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ENVISAT CYCLIC ALTIMETRIC REPORT

CYCLE 25 from 08-03-2004 to 12-04-2004

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 (RA2_FGD_2P) as well as on the main events occurred during cycle 25.

This reports covers the period from the 8th of March and the 12th of April 2004.

2 DISTRIBUTION LIST

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

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
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
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
S/W	Software
TM	Telemetry
TRP	Transponder
TWT	Traveling Wave Tube
UTC	Coordinated Universal Time

4 REFERENCE DOCUMENTS

[R – 1] F-PAC MONTHLY REPORT, SALP-RP-M-OP-15238-CN, March 2004
[R – 2] ENVISAT Microwave Radiometer Assessment Report Cycle 025, CLS.DOS/04.098, 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-1331, 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 – 9] ECMWF Report on ENVISAT RA- 2 for March 2004, 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 # 92-96, 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/

5 GENERAL QUALITY ASSESSMENT

5.1 Instruments status

The RA-2 instrument didn't undergo to any instrument anomaly during this cycle, 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 – 1].

5.2 Cycle quality

The summary of the RA-2 data products availability for this cycle is given in Table 1.

Start orbit	Stop orbit	Time instrum. unavailability	Time L0 gaps	Time L1b gaps	Time L2 (FGD) gaps	% instrum. avail.	% L0 avail.	% L1b avail.	% L2 (FGD) avail.
10576	10676.2	1012.03	548.32	545.727	49598.73	99.83267	99.742005	99.742435	91.63183
10676.2	10776.4	1077.692	549.59	545.98	12733.46	99.82181	99.730939	99.731536	97.716411
10776.4	10876.6	1070.933	548.39	543.82	555.419	99.82293	99.732255	99.73301	99.731092
10876.6	10976.8	1047.378	555.16	546.845	559.804	99.82682	99.735029	99.736404	99.734262
10976.8	11077	1089.383	550.41	6376.61	6390.828	99.81988	99.72887	98.765542	98.763191

Table 1: RA-2 L0, L1b and L2 FGD Data products availability summary for cycle 25

5.3 Orbit quality

On the 07-April-2004, a 1-burn SFCM orbit maintenance manoeuvre was executed as planned. The following table summarises the SFCM observed performance:

	Burn Start Time	Nominal Delta-V	Calibrated Delta-V	Mode
First burn	2004/04/07-21:05:00	0.0081 m/sec	0.0078 m/sec	SFCM

5.4 Ground Segment Processing Chain Status

5.4.1 IPF PROCESSING CHAIN

The current IPF version is V4.56, operational at the Envisat PDHS-K and PDHS-E since November the 26th 2003.

5.4.2 F-PAC PROCESSING CHAIN

Actual F-PAC CMA version is V6.2.1 installed on December the 3rd 2003. For what regards the Envisat products this version is equivalent to V6.1 installed on August the 4th 2003.

F-PAC CMA anomalies: anomalies are detailed in the F-PAC Monthly Report [R - 1].

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_AXVIEC20020313_174755_20020101_000000_20200101_000000
RA2_IFB_AXVIEC20020313_174959_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
```

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://envisat.esa.int/services/tools_table.html.

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
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 25, was never unavailable.

The HSU1 fuse problem (Ref anomaly occurrence during cycle 22) is still present. This problem does not affect nominal operations since the RA-2 instrument is heated by the nearby hardware.

The cause of the problem is still unknown. The heater fuses as well as the hardware used to report on the status of the fuses are presently under examination.

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 per day over Himalayan region.
- 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.
- Individual Echoes background planning: buffering of 20 Data block of individual Echoes and transmission of the in the following 160 Data Blocks. This repeated continuously.

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

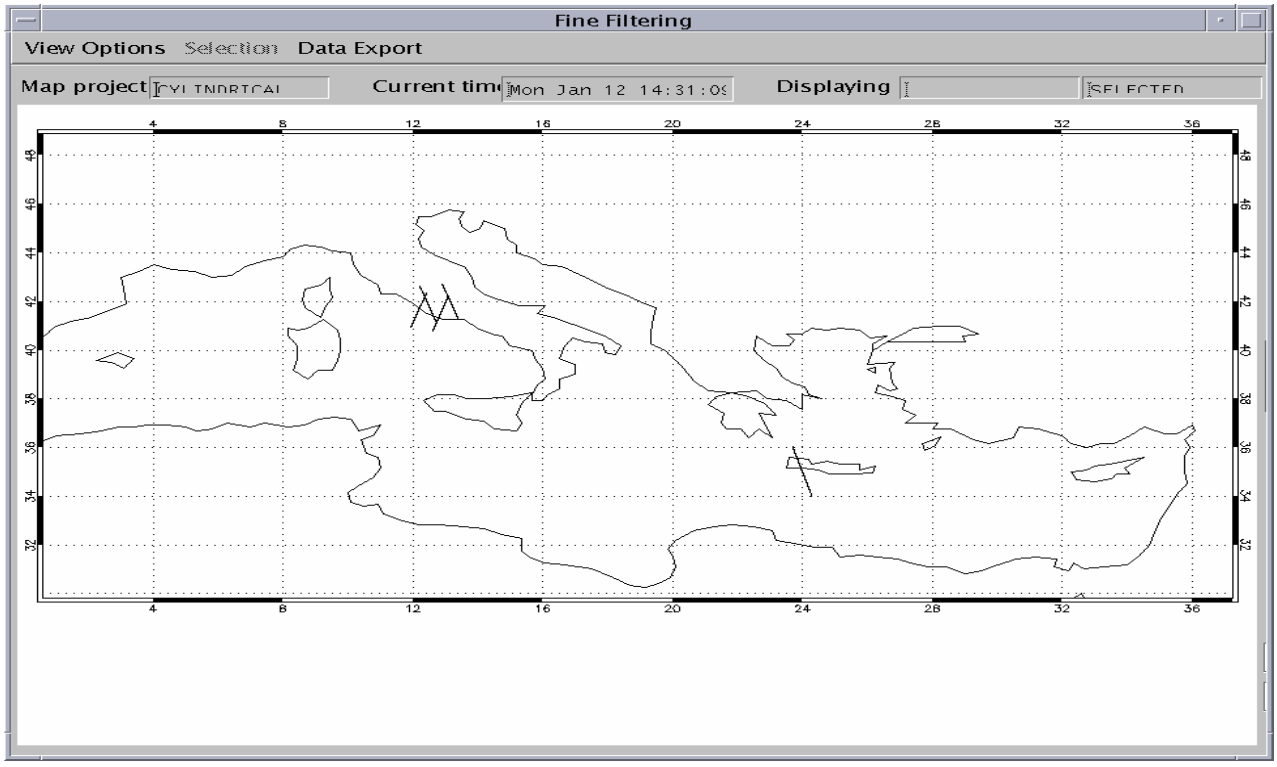

Figure 1: Transponder Acquisition sites for cycle 25

6.2 MWR Events

The MWR, during cycle 25 was never unavailable.

6.3 DORIS Events

The DORIS during cycle 25 was never unavailable.

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 25 are plotted in the left panel. The on-ground measured IF mask (ref [R – 4]) is also plotted in that panel with a red 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 25 the number of

valid IF masks has been of 14, representing the 40% 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).

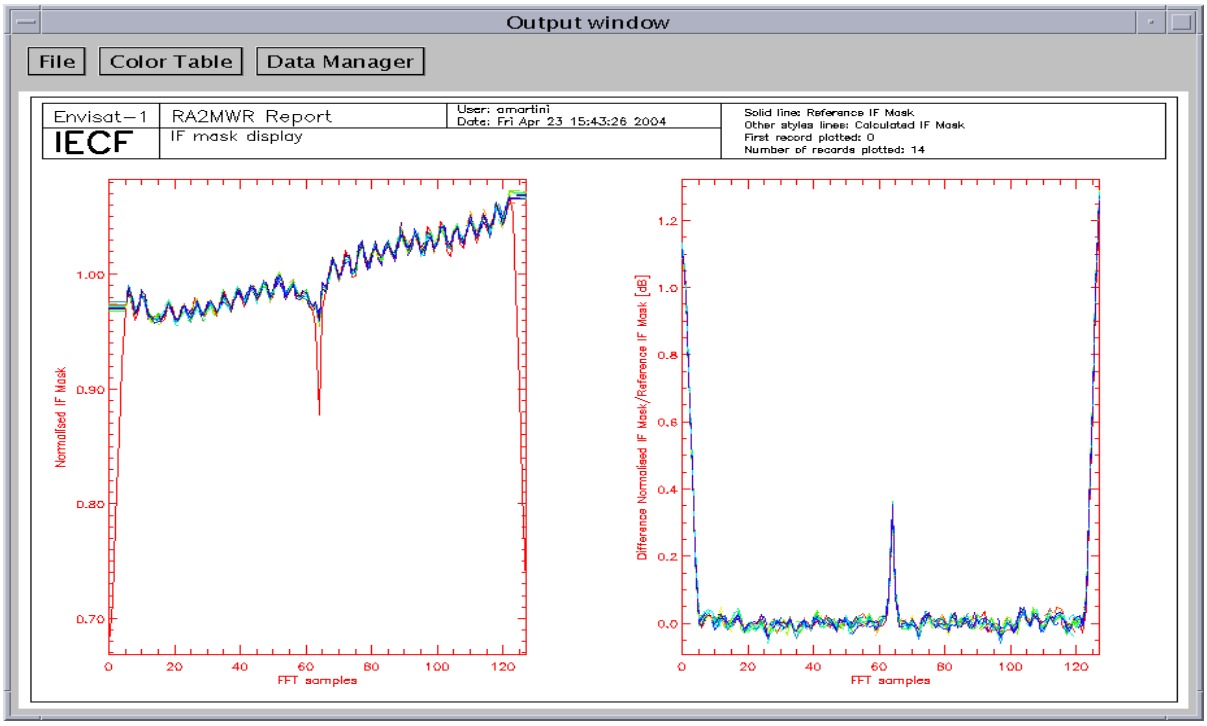

Figure 2: Valid IF masks retrieved daily during cycle 25 plotted together with the on-ground reference.

7.1.2 USO

In Figure 3 the USO clock period trend retrieved for cycle 25 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 1ps 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.

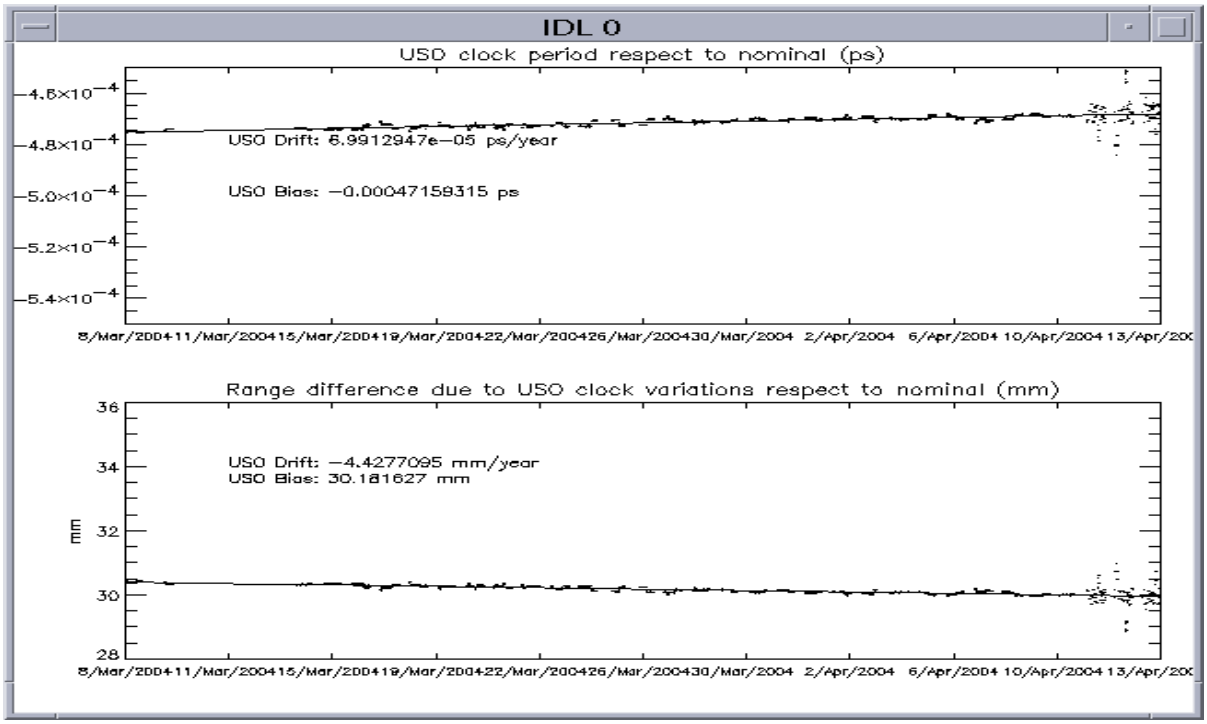

Figure 3: USO clock period for cycle 25

7.1.3 TRACKING CAPABILITY

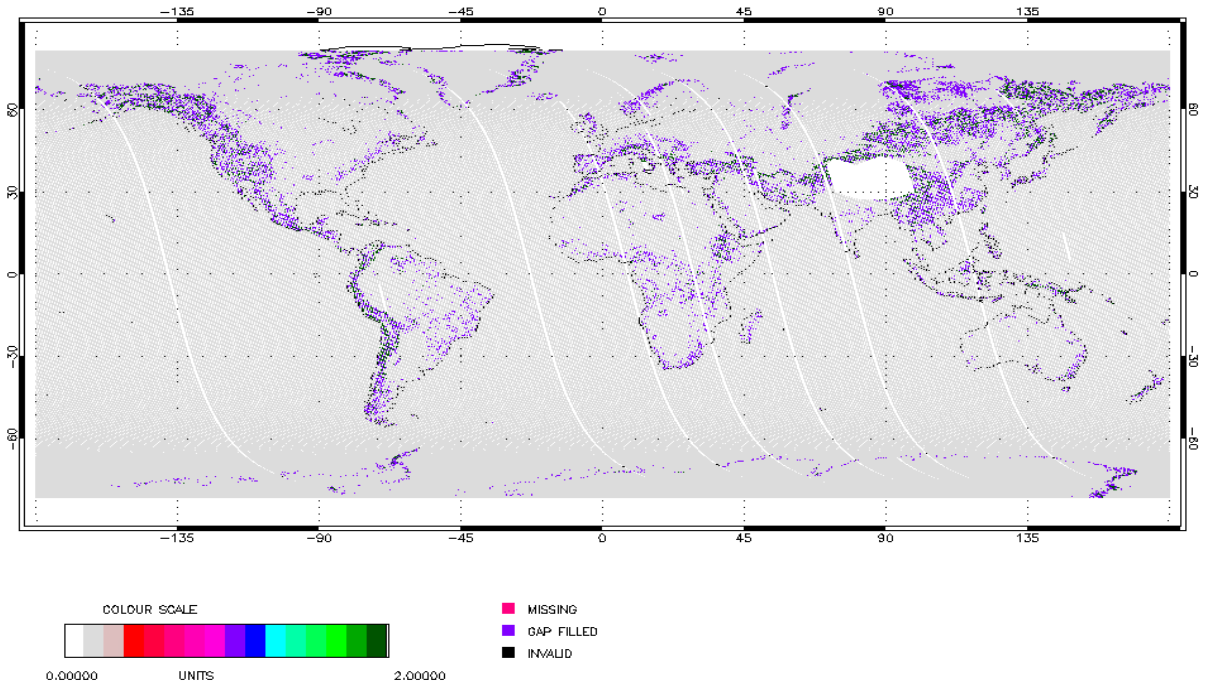

Figure 4: RA-2 Chirp ID for ascending passes during cycle 25

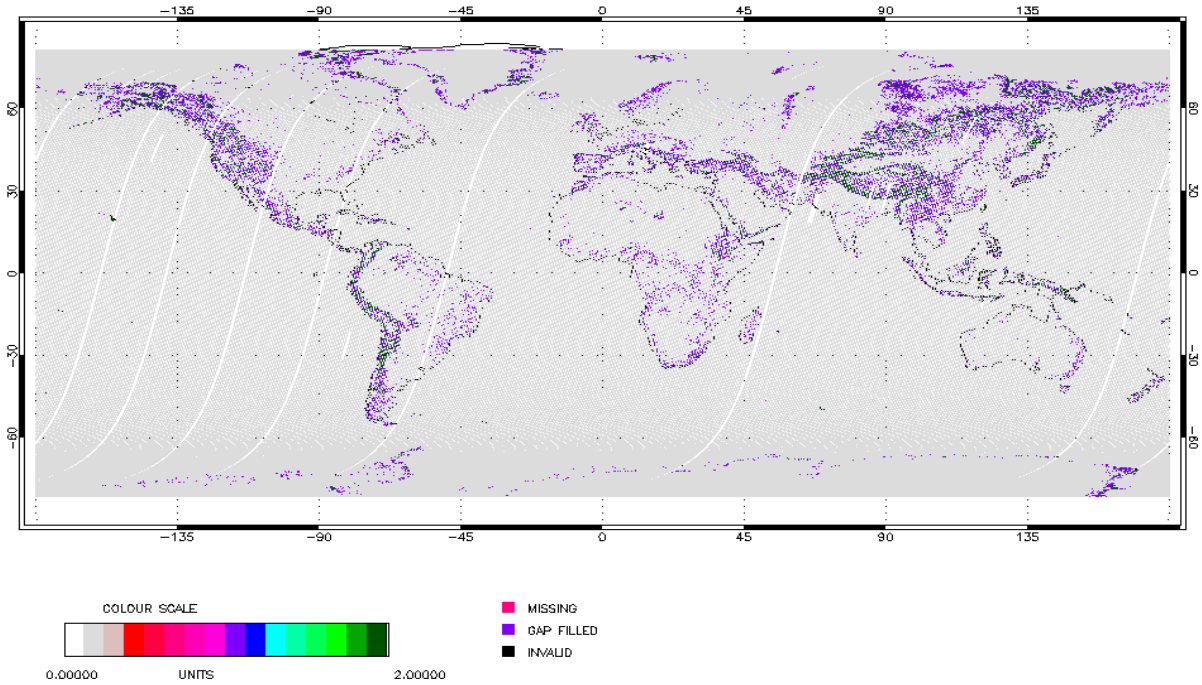

Figure 5: RA-2 Chirp ID for descending passes during cycle 25

In Figure 4 and Figure 5, the Chirp ID is plotted respectively for ascending and descending passes of cycle 25. 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 20MH bandwidth are plotted in dark green (Chirp ID equal to 2).

The corresponding percentages of acquisition in the different resolutions subdivided by surface type are given in Table 2:

Surface type	320 MHz	80 MHz	20MHz
Open Ocean	99.991%	0.008%	0.001%
Costal Water (ocean depth < 200 m)	98.37%	1.41%	0.22%
Sea Ice	99.15%	0.73%	0.12%
Ice Sheet	96.25%	3.01%	0.74%
Land	81.10%	13.67%	5.23%
All world	94.97%	3.77%	1.26%

Table 2: 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.

Those figures completely satisfy the objectives of the Commissioning Phase "RSL and Tracking optimization" 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 25 four Sigma_0 Transponder measurement where sperformed on the following dates:

11-MAR-2004	20:36:26
23-MAR-2004	09:41:53
30-MAR-2004	20:39:13
08-APR-2004	09:39:01

The first three acquisitions have been successfully performed at low resolution. The fourth one was executed with the highest resolution (320 MHz bandwidth) but unfortunately the transponder re-transmitted signal was not visible in the RA-2 receiving window. Investigation is on-going in order to understand the problem occurred and avoid to make it for future acquisitions.

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 Figure 6 (upper panel) 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 they are well under the 20 microseconds warning threshold. In the lower panel the ICU clock step for the same period is shown.

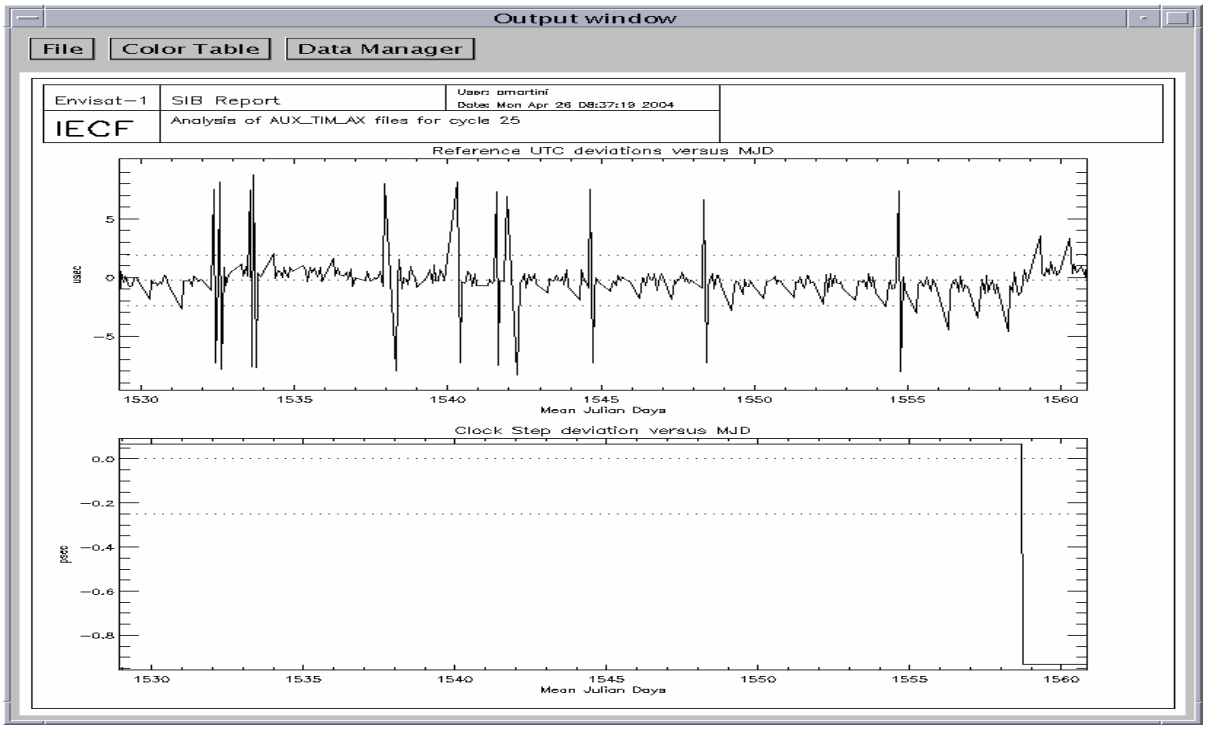

Figure 6: UTC deviations and ICU clock period for cycle 25

7.1.6 MISPOINTING

In Figure 7 and Figure 8 the trend and the histogram of the mispointing squared (smoothed over 120 s) is reported in deg^2*10e-4

The average mispointing value, as extracted from the RA2_FGD_2P data products, is around 0.025 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-2004 (ref. 5.4.4).

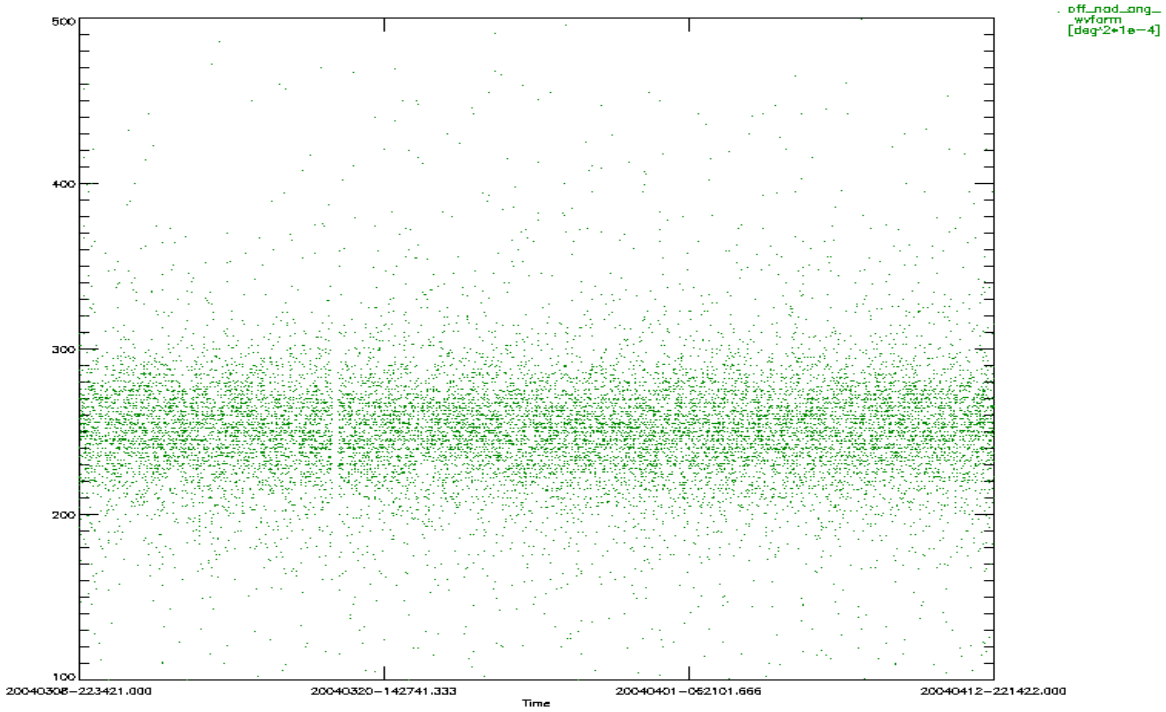

Figure 7: Smoothed mispointing squared trend and histogram for cycle 25 (deg^2*10^4)

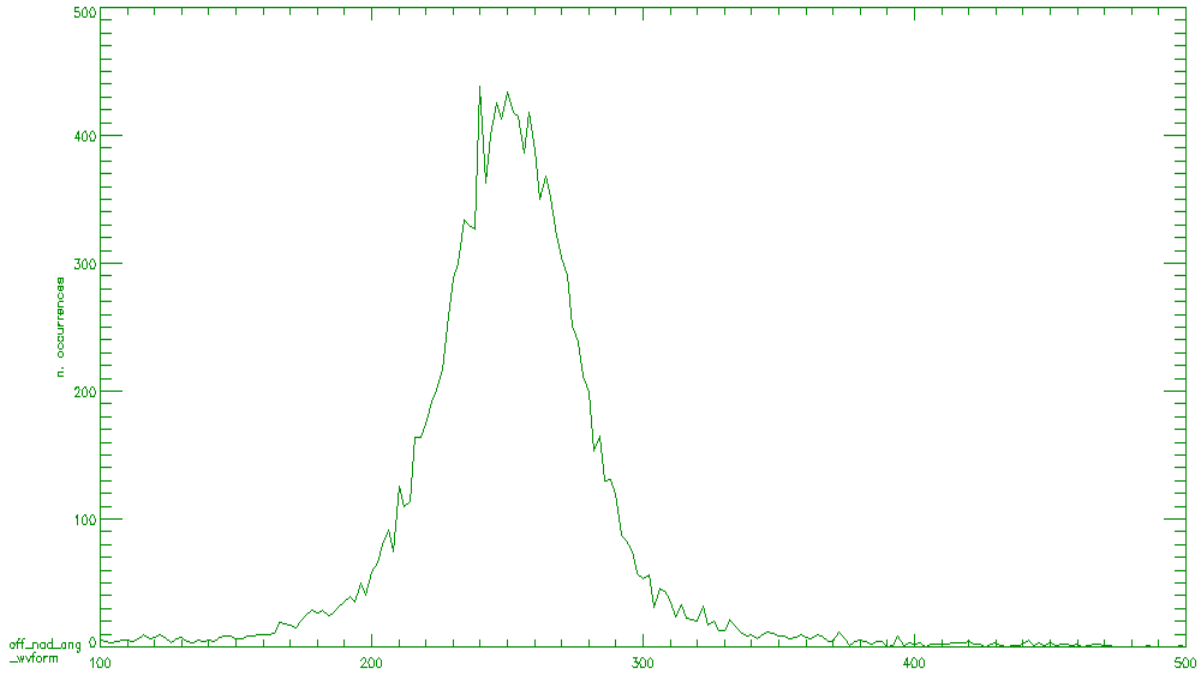

Figure 8: Smoothed mispointing squared histogram for cycle 25 (deg^2*10^4)

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 25. This corresponds to a total percentage of about 5 % 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_2PNPDK20040312_065924_000059642025_00049_10624_0014.N1	12-Mar-04	06:59:24.415441	12-Mar-04	08:38:48.715519
RA2_FGD_2PNPDK20040312_065924_000059642025_00049_10624_0015.N1	12-Mar-04	06:59:24.415441	12-Mar-04	08:38:48.715519
RA2_FGD_2PNPDK20040312_083817_000060582025_00050_10625_0017.N1	12-Mar-04	08:38:17.579222	12-Mar-04	10:19:15.455291
RA2_FGD_2PNPDK20040312_101844_000059482025_00051_10626_0018.N1	12-Mar-04	10:18:44.319000	12-Mar-04	11:57:51.909076
RA2_FGD_2PNPDK20040312_101844_000059482025_00051_10626_0019.N1	12-Mar-04	10:18:44.318993	12-Mar-04	11:57:51.909068
RA2_FGD_2PNPDK20040312_115635_000059812025_00052_10627_0021.N1	12-Mar-04	11:56:35.098772	12-Mar-04	13:36:16.108845
RA2_FGD_2PNPDK20040312_115635_000059812025_00052_10627_0020.N1	12-Mar-04	11:56:35.098772	12-Mar-04	13:36:16.108845
RA2_FGD_2PNPDK20040312_133438_000059952025_00053_10628_0022.N1	12-Mar-04	13:34:38.132549	12-Mar-04	15:14:33.624621
RA2_FGD_2PNPDK20040312_133438_000059952025_00053_10628_0023.N1	12-Mar-04	13:34:38.132549	12-Mar-04	15:14:33.624621
RA2_FGD_2PNPDK20040312_151332_000052052025_00054_10629_0024.N1	12-Mar-04	15:13:32.410331	12-Mar-04	16:40:16.962404
RA2_FGD_2PNPDK20040312_151332_000052052025_00054_10629_0025.N1	12-Mar-04	15:13:32.410331	12-Mar-04	16:40:16.962404
RA2_FGD_2PNPDK20040312_151332_000052052025_00054_10629_0026.N1	12-Mar-04	15:13:32.410331	12-Mar-04	16:40:16.962404
RA2_FGD_2PNPDK20040331_201222_000061982025_00329_10904_0327.N1	31-Mar-04	20:12:22.587425	31-Mar-04	21:55:40.827499
RA2_FGD_2PNPDE20040331_215436_000062572025_00330_10905_0221.N1	31-Mar-04	21:54:36.271199	31-Mar-04	23:38:53.553269
RA2_FGD_2PNPDE20040331_233631_000062842025_00331_10906_0222.N1	31-Mar-04	23:36:31.016957	01-Apr-04	01:21:15.035040
RA2_FGD_2PNPDE20040401_011953_000062562025_00332_10907_0223.N1	01-Apr-04	01:19:53.768743	01-Apr-04	03:04:09.936808
RA2_FGD_2PNPDE20040401_030322_000061392025_00333_10908_0226.N1	01-Apr-04	03:03:22.090510	01-Apr-04	04:45:41.288580
RA2_FGD_2PNPDE20040401_044506_000060852025_00334_10909_0230.N1	01-Apr-04	04:45:06.810282	01-Apr-04	06:26:31.422352
RA2_FGD_2PNPDE20040401_044539_000060262025_00334_10909_0233.N1	01-Apr-04	04:45:39.116280	01-Apr-04	06:26:04.686353
RA2_FGD_2PNPDK20040401_062558_000062162025_00335_10910_0330.N1	01-Apr-04	06:25:58.058054	01-Apr-04	08:09:34.122117
RA2_FGD_2PNPDK20040401_080848_000060952025_00336_10911_0331.N1	01-Apr-04	08:08:48.503818	01-Apr-04	09:50:23.141888
RA2_FGD_2PNPDK20040401_094936_000060142025_00337_10912_0332.N1	01-Apr-04	09:49:36.409590	01-Apr-04	11:29:50.839665
RA2_FGD_2PNPDK20040401_112916_000059592025_00338_10913_0333.N1	01-Apr-04	11:29:16.361366	01-Apr-04	13:08:35.091443
RA2_FGD_2PNPDK20040401_130800_000059102025_00339_10914_0334.N1	01-Apr-04	13:08:00.613144	01-Apr-04	14:46:30.327222
RA2_FGD_2PNPDK20040401_144524_000051312025_00340_10915_0335.N1	01-Apr-04	14:45:24.656924	01-Apr-04	16:10:55.685000

Table 3: List of L2 FGD Files affected by S-Band anomaly during cycle 25

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.

7.2 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 - 1].

8 PRODUCT PERFORMANCES

8.1 Availability of data

In Figure 9 and Table 4 the summary of unavailable RA-2 L0 products is given.
It is easy to notice that close to the Himalayan region a small gap in the data is present. This is due to the daily instrument switch-off (Heater 2 mode) performed to prevent the S-Band anomaly to last more than one day when it occurs

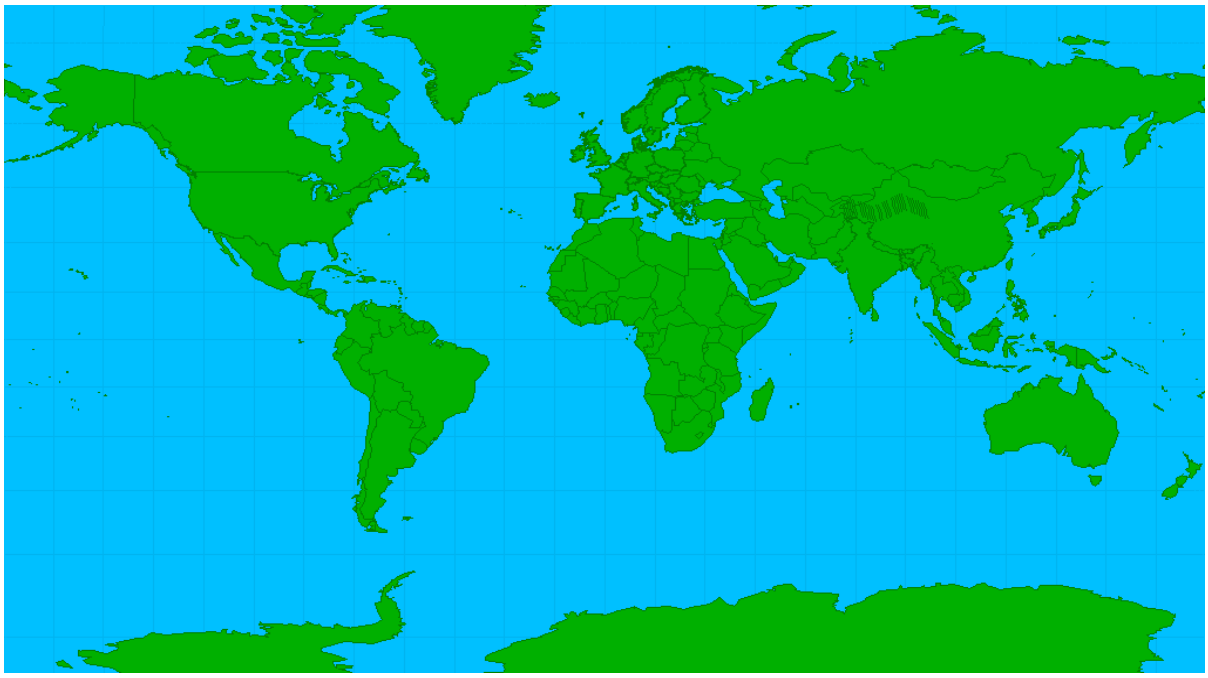

Figure 9: RA-2 L0 unavailable products for first part of cycle 25

Start date	Start time	Stop date	Stop time	Duration (s)	Start orbit	Stop orbit	Reason
09-Mar-04	16:36:43	09-Mar-04	16:38:01	78	10587	10587	PDS_UNKNOWN_FAILURE
10-Mar-04	16:04:40	10-Mar-04	16:05:58	78	10601	10601	PDS_UNKNOWN_FAILURE
11-Mar-04	15:30:51	11-Mar-04	15:30:54	3	10615	10615	PDS_UNKNOWN_FAILURE
11-Mar-04	15:33:55	11-Mar-04	15:35:13	78	10615	10615	PDS_UNKNOWN_FAILURE
12-Mar-04	16:42:07	12-Mar-04	16:43:25	78	10630	10630	PDS_UNKNOWN_FAILURE
13-Mar-04	16:10:23	13-Mar-04	16:11:41	78	10644	10644	PDS_UNKNOWN_FAILURE
14-Mar-04	15:39:31	14-Mar-04	15:40:49	78	10658	10658	PDS_UNKNOWN_FAILURE
15-Mar-04	15:07:22	15-Mar-04	15:08:40	78	10672	10672	PDS_UNKNOWN_FAILURE
16-Mar-04	16:16:18	16-Mar-04	16:17:35	77	10687	10687	PDS_UNKNOWN_FAILURE

17-Mar-04	15:45:07	17-Mar-04	15:46:24	77	10701	10701	PDS_UNKNOWN_FAILURE
18-Mar-04	15:13:17	18-Mar-04	15:14:35	78	10715	10715	PDS_UNKNOWN_FAILURE
19-Mar-04	16:22:13	19-Mar-04	16:23:30	77	10730	10730	PDS_UNKNOWN_FAILURE
20-Mar-04	15:47:53	20-Mar-04	15:47:56	3	10744	10744	PDS_UNKNOWN_FAILURE
20-Mar-04	15:50:42	20-Mar-04	15:52:00	78	10744	10744	PDS_UNKNOWN_FAILURE
21-Mar-04	15:16:45	21-Mar-04	15:16:48	3	10758	10758	PDS_UNKNOWN_FAILURE
21-Mar-04	15:19:12	21-Mar-04	15:20:30	78	10758	10758	PDS_UNKNOWN_FAILURE
23-Mar-04	15:56:17	23-Mar-04	15:57:35	78	10787	10787	PDS_UNKNOWN_FAILURE
24-Mar-04	15:22:24	24-Mar-04	15:22:26	2	10801	10801	PDS_UNKNOWN_FAILURE
24-Mar-04	15:25:07	24-Mar-04	15:26:24	77	10801	10801	PDS_UNKNOWN_FAILURE
25-Mar-04	16:34:01	25-Mar-04	16:35:19	78	10816	10816	PDS_UNKNOWN_FAILURE
26-Mar-04	16:01:53	26-Mar-04	16:03:10	77	10830	10830	PDS_UNKNOWN_FAILURE
27-Mar-04	15:28:02	27-Mar-04	15:28:04	2	10844	10844	PDS_UNKNOWN_FAILURE
27-Mar-04	15:31:01	27-Mar-04	15:32:19	78	10844	10844	PDS_UNKNOWN_FAILURE
28-Mar-04	16:39:25	28-Mar-04	16:40:43	78	10859	10859	PDS_UNKNOWN_FAILURE
30-Mar-04	15:33:40	30-Mar-04	15:33:43	3	10887	10887	PDS_UNKNOWN_FAILURE
30-Mar-04	15:36:42	30-Mar-04	15:38:00	78	10887	10887	PDS_UNKNOWN_FAILURE
31-Mar-04	16:44:49	31-Mar-04	16:46:07	78	10902	10902	PDS_UNKNOWN_FAILURE
01-Apr-04	16:13:19	01-Apr-04	16:14:37	78	10916	10916	PDS_UNKNOWN_FAILURE
02-Apr-04	15:39:18	02-Apr-04	15:39:21	3	10930	10930	PDS_UNKNOWN_FAILURE
02-Apr-04	15:42:17	02-Apr-04	15:43:35	78	10930	10930	PDS_UNKNOWN_FAILURE
03-Apr-04	15:08:16	03-Apr-04	15:08:18	2	10944	10944	PDS_UNKNOWN_FAILURE
03-Apr-04	15:10:18	03-Apr-04	15:11:36	78	10944	10944	PDS_UNKNOWN_FAILURE
04-Apr-04	16:19:13	04-Apr-04	16:20:31	78	10959	10959	PDS_UNKNOWN_FAILURE
06-Apr-04	15:16:12	06-Apr-04	15:17:30	78	10987	10987	PDS_UNKNOWN_FAILURE
07-Apr-04	16:25:07	07-Apr-04	16:26:25	78	11002	11002	PDS_UNKNOWN_FAILURE
08-Apr-04	15:50:43	08-Apr-04	15:50:46	3	11016	11016	PDS_UNKNOWN_FAILURE
08-Apr-04	15:53:27	08-Apr-04	15:54:45	78	11016	11016	PDS_UNKNOWN_FAILURE
09-Apr-04	15:19:31	09-Apr-04	15:19:34	3	11030	11030	PDS_UNKNOWN_FAILURE
09-Apr-04	15:22:06	09-Apr-04	15:23:24	78	11030	11030	PDS_UNKNOWN_FAILURE
10-Apr-04	16:31:02	10-Apr-04	16:32:19	77	11045	11045	PDS_UNKNOWN_FAILURE
11-Apr-04	15:59:02	11-Apr-04	16:00:20	78	11059	11059	PDS_UNKNOWN_FAILURE

Table 4: List of gaps for RA-2 L0 products during cycle 25

In Figure 10 and Table 5 the summary of unavailable MWR L0 products is given.

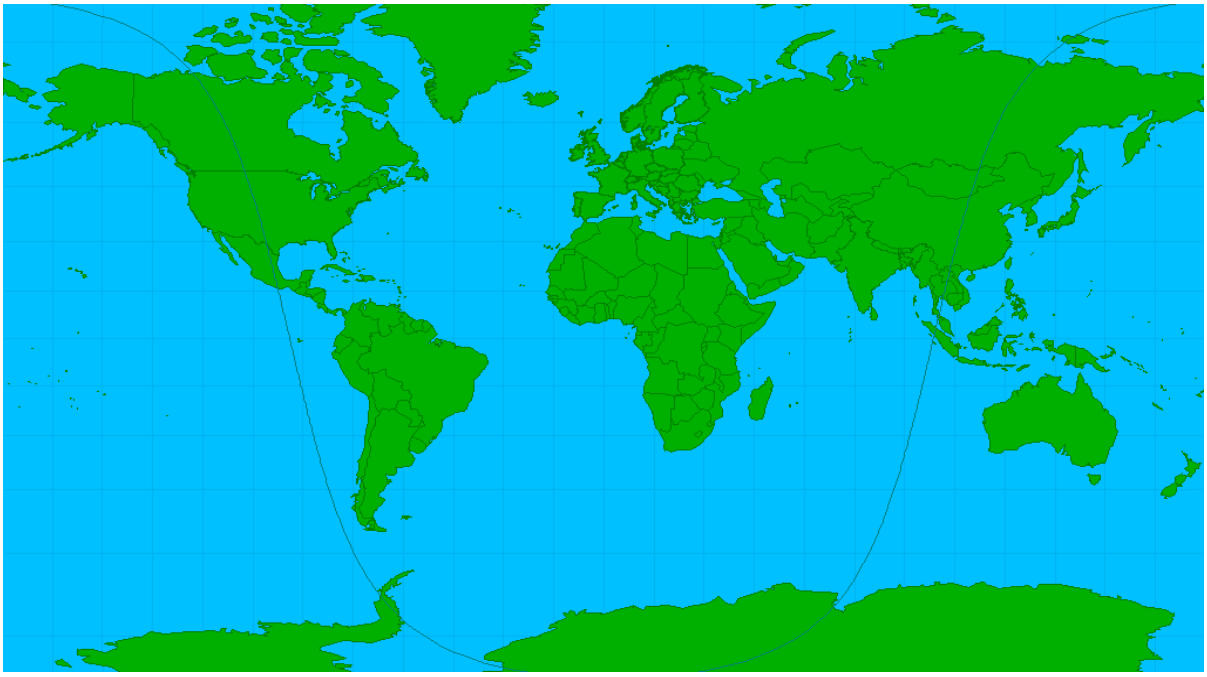

Figure 10: MWR L0 unavailable products for cycle 25

Start date	Start time	Stop date	Stop time	Duration (s)	Start orbit	Stop orbit	Reason
11-Mar-04	12:26:01	11-Mar-04	12:27:13	72	10613	10613	PDS_UNKNOWN_FAILURE
13-Mar-04	03:00:04	13-Mar-04	04:42:04	6120	10636	10637	PDS_UNKNOWN_FAILURE
01-Apr-04	19:40:21	01-Apr-04	21:19:33	5952	10918	10919	PDS_UNKNOWN_FAILURE

Table 5: List of gaps for MWR L0 products during cycle 25

In Figure 11 and Table 6 the summary of unavailable RA-2 L1b products is given.

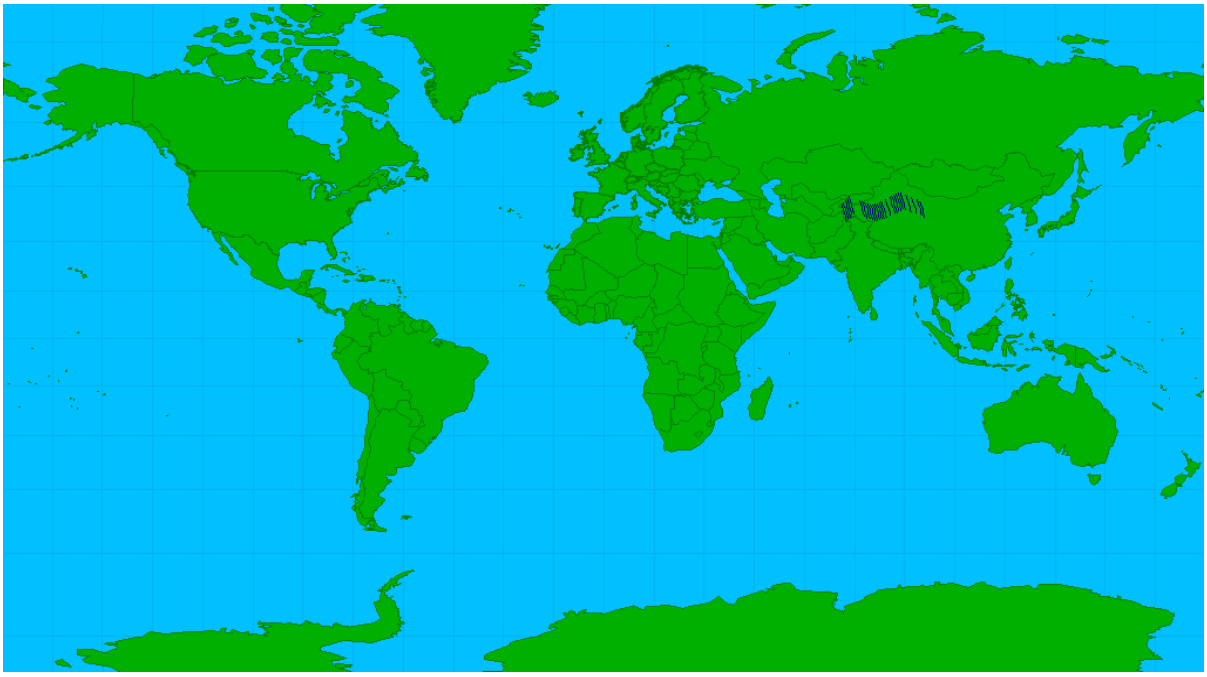

Figure 11: RA-2 L1b unavailable products for cycle 25

Start date	Start time	Stop date	Stop time	Duration (s)	Start orbit	Stop orbit	Reason
09-Mar-04	16:36:43	09-Mar-04	16:38:01	78	10587	10587	PDS_UNKNOWN_FAILURE
10-Mar-04	16:04:40	10-Mar-04	16:05:58	78	10601	10601	PDS_UNKNOWN_FAILURE
11-Mar-04	15:33:55	11-Mar-04	15:35:13	78	10615	10615	PDS_UNKNOWN_FAILURE
12-Mar-04	16:42:07	12-Mar-04	16:43:25	78	10630	10630	PDS_UNKNOWN_FAILURE
13-Mar-04	16:10:23	13-Mar-04	16:11:41	78	10644	10644	PDS_UNKNOWN_FAILURE
14-Mar-04	15:39:31	14-Mar-04	15:40:49	78	10658	10658	PDS_UNKNOWN_FAILURE
16-Mar-04	16:16:18	16-Mar-04	16:17:35	77	10687	10687	PDS_UNKNOWN_FAILURE
17-Mar-04	15:45:07	17-Mar-04	15:46:24	77	10701	10701	PDS_UNKNOWN_FAILURE
18-Mar-04	15:13:17	18-Mar-04	15:14:35	78	10715	10715	PDS_UNKNOWN_FAILURE
19-Mar-04	16:22:13	19-Mar-04	16:23:30	77	10730	10730	PDS_UNKNOWN_FAILURE
20-Mar-04	15:47:54	20-Mar-04	15:47:56	2	10744	10744	PDS_UNKNOWN_FAILURE
20-Mar-04	15:50:42	20-Mar-04	15:52:00	78	10744	10744	PDS_UNKNOWN_FAILURE
21-Mar-04	15:19:12	21-Mar-04	15:20:30	78	10758	10758	PDS_UNKNOWN_FAILURE
23-Mar-04	15:56:17	23-Mar-04	15:57:35	78	10787	10787	PDS_UNKNOWN_FAILURE
24-Mar-04	15:25:07	24-Mar-04	15:26:24	77	10801	10801	PDS_UNKNOWN_FAILURE
25-Mar-04	16:34:01	25-Mar-04	16:35:19	78	10816	10816	PDS_UNKNOWN_FAILURE
26-Mar-04	16:01:53	26-Mar-04	16:03:10	77	10830	10830	PDS_UNKNOWN_FAILURE
27-Mar-04	15:31:01	27-Mar-04	15:32:19	78	10844	10844	PDS_UNKNOWN_FAILURE
28-Mar-04	16:39:25	28-Mar-04	16:40:43	78	10859	10859	PDS_UNKNOWN_FAILURE
29-Mar-04	16:07:28	29-Mar-04	16:08:46	78	10873	10873	PDS_UNKNOWN_FAILURE
30-Mar-04	15:36:42	30-Mar-04	15:38:00	78	10887	10887	PDS_UNKNOWN_FAILURE
31-Mar-04	16:44:49	31-Mar-04	16:46:07	78	10902	10902	PDS_UNKNOWN_FAILURE
01-Apr-04	16:13:19	01-Apr-04	16:14:37	78	10916	10916	PDS_UNKNOWN_FAILURE

02-Apr-04	15:42:17	02-Apr-04	15:43:35	78	10930	10930	PDS_UNKNOWN_FAILURE
03-Apr-04	15:10:18	03-Apr-04	15:11:36	78	10944	10944	PDS_UNKNOWN_FAILURE
04-Apr-04	16:19:13	04-Apr-04	16:20:31	78	10959	10959	PDS_UNKNOWN_FAILURE
06-Apr-04	15:16:12	06-Apr-04	15:17:30	78	10987	10987	PDS_UNKNOWN_FAILURE
07-Apr-04	16:25:07	07-Apr-04	16:26:25	78	11002	11002	PDS_UNKNOWN_FAILURE
08-Apr-04	15:53:27	08-Apr-04	15:54:45	78	11016	11016	PDS_UNKNOWN_FAILURE
09-Apr-04	15:22:06	09-Apr-04	15:23:24	78	11030	11030	PDS_UNKNOWN_FAILURE
10-Apr-04	16:31:02	10-Apr-04	16:32:19	77	11045	11045	PDS_UNKNOWN_FAILURE
11-Apr-04	12:55:08	11-Apr-04	14:32:20	5832	11057	11058	PDS_UNKNOWN_FAILURE
11-Apr-04	15:59:02	11-Apr-04	16:00:20	78	11059	11059	PDS_UNKNOWN_FAILURE
12-Apr-04	15:28:01	12-Apr-04	15:29:19	78	11073	11073	PDS_UNKNOWN_FAILURE

Table 6: List of gaps for RA-2 L1b products during cycle 25

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

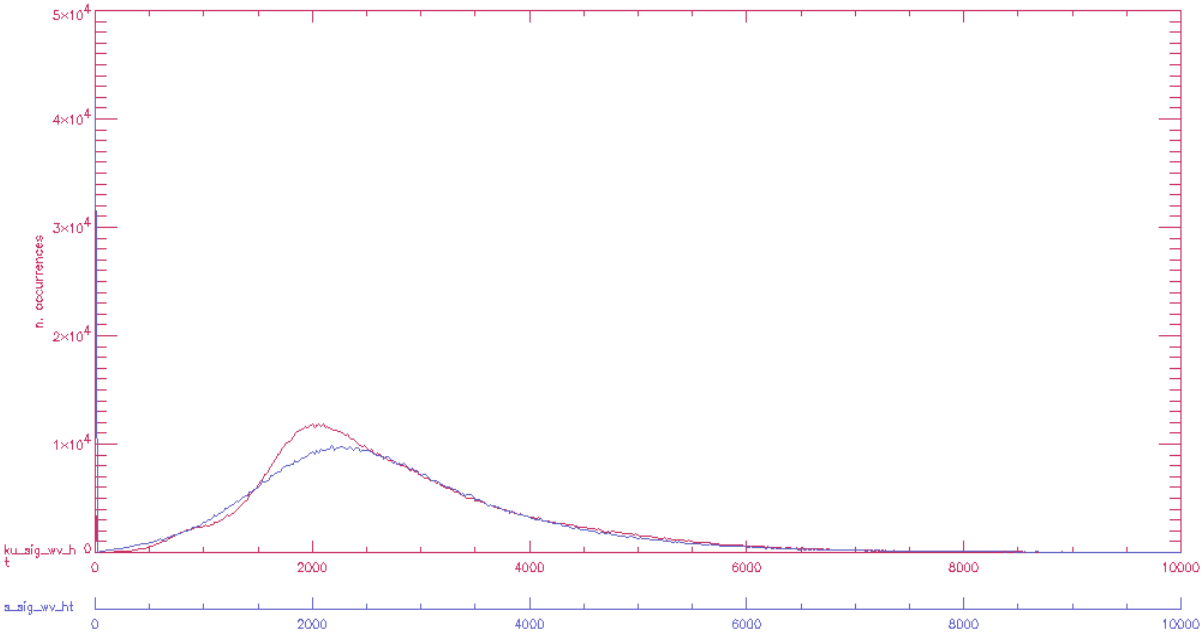

Figure 12: Histogram of Ku and S Band SWH for cycle 25 (mm)

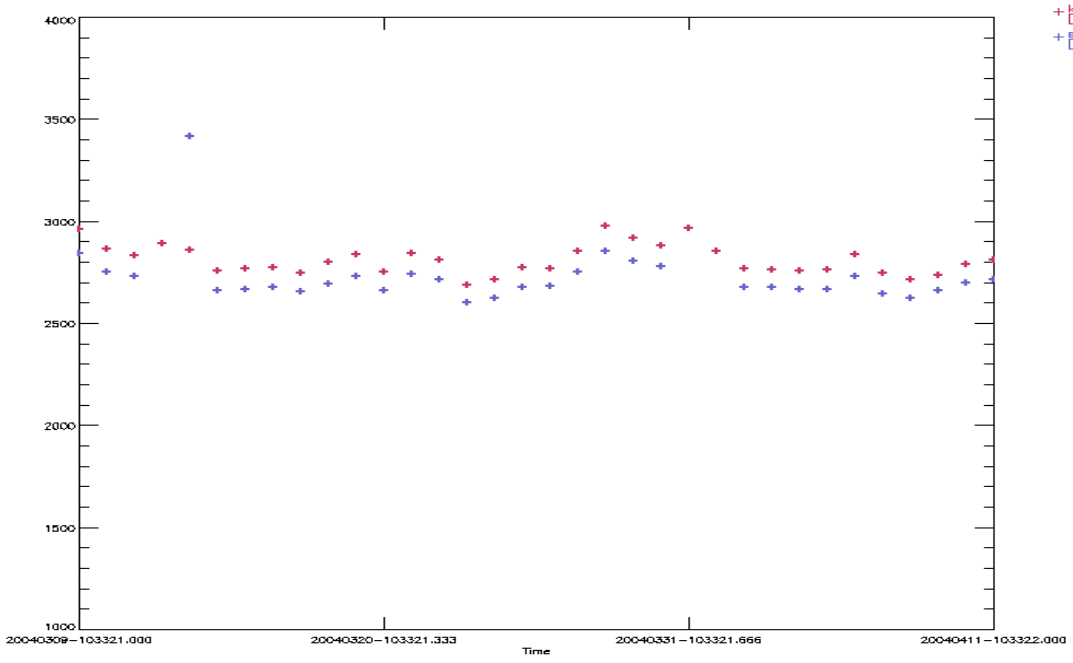

Figure 13: Ku and S SWH daily average for cycle 25 (mm)

The trend and the histogram of the SWH show a nominal behavior for this cycle; the high daily means (sometimes plotted outside the figure range) reported for the S-Band values are due to the so-called S-Band anomaly (ref. par.7.1.7).

8.2.3 BACKSCATTER COEFFICIENT – WIND SPEED

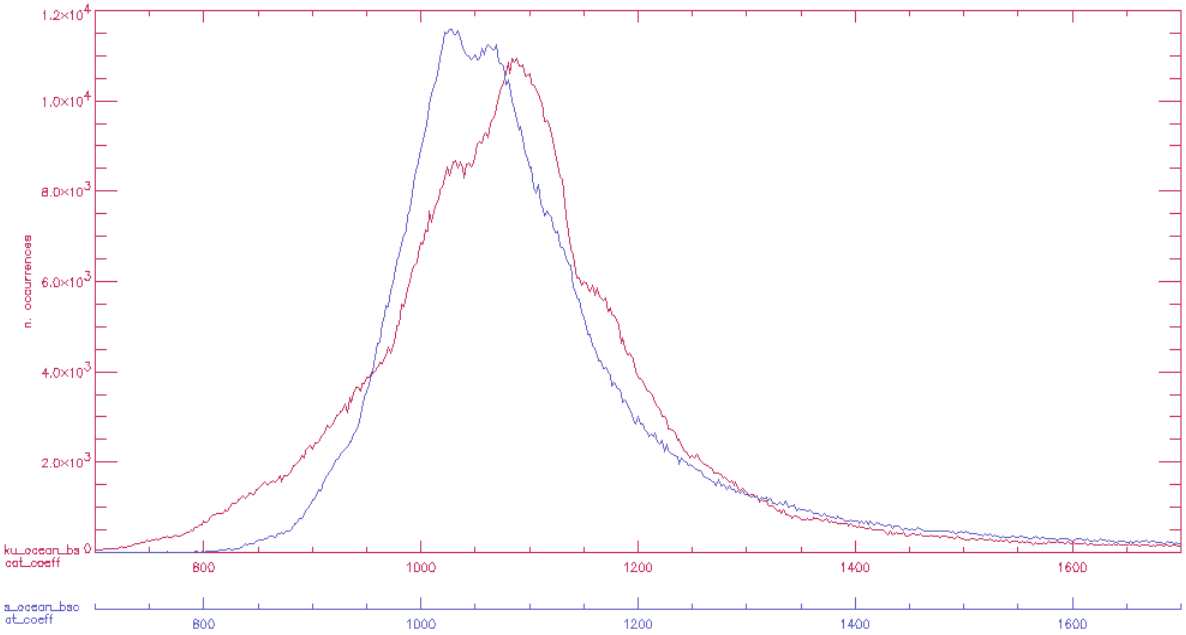

Figure 14: Histogram of Ku and S Band Backscattering Coefficient for cycle 25 (dB/100)

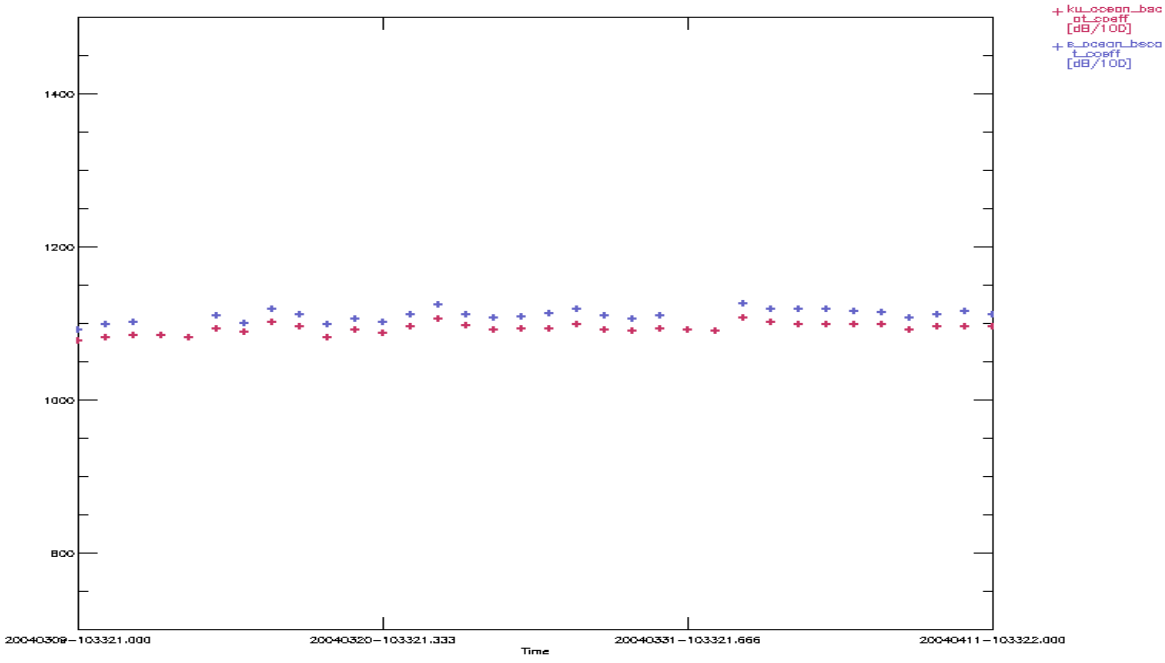

Figure 15: Ku and S Sigma_0 daily average for cycle 25 (dB/100)

The trend and the histogram of the Ku-Band Sigma_0 show a nominal behavior for this cycle. The S-Band Sigma_0 histogram shows a double peak the cause of which is, at the moment, under investigation. The high daily means (sometimes plotted outside the figure range) reported for the S-Band Sigma_0 trend are due to the so-called S-Band anomaly (ref. par. 7.1.7).

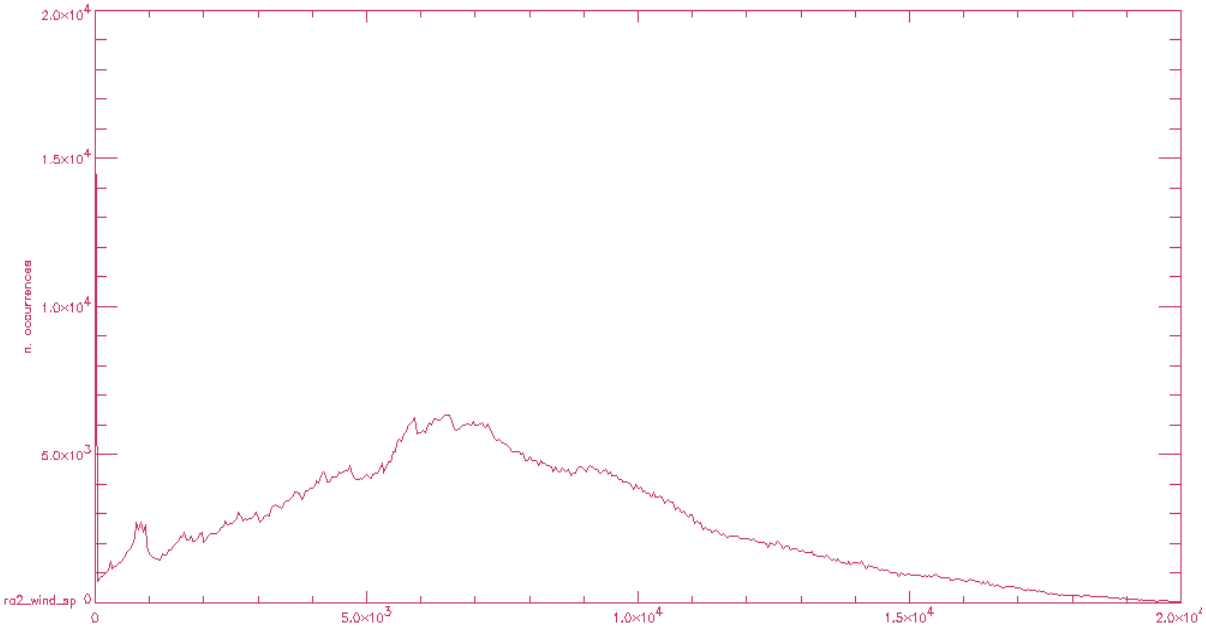

Figure 16: Histogram of Ku Wind Speed for cycle 25 (mm/s)

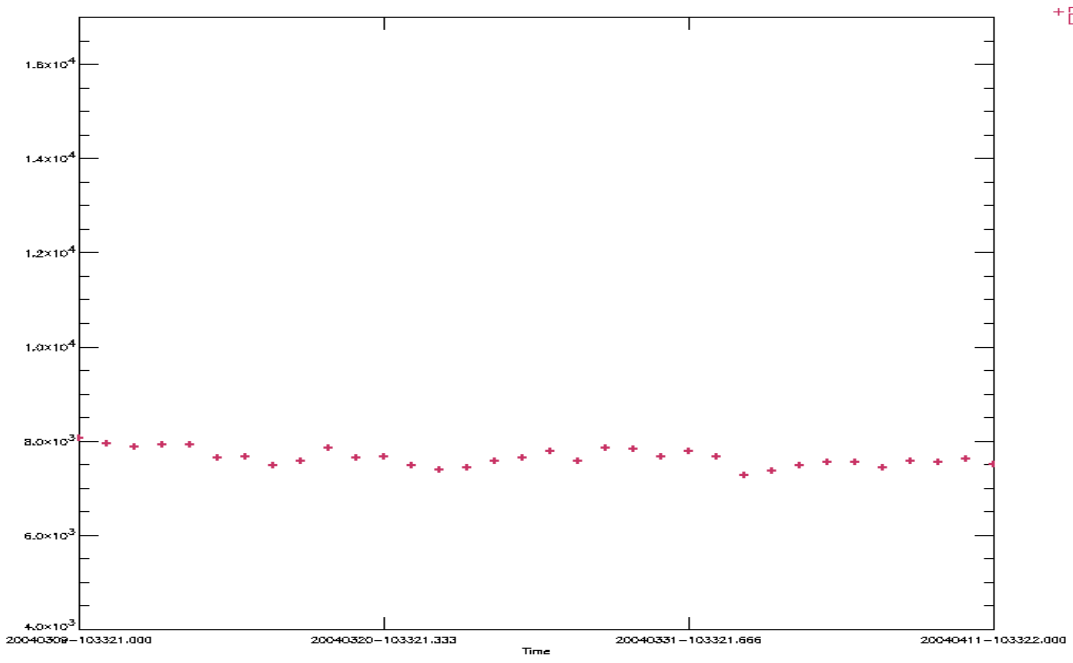

Figure 17: Wind Speed daily average for cycle 25 (mm/s)

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 7: 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.

As a consequence of the IPF V4.56 s/w version installation, the rain flag validity is currently affected. This shall be corrected with the loading of a new ADF table.

8.5.5 USO RANGE CORRECTION

The actual data of cycle 25 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 –4.42 mm per year. Eventually it could also be corrected for the given bias (30.18 mm) that has to be subtracted from the measured value.

8.6 Wind & Wave quality assessment

Refer to the ECMWF report given in [R – 9].

9 LONG TERM MONITORING

9.1 RA-2 Instrument monitoring

9.1.1 IF FILTER MASK

In Figure 18 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. Two peaks are visible on the plot that correspond to the data

acquired on September the 27th at 15:48 and on October the 29th at 15:42. The reason of this could be found in the instrument warming up considering that the IF Cal acquisition has been made, in the two 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.

Despite the quite constant IF mask trend, a weird behavior has been observed during the validation of several newly created IF mask correction auxiliary files. This phenomenon is currently under investigation but in the meantime the decision has been taken to avoid updating the auxiliary file in question.

During cycle 25 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 1 B ground processing.

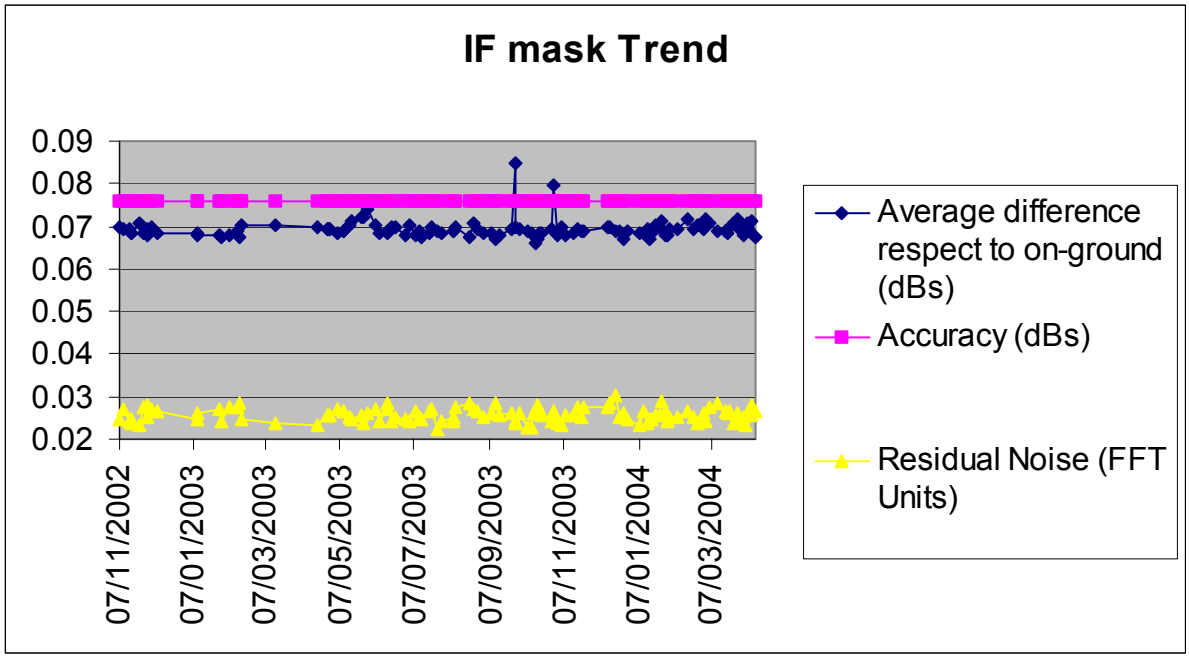

Figure 18: Evolution of the IF mask related parameters for valid IF masks retrieved until cycle 25.

9.1.2 USO

In Figure 19 the USO clock period trend retrieved until the end of cycle 25 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 32.58 mm and –3.07 mm/year as

calculated with data covering the period 13 June 2003 to 13 April 2004. The given bias and drift have to subtracted from the original altimetric range.

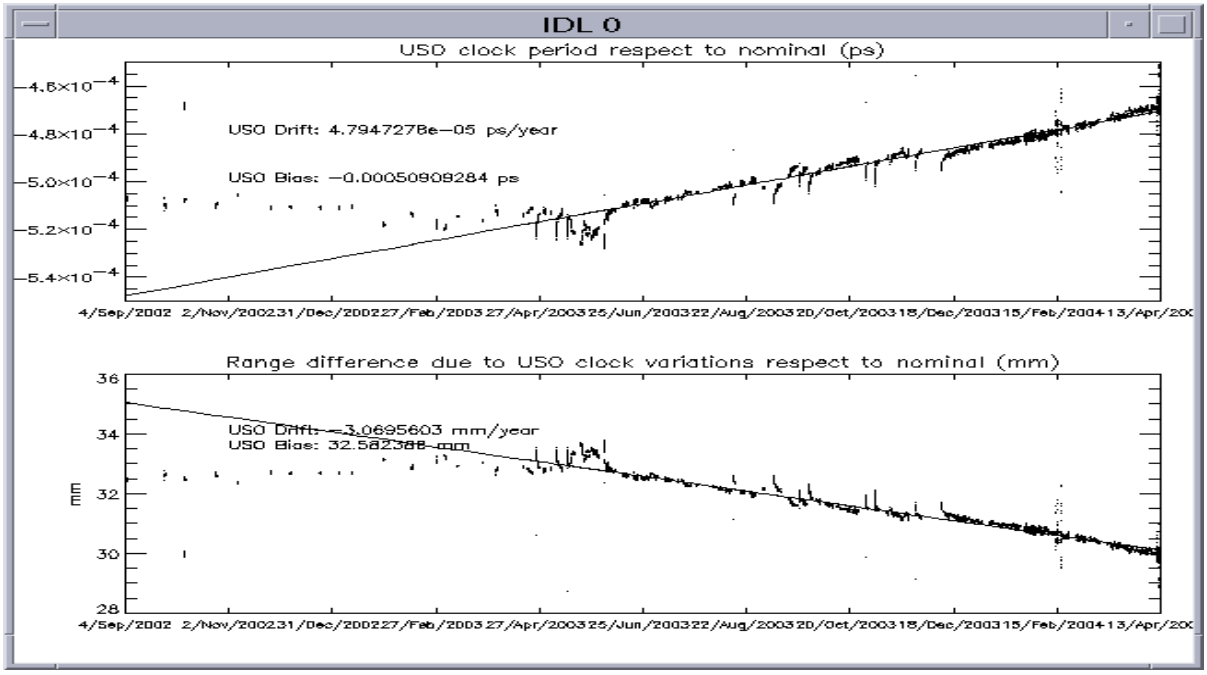

Figure 19: USO clock period until end of cycle 25

9.1.3 TRACKING CAPABILITY

In Figure 20, Figure 21 and Figure 22, 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.

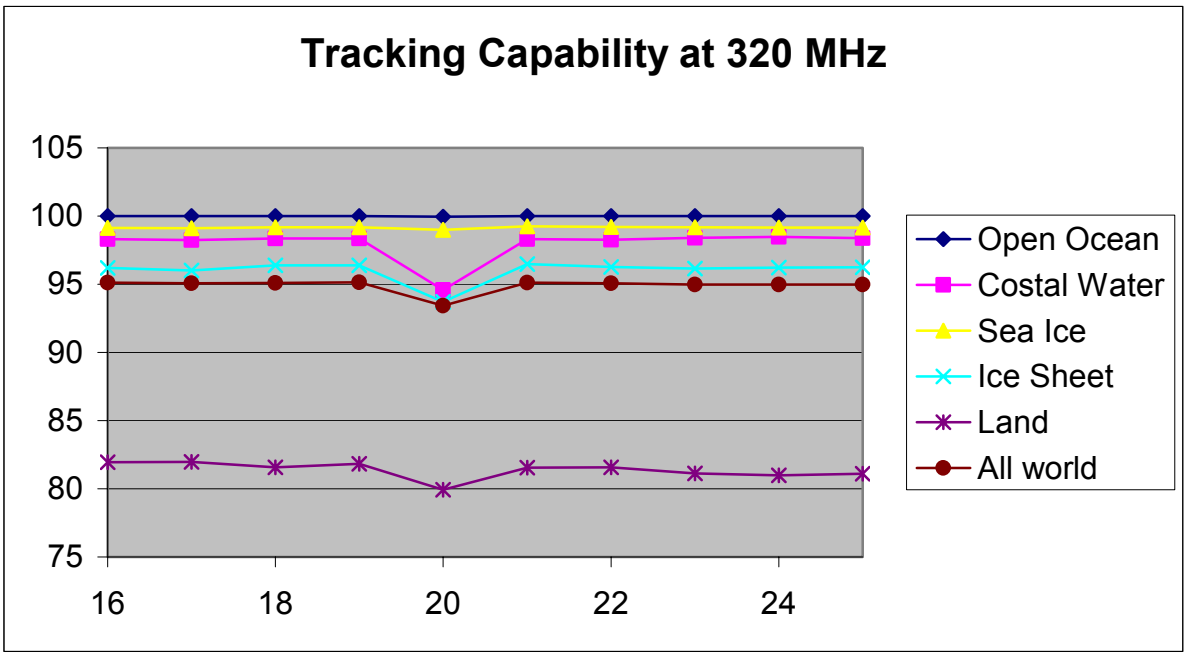

Figure 20: RA-2 Tracking percentage at 320MHz for different surfaces

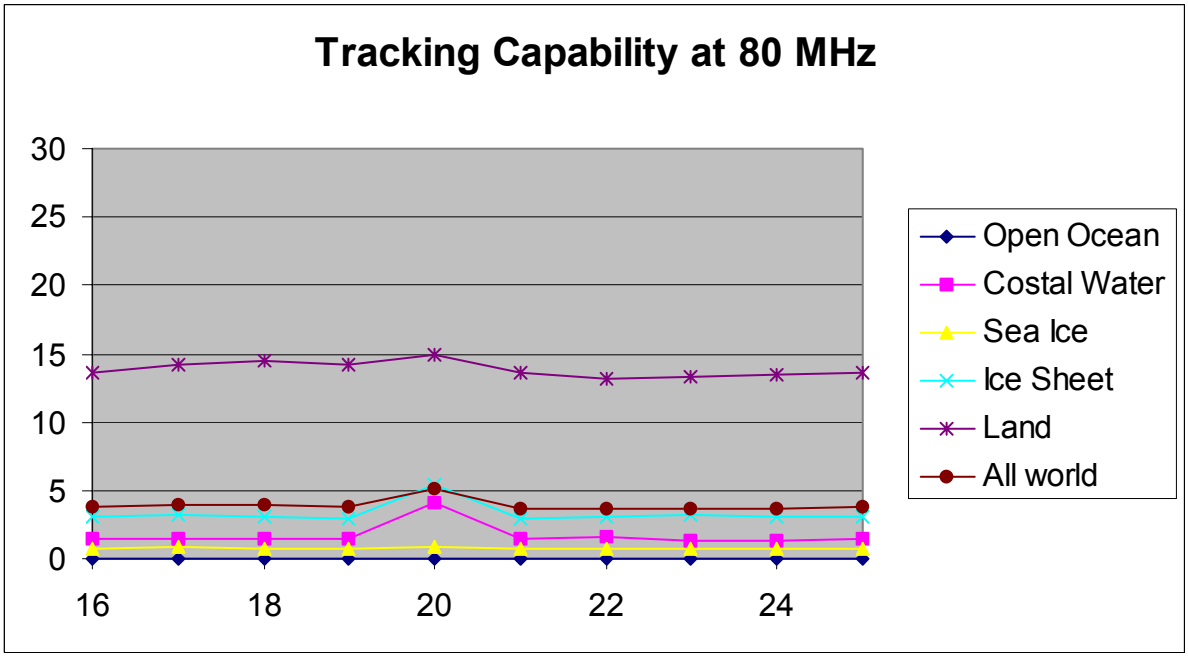

Figure 21: RA-2 Tracking percentage at 80MHz for different surfaces

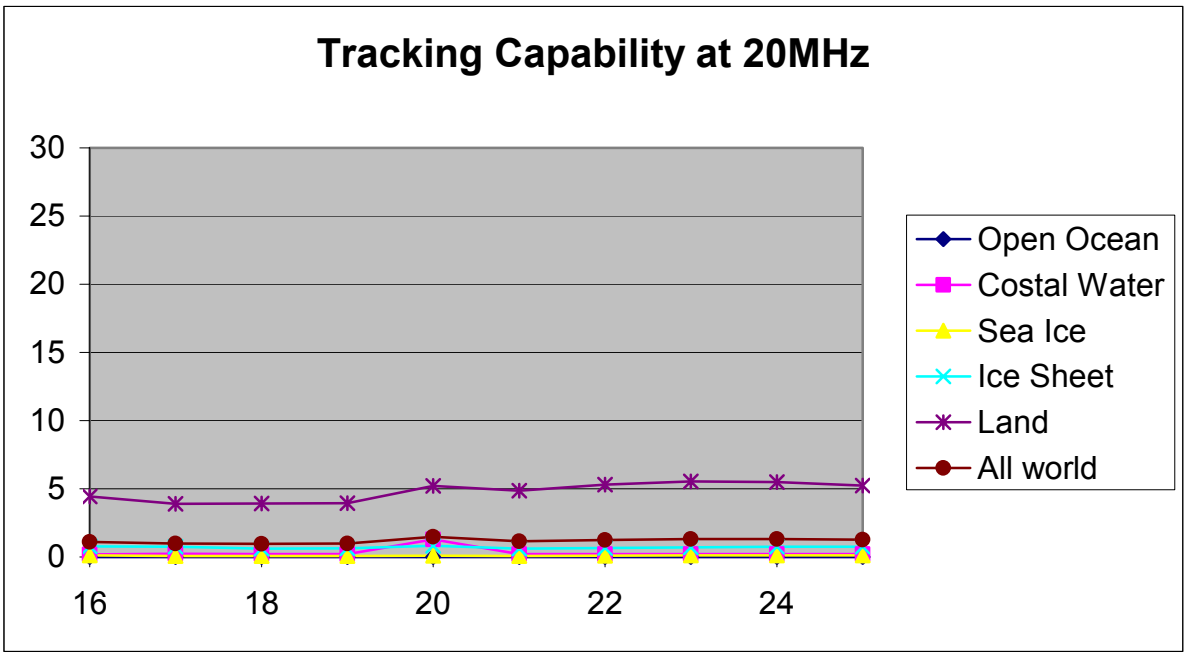

Figure 22: RA-2 Tracking percentage at 20MHz for different surfaces

9.1.4 DATATION

In Figure 23 (upper panel) the differences between the extrapolated UTC values and the corresponding real UTC values measured at the next Kiruna dump, are reported. 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, during the last cycle, the number of small differences (10 microseconds plus or minus) has increased a lot; this problem is currently under 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.

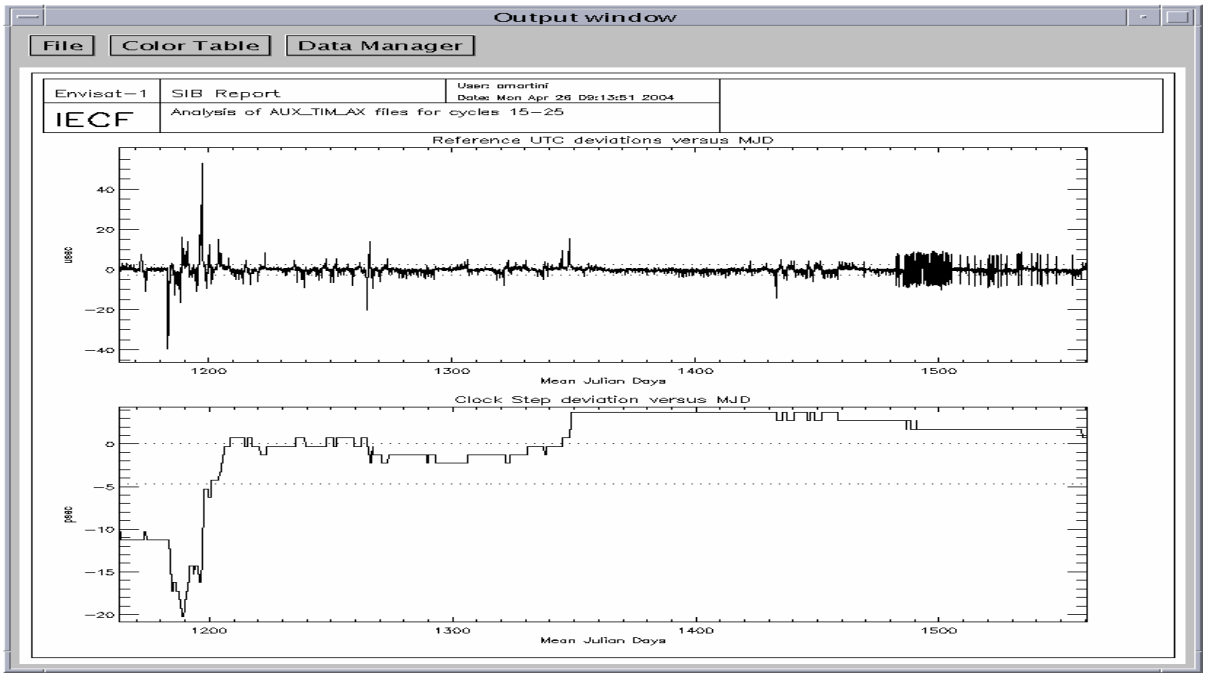

Figure 23: UTC deviations and ICU clock period up to cycle 25

9.1.5 MISPOINTING

In Figure 24 the overall mispointing squared trend is plotted for cycles 15 to 25. The two big jumps occurred on April the 7th and on November the 26th 2003 are correlated to the upload of IPF 4.54 and 4.56 respectively. In the second case the abrupt decreasing of the mispointing squared value is due to the usage of a new RA2_IFF_AX IF mask auxiliary file.
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 25. 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.

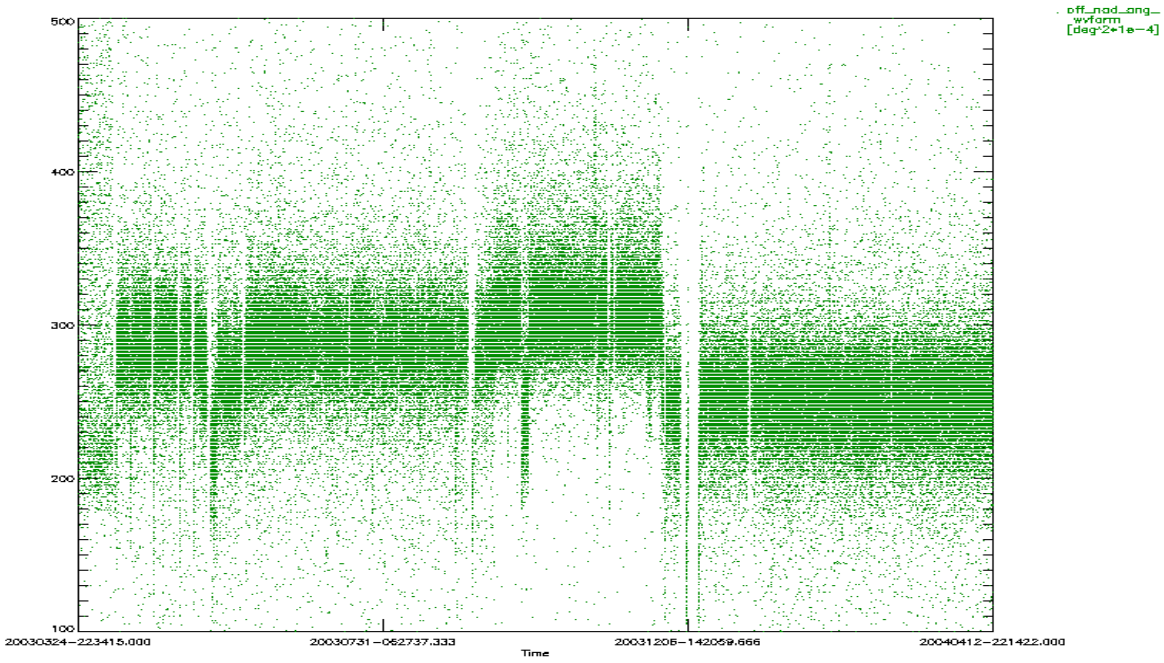

Figure 24: Smoothed mispointing squared trend until end of cycle 25 (deg^2*10e-4)

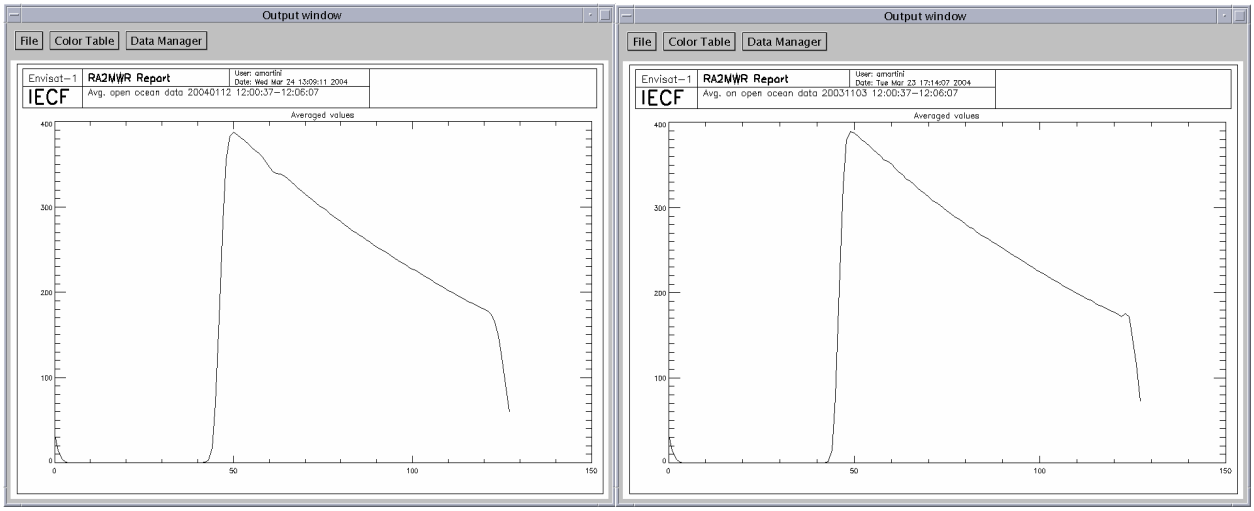

Figure 25: Open Ocean average waveforms before (left) and after an anomaly (right)

9.1.6 S-BAND ANOMALY

In the percentage of data per cycle that are affected by the so-called “S-Band” anomaly is reported. The figures are quite stable between 2.5% and 6.5%.

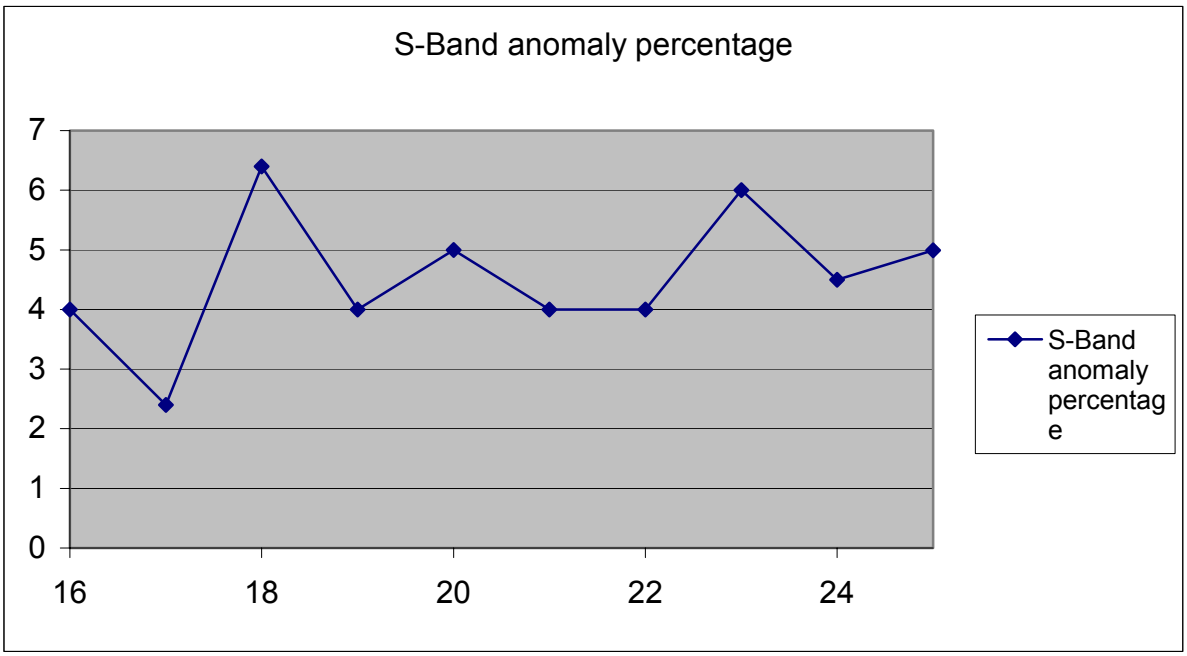

Figure 26: Percentage of data affected by the "S-Band Anomaly" for cycles 16-25

9.2 Products Monitoring

9.2.1 AVAILABILITY OF DATA

Hereafter the percentage of the different levels of products unavailability is reported for different cycles up to number 25. Considering as reference the instrument unavailability, it is possible to notice that in the last four months the situation is greatly improved for all levels of products.

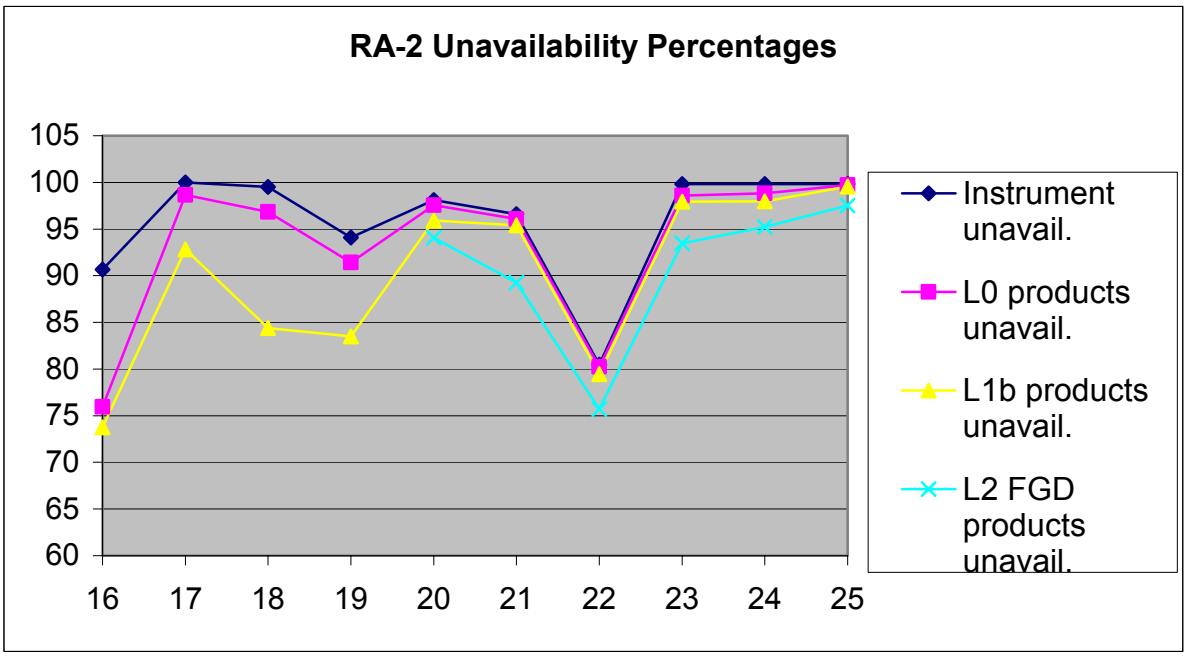

Figure 27: Percentage of Products unavailability up to cycle 25

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

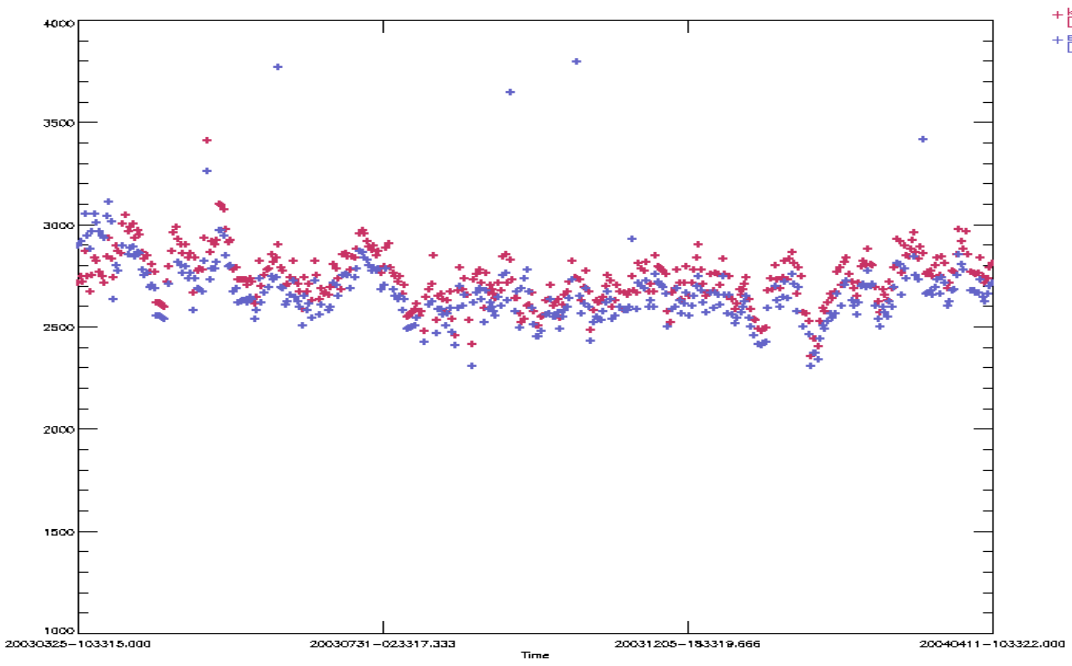

Figure 28: Ku and S SWH daily average up to cycle 25 (mm)

The Ku-Band SWH shows a stable behavior during the whole period. 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).

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 2004. 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.

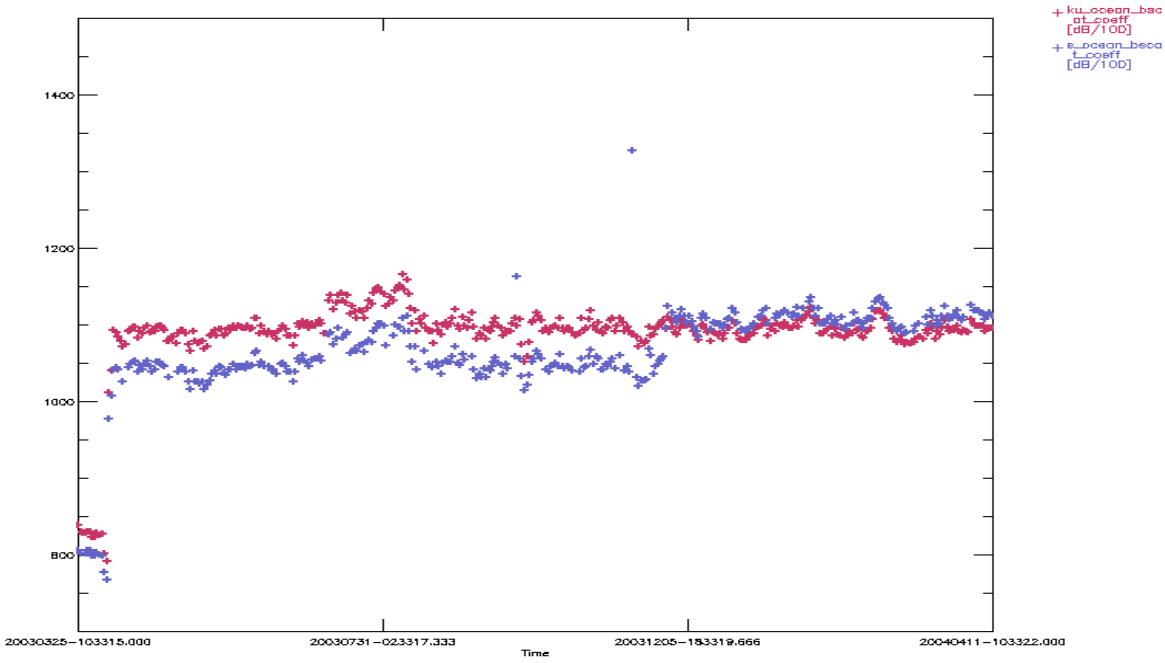

Figure 29: Ku and S Sigma_0 daily average up to cycle 25 (dB/100)

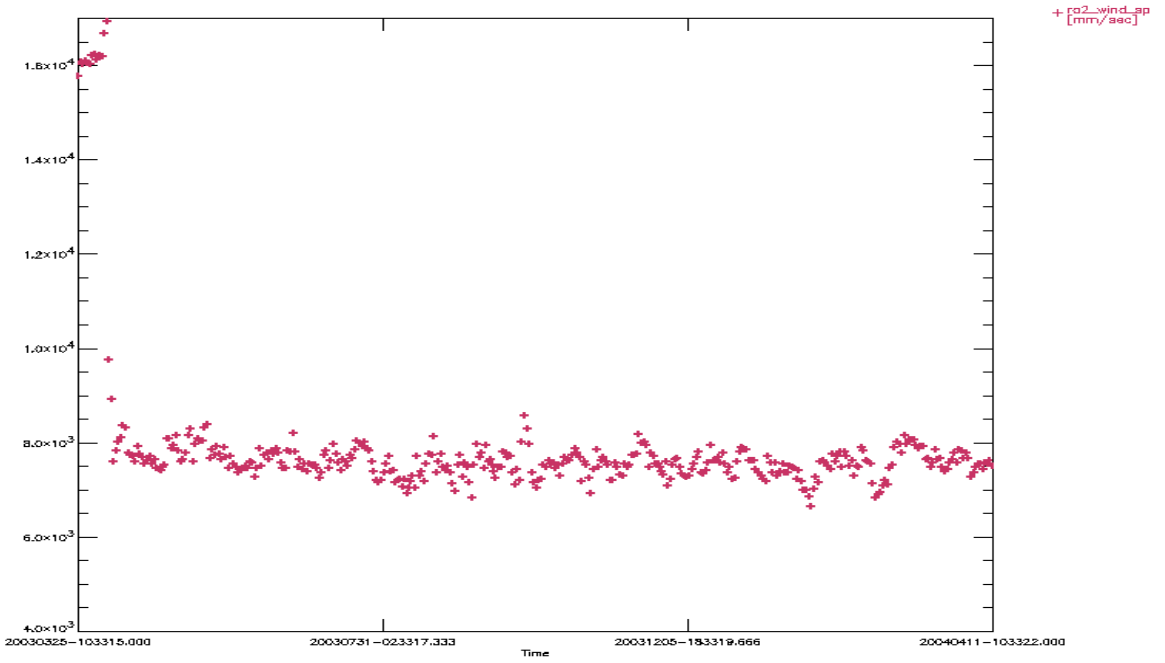

Figure 30: Wind Speed daily average for cycle 25 (mm/s)

10 PARTICULAR INVESTIGATIONS

On the data of cycle 25 a special investigation has been initiated with the aim to explain the presence of two peaks in the S-Band backscattering histogram (see par. 8.2.3)