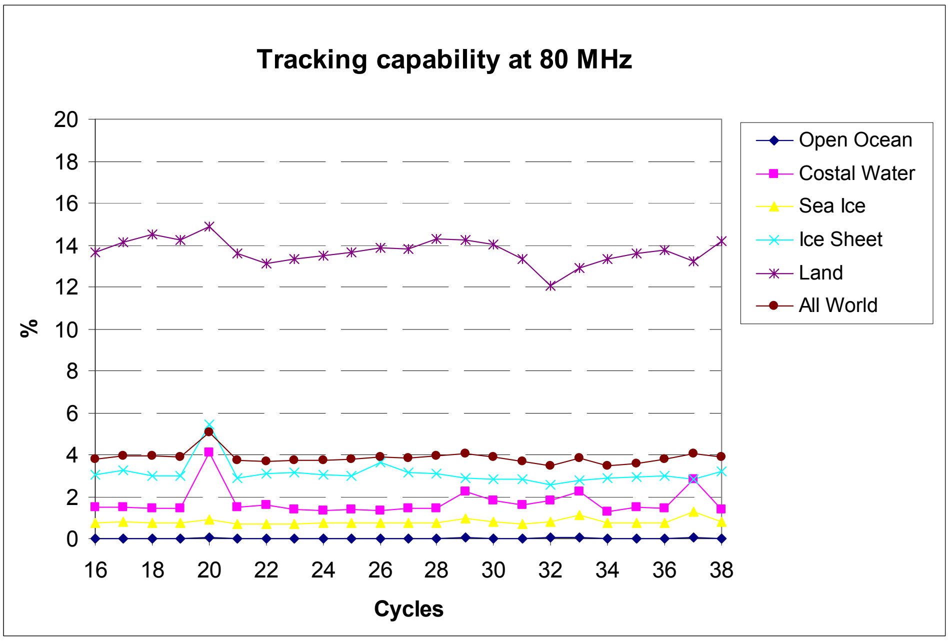

Figure 22: RA-2 Tracking percentage at 80MHz for different surfaces

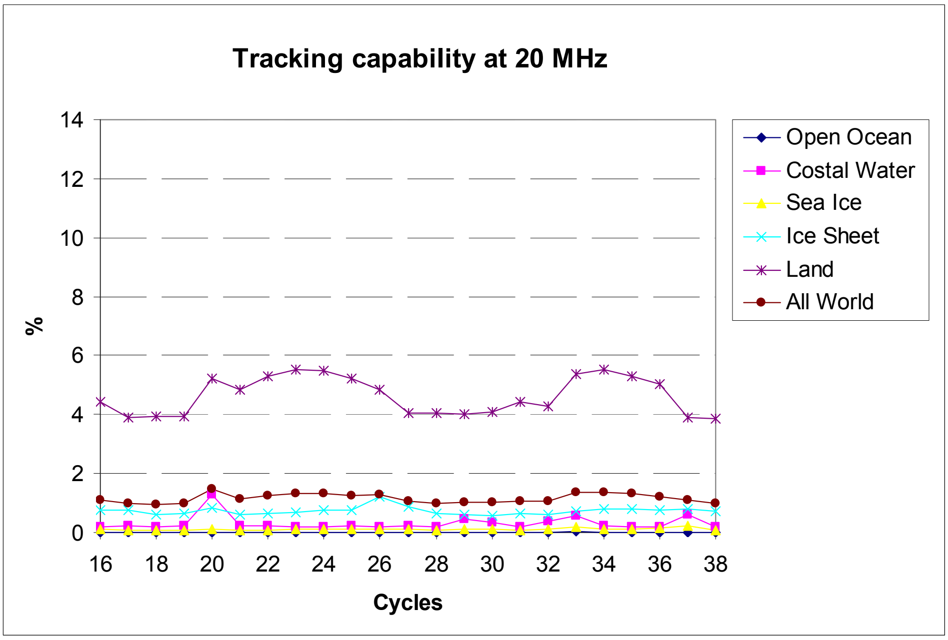

Figure 23: RA-2 Tracking percentage at 20MHz for different surfaces

9.1.4 SIGMA0 ABSOLUTE CALIBRATION

Table 11 reports the transponder measurement from cycle 24 up to cycle 38. 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 0.97 dB with a standard deviation of 0.066 dB. It is possible to notice that the Low Resolution measurements 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
17403	28-jun-05	Rome / 315	High	1,13	0,16
17525	7-jul-05	Valmontone / 437	High	1,04	0,13

Table 11: Transponder measurement results up to cycle 38

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.

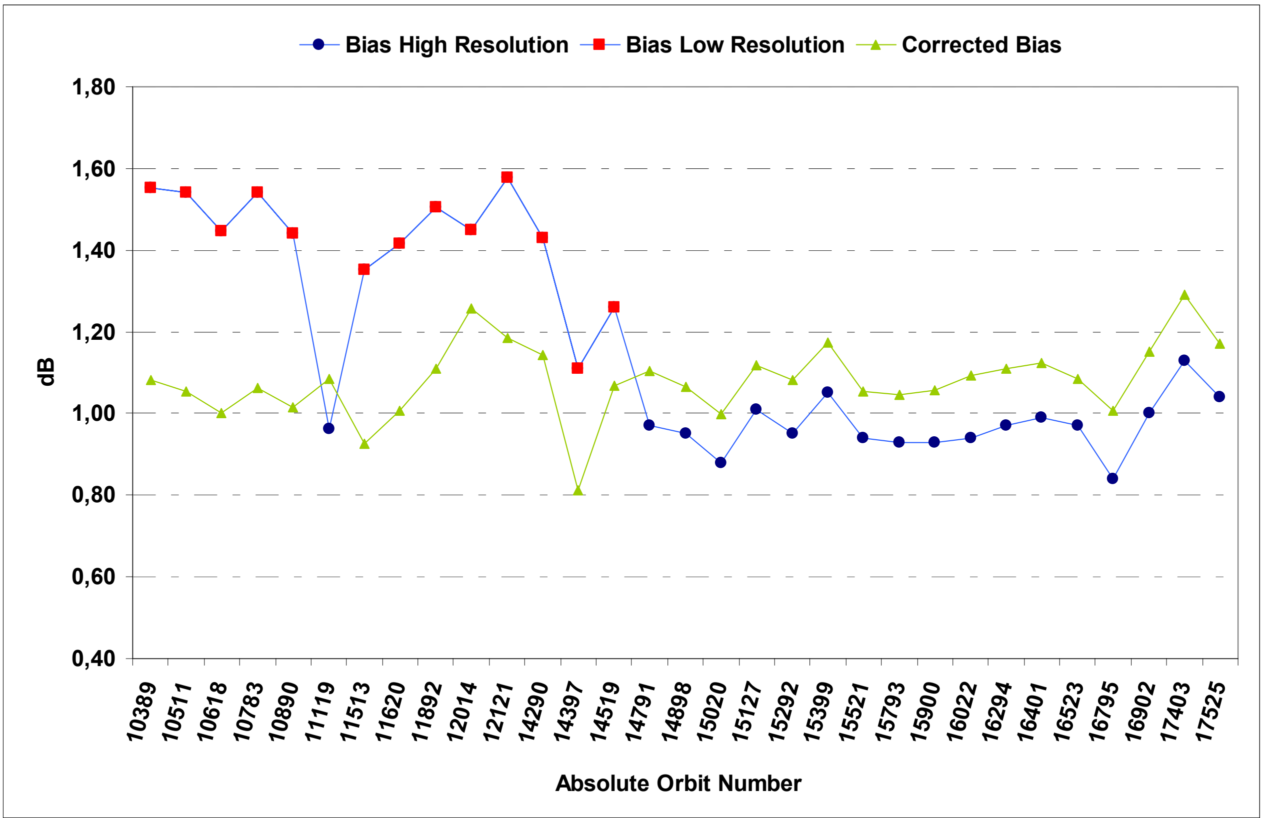

Figure 24: Time behavior of the transponder bias

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 for data up to cycle 32. The UTC deviations for cycle 33 up to cycle 38 are reported in Figure 25A.
The datation plots and comments pertinent to the cycle 38 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 (first part of Figure 25A); this phenomenon is now fixed. In the lower panel of both figures 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.

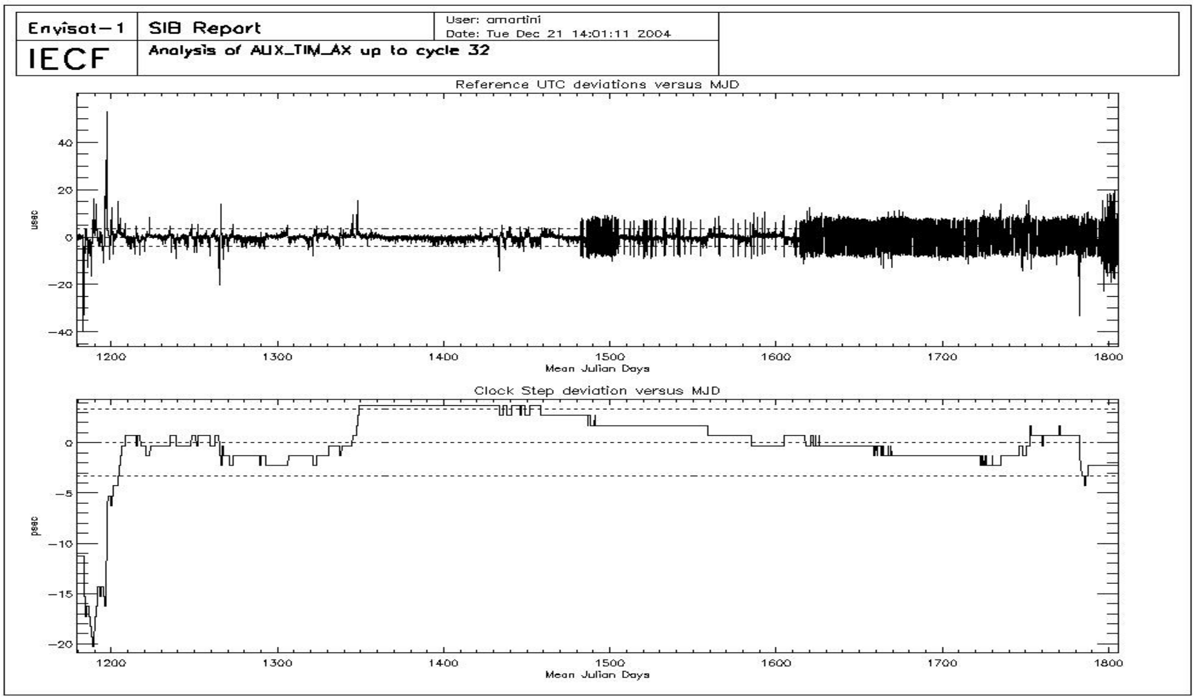

Figure 25: UTC deviations and ICU clock period up to cycle 32

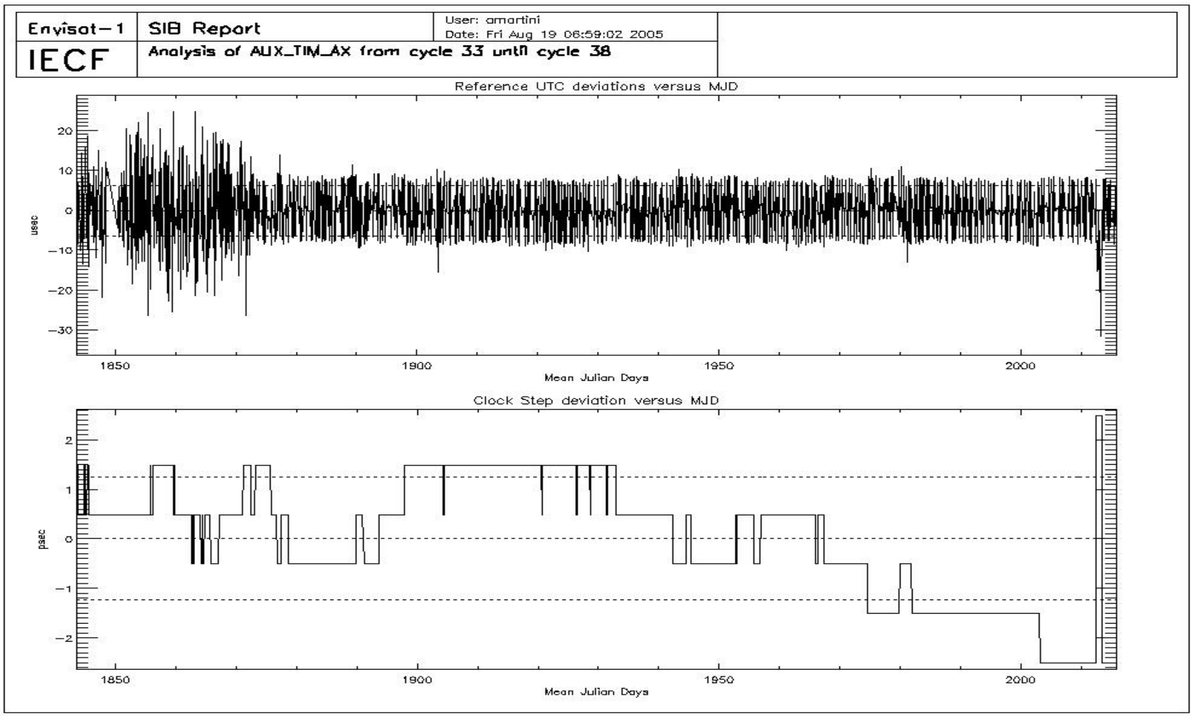

Figure 25A: UTC deviations and ICU clock period from cycle 33 up to cycle 38

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.

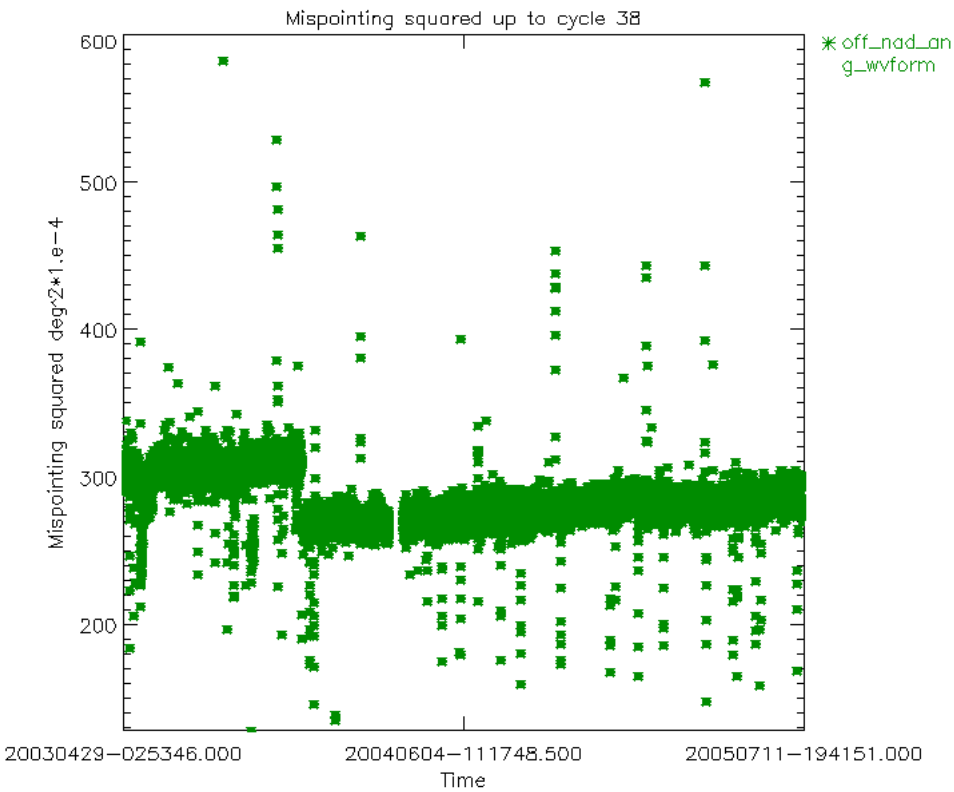

Figure 26: Smoothed mispointing squared trend until end of cycle 38 (deg^2*10e-4)

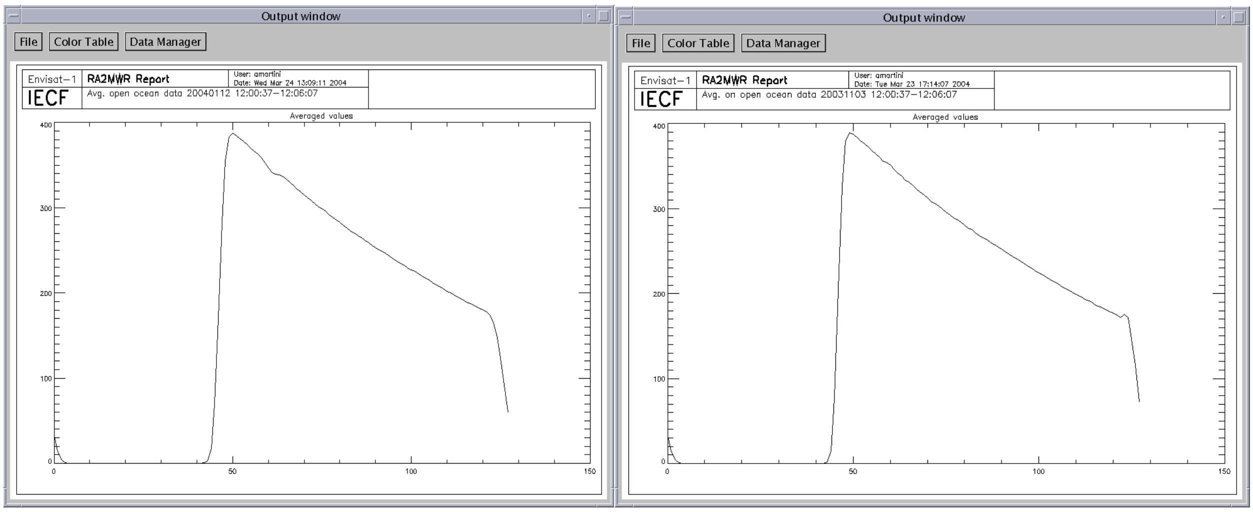

Figure 27: Open Ocean average waveforms before (left) and after an anomaly (right)

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.

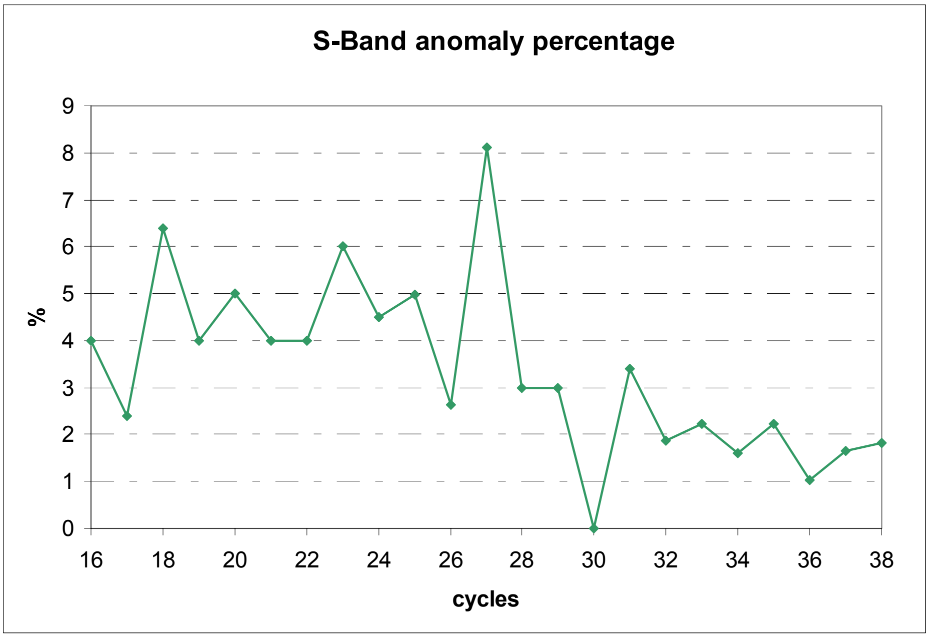

Figure 28: Percentage of data affected by the "S-Band Anomaly" for cycles 16-36

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.

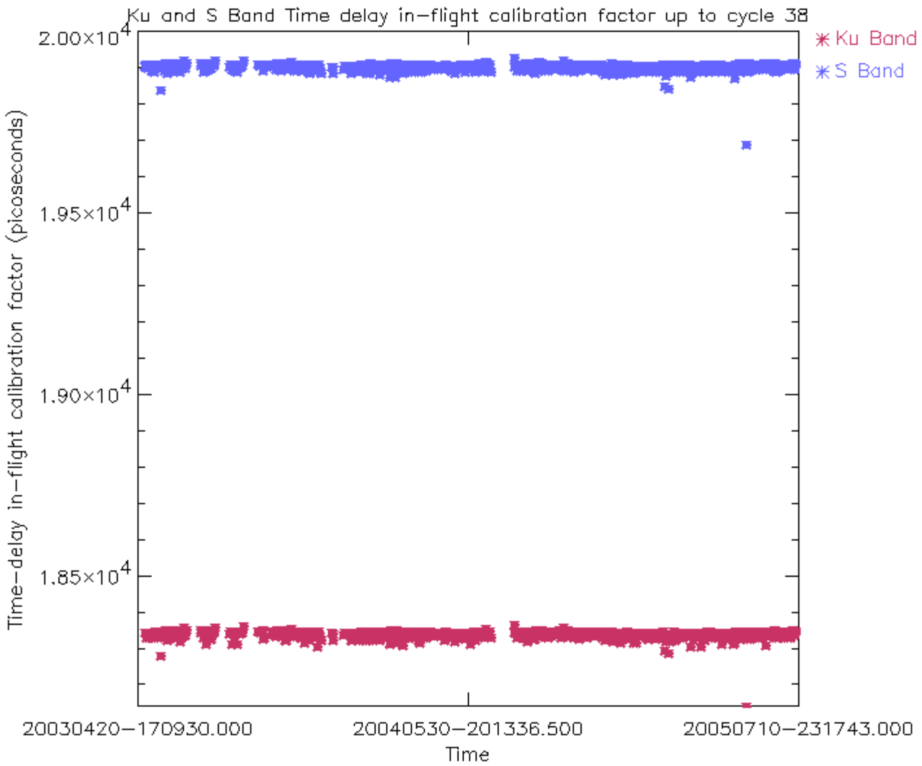

Figure 29: Ku and S Band in-flight time delay calibration factor up to cycle 38

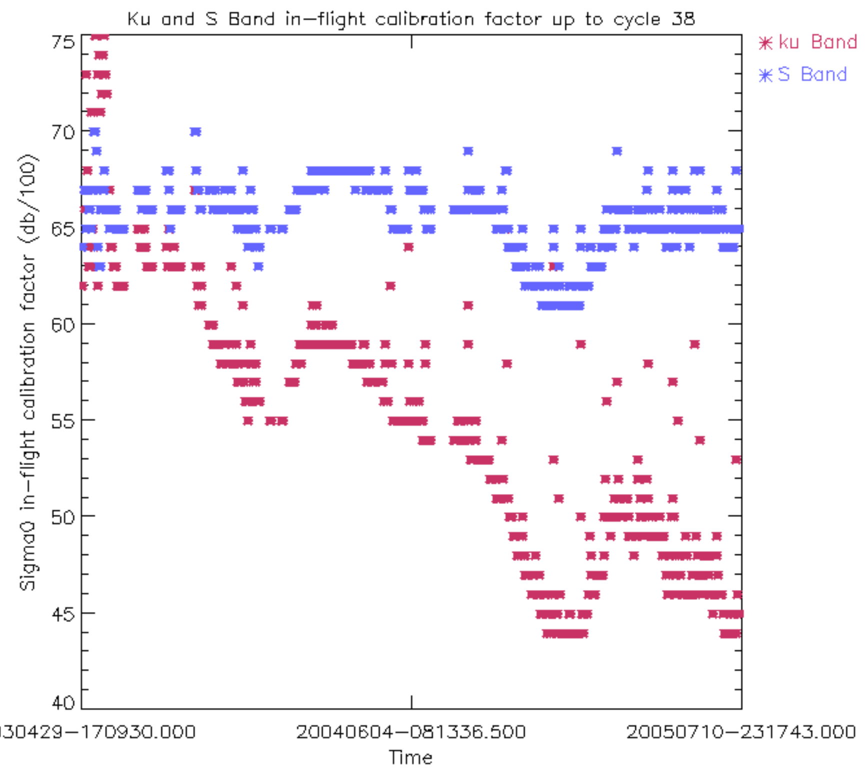

Figure 30: Ku and S Band in-flight Sigma0 calibration factor up to cycle 38

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.

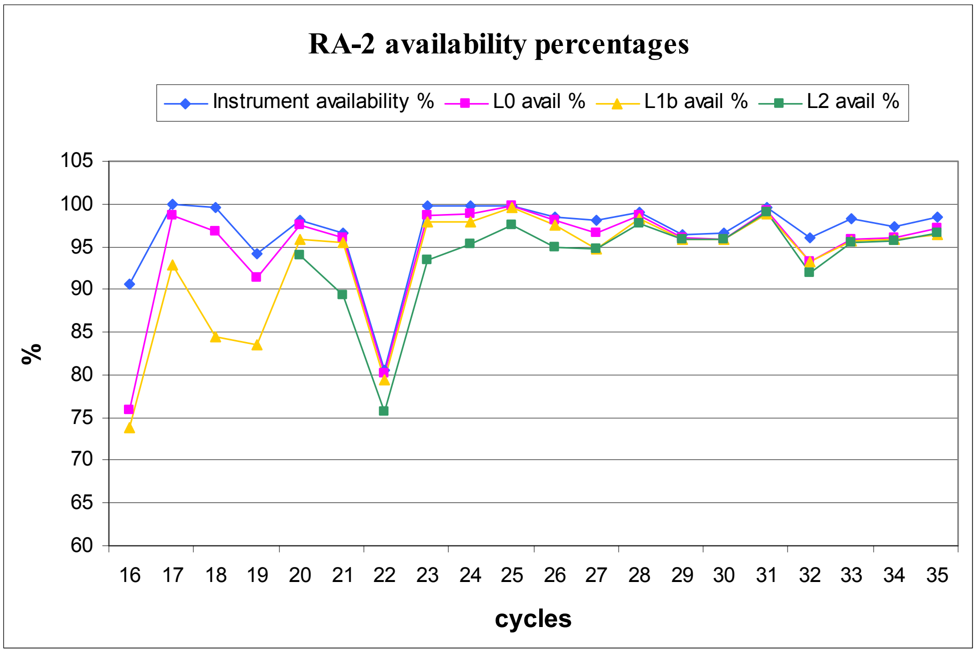

Figure 31: Percentage of Products unavailability up to cycle 38

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).

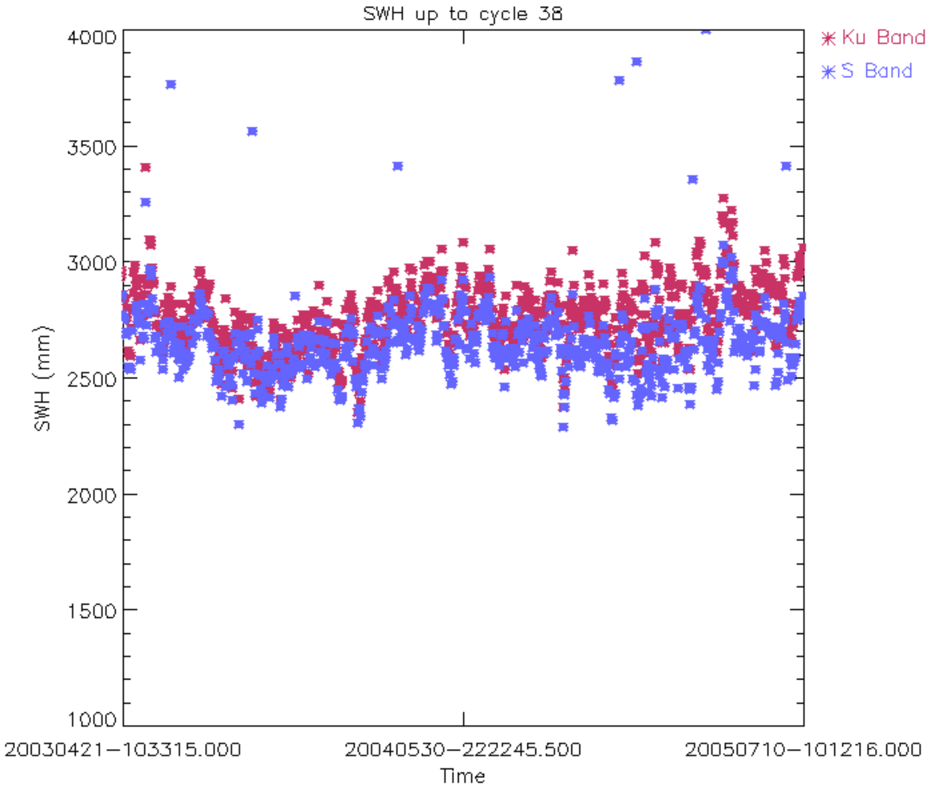

Figure 32: Ku and S SWH daily average up to cycle 38 (mm)

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.

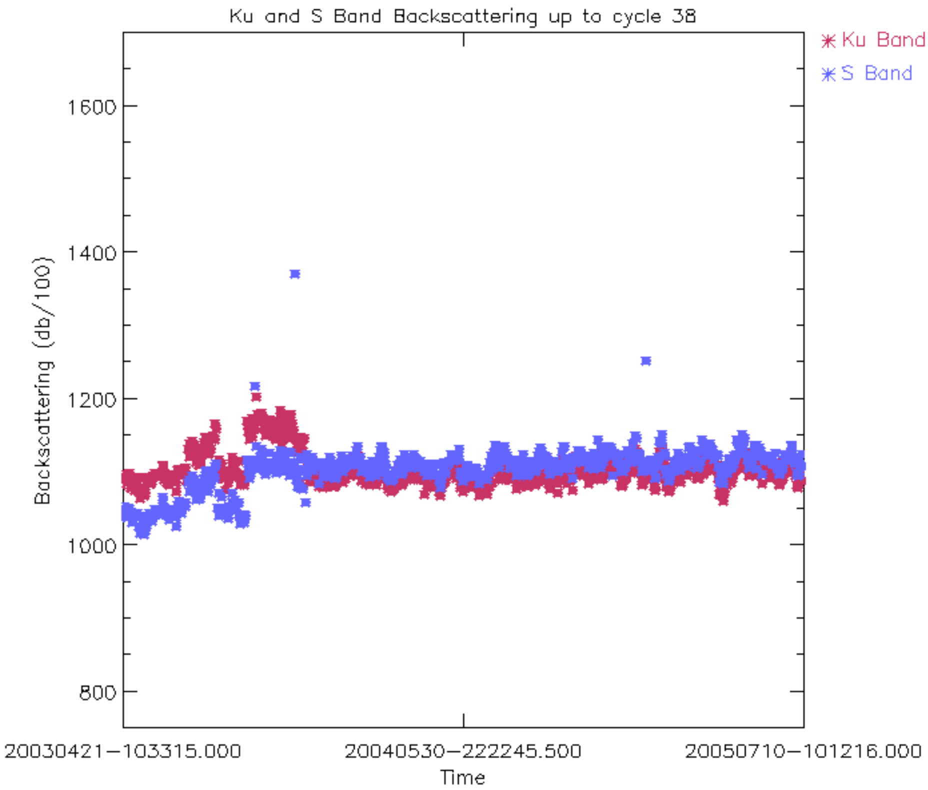

Figure 33: Ku and S band Backscattering daily averages up to cycle 38 (dB/100)

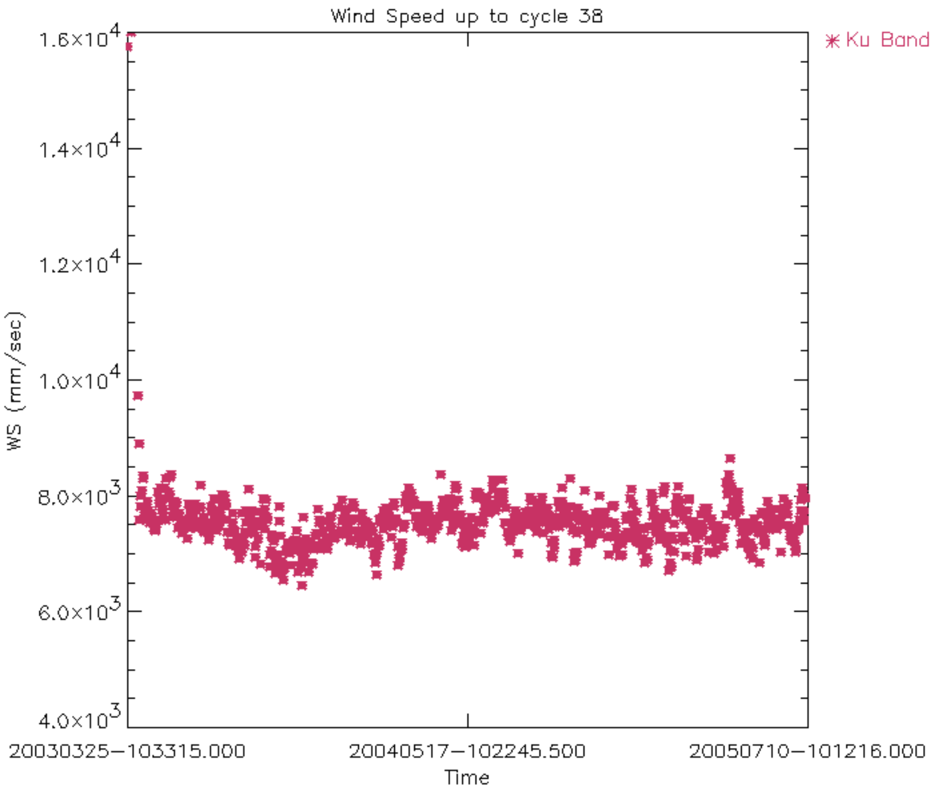

Figure 34: Wind Speed daily averages up to cycle 38 (mm/s)

10 PARTICULAR INVESTIGATIONS

During cycle 38 no special investigation has been performed.