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ENVISAT CYCLIC ALTIMETRIC REPORT

CYCLE 52 from 09-10-2006 to 13-11-2006

Quality Assessment Report

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1 INTRODUCTION

This document aims at reporting on the performance 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 which occurred during cycle 52.

This report covers the period from the 9th of October 2006 until the 13th of November 2006.

2 DISTRIBUTION LIST

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

3 ACRONYMS

AGC	Automatic Gain Control
APC	Antenna Pointing Controller
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	Globa l 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
SLA	Sea Level Anomalies
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
USO	Ultra Stable Oscillator
YSM	Yaw Stellar Mode

4 REFERENCE DOCUMENTS

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[R – 2] ENVISAT Microwave Radiometer Assessment Report Cycle, CLS.DOS/05.147, 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-1342, http://earth.esa.int/pcs/envisat/ra2/articles/
[R – 8] RA-2 Performance Results, Paper presented at the ENVISAT Calibration Review in September 2002
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[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 # 224-228, ENVI-ESOC-OPS-RP-1011-TOS-OF
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[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
[R-17] Envisat Cyclic Report Cycle 28, ENVI-GSOP-EOPG-03-0011
[R-18] ENVISAT RA-2 IF MASK AUX FILE - Updating Strategy: Investigation Report; C. Bignami and C.Loddo and N. Pierdicca.

5 GENERAL QUALITY ASSESSMENT

5.1 Cycle Overview

- The Envisat RA-2 has been operating nominally with the RFSS configured to the A side.
- The analysis of the RA-2 data confirmed the persistence of the abnormal RA-2 Ultra-Stable Oscillator (USO) behaviour affecting the Altimetric Range by few meters. No other altimeter parameter has been affected during the anomaly period.
  WARNING: Users are advised not to use the range parameter in Ku and S Band for the period covered by cycle 52 without correcting the data.
- Three USO corrections have been developed for the different Envisat Level 2 altimetry data products for correcting the abnormal RA-2 USO behaviour affecting the Altimetric Range by few meters w.r.t. the Mean Sea Surface:
  1. NRT orbit basis USO correction for FDGDR products , available from http://earth.esa.int/pcs/envisat/ra2/auxdata/;
  2. An Interim daily USO correction for IGDR products, available at the same F-PAC location as for IGDR, in the directory igdr_ous_corr
  3. An OFL cycle USO correction for GDR products, available at the same F-PAC location as for GDR, in the directory gdr_ous_corr.
- A software routine has been developed to allow users to insert the RA-2 Ultra-Stable Oscillator (USO) corrections into Envisat Level 2 altimetry data products and is available in the same web site as the correction files, see above.
- The NRT USO correction has been made available from July 24, 2006 onwards.
- The number of valid IF masks are 13 (32% of acquired masks). The auxiliary file RA2_IFF_AX has been updated once, on date 27 October 2006.
- The S Band Anomaly affected 15 orbits, corresponding to 3% of the data.

- Tracking performances in the different resolutions are well in line with the output figures and objectives of the Commissioning Phase.
- During cycle 52, no update of the RA2_USO_AX has been done.
- The Radar Altimeter was unavailable twice, RA-2 Data availability is around 96.9%
- DORIS was never unavailable, with data availability of 98.7%
- MWR was never unavailable, with data availability of 98.7%

5.2 Payload status

5.2.1 ALTIMETER EVENTS

The Radar Altimeter 2, during cycle 52, was unavailable twice as follows.

1. 26 Oct 2006 04:02:43.000 Orbit = 24335
   26 Oct 2006 10:32:00.000 Orbit = 24339
   RA-2 Back to Measurement following Multiple SEU Anomaly

2. 2 Nov 2006 15:20:19.000 Orbit = 24442
   2 Nov 2006 20:07:00.000 Orbit = 24445
   RA-2 Back to Measurement following Multiple SEU Anomaly

5.2.1.1 RA-2 instrument planning

The RA-2 instrument planning was performed as follows:

- IF Calibration Mode according to the nominal operational acquisition scheme: 100 seconds of data twice per day over Himalayan region (ascending and descending passes).
- 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 the Himalayan region (both ascending and descending passes) and is operated for half a day.
- Individual Echoes acquisitions during PLO activity over ESA transponder located in Rome (1 second length acquisition, 1 repetition)
- Individual Echoes acquisition (1 second length acquisition, 1 repetition) over the following sites:
  Capraia, Toulon D, Vostok , Dome C. Appendix 6 contains a table with the coordinates.
- Individual Echoes acquisitions over the Uyuni Salar
- Preset Loop Output mode for GAVDOS Range transponders, located in Creta.
- Preset Loop Output mode over the ESA transponder located in Rome (permanent location); high chirp resolution.

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

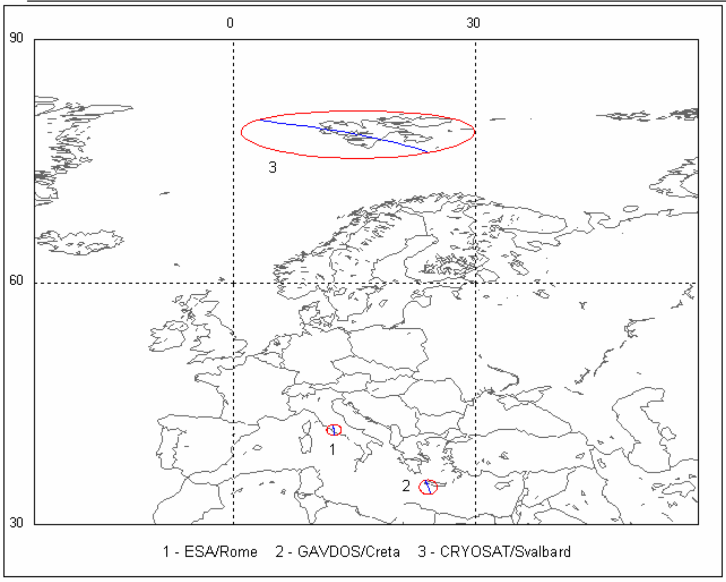

Figure 1: Transponder Acquisition sites

5.2.2 MWR EVENTS

The MWR, during cycle 52 was never unavailable [R-13].

5.2.3 DORIS EVENTS

The DORIS, during cycle 52 was never unavailable [R-13].

5.3 Availability

The summary of the RA-2 data products availability for this cycle is reported in Appendix 2.
Data availability was 96.89% for RA2 products, 98.68% for MWR and around 98.60% for DORIS products.

5.4 Orbit quality

During the period covered by cycle 52 the spacecraft ground track remained within the +/-1km deadband around the reference ground track without any orbit control manoeuvre.

5.5 Ground Segment Processing Chain Status

5.5.1 IPF PROCESSING CHAIN

5.5.1.1 Version

Cycle 52 data has been processed with the IPF processing chain V5.03, installed in both PDHS-E and PDHS-K on 19th September 2006. It contains the following evolutions:

1. S-band anomaly flag valid for all surfaces well implemented. Users are advised to take advantage of this flag to detect the data affected by the S-band anomaly.
   This flag is available in:
   Level 1B : in bit 1 of MCD (field 14)
   Level 2 : in bit 7 of MCD (field 8).
2. Correction of the Level 0 Rx_dist_fine. The error in the window delay (for the 80 and 20 MHz bandwidths) that depends on the L0 parameter Rx_dist_fine is now corrected and well implemented.
3. Orbit Flag on L1b and L2 Data Products is properly set in the L1B and L2 data products and can be found at the following locations :
   Level 1B RA2 MDSR : bit 0 of MCD (field 14)
   L1B/L2-MWR MDSR : bit1 of MCD (field 8)
   L2-RA2 MDSR : bit27 of MCD (field 8)
4. MWR MDSR differences: differences between the IPF and the reference processor, up to few tenths of degree Kelvin have been found in the Channel 2 brightness temperature. This is now corrected and well implemented.
5. Peakiness in FDMAR products are no more set to default value: field 89 for Ku band and field 90 for S band.

A complete table of IPF Level1b and Level2 upgrades is reported in Appendix 1.

5.5.1.2 Auxiliary Data File

The Auxiliary files actually used by the IPF ground processing are reported in Appendix 3.
The RA2_POL_AX, RA2_SOL_AX and RA2_PLA_AX have been regularly updated without problems. The RA2_IFF_AX has been updated during the reporting period. The RA2_USO_AX has never been updated during the reporting period given the anomaly in the USO clock period, see Chapter 6.1.3. Data are corrected with the RA2_USO_AX estimated before the USO Clock anomaly (USO_Clock_Period = 12499999726, USO_Range_Correction= 17.3 mm).

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

5.5.2 F-PAC PROCESSING CHAIN

The current version of CMA is V7.1 operational since 24th October 2005.
F-PAC CMA anomalies are detailed in the F-PAC Monthly Report [R – 1a] and [R-1b].
The F-PAC CMA processing chain includes all the IPF evolutions plus some others like:
- Inclusion of GPS Ionospheric correction
- Inclusion of MOG2D Inverse Barometer Geophysical Correction in Level 2 products
- FES2004
- Addition of a field for Level 1B SW ID in Level 2 products
- Inclusion of nadir location not corrected for slope model

6 INSTRUMENT PERFORMANCE

6.1 RA-2 Performance

6.1.1 TRACKING CAPABILITY

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

Surface type	320 MHz	Commissioning Phase objectives 320 MHz	80 MHz	20MHz
Open Ocean	99,92	>99%	0,06	0,02
Costal Water (ocean depth < 200 m)	97,13	No specific requirement	2,42	0,45
Sea Ice	98,91	>95%	0,95	0,14
Ice Sheet	96,67	>95%	2,70	0,63
Land	82,72	No specific requirement	12,91	4,37
All world	95,42		3,47	1,11

Table 1: RA-2 Tracking capability: Chirp ID percentages discriminated by surface type

The figures given for the RA-2 tracking performances during this cycle are in line with the ones recorded at the end of the Commissioning Phase reported in the last column and presented in [R – 8].

In Figure 2, Figure 3 and Figure 4 the cyclic tracking percentages for the three RA-2 bandwidths are reported.
The worsening in performance noticeable for cycle 20 was due to the up-load of wrong on-board software parameters which lasted for about three days whilst for cycle 47 a special operation has been performed to limit RA-2 Chirp Bandwidth to fixed values.

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 Table 1.

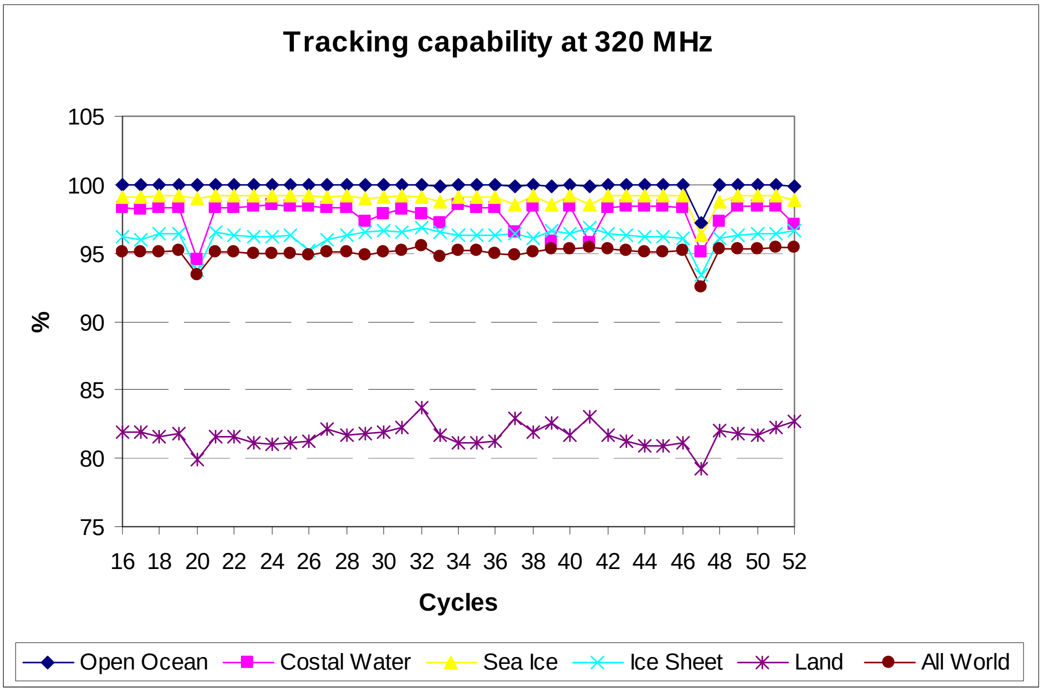

Figure 2: RA-2 Tracking percentage at 320MHz for different surfaces

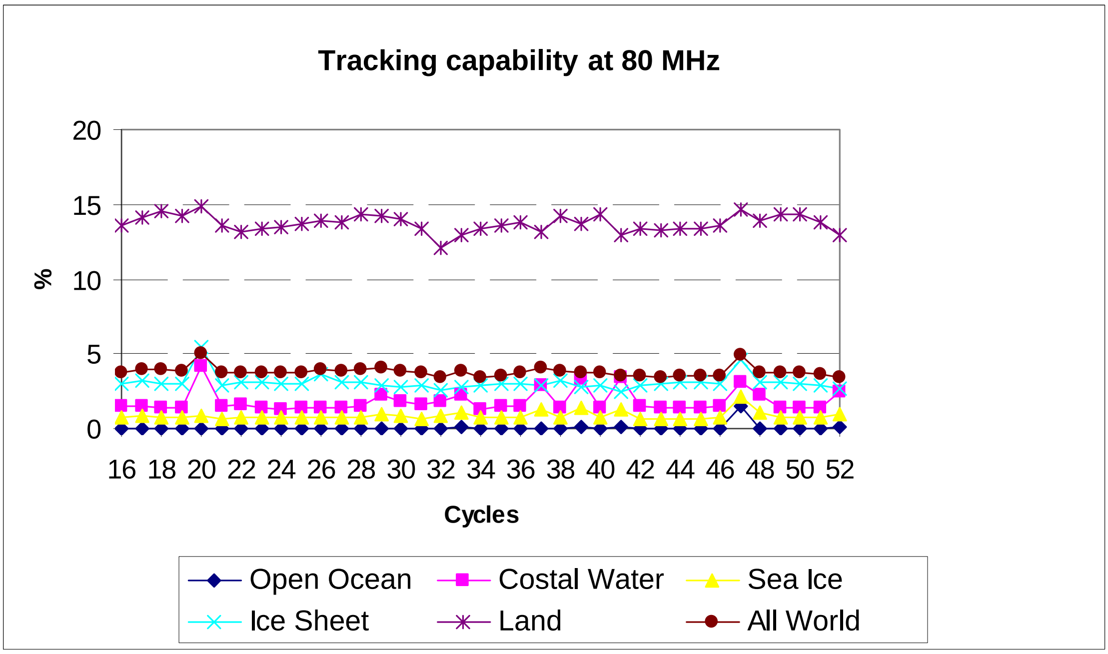

Figure 3: RA-2 Tracking percentage at 80MHz for different surfaces

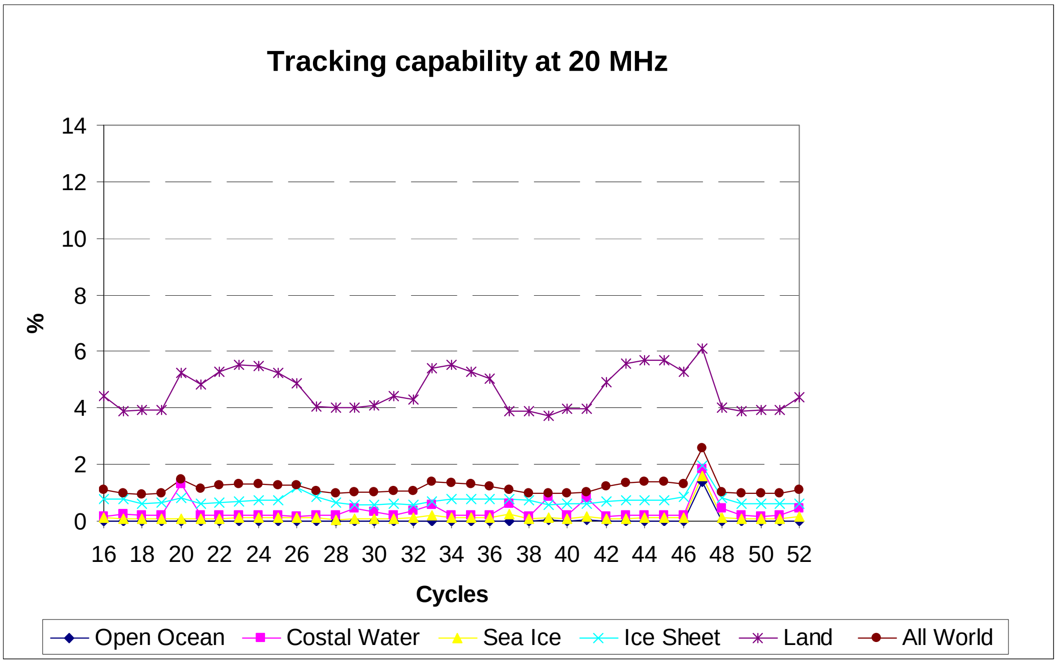

Figure 4: RA-2 Tracking percentage at 20MHz for different surfaces

6.1.2 IF FILTER MASK

In Figure 5 all valid IF masks retrieved during cycle 52 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. The average difference with respect to the on-ground is used as the criteria for defining valid masks: if it is lower than 0.01 dbs, the mask is considered valid.

During cycle 52, the number of valid IF masks has been 13, representing 32 % of the acquired 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 generating it consists in a monthly average according to the strategy defined in [R-18] with an editing criteria based on the comparison between each of the single IF masks and the reference one (on-ground).

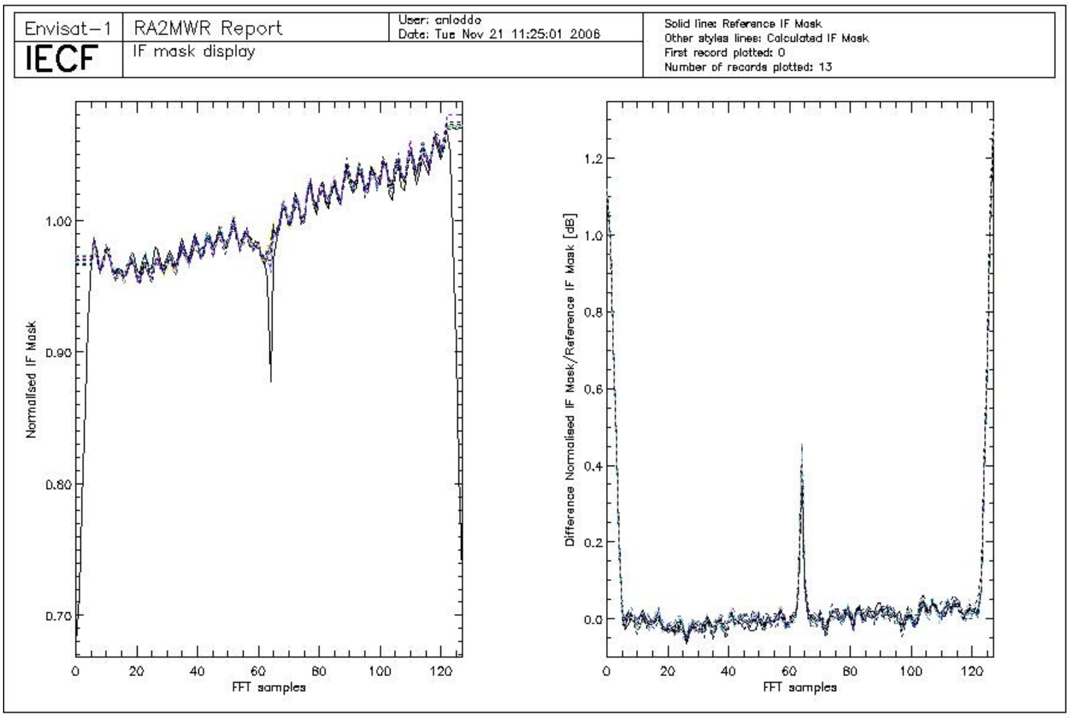

Figure 5: Valid IF masks retrieved daily during cycle 52 plotted together with the on-ground reference.

Since the 24th of October, the auxiliary file RA2_IFF_AX have been updated regularly once per month. In Figure 6 the new IF Mask, updated on the 27 of October, and the previous IF Mask used for processing are plotted.

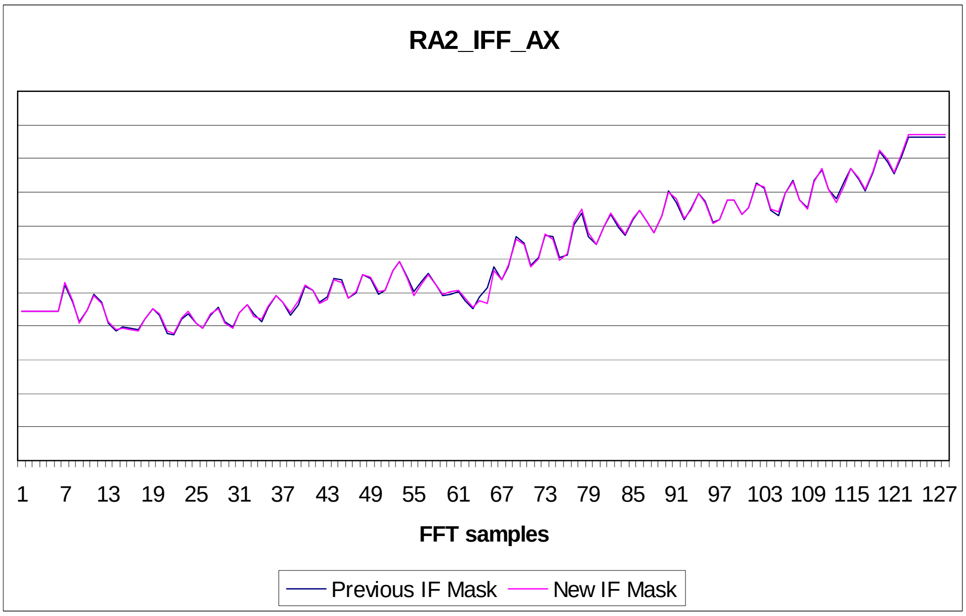

Figure 6: Previous and New IF Mask

In Figure 7 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.
Four 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, on May the 10th 2004 at 15:45 and on April 9th 2006. The reason of this could be found in the instrument warming up considering that the IF Cal acquisition has been made, in the three first cases, only a couple of hours after an anomaly recovery. In the last case the unavailability was very long, more than two days, and the warming up effect lasted longer. The residual noise and the accuracy show a very constant behavior over the whole period.
During cycle 52 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 prevent the generation of the IF mask correction file, used in input to the Level 1B ground processing.

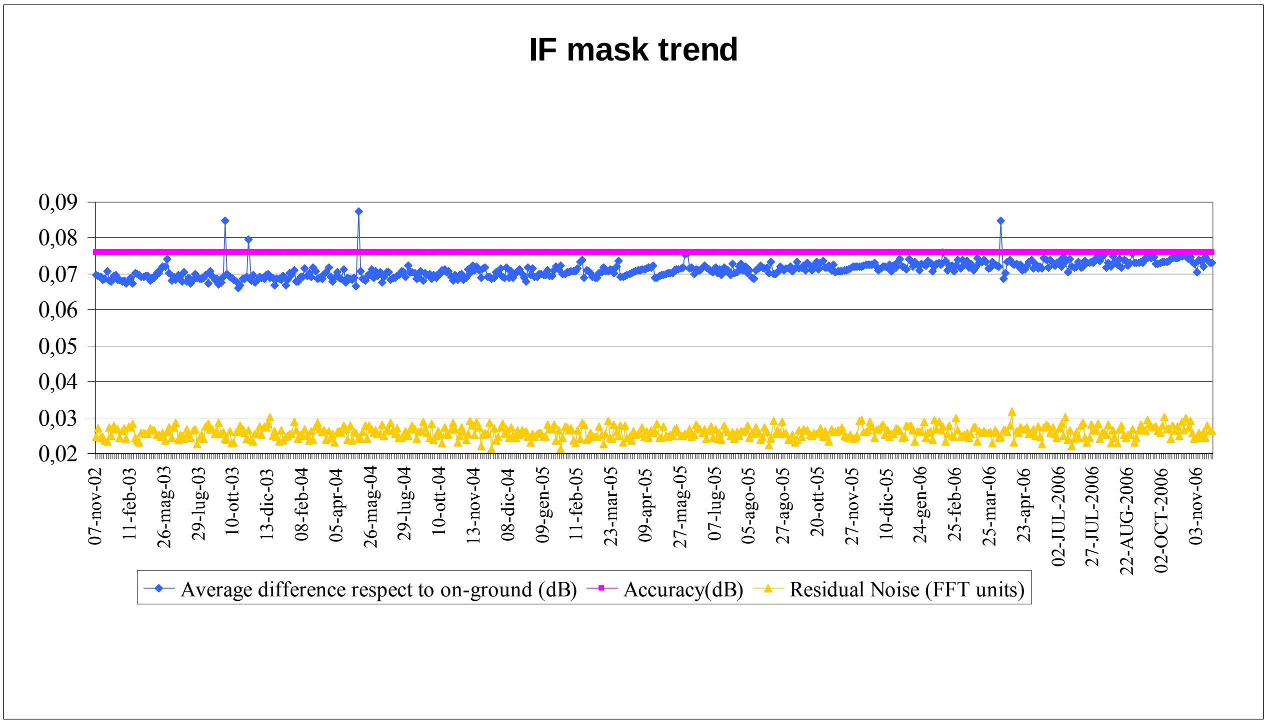

Figure 7: Evolution of the IF mask related parameters for valid IF masks retrieved up to cycle 52

In Figure 8 the percentages of valid IF masks from cycle 20 up to cycle 52 are reported. This percentage is computed with reference to the acquired masks per cycle. The higher number of valid IF Masks in cycle 48 is a consequence of the special IF Calibration operations which took place on 8 and 9 June 2006.

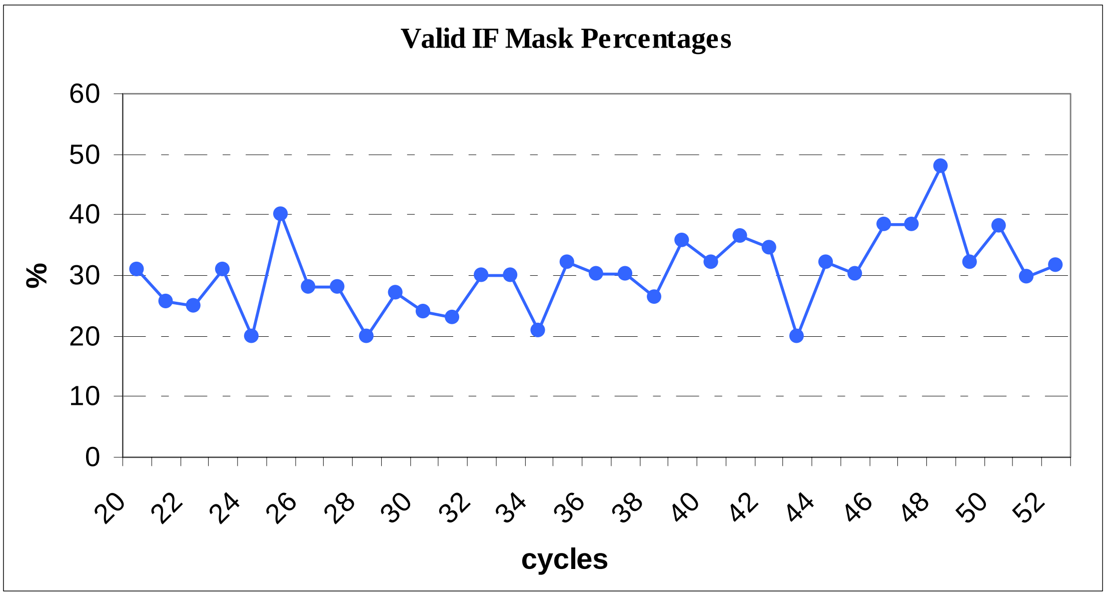

Figure 8: Percentages of valid IF Mask up to cycle 52

6.1.3 USO

Since the 24th of October, with IPF V5.02, the actual value of the USO clock period has been used within the L1b processing; this means that the data are corrected for the bias and the drift correlated to the actual USO clock period.
The evaluation of the actual USO clock period is performed off-line respect to the IPF processing and it is updated once per week in the auxiliary file RA2_USO_AX.
Note: Since the 9th of March this file hasn't been updated given the anomaly of the USO clock period described bellow.

In Figure 9 the USO clock period trend 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.

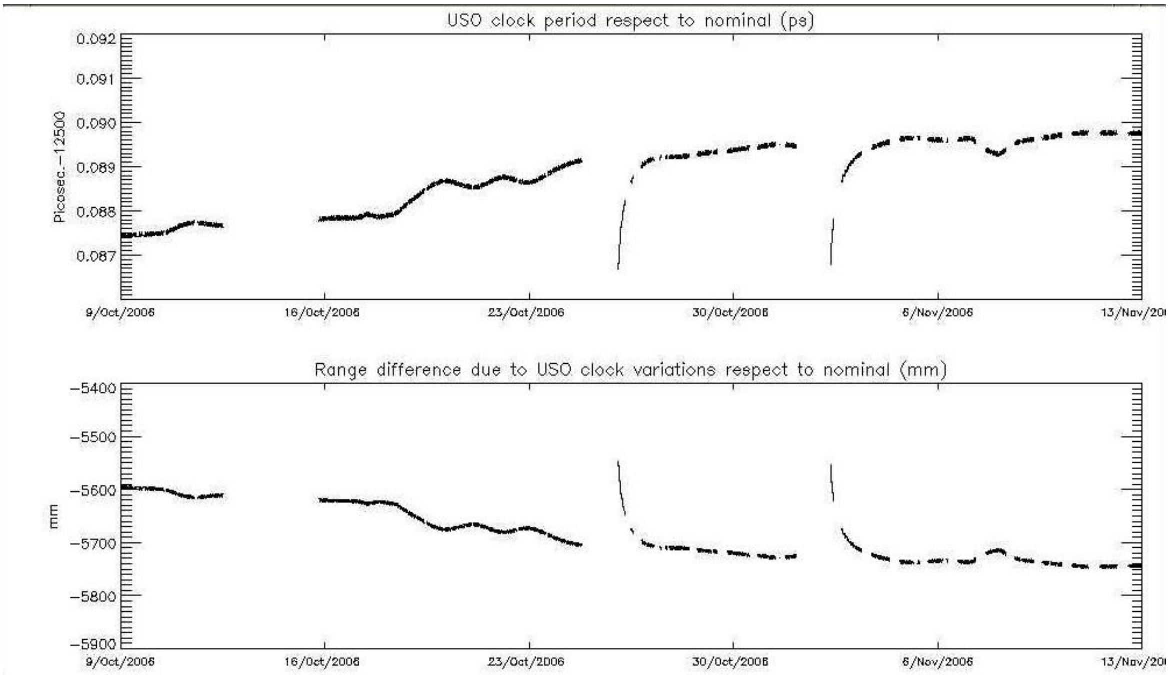

Figure 9: USO clock period for cycle 52 with RA-2 Data unavailability on 26th of Oct. and 2nd of Nov. 2006 impact

The gap at the beginning of the plot is related to some operational problems, i.e. data were not available for processing and computing the USO Clock Period on 13, 14 and 15 October.

WARNING:

- **Users are advised not to use the range parameter in Ku and S Band during cycle 52 without applying the USO correction**

The USO Clock Period anomaly is still present in cycle 52. It started in cycle 44, on date 1 Feb 2006 12:04:30, Orbit = 205181. It directly happened after the recovery of a RA-2 on-board anomaly occurred on the 2006/02/01 at 05:17:56. The range correction jumped by several meters and presented some oscillations at the orbital period that make the range unusable for both Ku and S Band, see Chapter 7.4.1. The anomaly persisted intermittently until the 15th of May 14:21:50, Orbit = 21994, when the instrument was configured to its RFSS B-side. It appeared again when the instrument was reconfigured to its nominal RFSS A-side on date 21 June 13:20:15, Orbit = 22523.

Three USO corrections have been developed for the different Envisat Level 2 altimetry data products for correcting the abnormal RA-2 USO behaviour affecting the Altimetric Range by few meters w.r.t. the Mean Sea Surface, see Chapter 7.2.5.
The NRT USO correction has been made available from July 28, 2006 onwards.

In Figure 10, the USO clock period trend retrieved from the beginning of the mission until the last week of cycle 49 is reported. In Figure 10A, the USO clock period trend retrieved from cycle 50 onwards is reported.

Three different periods can be distinguished:

1. From the beginning of the mission until the 24th of October the Nominal USO clock period has been used in the processing. The data was not corrected for the bias and the drift correlated to the actual USO clock period;
2. From the 24th of October until the 1st of February, and from the 11th of February until the 13th of March, the actual USO clock period has been used within the processing. The data was corrected for the bias and the drift correlated to the actual USO clock period. Those values, translated into altimetric range figures, are respectively of 28.5 mm and –4.58 mm/year as calculated with data covering the period 13 June 2003 to 01 February 2006 (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);
3. From the 1st of February until the 11th of February and from the 13th of March onwards, data has not been corrected with the proper value of the USO Clock period.

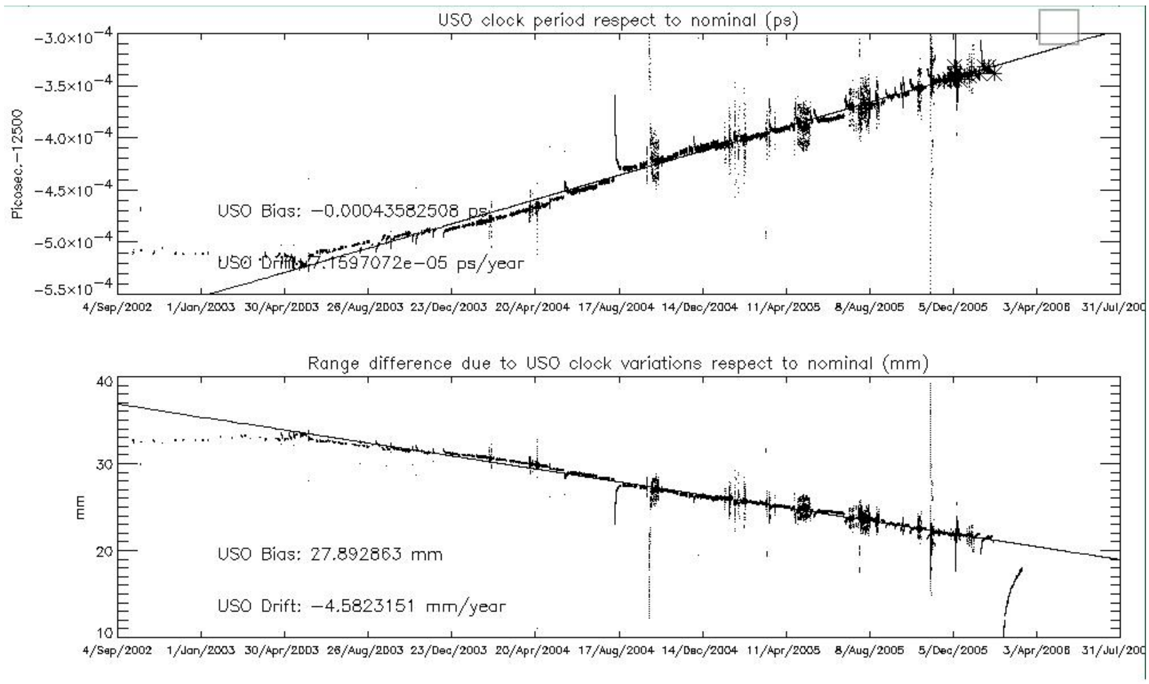

Figure 10: USO clock period until cycle 49

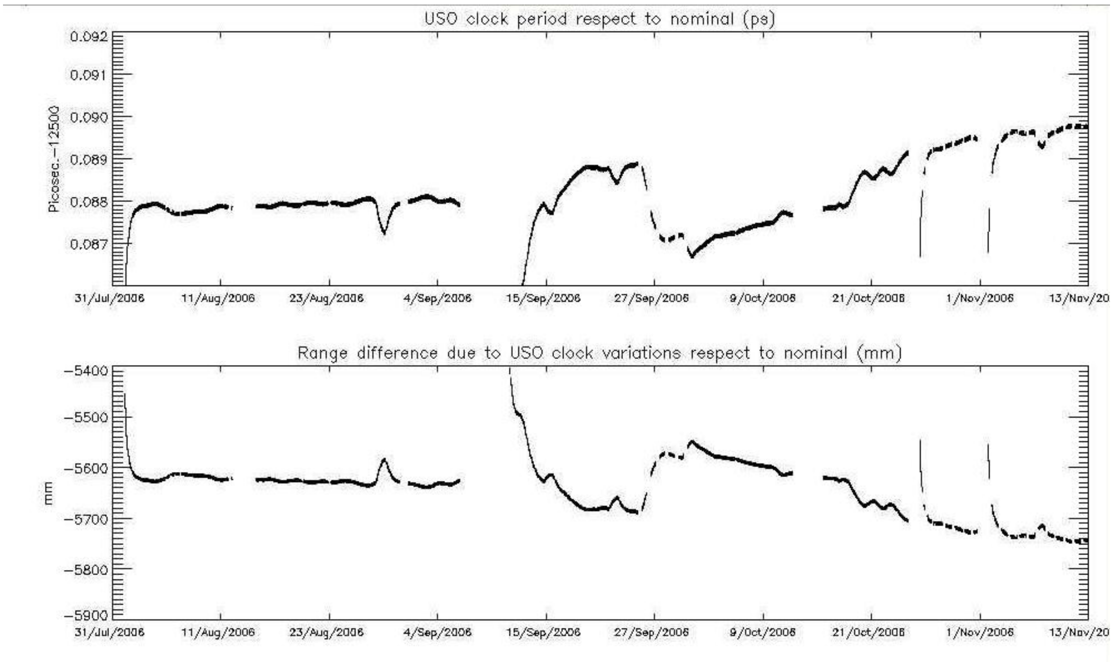

Figure 10A: USO clock period from cycle 50 onwards

6.1.4 DATATION

A significant part of an eventual error in the RA-2 products datation could result from imperfect synchronisation 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 11, the differences between the extrapolated UTC values and the corresponding real UTC values measured at the next Kiruna dump, are reported. In the lower panel, the ICU clock step for the same period is shown.

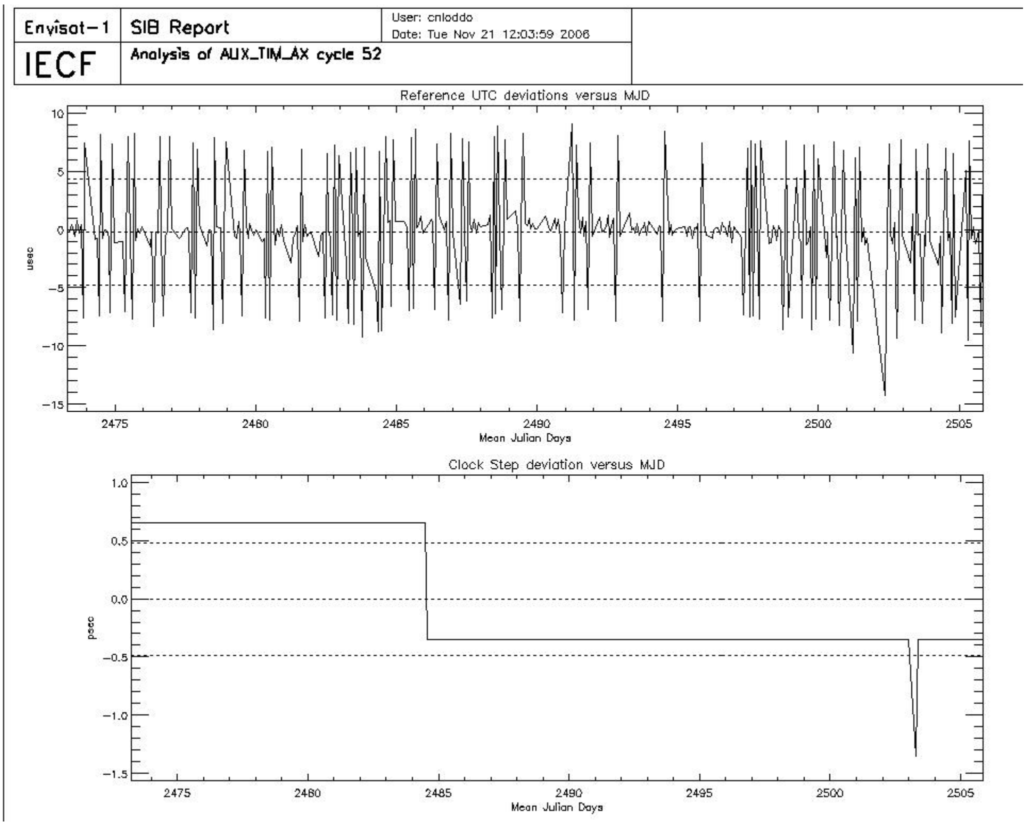

Figure 11: UTC deviations and ICU clock period for cycle 52

In Figure 12 (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 onwards are reported in Figure 13.

Only a 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 12); 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. The jump observed around MJD 2288 (07-APR-2006) on Figure 13 is related to the reconfiguration of the Precise Time Correlation process, which became blocked with invalid data after the Service Module anomaly and reconfiguration occurred on 6 April 2006. This is however not a problem because the ICU clock period variations are included in the algorithm for the SBT/UTC correlation evaluation.

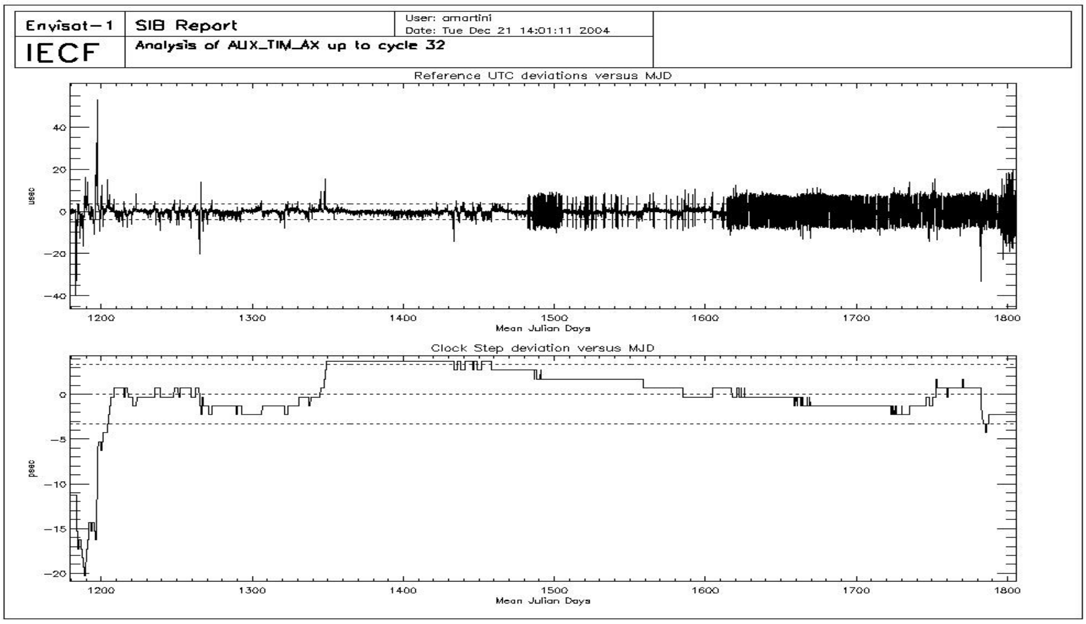

Figure 12: UTC deviations and ICU clock period up to cycle 32

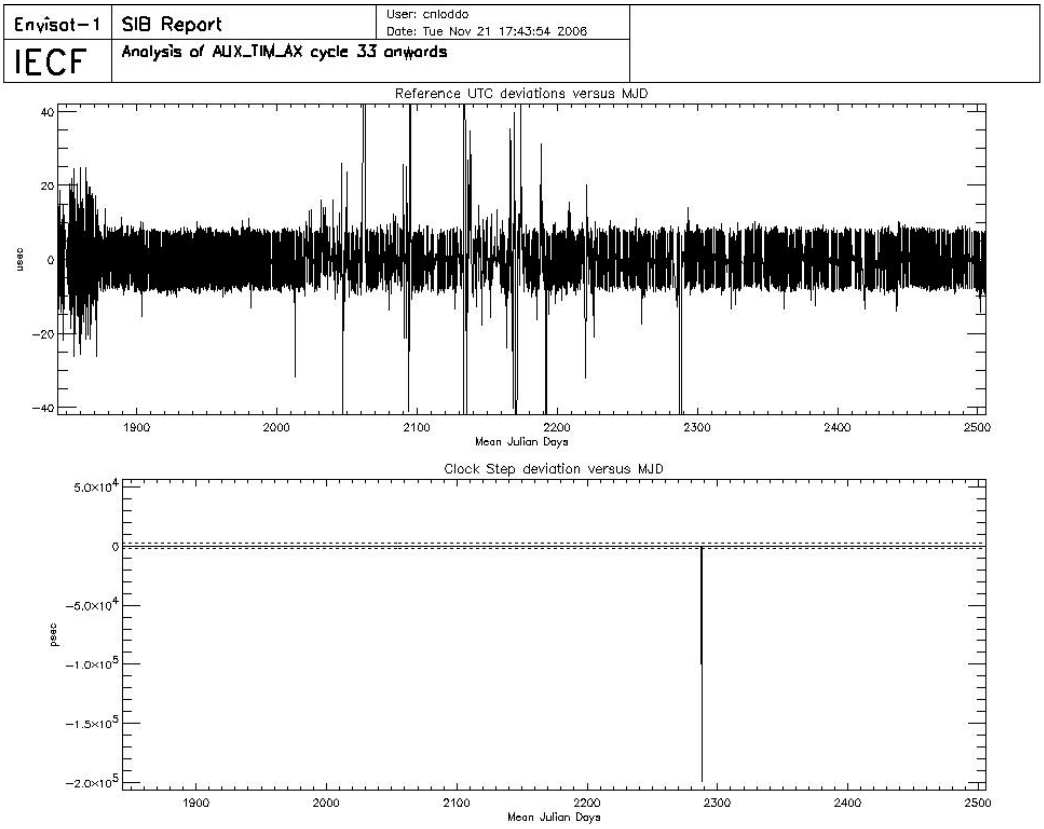

Figure 13: UTC deviations and ICU clock period from cycle 33 onwards

6.1.5 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 52 (averaged per day) are reported in the next figures.

The Time delay in-flight calibration factor and the Sigma0 calibration factor, reported in Figures 14 and 15, show a regular behaviour as observed on previous cycles.

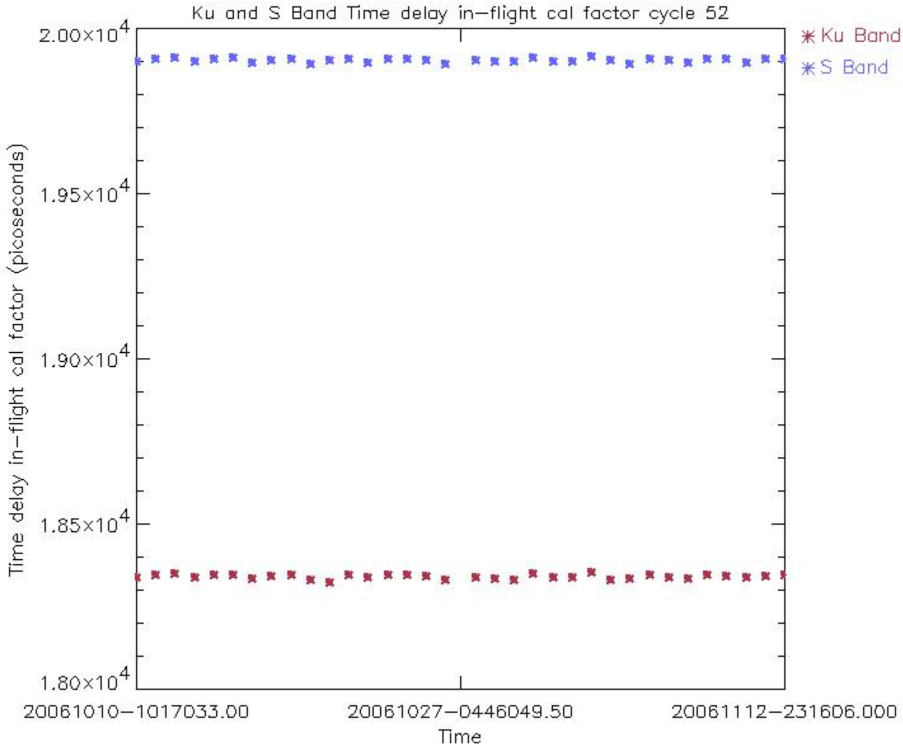

Figure 14: Ku and S Band in-flight time delay calibration factor for cycle 52

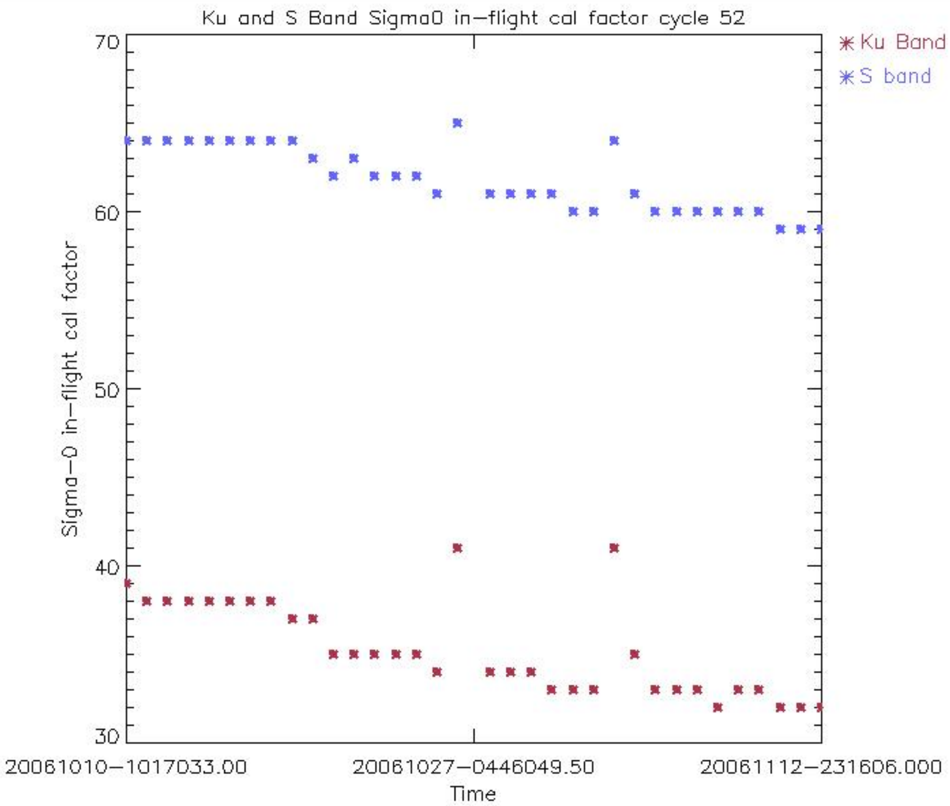

Figure 15: Ku and S Band in-flight Sigma0 calibration factor for cycle 52

Figure 16 and Figure 17 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 is shown 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. As this instability is quite small, it is not being considered a problem for the moment, since the calibration factor is indeed introduced especially to correct for eventual instrumental changes. However, special attention is kept on the monitoring of this parameter. The jump observed on the last part of the plot is related to the period on which the instrument sub-system Radio Frequency Module (RFM) was switched to its B-side, occurred between 15 May and 21 June 2006.

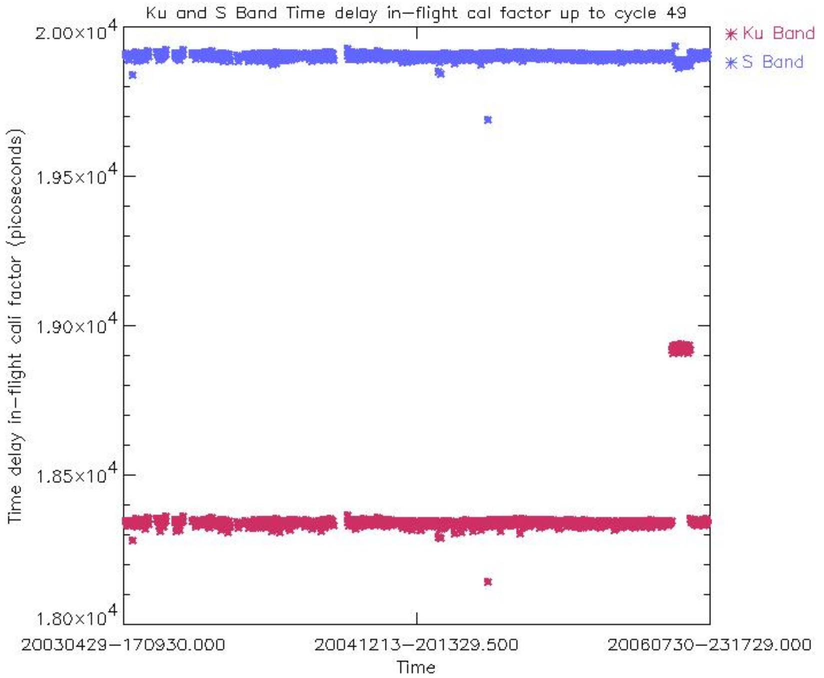

Figure 16: Ku and S Band in-flight time delay calibration factor up to cycle 49

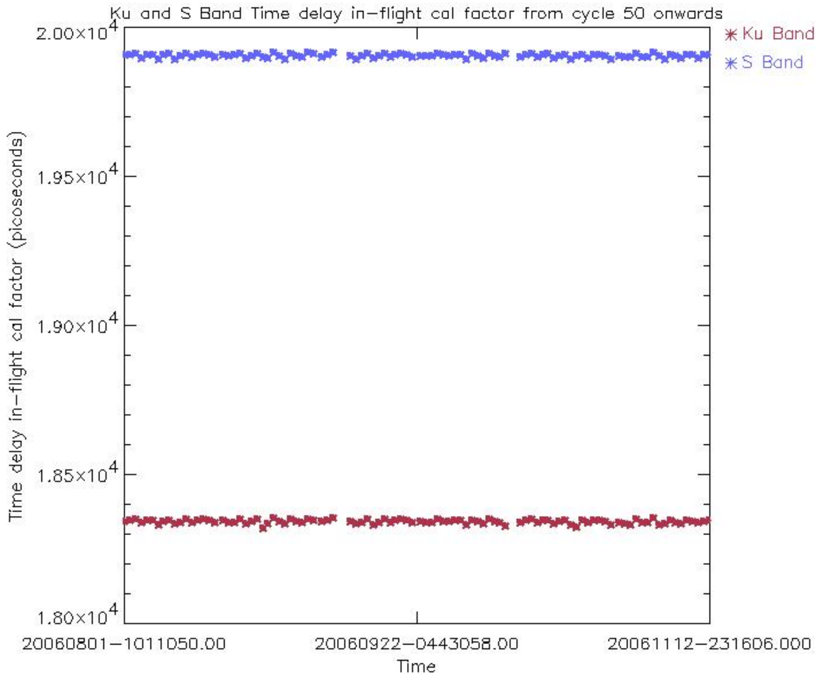

Figure 16A: Ku and S Band in-flight time delay calibration factor from cycle 50 onwards

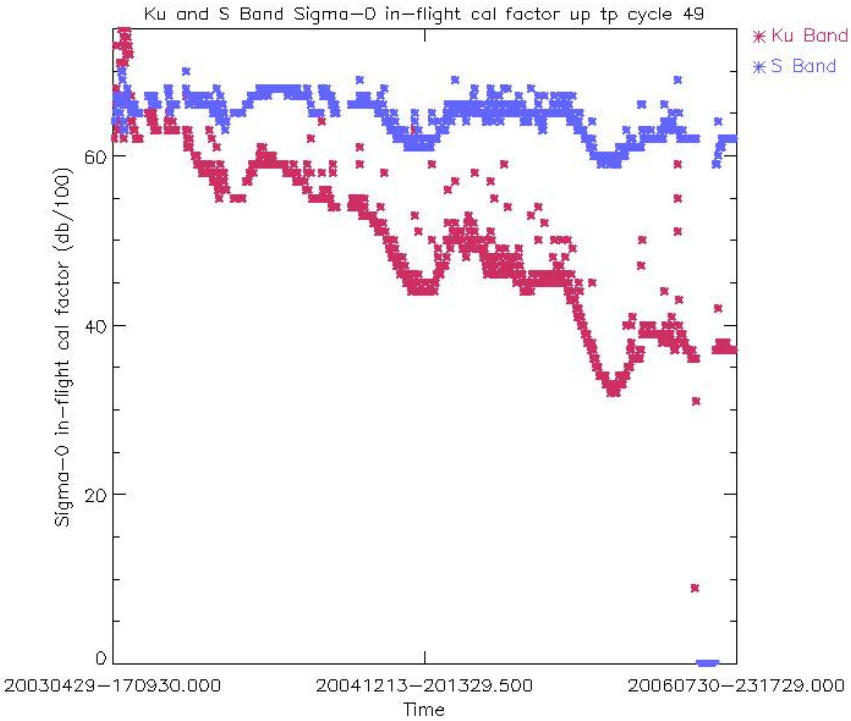

Figure 17: Ku and S Band in-flight Sigma0 calibration factor up to cycle 49

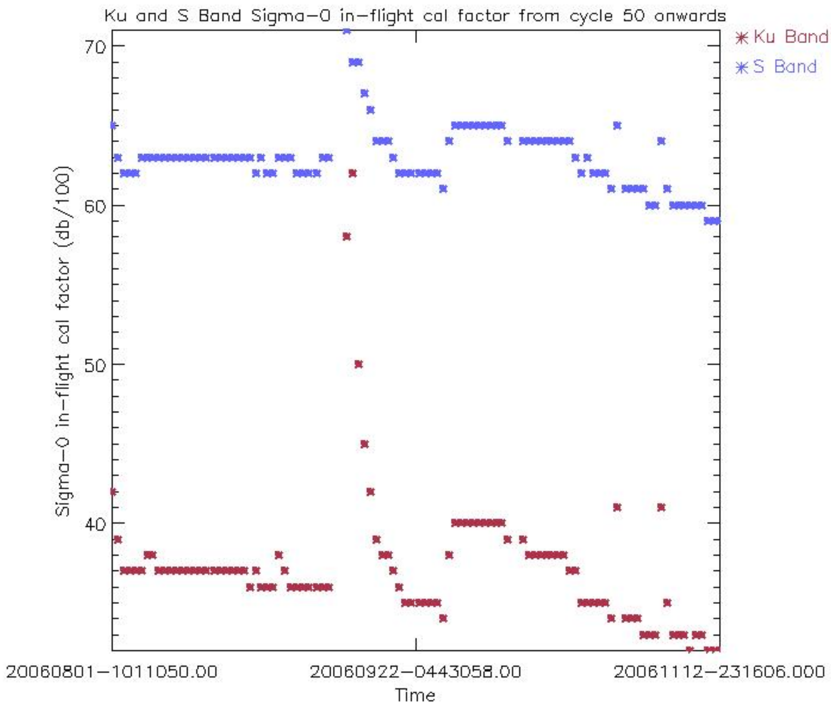

Figure 17A: Ku and S Band in-flight Sigma0 calibration factor from cycle 50 onwards

6.1.6 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 the calibration results and to monitor the RA-2 calibration of σ° during the Envisat lifetime, continual monitoring is accomplished by operating the transponder for as many Envisat overpasses as possible.
Since the 11th of October the transponder has been moved to a permanent site located in Rome. The acquisition planned for the 31 of October has been successfully performed.

Absolute Orbit nb	Date of Measurement	Location / Rel. track	RA-2 resolution	Transponder Bias [dB]	ECMWF Wet Tropo. Corr. [dB]
24417	31-Oct-06	Perm site Rome / 315	High	1,08	0,146

Appendix 4 reports the transponder measurements from cycle 24 up to cycle 52.
The mean value of the estimated bias at High Resolution is 0.96 dB with a standard deviation of 0.2 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 due to a processing problem with the internal calibration factor not taken into account in Low Resolution Mode.

In Figure 18, 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.

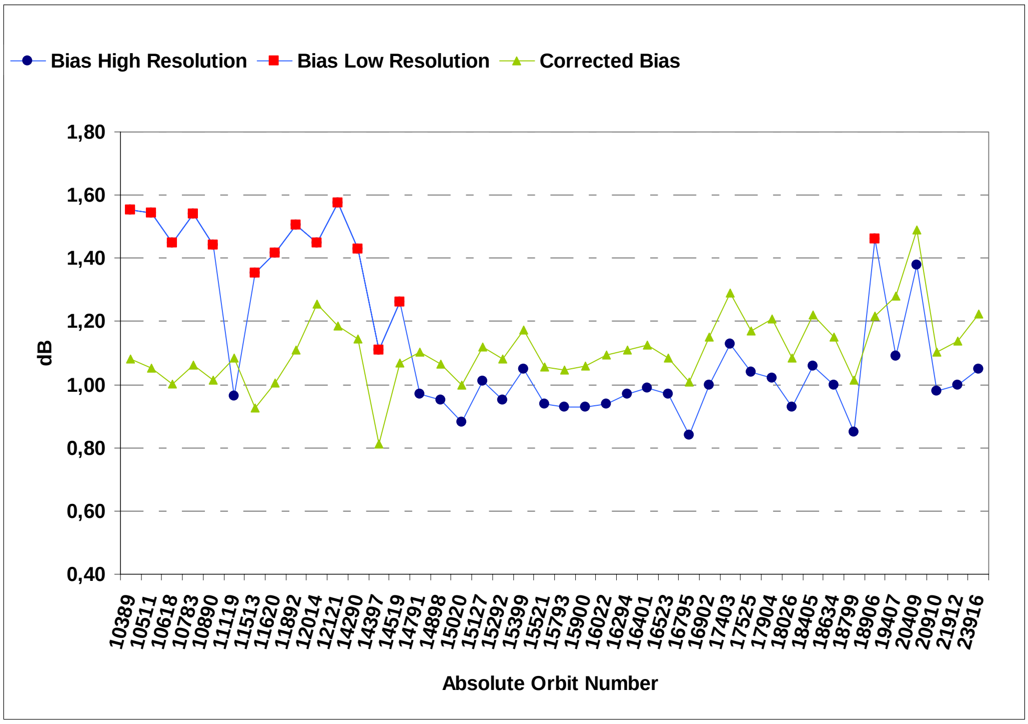

Figure 18: Time behavior of the transponder bias

6.1.7 MISPOINTING

In Figure 19, 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, has decreased from about 0.028 deg^2, to 0.0075 deg^2. This is due to the new algorithm currently used to retrieve the mispointing value from the RA-2 waveform data, see section 5.1.1.1. With the new IPF version 5.02, the mispointing is estimated through the waveform trailing edge slope using an optimum and fixed gate and no longer an adaptive window as defined previously. This allows avoidance of the filter bump effect that leads to high values of the mispointing.

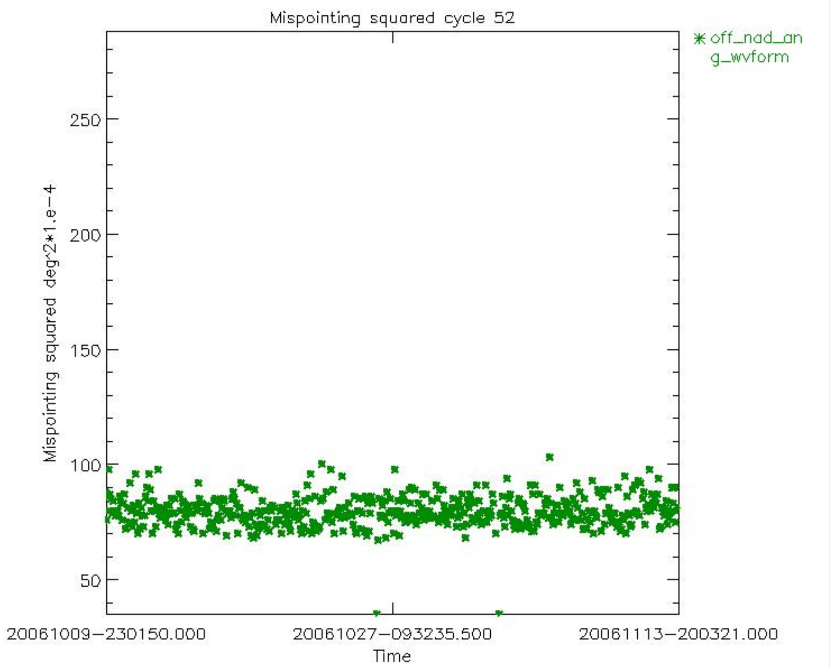

Figure 19: Smoothed mispointing squared trend for cycle 52 (deg^2*10^4)

In Figure 20, the overall mispointing squared trend (averaged over each orbit) is plotted for cycles 16 onwards.

The low values at the end of the plot are related to the acquisition in RFFS B-Side, occurred between 15 May and 21 June 2006.
The jump which occurred on date October 24th is related to the upload of IPF version 5.02. The abrupt decreasing of the mispointing squared value is related to the new algorithm, as described in the previous paragraph.
The jump which occurred on November the 26th 2003 is correlated to the upload of IPF version 4.56; the abrupt decrease 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. For this reason, the RA2_IFF_AX will be updated regularly, once per month.

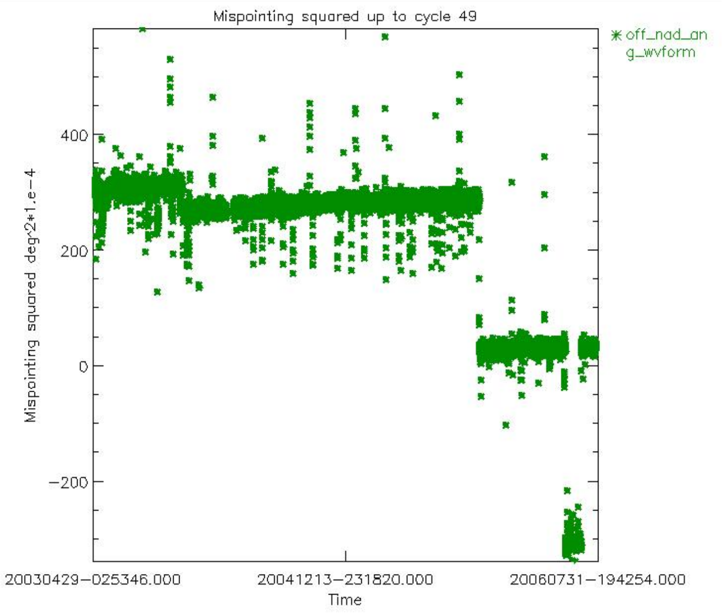

Figure 20: Smoothed mispointing squared trend until end of cycle 49 (deg^2*10e-4)

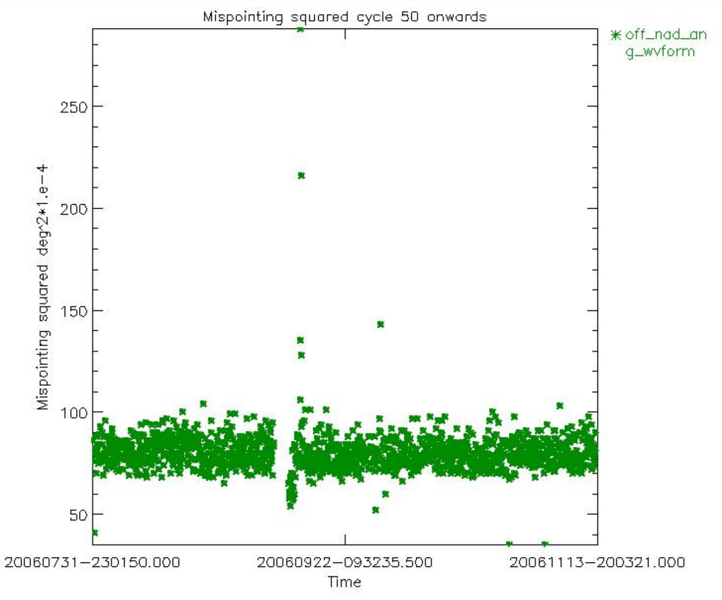

Figure 20A: Smoothed mispointing squared trend until from cycle 50 onwards (deg^2*10e-4)

It can be noticed that the mispointing squared assumes lower values just after an instrument anomaly, showing an increasing trend until it reaches a standard mispointing value.
This problem has been reduced with the introduction of the updated mispointing retrieval algorithm as described in the previous paragraph.

This particular behavior has always been explained by the different shape that the over-ocean average waveform has before and after an anomalous event as visible in Figure 21, i.e the disappearance of the small dip in the waveforms acquired after the anomaly. Since the new strategy of updating once per month the RA2_IFF_AX file, the small bump is not present anymore in the waveforms, see Figure 21_A, so a new explanation is currently under investigation.

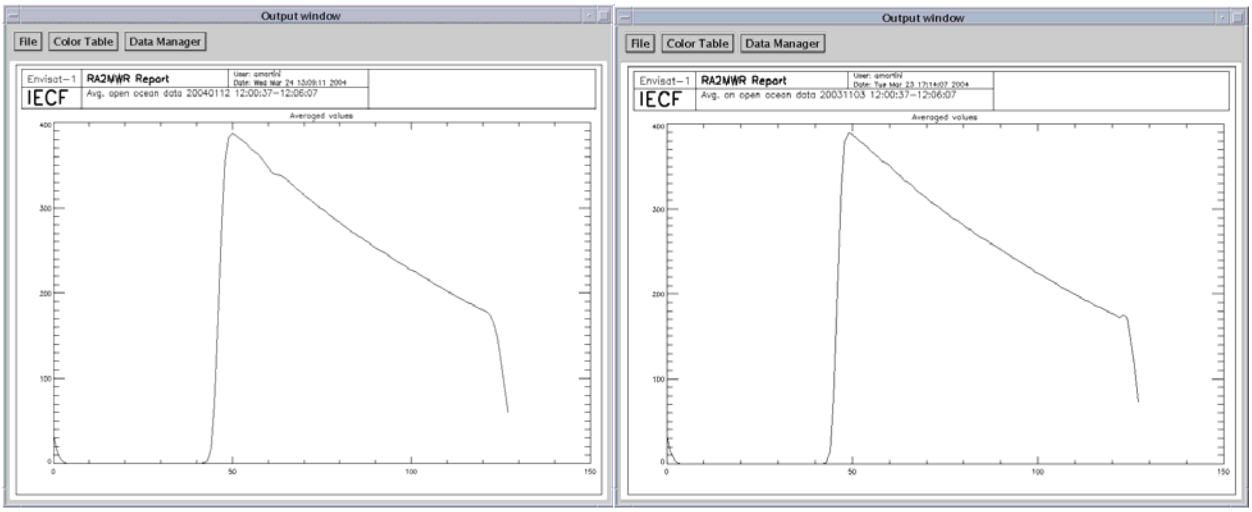

Figure 21: Open Ocean average waveforms before (left) and after an anomaly (right)

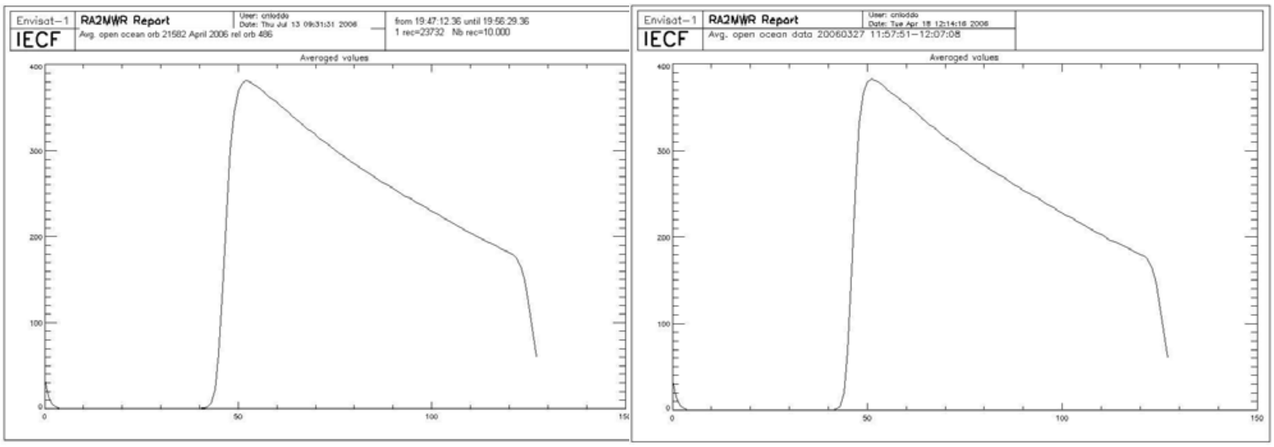

Figure 21_A: Open Ocean average waveforms before (left) and after an anomaly (right)

6.1.8 S-BAND ANOMALY

The so-called "S-Band anomaly" affects the RA-2 data products quality.

The list of product files affected by the S-band anomaly problem during cycle 52 is reported in appendix 5. Fifteen orbits were affected by the S-Band anomaly during Cycle 52, corresponding to 3% of data.

The method used for the identification of the "S-Band anomaly" is statistical and requires a minimum of 1000 seconds of data over ocean. This choice is supported by the fact that the "S-Band anomaly" is associated with a particular instrumental behavior that cannot appear and disappear within a short time frame. (ref. [R – 7])
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.
The IPF version 5.03 includes an algorithm that can detect the presence of the so-called "S-Band anomaly" over any surface. In case of S-Band anomaly detection, bit 1 of the L1b products MCD is set to one; the anomaly is properly detected in 99.9% of the cases.

In Figure 22, 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 the S Band anomaly decreased from a mean value of 4% to 2% from cycle 31 onwards due to the implementation of the 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.

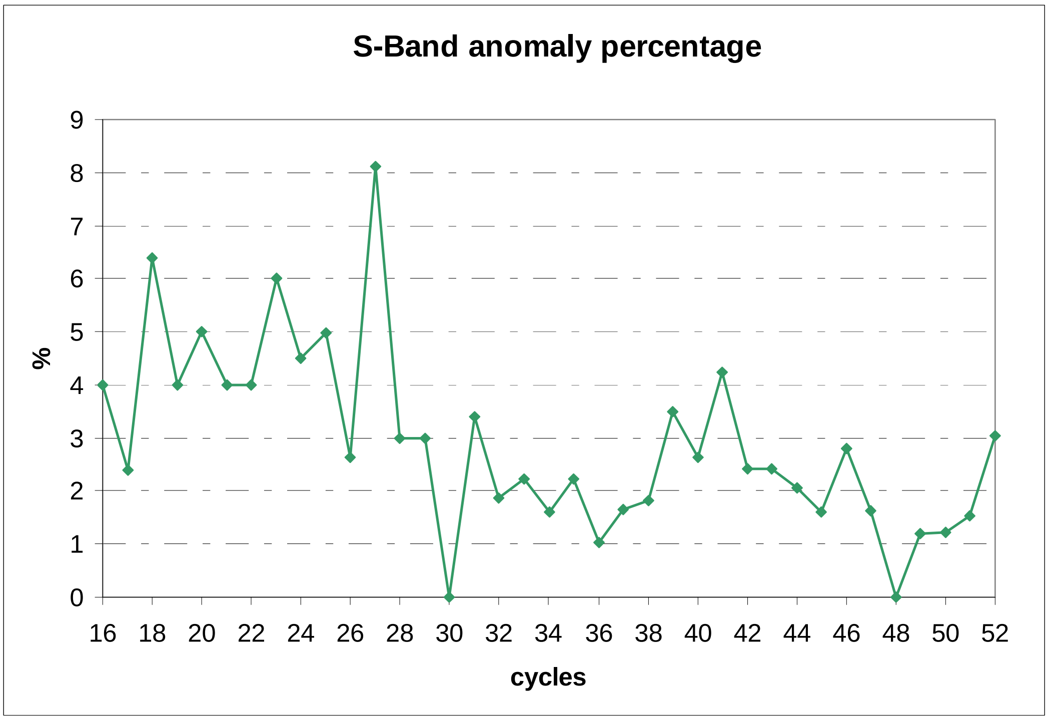

Figure 22: Percentage of data affected by the "S-Band Anomaly" for cycles 16 onwards

6.2 MWR Performance

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

6.3 DORIS Performance

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

7 PRODUCT PERFORMANCE

7.1 Product disclaimer

A summary of the products released to users and disclaimers on product quality have been established for some products and are available in the following web link: http://envisat.esa.int/dataproducts/availability/

7.2 Data handling recommendations

7.2.1 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#42 of L2 data)*| > 10 cm
OR
Peakiness *(Ku_peak: field#139 of L2 data)* >2

7.2.2 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.

7.2.3 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.

7.2.4 S-BAND BACKSCATTERING COEFFICIENT

For the data processed with IPF version 4.56 on, the S-Band Backscattering coefficient has been demonstrated to be on 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 closer to 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.

7.2.5 USO RANGE CORRECTION

As reported in chapter 6.1.3, since the 24th of October, with the new IPF V5.02, the actual value of the USO clock period has been used within the L1b processing. Given though the abnormal RA-2 USO behaviour affecting the Altimetric Range by few meters w.r.t. the Mean Sea Surface since the 1st February 2006, a NRT orbit basis USO correction has been developed for the FDGDR products. The actual data of cycle 52 have to be corrected to compensate for the Ultra Stable Oscillator drift, bias and orbital variations. The new correction files are available since the 24 July on the web site http://earth.esa.int/pcs/envisat/ra2/auxdata/NewCorrection

Warning for data acquired after 1st February 2006: This correction has to be **ADDED** to the Ku and S Band altimetric range.

A software routine has been developed to allow users to insert the RA-2 Ultra-Stable Oscillator (USO) corrections into Envisat Level 2 altimetry data products and is available in the same web site of the new correction files.

Data acquired from 24th October 2005 until 1st February 2006 should not be corrected given that the proper value of the USO clock period has been used within the L1b processing.

All data acquired before 24th October 2005, beginning of cycle 42, still have to be corrected using the old correction files available on the web site:
http://earth.esa.int/pcs/envisat/ra2/auxdata/OldCorrection.

The measured Range shall be corrected considering a drift of -4.58 mm per year and a bias of 29.6 mm.
Warning for data acquired before cycle 42: bias and drift have to be **SUBTRACTED** from 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.

7.2.6 KU-BAND BACKSCATTERING COEFFICIENT CALIBRATION

The results of the Ku-Band Sigma0 absolute calibration performed with a transponder have been presented in par. 6.1.4. Those results are going to be consolidated and are summarized in appendix 4, table 12. 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)

7.2.7 ABNORMAL RA-2 RANGE BEHAVIOR AFTER ANOMALY RECOVERY

WARNING: Envisat Side A RA-2 was still affected by the on-board anomaly which affects the RA-2 Altimetric Range by few meters. The analysis of the Sea Level Anomaly (SLA) currently shows a bias of ~5 meters and an orbital variability, with average values between ascending and descending passes different by about 30 cm.

The un-expected behavior of the Envisat RA-2 sensor was first observed from 1 Feb 2006 12:04:30, Orbit = 205181 until 11 Feb 2006. This directly happened after the recovery of a RA-2 on-board anomaly occurred on the 2006/02/01 at 05:17:56. The altimetric range jumped by several meters w.r.t. the Mean Sea Surface.

Another 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.

7.2.8 RA-2 RADIO FREQUENCY MODULE SWITCHED BACK TO A-SIDE

The Envisat RA-2 sensor has been successfully reconfigured on its nominal side (RFSS A-side) and was commanded back into Measurement Mode on June 21, 2006 at 13.20.15.000 UTC time, Orbit = 22523.

The analysis of the RA-2 data shows an expected behaviour of the RA-2 parameters but also confirmed the persistence of the abnormal RA-2 Ultra-Stable Oscillator (USO) behaviour affecting the Altimetric Range by few meters.

Data from 22 May until 21 June was acquired with RFSS B-side and on-ground data processing has been performed with ADFs configured for A-side. For this reason data should be used with maximum care.

7.3 Availability of data

7.3.1 RA-2

In Figure 23 and Table 9 (Appendix 2) the summary of unavailable RA-2 L0 products is given.
It is easy to notice that close to the Himalayan region two small gaps, about 77 seconds, in the data are present. This is due to the daily instrument switch-offs (Heater 2 mode) performed to prevent the S-Band anomaly lasting more than half a day if it occurs.

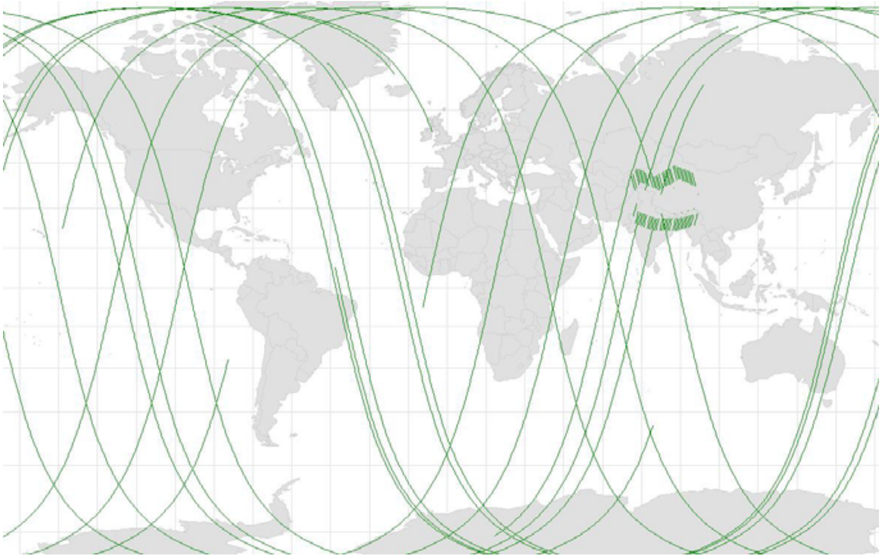

Figure 23: RA-2 L0 unavailable products for cycle 52

In Figure 24 and Table 11 (Appendix 2) the summary of unavailable RA-2 L1b products is given.

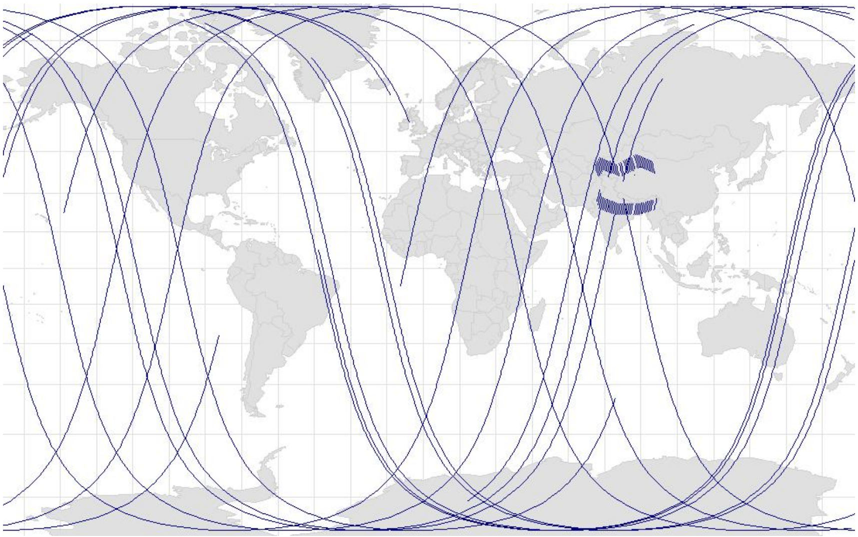

Figure 24: RA-2 L1b unavailable products for cycle 52

Hereafter the percentage of the different levels of products availability is reported. Considering as reference the instrument unavailability, it is possible to notice that since cycle 32 the situation is slightly improved for all levels of products.

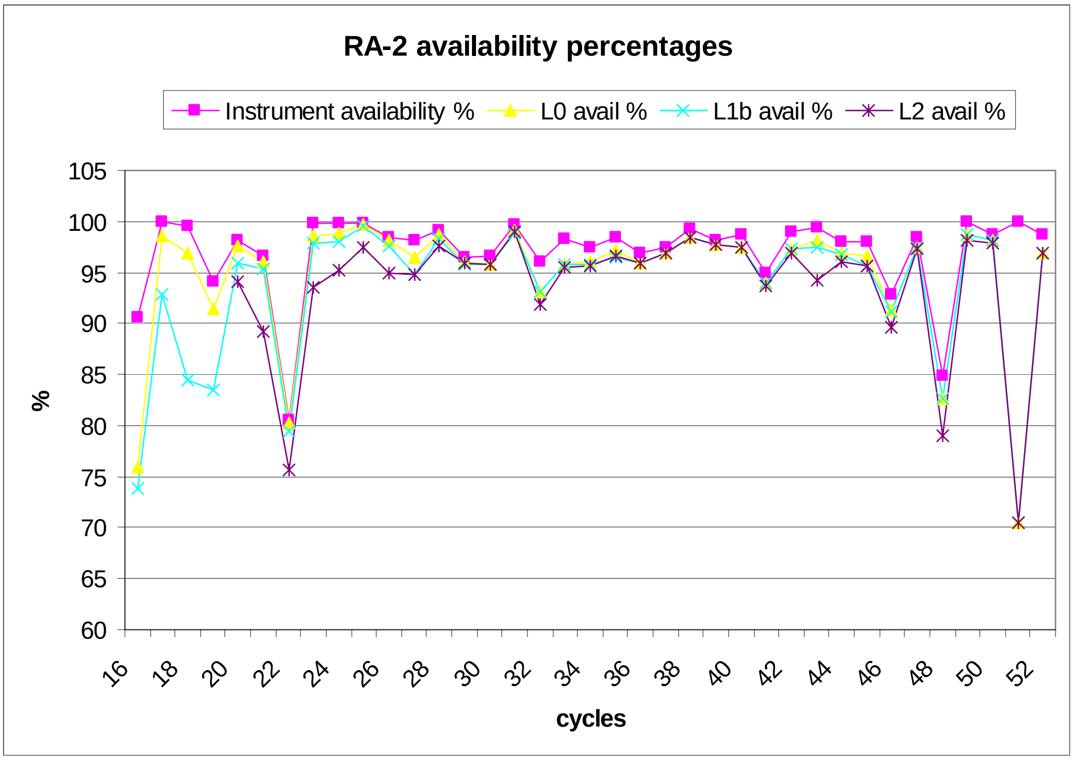

Figure 25: Percentage of Products unavailability

7.3.2 MWR

In Figure 26 and Table 10 (Appendix 2) the summary of unavailable MWR L0 products is given.

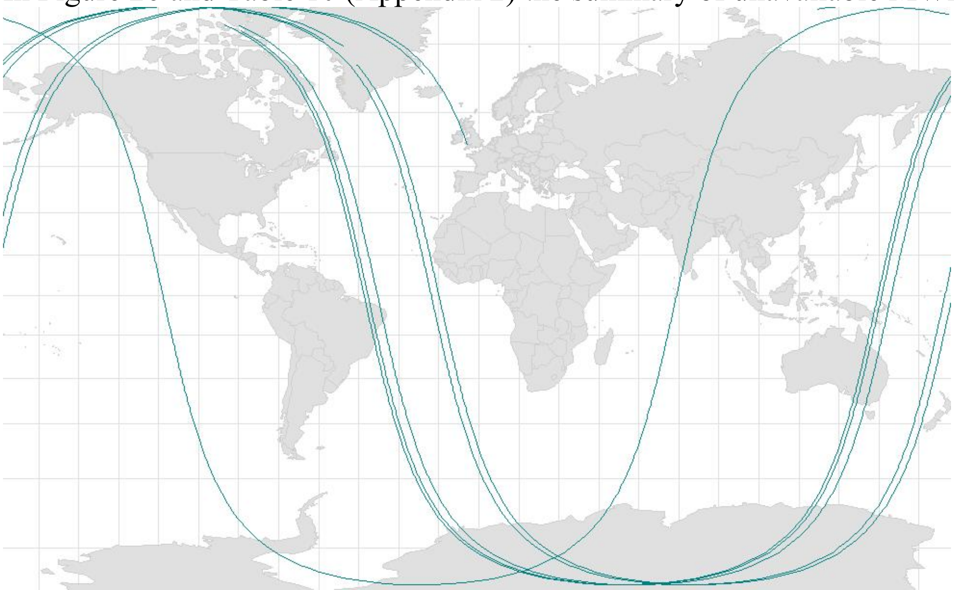

Figure 26: MWR L0 unavailable products for cycle 52

7.4 RA-2 Altimeter Parameters

Hereafter a summary of the main Altimetric parameters performances is reported; these results have been obtained using only ocean surface type and all world zone criteria for RA2_FGD products.

7.4.1 ALTIMETER RANGE

Since the 24th of October, operations date of IPF version 5.02, the DORIS Navigator data were expected to be used to evaluate the location, the altitude and the altitude rate corresponding to any Data Set Record of the products. Due to some operational problems under investigation in the PDS, at least 10 % of NRT data is still being processed without DORIS.

The un-expected behavior of the Envisat RA-2 sensor observed since cycle 44 persisted after the RA-2 sensor reconfiguration on its nominal A-side, on date 21 June at 13.20.15, orbit = 22523. The altimetric range jumped by several meters (about 5.6m) w.r.t. the Mean Sea Surface (Figure 27) due to an anomaly in the USO clock period (see Chapter 6.1.3). Moreover, oscillations at the orbital period with an amplitude of 20-30 cm affect the Sea Level Anomalies during the anomaly.

A software correcting the data has been developed and the USO range correction which are to be applied on the data can be found at the following location, (see paragraph 7.2.5) http://earth.esa.int/pcs/envisat/ra2/auxdata/NewCorrection

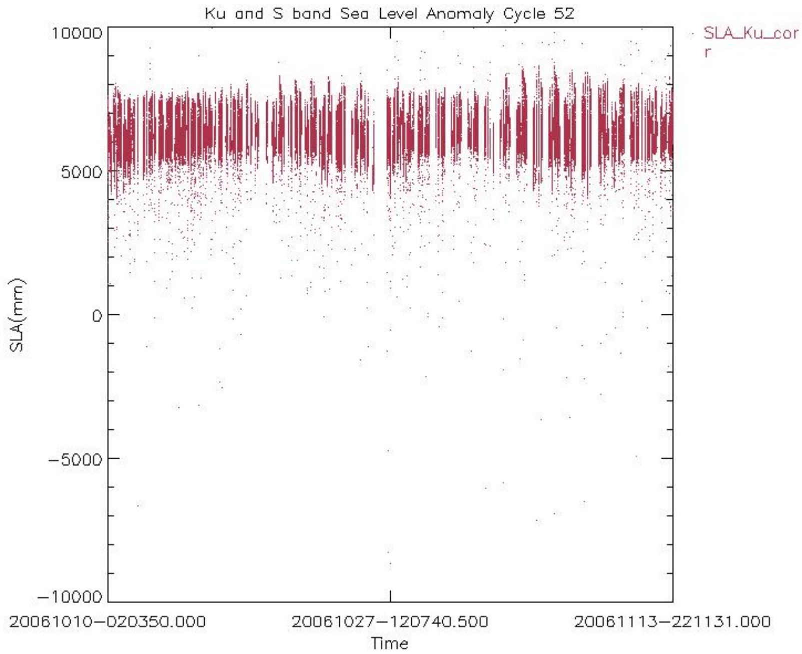

Figure 27: Sea Level Anomalies cycle 52

Fast Delivery data was corrected with the wrong USO clock period correction, RA2_USO_AX, since cycle 44.

WARNING: **Users are advised not to use the range parameter in Ku and S Band for data acquired from cycle 44 onwards without correcting the data.**

7.4.2 SIGNIFICANT WAVE HEIGHT

The histogram of the SWH reported in Figure 28 shows a nominal behavior for cycle 52. The trend goes on following the behavior as detected for the previous cycle. The largest peak (about 60000 data for SWH = 0m) was removed from the plot in order to have the complete picture of the SWH histogram.

Figure 29 shows the SWH daily mean. The possible high values, plotted outside the figure range, reported for the S-Band data are due to the so-called S-Band anomaly (ref. par.6.1.8). The histogram of the SWH for the current cycle is not reported due to operational problems.

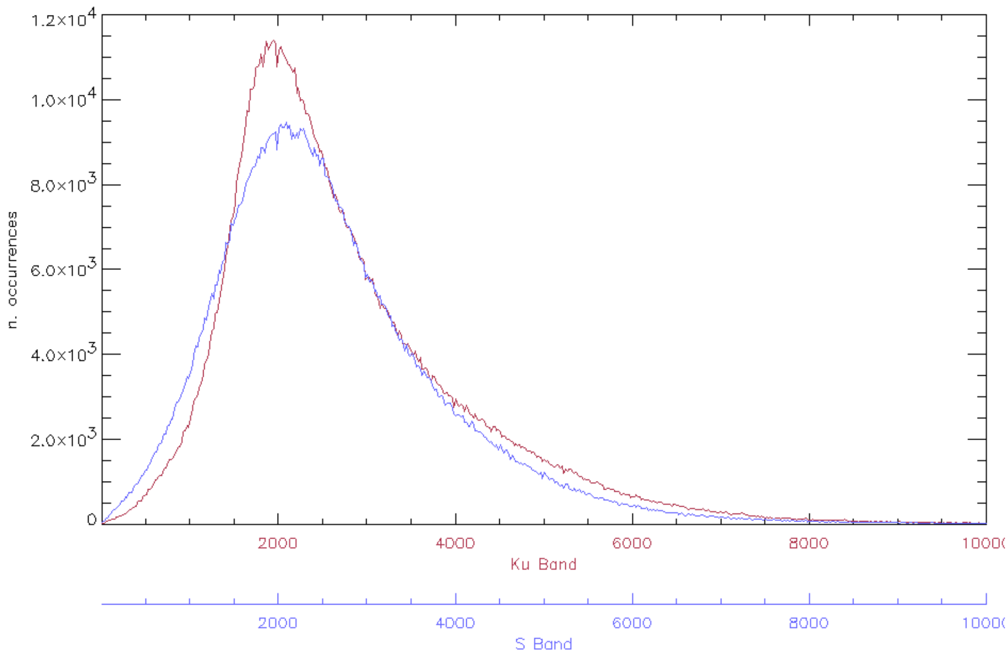

Figure 28: Histogram of Ku and S Band SWH for cycle 52

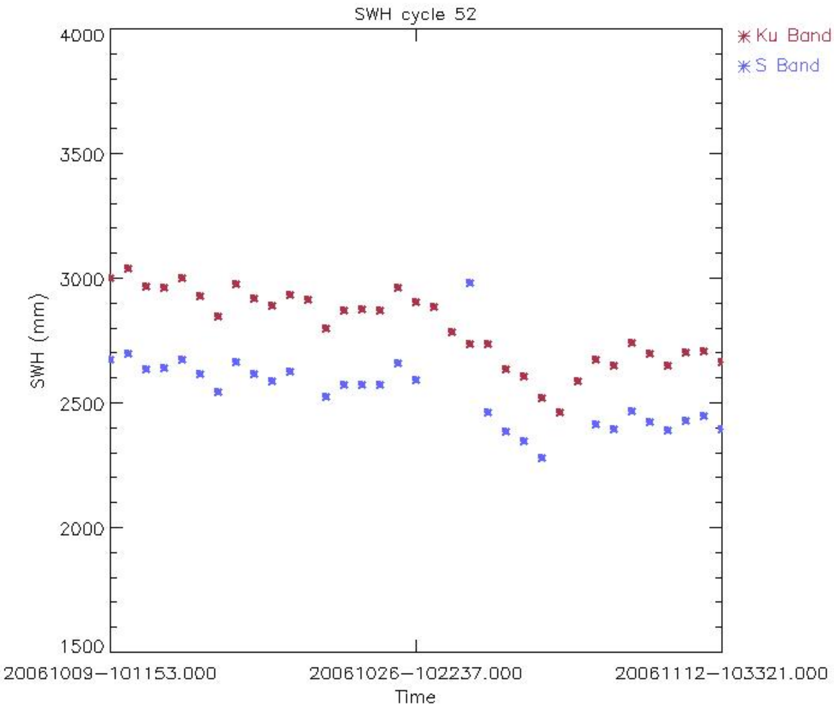

Figure 29: Ku and S SWH daily average for cycle 52 (mm)

The SWH long term plot is reported in two plots, cycle 16 until cycle 49 on Figure 30 and cycle 50 onwards on Figure 30A. It can be noticed that the SWH in both bands shows a trend which follows the seasonal variability. The high daily averages reported (sometimes plotted outside the figure's range) are due to the so-called S-Band anomaly (ref. par.6.1.8).

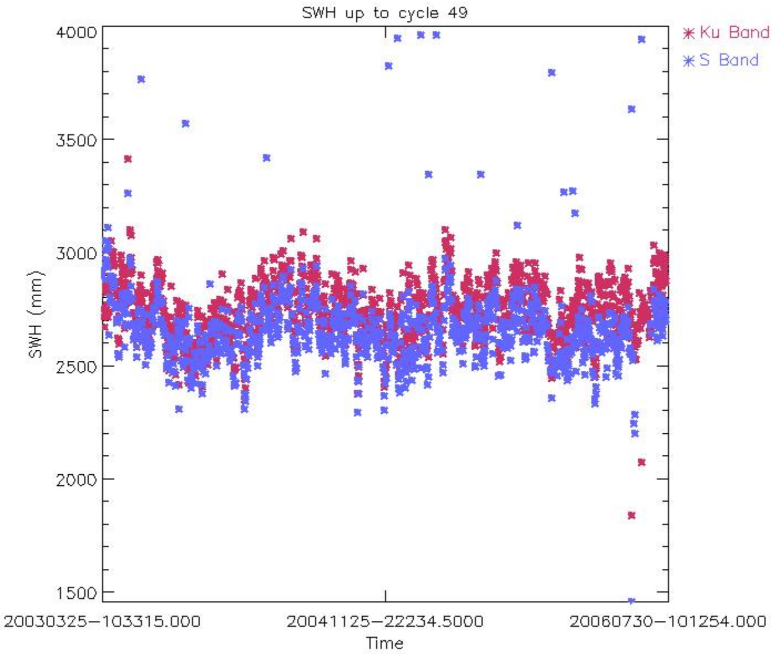

Figure 30: Ku and S SWH daily average up to cycle 49 (mm)

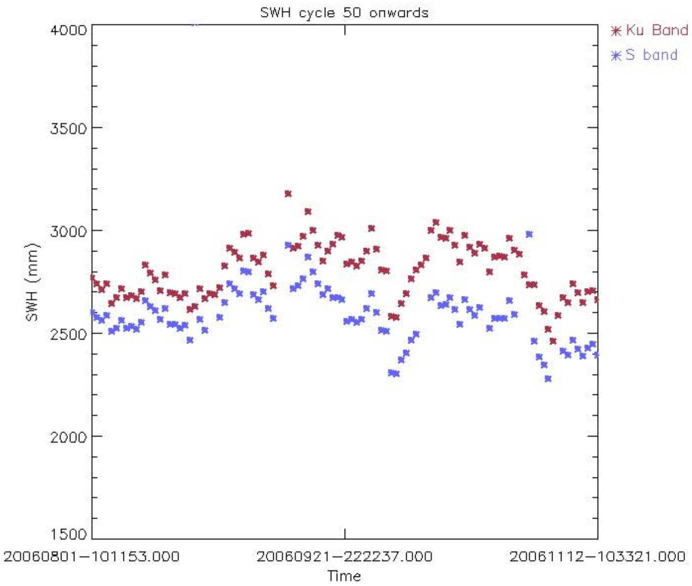

Figure 30A: Ku and S SWH daily average from cycle 50 onwards (mm)

7.4.3 BACKSCATTER COEFFICIENT – WIND SPEED

The Sigma_0 histogram both in Ku and S Band, shows secondary peaks, see Figure 31. A small investigation on this problem, performed on the data of cycle 29, demonstrated that the backscattering distribution assumes a different behavior for different sea conditions [R-17]. 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).

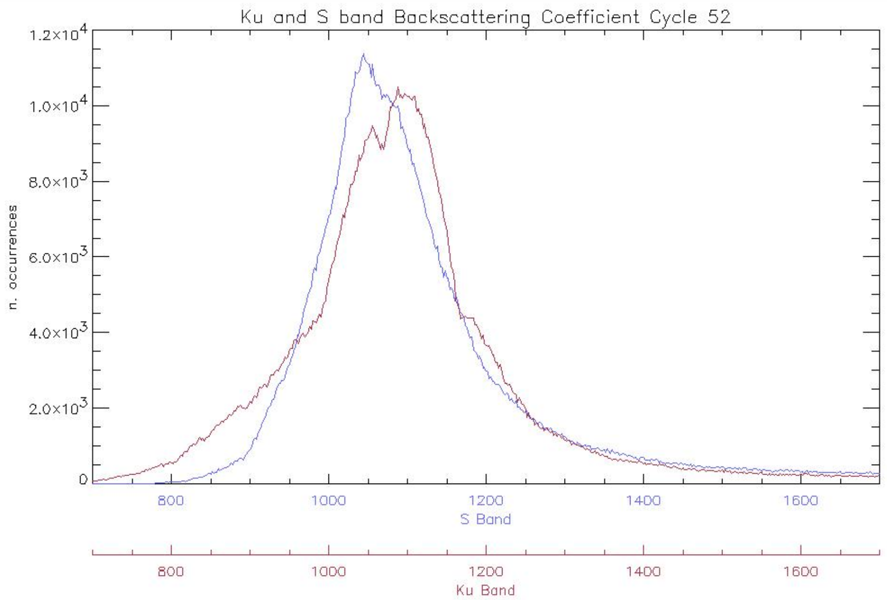

Figure 31: Histogram of Ku and S Band Backscattering Coefficient for cycle 52

In Figure 32, the backscattering coefficient daily average, computed for only ocean data, trend is reported. The trend shows a nominal behaviour for both bands. The S-Band Sigma_0 daily means that are plotted outside the figure range can be traced back to the so-called S-Band anomaly (ref. par. 6.1.8).

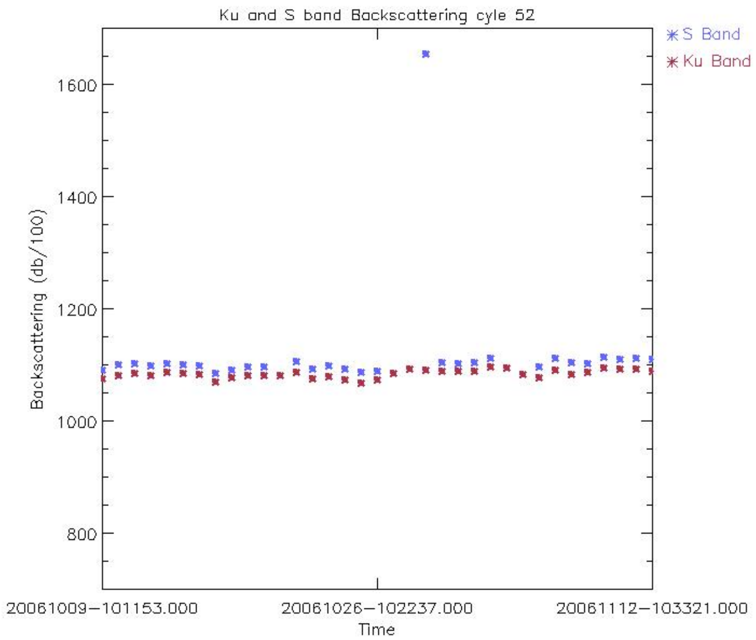

Figure 32: Ku and S Sigma_0 daily average for cycle 52 (dB/100)

The histograms of Wind Speed computed for the Ku-band and the time behavior during cycle 52 are reported in Figure 33 and 34, respectively. Given that the wind table has been updated since IPF version 5.02, S.Abdallah Table is now used, the wind takes values between 1.18m/ and 21.30m/s.

The largest peak present in the histogram (about 50000 data for Wind < 1.2m/s) was removed from the plot in order to have the complete picture of the wind histogram.

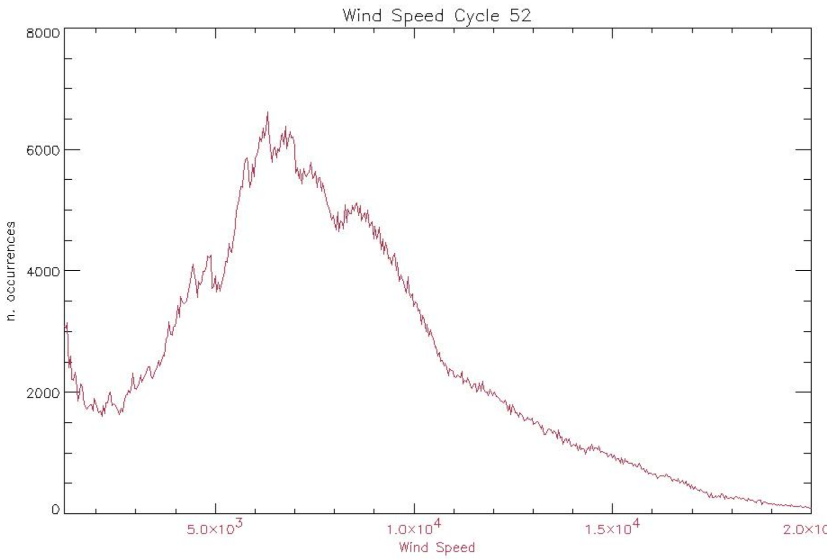

Figure 33: Histogram of Ku Wind Speed for cycle 52 (mm/sec)

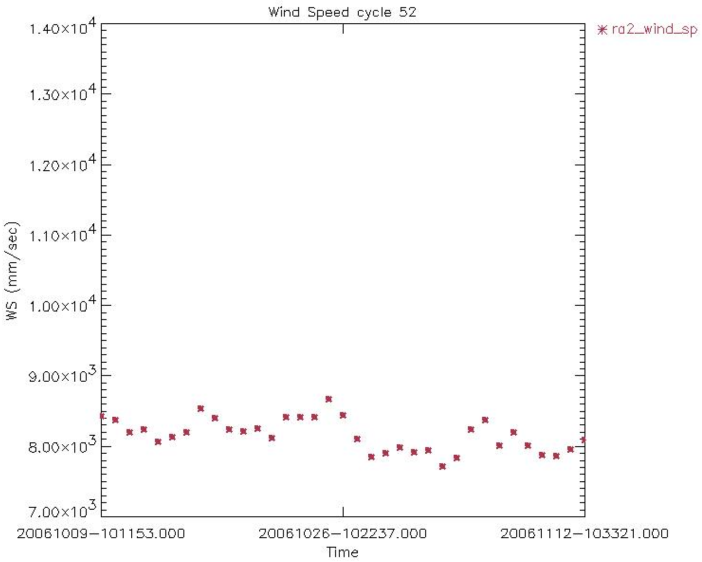

Figure 34: Ku Band Wind Speed daily average for cycle 52 (mm/s)

The Ku-Band Sigma_0 trend, reported hereafter (Figure 35 and 35A), is characterized by a jump of on average 3.24 dBs concomitant with the operational up-load of IPF version 4.54 which occurred on the 9th of April 2003. 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 in Figure 36.

Beyond the huge jump that 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. The very low values of the S Band Backscattering around 30 July 2006 are related to the S Band Power Drop Anomaly occurred when the instrument was operating on RFFS B-side from 15 May until 21 June 2006.

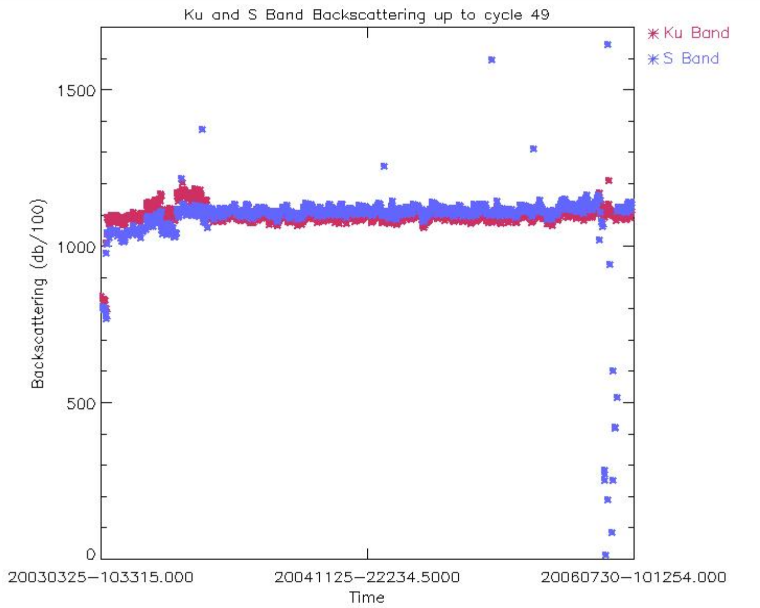

Figure 35: Ku and S band Backscattering daily averages up to cycle 49 (dB/100)

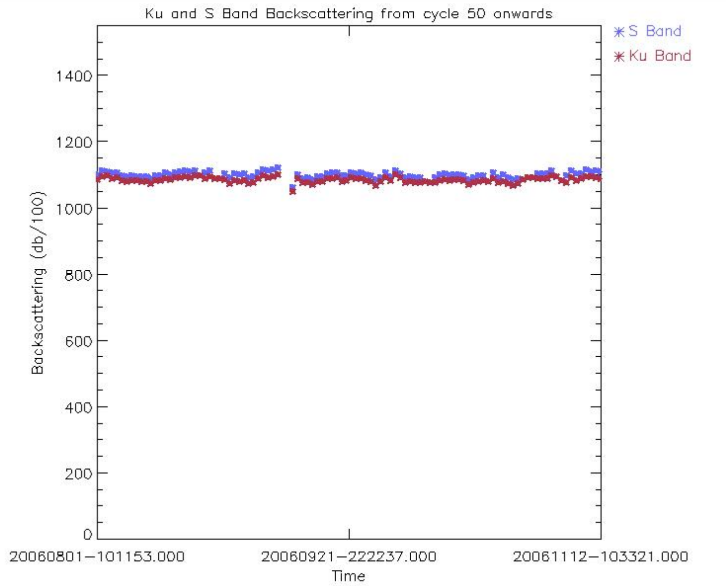

Figure 35A: Ku and S band Backscattering daily averages from cycle 50 onwards (dB/100)

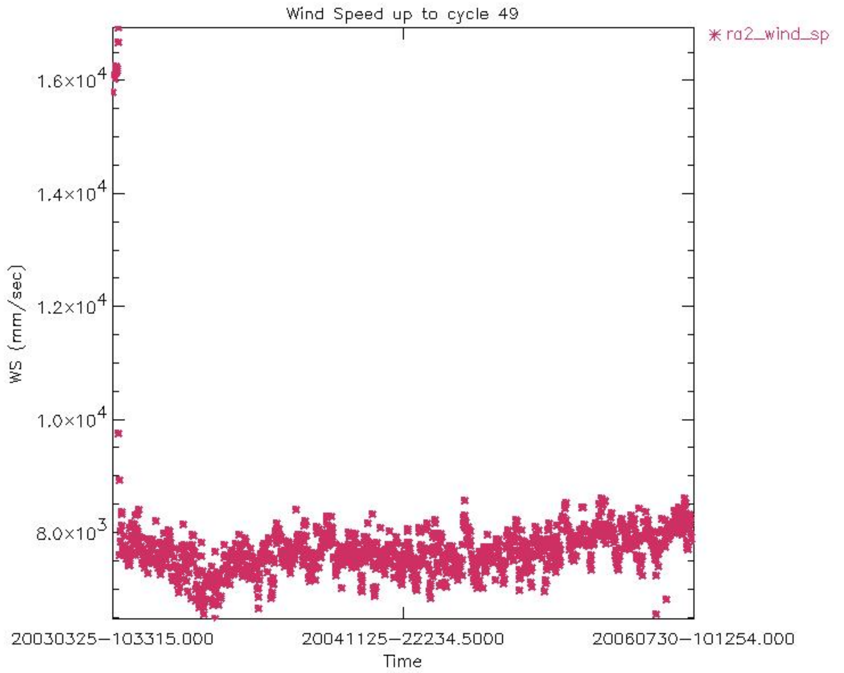

Figure 36: Wind Speed daily averages up to cycle 49 (mm/s)

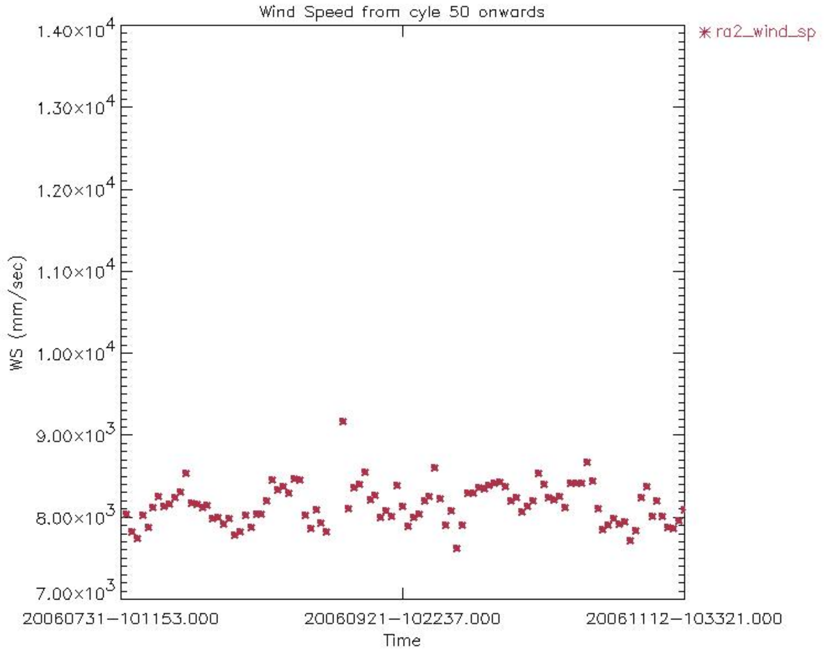

Figure 36A: Wind Speed daily averages from cycle 50 onwards (mm/s)

8 PARTICULAR INVESTIGATIONS

The un-expected behavior of the Envisat RA-2 sensor observed since cycle 44 is still present on cycle 52.
The altimetric range jumped by several meters (about 5.6m) w.r.t. the Mean Sea Surface.
The anomaly was not present when the instrument sub-system Radio Frequency Module (RFM) was switched to its B-side, from 15 May until 21 June 2006.

The investigations are currently oriented in understanding the USO anomaly on A-side. In the mean time correction files have been delivered on the web so that the end users can correct the data from the USO anomaly.

APPENDIX 1: IPF UPGRADES

Table 4: L1B IPF version

IPF Version	Date of issue PDHSK& E, LRAC	L1B Algortihm upgrades	L1B ADF updates	ADF filename
V4.53	Nov. 27, 2002			
V4.54	Apr. 7, 2003	*Wrong sign in AGC calibration estimation *Missing integrity check for the Data Block number read from the Level 0 Data Blocks *The altitude above CoG and the altitude rate have to be included in the records also in case of dummy records *1Hz data should be referenced to data block 9.5 not block 10	Correction of the Tx-Rx gain of Ku and S band parameters (3.5 dB)	RA2_CHD_AX
V4.56	Nov. 26, 2003	1- Extrapolation of AGC value to the Waveform center (49.5) for both Ku- and Sband. 2 - Correction for an error found in the evaluation of S band AGC.	RA2 IF Mask	RA2_IFF_AX
V4.57	PDHS-K: 29-04-2004			

	PDHS-E: 28-04-2004			
V4.58	Aug. 9, 2004			
V5.0.2	Oct. 24, 2005	MWR Side Lobe correction upgrade USO clock period units correction RA-2 alignment: OBDH & USO datation, IE flags correction Rain Flag tunning to compensate for the increase of the S band Sigma0 Monthly IF estimation Level 1B S-Band anomaly flag DORIS Navigator CFI upgrade (RA-2 & MWR)	side lobe table and Config param New ADF format - clock period unit New table in SOI file New format	MWR_SLT_AX MWR_CON_AX RA2_USO_AX RA2_CHD_AX RA2_CON_AX RA2_SOI_AX RA2_IFF_AX RA2_CON_AX
V5.03	Sep. 19, 2006	Level 1B S-Band anomaly flag well implemented Orbit Flag		

Table 5: L2 IPF version

PF Version	Date of issue PDHS	L2 Algortihm upgrades	L2 ADF updates	ADF filename
V4.53	Nov. 27, 2002			
V4.54	Apr. 7, 2003			
V4.56	Nov. 26, 2003	SPR 26 Tuning of the Ice2 retracking New MWR NN algorithm	MSS CLS01 Rain flag Updated OCOG retracker thresholds Ice1/Sea Ice Conf file Sea State Bias Table file GOT00.2 Ocean Tide Sol 1 Map file FES 2002 Ocean Tide Sol 2 Map file FES 2002 Tidal Loading Coeff Map	RA2_MSS_AX RA2_SOI_AX RA2_ICT_AX RA2_SSB_AX RA2_OT1_AX RA2_OT2_AX RA2_TLD_AX

V4.57	PDHS-K: 29-04-2004 PDHS-E: 28-04-2004	ECMWF meteo files handling		
V4.58	Aug. 9, 2004	Addition of a Pass Number Field in FD Level		
V5.0.2	Oct. 24, 2005	- Handling of the new RA2_CHD_AX ADF - Rain Flag tuning to compensate for the increase of the S band Sigma0 - Improving the mispointing estimation - Export of the Level 1B S-band flag into the Level 2 data product - Export of the Level 1B NRT orbit quality flag - Addition of a Pass Number Field in FD Level 2 SPH product - Addition of peakiness in Ku and S band in FDMAR - Addition of square of the SWH in Ku and S band - Correction of MCD flag - SPH pass number (field 8) set to 0 in SPH NRT Level 2 data products	New table in SOI file Two needed parameters in SOI file New format Addition of GOT2000.2 TLD New DEM AUX file (MACESS) merge of ACE land elevation data and Smith and Sandwell ocean bathymetry	RA2_CHD_AX RA2_SOI_AX RA2_SOI_AX RA2_SOI_AX RA2_TLG_AX AUX_DEM_AX
V 5.03	Sep. 19, 2006			

APPENDIX 2: AVAILABILITY:

Table 6: RA-2 L0, L1b and L2 FGD Data products availability summary for cycle 52

Start orbit	Stop orbit	Time [sec] instrum. Unavail-ability	Data Unav Time [sec]	Time [sec] L0 gaps	Time [sec] L1b gaps	Time [sec] L2 (FGD) gaps	% instrum. avail.	% data avail.	% L0 avail.	% L1b avail.	% L2 (FGD) avail.
24103	24203	0,00	1969,93	1093,40	1088,36	1104,99	100,00	99,67	99,49	99,49	99,49
24203	24303	0,00	2121,04	2604,70	2597,87	2616,01	100,00	99,65	99,22	99,22	99,22
24303	24404	23226,99	25337,65	28625,33	28613,95	28636,10	96,16	95,81	91,08	91,08	91,08
24404	24504	17056,40	19124,15	6812,04	6802,22	6816,17	97,18	96,84	95,71	95,71	95,71
24504	24604	0,00	2148,02	4147,93	4139,63	4150,27	100,00	99,64	98,96	98,96	98,96

Table 7: MWR L0 Data products availability summary for cycle 52

Start orbit	Stop orbit	Time [sec] instrum. unavailability	Time [sec] L0 gaps	% instrum. avail.	% L0 avail.
24103	24203	0,00	0,00	100,00	100,00
24203	24303	0,00	1559,94	100,00	99,74
24303	24404	0,00	29401,06	100,00	95,14
24404	24504	0,00	6120,00	100,00	98,99
24504	24604	0,00	2736,00	100,00	99,55

Table 8: DORIS L0 Data products availability summary for cycle 52

Start orbit	Stop orbit	Time [sec] instrum. unavailability	Time [sec] L0 gaps	% instrum. avail.	% L0 avail.
24103	24203	0	1150,00	100,00	99,90
24203	24303	0	4953,89	100,00	99,59
24303	24404	0	57661,11	100,00	95,23
24404	24504	0	14345,00	100,00	98,81
24504	24604	0	6441,00	100,00	99,47

Table 9: List of gaps for RA-2 L0 cycle 52

Start date	Start time	Stop date	Stop time	Duration [sec]	Start orbit	Stop orbit	Reason
09-OCT-2006	4.15.35	09-OCT-2006	4.16.52	77	24092	24092	PDS_UNKNOWN_FAILURE
09-OCT-2006	15.28.02	09-OCT-2006	15.29.20	78	24099	24099	PDS_UNKNOWN_FAILURE
10-OCT-2006	5.23.55	10-OCT-2006	5.25.12	77	24107	24107	PDS_UNKNOWN_FAILURE
10-OCT-2006	16.36.42	10-OCT-2006	16.38.00	78	24114	24114	PDS_UNKNOWN_FAILURE
11-OCT-2006	4.53.00	11-OCT-2006	4.54.18	78	24121	24121	PDS_UNKNOWN_FAILURE
11-OCT-2006	16.04.39	11-OCT-2006	16.05.57	78	24128	24128	PDS_UNKNOWN_FAILURE
12-OCT-2006	4.21.23	12-OCT-2006	4.22.41	78	24135	24135	PDS_UNKNOWN_FAILURE
12-OCT-2006	15.30.50	12-OCT-2006	15.30.53	3	24142	24142	PDS_UNKNOWN_FAILURE
12-OCT-2006	15.33.54	12-OCT-2006	15.35.12	78	24142	24142	PDS_UNKNOWN_FAILURE
13-OCT-2006	16.42.06	13-OCT-2006	16.43.24	78	24157	24157	PDS_UNKNOWN_FAILURE
13-OCT-2006	5.28.54	13-OCT-2006	5.30.12	78	24150	24150	PDS_UNKNOWN_FAILURE
14-OCT-2006	4.58.39	14-OCT-2006	4.59.56	77	24164	24164	PDS_UNKNOWN_FAILURE
14-OCT-2006	16.10.22	14-OCT-2006	16.11.39	77	24171	24171	PDS_UNKNOWN_FAILURE
17-OCT-2006	5.04.16	17-OCT-2006	5.05.34	78	24207	24207	PDS_UNKNOWN_FAILURE
17-OCT-2006	16.16.17	17-OCT-2006	16.17.34	77	24214	24214	PDS_UNKNOWN_FAILURE
18-OCT-2006	4.32.53	18-OCT-2006	4.34.11	78	24221	24221	PDS_UNKNOWN_FAILURE
18-OCT-2006	15.42.08	18-OCT-2006	15.42.10	2	24228	24228	PDS_UNKNOWN_FAILURE
18-OCT-2006	15.45.05	18-OCT-2006	15.46.23	78	24228	24228	PDS_UNKNOWN_FAILURE
19-OCT-2006	4.00.55	19-OCT-2006	4.02.13	78	24235	24235	PDS_UNKNOWN_FAILURE
19-OCT-2006	15.13.16	19-OCT-2006	15.14.34	78	24242	24242	PDS_UNKNOWN_FAILURE

20-OCT-2006	16.22.11	20-OCT-2006	16.23.29	78	24257	24257	PDS_UNKNOWN_FAILURE
20-OCT-2006	5.09.53	20-OCT-2006	5.11.11	78	24250	24250	PDS_UNKNOWN_FAILURE
21-OCT-2006	4.35.37	21-OCT-2006	4.35.40	3	24264	24264	PDS_UNKNOWN_FAILURE
21-OCT-2006	4.38.38	21-OCT-2006	4.39.56	78	24264	24264	PDS_UNKNOWN_FAILURE
21-OCT-2006	15.50.41	21-OCT-2006	15.51.59	78	24271	24271	PDS_UNKNOWN_FAILURE
22-OCT-2006	4.06.47	22-OCT-2006	4.08.05	78	24278	24278	PDS_UNKNOWN_FAILURE
22-OCT-2006	15.19.11	22-OCT-2006	15.20.29	78	24285	24285	PDS_UNKNOWN_FAILURE
23-OCT-2006	5.15.30	23-OCT-2006	5.16.48	78	24293	24293	PDS_UNKNOWN_FAILURE
23-OCT-2006	16.28.06	23-OCT-2006	16.29.24	78	24300	24300	PDS_UNKNOWN_FAILURE
23-OCT-2006	21.34.30	23-OCT-2006	23.20.09	6339	24303	24304	PDS_UNKNOWN_FAILURE
24-OCT-2006	4.44.23	24-OCT-2006	4.45.41	78	24307	24307	PDS_UNKNOWN_FAILURE
24-OCT-2006	15.56.17	24-OCT-2006	15.57.34	77	24314	24314	PDS_UNKNOWN_FAILURE
25-OCT-2006	4.12.39	25-OCT-2006	4.13.57	78	24321	24321	PDS_UNKNOWN_FAILURE
25-OCT-2006	15.22.23	25-OCT-2006	15.22.25	2	24328	24328	PDS_UNKNOWN_FAILURE
25-OCT-2006	15.25.06	25-OCT-2006	15.26.24	78	24328	24328	PDS_UNKNOWN_FAILURE
26-OCT-2006	16.34.01	26-OCT-2006	16.35.18	77	24343	24343	PDS_UNKNOWN_FAILURE
26-OCT-2006	23.28.29	27-OCT-2006	0.48.15	4786	24347	24348	PDS_UNKNOWN_FAILURE
26-OCT-2006	4.02.29	26-OCT-2006	4.02.43	14	24335	24335	PDS_UNKNOWN_FAILURE
26-OCT-2006	10.32.00	26-OCT-2006	10.33.06	66	24339	24339	PDS_UNKNOWN_FAILURE
26-OCT-2006	4.02.43	26-OCT-2006	5.18.57	4574	24335	24336	UNAV_RA2
26-OCT-2006	5.21.07	26-OCT-2006	10.32.00	18653	24336	24339	UNAV_RA2
27-OCT-2006	4.47.32	27-OCT-2006	4.47.34	2	24350	24350	PDS_UNKNOWN_FAILURE
27-OCT-2006	4.50.08	27-OCT-2006	4.51.26	78	24350	24350	PDS_UNKNOWN_FAILURE
27-OCT-2006	16.01.52	27-OCT-2006	16.03.10	78	24357	24357	PDS_UNKNOWN_FAILURE
28-OCT-2006	4.18.31	28-OCT-2006	4.19.49	78	24364	24364	PDS_UNKNOWN_FAILURE
28-OCT-2006	15.28.01	28-OCT-2006	15.28.04	3	24371	24371	PDS_UNKNOWN_FAILURE
28-OCT-2006	15.31.01	28-OCT-2006	15.32.18	77	24371	24371	PDS_UNKNOWN_FAILURE
29-OCT-2006	21.50.18	30-OCT-2006	1.14.58	12280	24389	24391	PDS_UNKNOWN_FAILURE
30-OCT-2006	4.44.20	30-OCT-2006	4.53.31	551	24393	24393	PDS_UNKNOWN_FAILURE
30-OCT-2006	4.55.51	30-OCT-2006	6.19.48	5037	24393	24394	PDS_UNKNOWN_FAILURE
30-OCT-2006	16.07.27	30-OCT-2006	16.08.45	78	24400	24400	PDS_UNKNOWN_FAILURE
31-OCT-2006	4.24.16	31-OCT-2006	4.25.34	78	24407	24407	PDS_UNKNOWN_FAILURE
31-OCT-2006	15.36.42	31-OCT-2006	15.38.00	78	24414	24414	PDS_UNKNOWN_FAILURE
04-nov-06	15.10.19	04-nov-06	15.11.36	77	24471	24471	PDS_UNKNOWN_FAILURE
05-nov-06	23.19.10	06-nov-06	0.54.35	5725	24490	24491	PDS_UNKNOWN_FAILURE
06-nov-06	4.35.45	06-nov-06	4.37.03	78	24493	24493	PDS_UNKNOWN_FAILURE
06-nov-06	15.45.00	06-nov-06	15.45.02	2	24500	24500	PDS_UNKNOWN_FAILURE
06-nov-06	15.47.53	06-nov-06	15.49.11	78	24500	24500	PDS_UNKNOWN_FAILURE
07-nov-06	4.03.51	07-nov-06	4.05.08	77	24507	24507	PDS_UNKNOWN_FAILURE
07-nov-06	15.16.13	07-nov-06	15.17.31	78	24514	24514	PDS_UNKNOWN_FAILURE
08-nov-06	5.12.41	08-nov-06	5.13.59	78	24522	24522	PDS_UNKNOWN_FAILURE

08-nov-06	16.25.08	08-nov-06	16.26.26	78	24529	24529	PDS_UNKNOWN_FAILURE
09-nov-06	15.53.28	09-nov-06	15.54.46	78	24543	24543	PDS_UNKNOWN_FAILURE
09-nov-06	4.41.30	09-nov-06	4.42.48	78	24536	24536	PDS_UNKNOWN_FAILURE
09-nov-06	15.50.44	09-nov-06	15.50.47	3	24543	24543	PDS_UNKNOWN_FAILURE
10-nov-06	4.09.42	10-nov-06	4.11.00	78	24550	24550	PDS_UNKNOWN_FAILURE
10-nov-06	5.35.01	10-nov-06	6.19.53	2692	24551	24551	PDS_UNKNOWN_FAILURE
10-nov-06	15.19.32	10-nov-06	15.19.35	3	24557	24557	PDS_UNKNOWN_FAILURE
10-nov-06	15.22.07	10-nov-06	15.23.25	78	24557	24557	PDS_UNKNOWN_FAILURE
11-nov-06	5.18.18	11-nov-06	5.19.35	77	24565	24565	PDS_UNKNOWN_FAILURE
11-nov-06	16.31.03	11-nov-06	16.32.20	77	24572	24572	PDS_UNKNOWN_FAILURE
12-nov-06	4.47.15	12-nov-06	4.48.32	77	24579	24579	PDS_UNKNOWN_FAILURE

Table 10: List of gaps for MWR L0 cycle 52

Start date	Start time	Stop date	Stop time	Duration [sec]	Start orbit	Stop orbit	Reason
23-OCT-2006	21.33.40	23-OCT-2006	23.20.04	6384	24303	24304	PDS_UNKNOWN_FAILURE
26-OCT-2006	23.27.23	27-OCT-2006	1.08.35	6072	24347	24348	PDS_UNKNOWN_FAILURE
29-OCT-2006	21.50.18	30-OCT-2006	1.14.42	12264	24389	24391	PDS_UNKNOWN_FAILURE
30-OCT-2006	4.38.18	30-OCT-2006	6.19.31	6073	24393	24394	PDS_UNKNOWN_FAILURE
05-nov-06	23.12.34	06-nov-06	0.54.34	6120	24490	24491	PDS_UNKNOWN_FAILURE
10-nov-06	5.33.56	10-nov-06	6.19.32	2736	24551	24551	PDS_UNKNOWN_FAILURE

Table 11: List of gaps for RA-2 L1b cycle 52

Start date	Start time	Stop date	Stop time	Duration [sec]	Start orbit	Stop orbit	Reason
09-OCT-2006	4.15.35	09-OCT-2006	4.16.52	77	24092	24092	PDS_UNKNOWN_FAILURE
09-OCT-2006	15.28.02	09-OCT-2006	15.29.20	78	24099	24099	PDS_UNKNOWN_FAILURE
14-OCT-2006	4.58.39	14-OCT-2006	4.59.56	77	24164	24164	PDS_UNKNOWN_FAILURE
10-OCT-2006	5.23.55	10-OCT-2006	5.25.12	77	24107	24107	PDS_UNKNOWN_FAILURE
10-OCT-2006	16.36.42	10-OCT-2006	16.38.00	78	24114	24114	PDS_UNKNOWN_FAILURE
11-OCT-2006	4.53.00	11-OCT-2006	4.54.18	78	24121	24121	PDS_UNKNOWN_FAILURE
11-OCT-2006	16.04.39	11-OCT-2006	16.05.57	78	24128	24128	PDS_UNKNOWN_FAILURE
12-OCT-2006	4.21.23	12-OCT-2006	4.22.41	78	24135	24135	PDS_UNKNOWN_FAILURE
12-OCT-2006	15.33.54	12-OCT-2006	15.35.12	78	24142	24142	PDS_UNKNOWN_FAILURE
13-OCT-2006	5.28.54	13-OCT-2006	5.30.12	78	24150	24150	PDS_UNKNOWN_FAILURE
13-OCT-2006	16.42.06	13-OCT-2006	16.43.24	78	24157	24157	PDS_UNKNOWN_FAILURE
21-OCT-2006	4.38.38	21-OCT-2006	4.39.56	78	24264	24264	PDS_UNKNOWN_FAILURE
21-OCT-2006	15.50.41	21-OCT-2006	15.51.59	78	24271	24271	PDS_UNKNOWN_FAILURE
22-OCT-2006	4.06.47	22-OCT-2006	4.08.05	78	24278	24278	PDS_UNKNOWN_FAILURE
22-OCT-2006	15.19.11	22-OCT-2006	15.20.29	78	24285	24285	PDS_UNKNOWN_FAILURE
17-OCT-2006	5.04.16	17-OCT-2006	5.05.34	78	24207	24207	PDS_UNKNOWN_FAILURE

17-OCT-2006	16.16.17	17-OCT-2006	16.17.34	77	24214	24214	PDS_UNKNOWN_FAILURE
18-OCT-2006	4.32.53	18-OCT-2006	4.34.11	78	24221	24221	PDS_UNKNOWN_FAILURE
18-OCT-2006	15.45.05	18-OCT-2006	15.46.23	78	24228	24228	PDS_UNKNOWN_FAILURE
19-OCT-2006	4.00.55	19-OCT-2006	4.02.13	78	24235	24235	PDS_UNKNOWN_FAILURE
19-OCT-2006	15.13.16	19-OCT-2006	15.14.34	78	24242	24242	PDS_UNKNOWN_FAILURE
20-OCT-2006	5.09.53	20-OCT-2006	5.11.11	78	24250	24250	PDS_UNKNOWN_FAILURE
20-OCT-2006	16.22.11	20-OCT-2006	16.23.29	78	24257	24257	PDS_UNKNOWN_FAILURE
23-OCT-2006	5.15.30	23-OCT-2006	5.16.48	78	24293	24293	PDS_UNKNOWN_FAILURE
23-OCT-2006	16.28.06	23-OCT-2006	16.29.24	78	24300	24300	PDS_UNKNOWN_FAILURE
26-OCT-2006	23.28.30	27-OCT-2006	0.48.15	4785	24347	24348	PDS_UNKNOWN_FAILURE
27-OCT-2006	4.50.08	27-OCT-2006	4.51.26	78	24350	24350	PDS_UNKNOWN_FAILURE
27-OCT-2006	16.01.52	27-OCT-2006	16.03.10	78	24357	24357	PDS_UNKNOWN_FAILURE
28-OCT-2006	4.18.31	28-OCT-2006	4.19.49	78	24364	24364	PDS_UNKNOWN_FAILURE
28-OCT-2006	15.31.01	28-OCT-2006	15.32.18	77	24371	24371	PDS_UNKNOWN_FAILURE
23-OCT-2006	21.34.32	23-OCT-2006	23.20.09	6337	24303	24304	PDS_UNKNOWN_FAILURE
24-OCT-2006	4.44.23	24-OCT-2006	4.45.41	78	24307	24307	PDS_UNKNOWN_FAILURE
24-OCT-2006	15.56.17	24-OCT-2006	15.57.34	77	24314	24314	PDS_UNKNOWN_FAILURE
25-OCT-2006	4.12.39	25-OCT-2006	4.13.57	78	24321	24321	PDS_UNKNOWN_FAILURE
25-OCT-2006	15.25.06	25-OCT-2006	15.26.24	78	24328	24328	PDS_UNKNOWN_FAILURE
26-OCT-2006	4.02.30	26-OCT-2006	4.02.43	13	24335	24335	PDS_UNKNOWN_FAILURE
26-OCT-2006	10.32.00	26-OCT-2006	10.33.06	66	24339	24339	PDS_UNKNOWN_FAILURE
26-OCT-2006	16.34.01	26-OCT-2006	16.35.18	77	24343	24343	PDS_UNKNOWN_FAILURE
26-OCT-2006	4.02.43	26-OCT-2006	5.18.57	4574	24335	24336	UNAV_RA2
26-OCT-2006	5.21.07	26-OCT-2006	10.32.00	18653	24336	24339	UNAV_RA2
29-OCT-2006	5.26.25	29-OCT-2006	5.27.43	78	24379	24379	PDS_UNKNOWN_FAILURE
29-OCT-2006	16.39.25	29-OCT-2006	16.40.43	78	24386	24386	PDS_UNKNOWN_FAILURE
29-OCT-2006	21.48.18	30-OCT-2006	1.14.58	12400	24389	24391	PDS_UNKNOWN_FAILURE
30-OCT-2006	4.44.21	30-OCT-2006	4.53.31	550	24393	24393	PDS_UNKNOWN_FAILURE
30-OCT-2006	4.55.51	30-OCT-2006	6.19.48	5037	24393	24394	PDS_UNKNOWN_FAILURE
31-OCT-2006	4.24.16	31-OCT-2006	4.25.34	78	24407	24407	PDS_UNKNOWN_FAILURE
31-OCT-2006	15.36.42	31-OCT-2006	15.38.00	78	24414	24414	PDS_UNKNOWN_FAILURE
01-nov-06	3.52.07	01-nov-06	3.53.24	77	24421	24421	PDS_UNKNOWN_FAILURE
01-nov-06	16.44.49	01-nov-06	16.46.07	78	24429	24429	PDS_UNKNOWN_FAILURE
02-nov-06	20.07.00	02-nov-06	20.08.06	66	24445	24445	PDS_UNKNOWN_FAILURE
02-nov-06	5.01.27	02-nov-06	5.02.45	78	24436	24436	PDS_UNKNOWN_FAILURE
02-nov-06	15.20.17	02-nov-06	15.20.19	2	24442	24442	PDS_UNKNOWN_FAILURE
02-nov-06	15.20.19	02-nov-06	16.10.55	3036	24442	24443	UNAV_RA2
02-nov-06	16.13.19	02-nov-06	20.07.00	14021	24443	24445	UNAV_RA2
03-nov-06	4.30.01	03-nov-06	4.31.18	77	24450	24450	PDS_UNKNOWN_FAILURE
03-nov-06	15.42.18	03-nov-06	15.43.35	77	24457	24457	PDS_UNKNOWN_FAILURE
04-nov-06	3.57.59	04-nov-06	3.59.16	77	24464	24464	PDS_UNKNOWN_FAILURE

04-nov-06	15.10.19	04-nov-06	15.11.36	77	24471	24471	PDS_UNKNOWN_FAILURE
05-nov-06	5.07.04	05-nov-06	5.08.22	78	24479	24479	PDS_UNKNOWN_FAILURE
05-nov-06	16.19.14	05-nov-06	16.20.32	78	24486	24486	PDS_UNKNOWN_FAILURE
05-nov-06	23.19.11	06-nov-06	0.54.35	5724	24490	24491	PDS_UNKNOWN_FAILURE
05-nov-06	23.19.11	06-nov-06	0.54.35	5724	24490	24491	PDS_UNKNOWN_FAILURE
06-nov-06	4.35.45	06-nov-06	4.37.03	78	24493	24493	PDS_UNKNOWN_FAILURE
06-nov-06	15.47.53	06-nov-06	15.49.11	78	24500	24500	PDS_UNKNOWN_FAILURE
07-nov-06	4.03.51	07-nov-06	4.05.08	77	24507	24507	PDS_UNKNOWN_FAILURE
07-nov-06	15.16.13	07-nov-06	15.17.31	78	24514	24514	PDS_UNKNOWN_FAILURE
08-nov-06	5.12.41	08-nov-06	5.13.59	78	24522	24522	PDS_UNKNOWN_FAILURE
08-nov-06	16.25.08	08-nov-06	16.26.26	78	24529	24529	PDS_UNKNOWN_FAILURE
09-nov-06	4.41.30	09-nov-06	4.42.48	78	24536	24536	PDS_UNKNOWN_FAILURE
09-nov-06	15.53.28	09-nov-06	15.54.46	78	24543	24543	PDS_UNKNOWN_FAILURE
10-nov-06	5.35.02	10-nov-06	6.19.53	2691	24551	24551	PDS_UNKNOWN_FAILURE
10-nov-06	15.19.33	10-nov-06	15.19.35	2	24557	24557	PDS_UNKNOWN_FAILURE
10-nov-06	15.22.07	10-nov-06	15.23.25	78	24557	24557	PDS_UNKNOWN_FAILURE
10-nov-06	4.09.42	10-nov-06	4.11.00	78	24550	24550	PDS_UNKNOWN_FAILURE
11-nov-06	5.18.18	11-nov-06	5.19.35	77	24565	24565	PDS_UNKNOWN_FAILURE
11-nov-06	16.31.03	11-nov-06	16.32.20	77	24572	24572	PDS_UNKNOWN_FAILURE
12-nov-06	4.47.15	12-nov-06	4.48.32	77	24579	24579	PDS_UNKNOWN_FAILURE

APPENDIX 3: LEVEL 2 STATIC AUXILIARY DATA FILES

AUX_DEM_AXVIEC20031201_000000_20031201_000000_20200101_000000
AUX_ATT_AXVIEC20020924_131534_20020703_120000_20781231_235959
AUX_LSM_AXVIEC20020123_141228_20020101_000000_20200101_000000
MWR_LSF_AXVIEC20020313_172218_20020101_000000_20200101_000000
MWR_CHD_AXVIEC20021111_131410_20020101_000000_20200101_000000
MWR_LSF_AXVIEC20020313_172218_20020101_000000_20200101_000000
MWR_SLT_AXVIEC20050426_120000_20020101_000000_20200101_000000
RA2_IFA_AXVIEC20050216_125529_20020101_000000_20200101_000000
RA2_IFB_AXVIEC20050216_125738_20020101_000000_20200101_000000
RA2_CHD_AXVIEC20051017_093900_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_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_AXVIEC20051003_170000_20020101_000000_20200101_000000
RA2_SSB_AXVIEC20051129_111810_20020101_000000_20200101_000000
RA2_TLD_AXVIEC20031208_151137_20020101_000000_20200101_000000
RA2_TLG_AXVIEC20040310_110000_20020101_000000_20200101_000000

APPENDIX 4: SIGMA0 ABSOLUTE CALIBRATION

Table 18: Transponder measurement results up to cycle 49

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	0,142
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	1,427	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
17904	02-aug-05	Rome / 315	High	1,02	0,188
18026	11-aug-05	Valmontone / 437	High	0,93	0,154
18405	06-sep-05	Rome / 315	High	1,06	0,16
18634	22-Sep-05	Fiuggi/43	High	1,00	0,152
18799	04-Oct-05	Maccarese/208	High	0,85	0,164
18906	11-Oct-05	Perm site Rome / 315	Low	1,46	0,156

19407	15-Nov-05	Perm site Rome / 315	High	1,09	0,19
20409	24-Jan-06	Perm site Rome / 315	High	1,38	0,110
20910	28-Feb-06	Perm site Rome / 315	High	0,98	0,124
21912	9-May-06	Perm site Rome / 315	High	1,0	0,138
23916	26-Sep-06	Perm site Rome / 315	High	1,05	0,172
24417	31-Oct-06	Perm site Rome / 315	High	1,08	0,146

APPENDIX 5: S-BAND ANOMALY

Table 13: List of L2 FGD Files affected by S-Band anomaly during cycle 52

File name	Start date	Start time	Stop date	Stop time
RA2_FGD_2PNPDE20061019_234706_000062222052_00145_24247_0914.N1	19-OCT-2006	23:47:06.63	20-OCT-2006	01:30:48.30
RA2_FGD_2PNPDE20061020_012941_000061102052_00146_24248_0915.N1	20-OCT-2006	01:29:41.52	20-OCT-2006	03:11:31.80
RA2_FGD_2PNPDE20061020_031023_000061772052_00147_24249_0916.N1	20-OCT-2006	03:10:23.90	20-OCT-2006	04:53:21.02
RA2_FGD_2PNPDE20061020_045223_000009202052_00148_24250_0918.N1	20-OCT-2006	04:52:23.14	20-OCT-2006	05:07:43.26
RA2_FGD_2PNPDK20061027_125636_000059932052_00253_24355_1444.N1	27-OCT-2006	12:56:36.55	27-OCT-2006	14:36:29.86
RA2_FGD_2PNPDK20061027_143533_000050332052_00254_24356_1445.N1	27-OCT-2006	14:35:33.10	27-OCT-2006	15:59:26.13
RA2_FGD_2PNPDK20061028_104456_000060202052_00266_24368_1457.N1	28-OCT-2006	10:44:56.11	28-OCT-2006	12:25:16.15
RA2_FGD_2PNPDK20061028_122409_000060092052_00267_24369_1458.N1	28-OCT-2006	12:24:09.37	28-OCT-2006	14:04:18.27
RA2_FGD_2PNPDK20061028_140320_000050822052_00268_24370_1459.N1	28-OCT-2006	14:03:20.40	28-OCT-2006	15:28:02.45
RA2_FGD_2PNPDK20061029_195953_000000342052_00286_24388_1480.N1	29-OCT-2006	19:59:53.86	29-OCT-2006	20:00:28.34
RA2_FGD_2PNPDK20061103_204632_000064602052_00358_24460_1555.N1	03-nov-06	20:46:32.01	03-nov-06	22:34:12.09
RA2_FGD_2PNPDE20061103_223317_000065512052_00359_24461_0366.N1	03-nov-06	22:33:17.56	04-nov-06	00:22:28.98
RA2_FGD_2PNPDE20061104_001623_000064382052_00360_24462_0646.N1	04-nov-06	00:16:23.65	04-nov-06	02:03:41.44
RA2_FGD_2PNPDE20061104_015745_000064832052_00361_24463_0803.N1	04-nov-06	01:57:45.01	04-nov-06	03:45:48.49
RA2_FGD_2PNPDE20061104_034111_000008872052_00362_24464_1489.N1	04-nov-06	03:41:11.15	04-nov-06	03:55:57.85

APPENDIX 6: IE SITES COORDINATES

ZONE_ID="CapraiaA"
RECORD polygon_pt: LONG=+009.934000<deg> LAT=+042.970000<deg>
ENDRECORD
RECORD polygon_pt: LONG=+009.863000<deg> LAT=+042.970000<deg>
ENDRECORD
RECORD polygon_pt: LONG=+009.863000<deg> LAT=+043.166000<deg>
ENDRECORD
RECORD polygon_pt: LONG=+009.934000<deg> LAT=+043.166000<deg>
ENDRECORD

ZONE_ID="Toulon_D"
RECORD polygon_pt: LONG=+005.500000<deg> LAT=+043.070000<deg>
ENDRECORD
RECORD polygon_pt: LONG=+005.473000<deg> LAT=+043.070000<deg>
ENDRECORD
RECORD polygon_pt: LONG=+005.473000<deg> LAT=+043.160000<deg>
ENDRECORD
RECORD polygon_pt: LONG=+005.500000<deg> LAT=+043.160000<deg>
ENDRECORD
ZONE_ID="Vostok_x"
RECORD polygon_pt: LONG=+106.500000<deg> LAT=-078.000000<deg>
ENDRECORD
RECORD polygon_pt: LONG=+105.500000<deg> LAT=-078.000000<deg>
ENDRECORD
RECORD polygon_pt: LONG=+105.500000<deg> LAT=-077.500000<deg>
ENDRECORD
RECORD polygon_pt: LONG=+106.500000<deg> LAT=-077.500000<deg>
ENDRECORD
ZONE_ID="Dome_x__"
RECORD polygon_pt: LONG=+124.000000<deg> LAT=-075.250000<deg>
ENDRECORD
RECORD polygon_pt: LONG=+122.000000<deg> LAT=-075.250000<deg>
ENDRECORD
RECORD polygon_pt: LONG=+122.000000<deg> LAT=-074.750000<deg>
ENDRECORD
RECORD polygon_pt: LONG=+124.000000<deg> LAT=-074.750000<deg>
ENDRECORD