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ENVISAT CYCLIC ALTIMETRIC REPORT

CYCLE 50 and 51 from 31-07-2006 to 09-10-2006

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 cycles 50 and 51.

This report covers the period from the 31st of July 2006 until the 9th of October 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 044, CLS.DOS/05.147, http://earth.esa.int/pcs/envisat/mwr/reports/
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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
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[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 50 and 51 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.
- During cycle 50, the number of valid IF masks has been 26, representing 38 % of the acquired IF masks. During cycle 51, the number of valid IF masks has been 14, representing 30 % of the acquired IF masks. The auxiliary file RA2_IFF_AX has been updated twice, on 22 of August and 26 September 2006.

- During the reporting period, the S Band Anomaly only occurred once per cycle, affecting six consecutive orbits on cycle 50, corresponding to 1.2% of data, and seven consecutive orbits during cycle 51, corresponding to 1.5% of data.
- Tracking performances in the different resolutions are well in line with the output figures and objectives of the Commissioning Phase.
- During cycle 50 and 51, no update of the RA2_USO_AX has been done.
- Data availability has decreased on cycle 51 due to the interruption of the Envisat data transmission via the ESA Data Relay Satellite Artemis (anomaly with Envisat Ka-band antenna) from 26 September until 1 October.
- The Radar Altimeter was unavailable twice, RA-2 Data availability is around 98.22% on cycle 50 and 70.48% on cycle 51 (mainly due to ENVISAT Ka-Band antenna anomaly).
- DORIS was unavailable once, with data availability of 99.41% on cycle 50 and 80.53% on cycle 51 (mainly due to ENVISAT Ka-Band antenna anomaly).
- MWR was unavailable once, with data availability of 99.64% on cycle 50 and 70.11% on cycle 51 (mainly due to ENVISAT Ka-Band antenna anomaly).

5.2 Payload status

5.2.1 ALTIMETER EVENTS

The Radar Altimeter 2, during cycle 50 and 51, was unavailable twice.

1. Start: 1 Aug 2006 01:14:40, Orbit = 23102
   Stop: 1 Aug 2006 08:54:30, Orbit = 23107
   RA-2 Back to Measurement following Multiple SEU Anomaly
2. Start: 7 Sep 2006 16:40:30, Orbit = 23641
   Stop: 10 Sep 2006 15:47:30, Orbit = 23684
   RA-2 Back to Measurement following a Service Module 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.

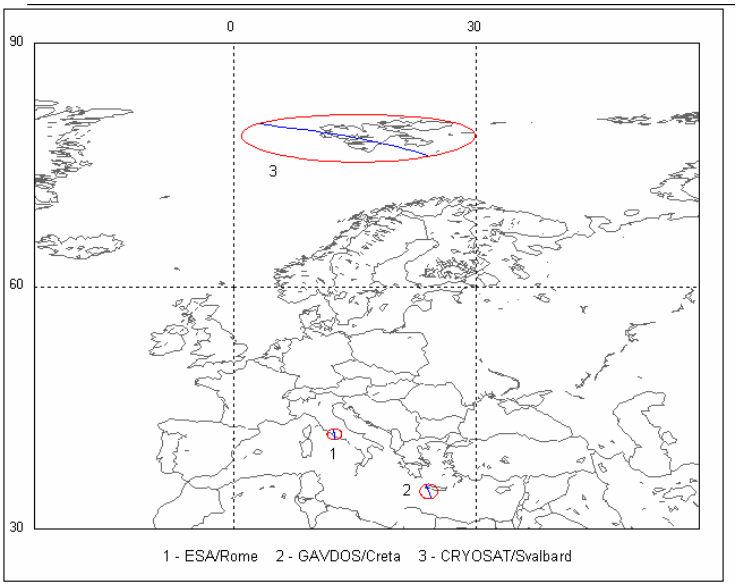


Figure 1: Transponder Acquisition sites

5.2.2 MWR EVENTS

The MWR, during the reporting period, was unavailable once, in correspondence of the Service Module Anomaly.

Start: 7 Sep 2006 16:40:30.000, Orbit = 23641

Stop: 11 Sep 2006 08:41:30, Orbit = 23694

5.2.3 DORIS EVENTS

The DORIS, during the reporting period, was unavailable once, in correspondence of the Service Module Anomaly.

Start: 7 Sep 2006 16:40:30, Orbit = 23641

Stop: 11 Sep 2006 08:45:38, Orbit = 23694

DORIS was back to its Navigator nominal accuracy on the 14th of September.

5.3 Availability

The summary of the RA-2 data products availability for this cycle is reported in Appendix 2.
On cycle 50, data availability was 98.22% for RA2 products, 99.64% for MWR and around 99.41% for DORIS products.
On cycle 51, data availability was 70.48% for RA2 products, 70.11% for MWR and around 80.53% for DORIS products.

5.4 Orbit quality

During cycle 50 no orbit manoeuvres were executed.

During the period 31 July until 6 August the spacecraft ground track partially remained outside the +/- 1km deadband around the reference ground track after having exited it on July 4, 2006 (DOY 185) at around 06:00 utc on its western boundary at ascending node.
This deadband violation is the combined effect of the very low level of air drag and of the debris collision avoidance manoeuvre performed on June 20th 2006.

During cycle 51 two orbit manoeuvres were executed:

1. On September 12th, 2006 (DOY 255) an orbit in-plane correction manoeuvre took place. The characteristics of this manoeuvre were:
   - Planned delta V size: 0.013 m/s, increasing the semi major axis by approximately 20 metres
   - Mid thrust time: 03:18:53.178 utc at PSO 134.933 degree
   - Thrust duration: 7 seconds
   - Measured delta V: 0.013 m/s along track (towards flight direction)
   The scope of this in plane correction manoeuvre was twofold: correct for the perturbations caused by the return to thruster controlled attitude modes (RRM up to FAM2) on September 7 and 8th, and initiate a ground track control cycle prior to the inclination correction described below.

2. On September 13th, 2006 (DOY 256) an orbit inclination correction manoeuvre took place. The characteristics of this manoeuvre were:
   - Planned delta V size: 2.1 m/s, increasing orbit inclination by approximately 0.015 degree
   - Mid thrust time: 05:30:50.090 utc at PSO 0.0 degree
   - Thrust duration: 1090.9 seconds
   - Measured delta V: 2.092 m/s across track, 0.0082 m/s along track (towards flight direction), -0.0104 m/s radial (towards downward vertical).

5.5 Ground Segment Processing Chain Status

5.5.1 IPF PROCESSING CHAIN

5.5.1.1 Version

Cycle 50 data has been processed with the IPF processing chain V5.02, installed in both PDHS-E and PDHS-K on 24th October 2005. It contains the following algorithms and auxiliary data files upgrade:

1. USO instrumental correction within the RA-2 L1b processor.
2. New MWR Side Lobes correction algorithm within MWR L1b processor
3. Correction of the mispointing evaluation algorithm within the RA-2 L2 processor
4. Inclusion of the loading tide for the GOT2000.2 model.
5. Addition of the peakiness fields in Ku and S band to the RA-2 and MWR FD/I/MAR meteorological products
6. Inclusion of the square of the significant wave height in Ku and S band
7. Inclusion of an S-band anomaly flag, see [R – 16]
8. Upgrade of the Level 1B and Level 2 processing for DORIS NRT orbital information computation
9. New ADF for Digital Elevation Model (DEM): AUX_DEM_AX
10. Adjustment of the S Band computation for the rain flag
11. New ADF for wind table: RA2_SOI_AX
12. New ADF for Sea State Bias: RA2_SSB_AX

On September 19th, third week of Cycle 51, a new version of the IPF has been released, V5.03. 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 :
   Level 1B : in bit 1 of MCD field 14 of L1B-RA2 MDSR
   Level 2 : in bit 7 of MCD field 8 of L2-RA2 MDSR.
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.

The previous IPF version V4.58 was operational at the Envisat PDHS-K and PDHS-E from 16th July 2004 until 25th October 2005. 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	99,99	>99%	0,01	0,00
Costal Water (ocean depth < 200 m)	98,39	No specific requirement	1,41	0,20
Sea Ice	99,21	>95%	0,71	0,08

Ice Sheet	96,42	>95%	2,97	0,61
Land	81,97	No specific requirement	14,10	3,93
All world	95,38		3,65	0,97

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.

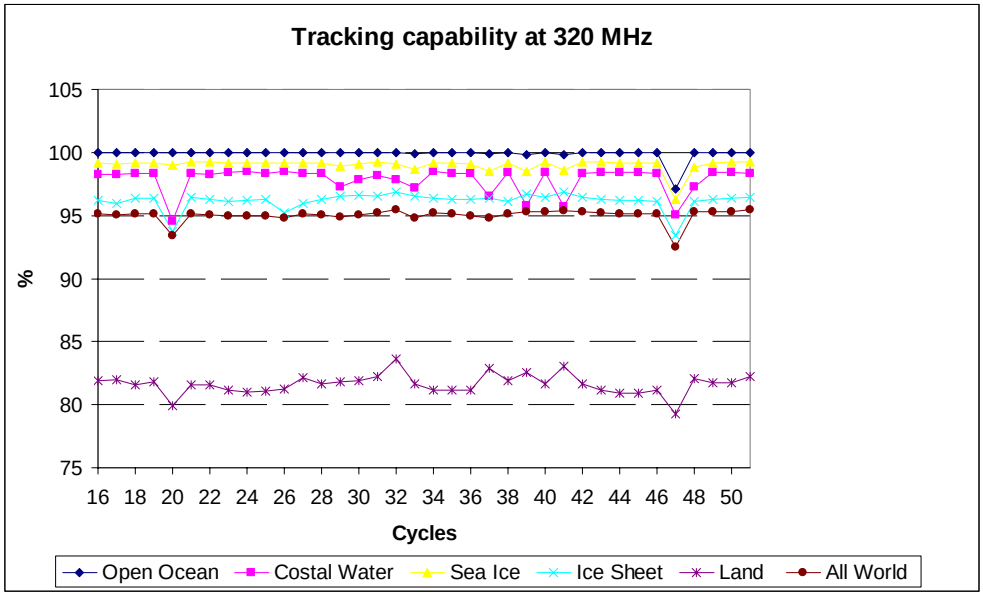


Figure 2: RA-2 Tracking percentage at 320MHz for different surfaces

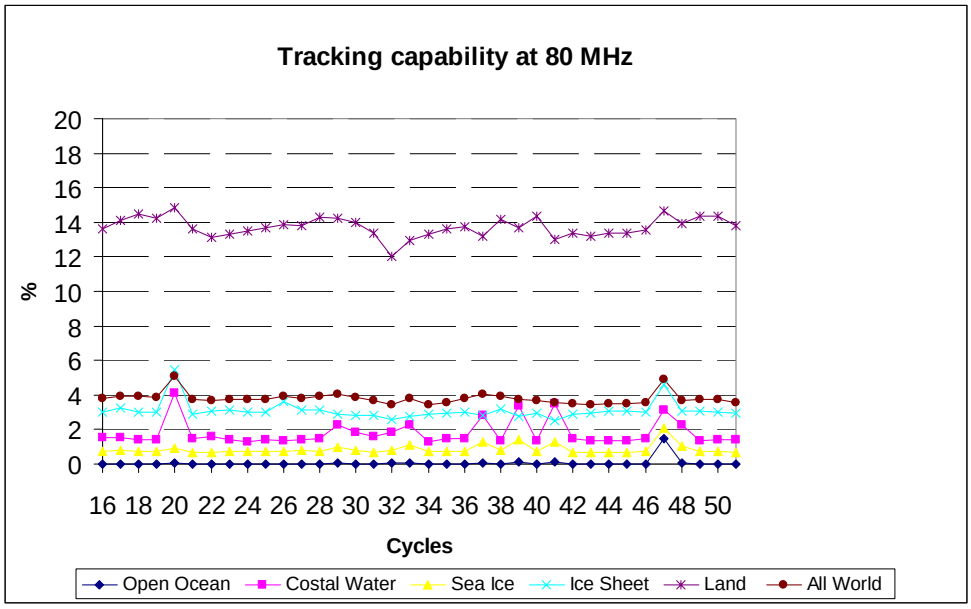


Figure 3: RA-2 Tracking percentage at 80MHz for different surfaces

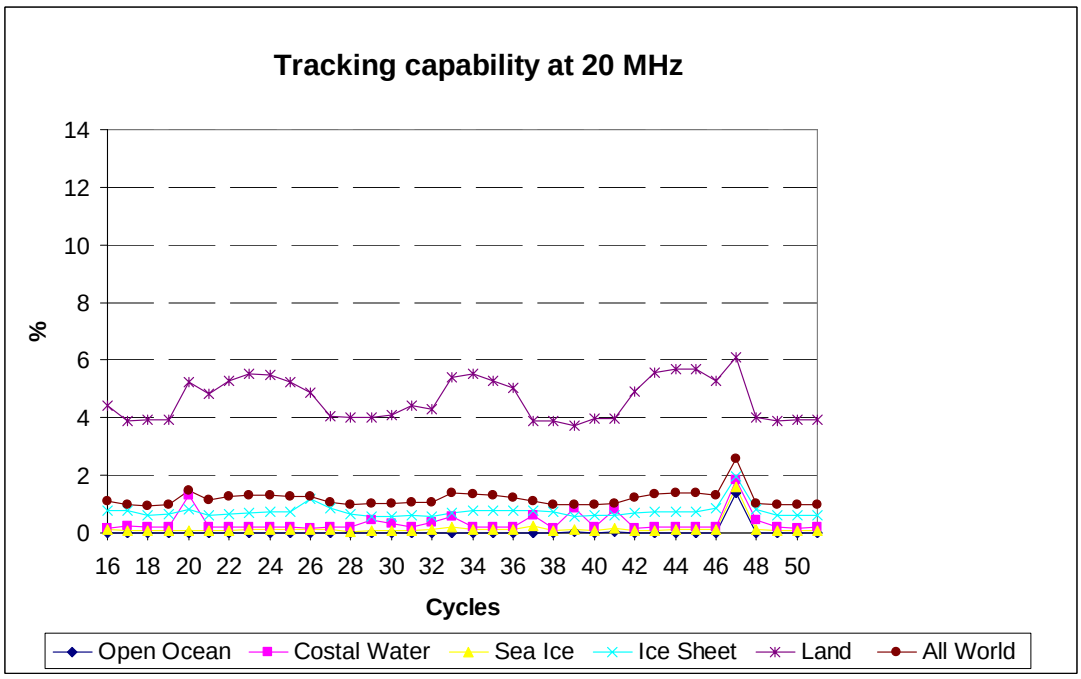


Figure 4: RA-2 Tracking percentage at 20MHz for different surfaces

6.1.2 IF FILTER MASK

In Figure 5 all valid IF masks retrieved during cycle 50 and 51 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 dB, the mask is considered valid.

During cycle 50, the number of valid IF masks has been 26, representing 38 % of the acquired IF masks. During cycle 51, the number of valid IF masks has been 14, representing 30 % 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).

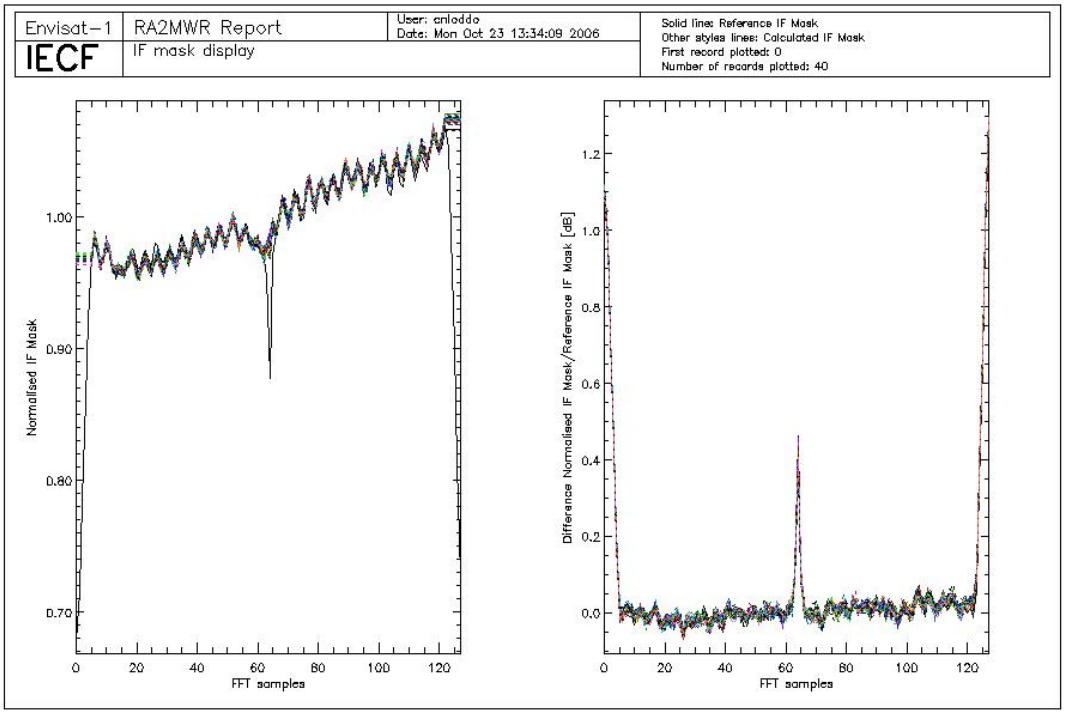


Figure 5: Valid IF masks retrieved daily during cycle 50 and 51 plotted together with the on-ground reference.

Since the 24th of October, the auxiliary file RA2_IFF_AX have been updated regularly once per month. In Figure 6 the new IF Masks, updated on the 22 of August, and on the 26 of September and the previous IF Mask used for processing are plotted.

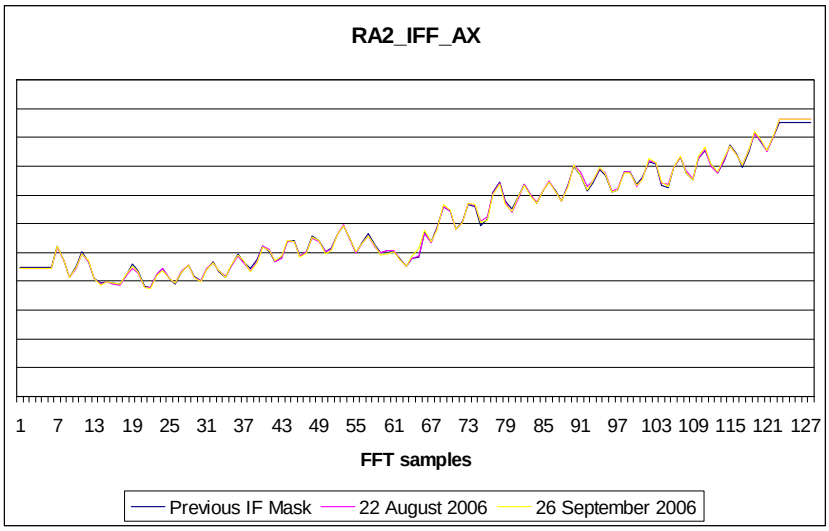


Figure 6: Previous and New IF Masks

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 dB.

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 50 and 51 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.

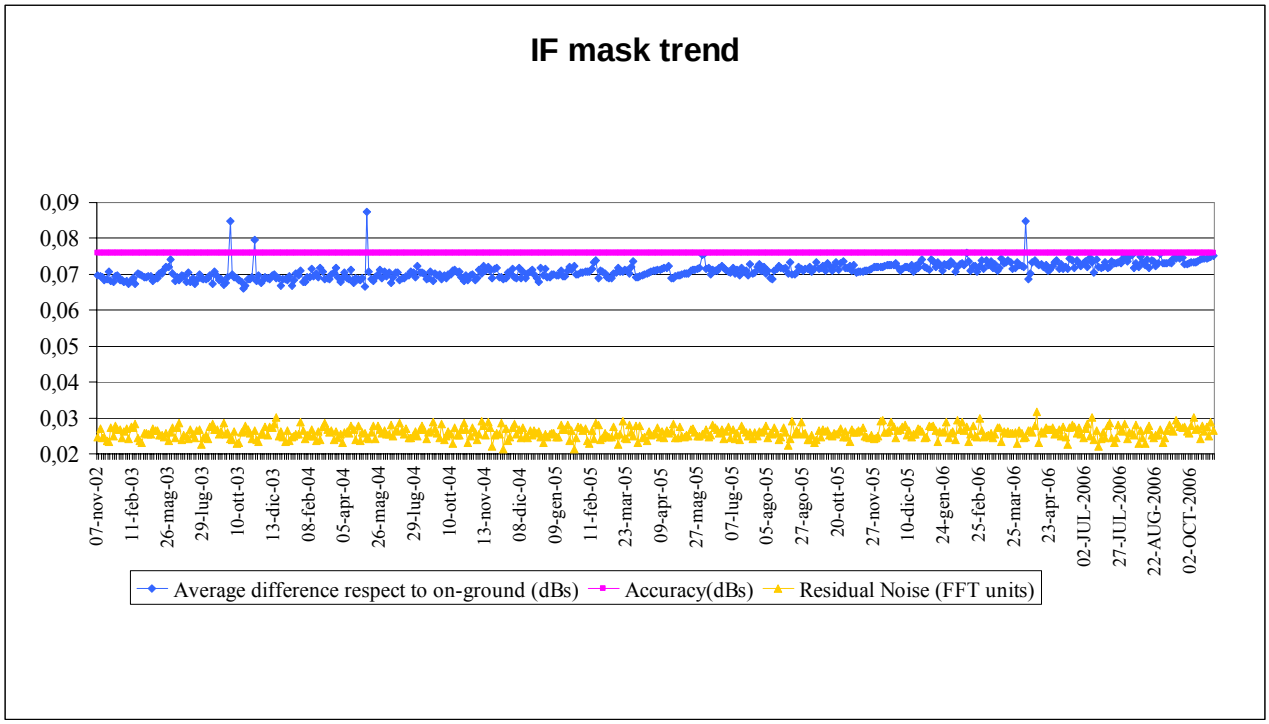


Figure 7: Evolution of the IF mask related parameters for valid IF masks retrieved up to cycle 51

In Figure 8 the percentages of valid IF masks from cycle 20 up to cycle 51 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.

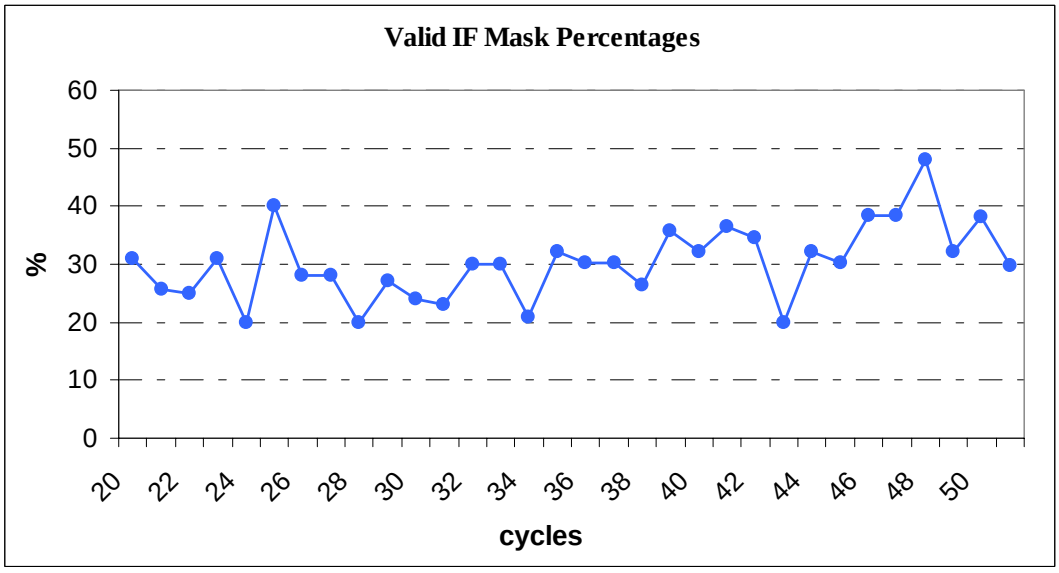


Figure 8: Percentages of valid IF Mask up to cycle 51

6.1.3 USO

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. The gap between 7 and 11 September are related to the Payload unavailability, see Chapter 5.2.1. After the instrument unavailability the USO clock period presented a different behavior until the end of cycle 51.

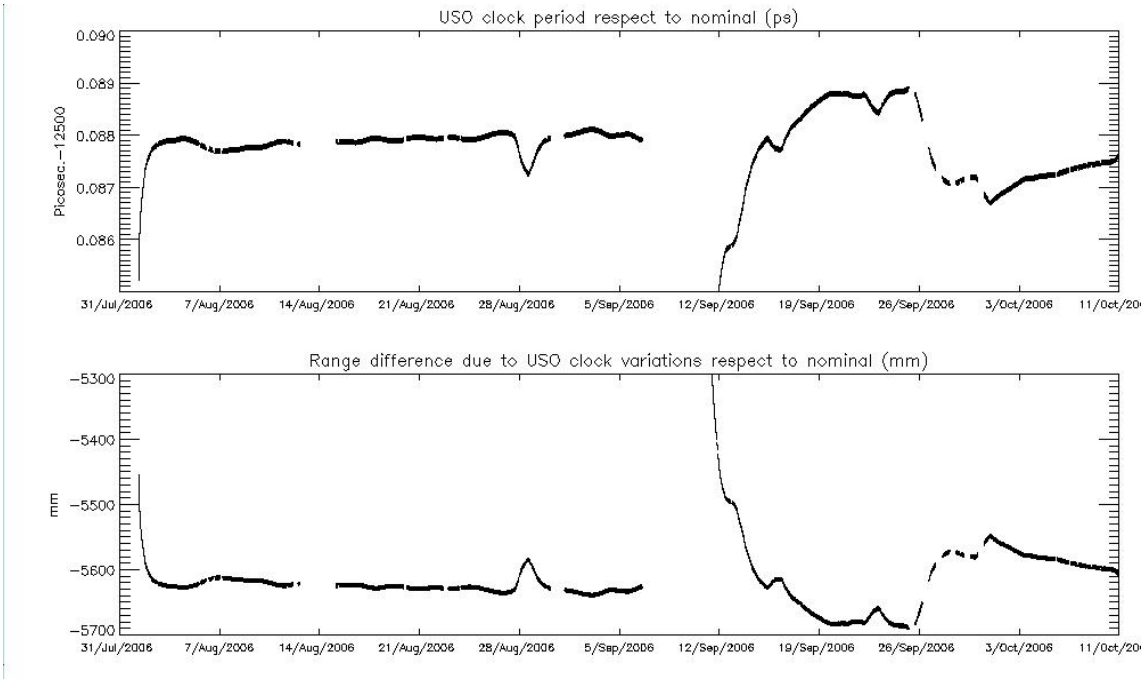


Figure 9: USO clock period for cycle 50 and 51

WARNING:

- **Users are advised not to use the range parameter in Ku and S Band during cycle 50 and 51 without applying the USO correction**

The USO Clock Period anomaly is still present in cycle 50 and 51. 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. 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 were 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 were 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.

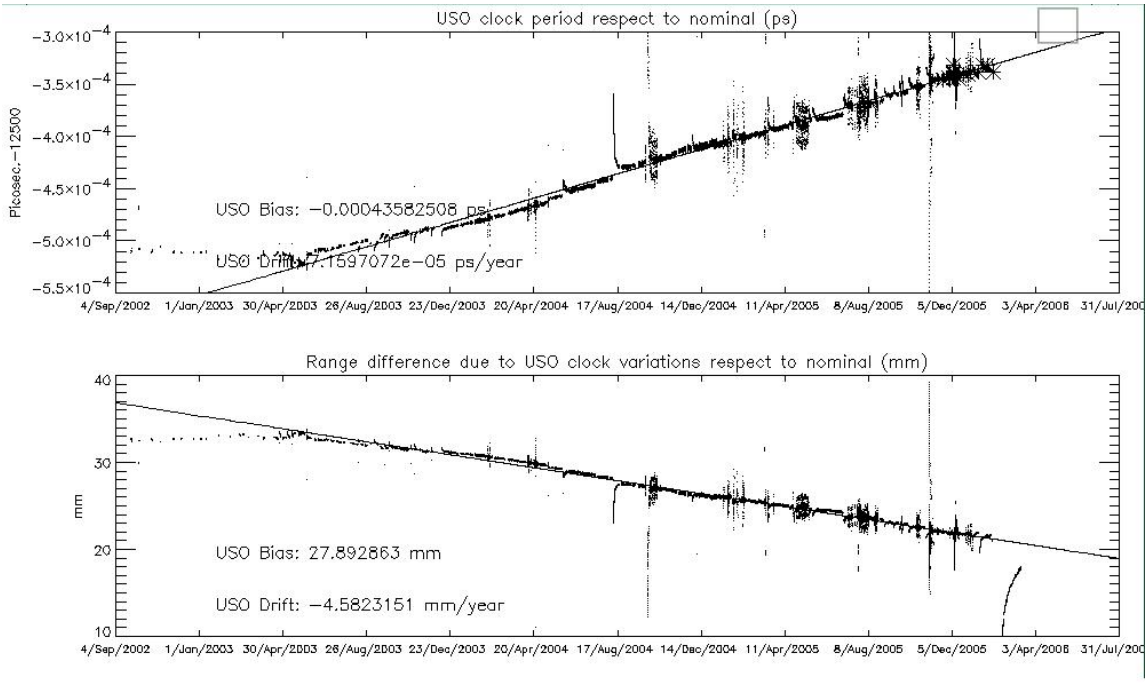


Figure 10: USO clock period until cycle 49

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.

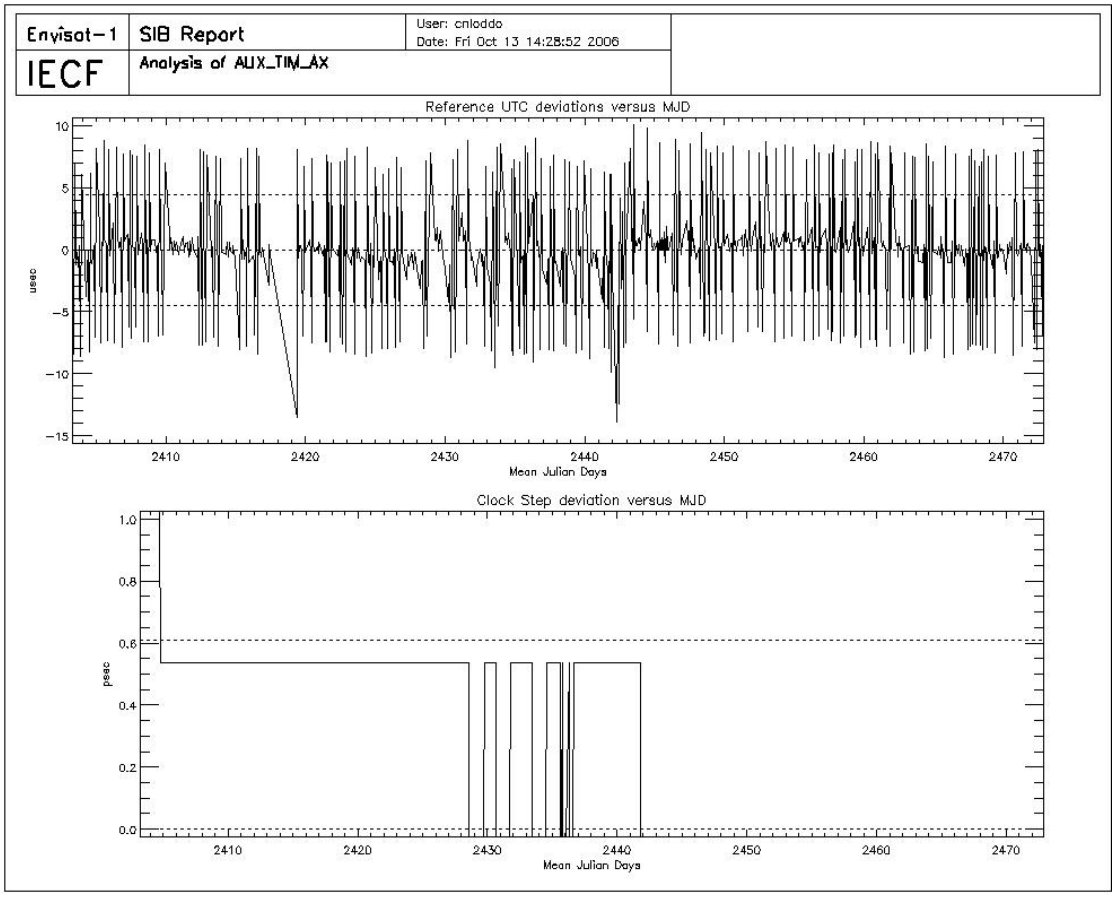


Figure 11: UTC deviations and ICU clock period for cycle 50 and 51

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 up to cycle 51 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.

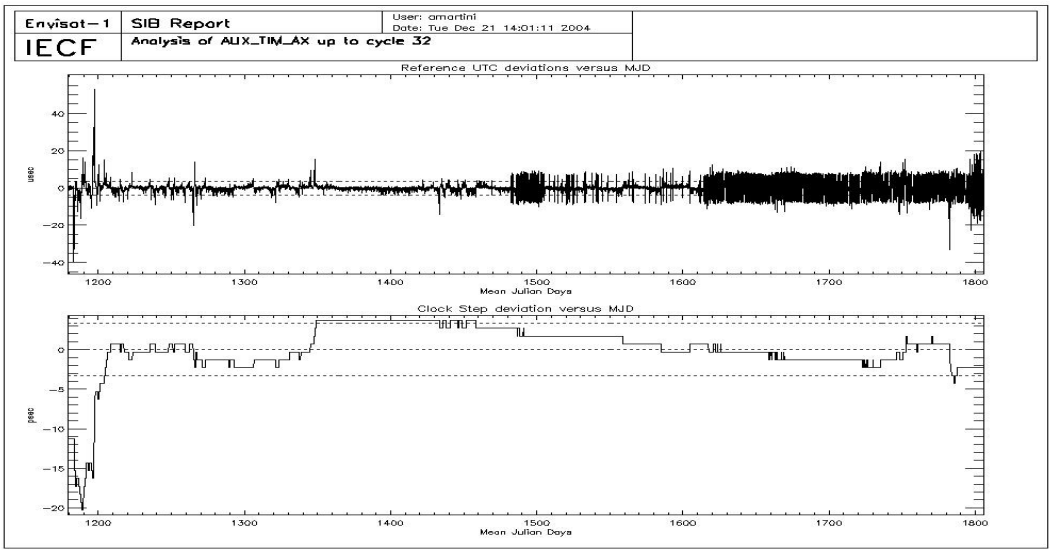


Figure 12: UTC deviations and ICU clock period up to cycle 32

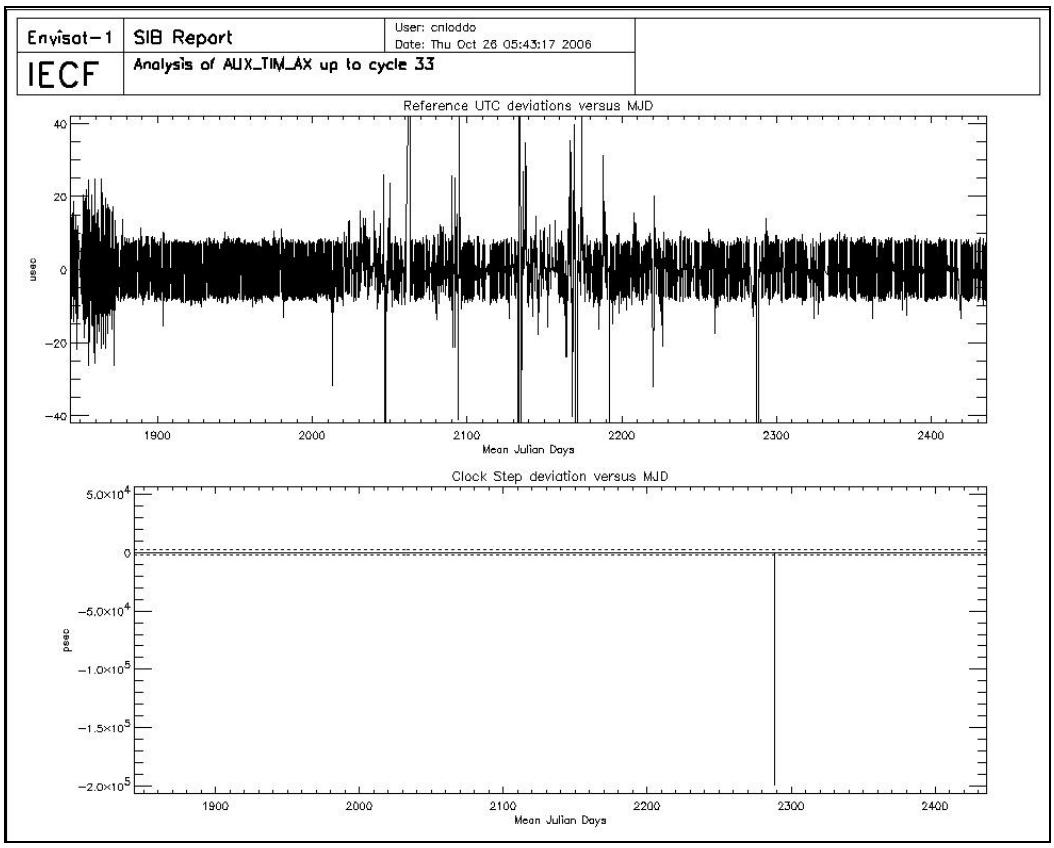


Figure 13: UTC deviations and ICU clock period from cycle 33 up to cycle 51

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 50 and 51 (averaged per day) are reported in the next figures.

The Time delay in-flight calibration factor, Figure 14, shows a regular behaviour as observed on previous cycles. The Sigma0 calibration factor, Figure 15, presented very high values just after the instrument unavailability, which occurred from 7 until the 11 September. It reached the nominal value after five days.

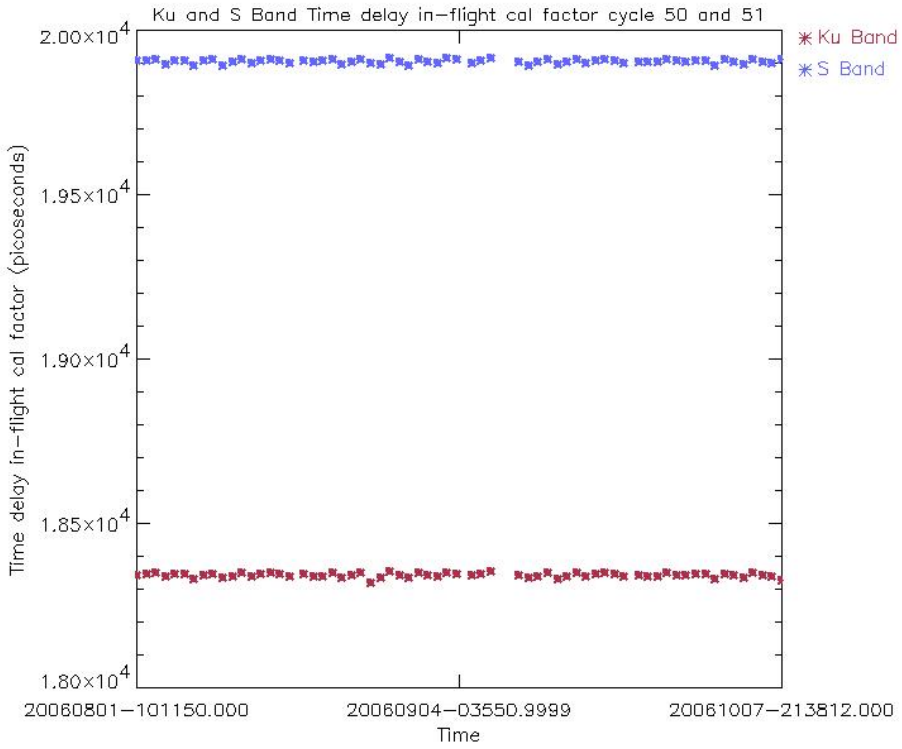


Figure 14: Ku and S Band in-flight time delay calibration factor for cycle 50 and 51

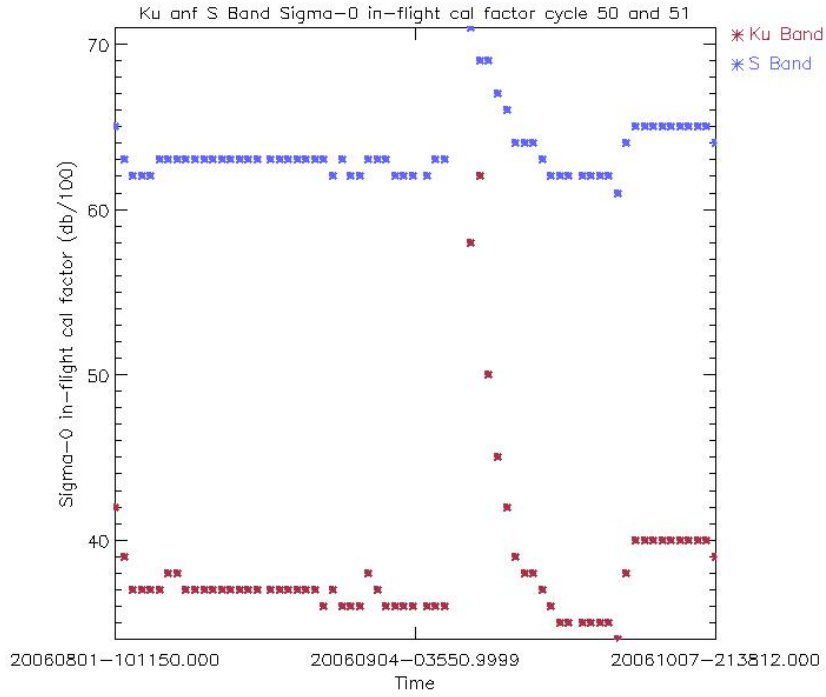


Figure 15: Ku and S Band in-flight Sigma0 calibration factor for cycle 50 and 51

Due to some operational constrains, long term plots have been divided into two plots, one covering cycle 16 until 49 and another from cycle 50 onwards. Figure 16 and Figure 17 report Ku and S Band in-flight calibration factors for Time Delay and Sigma0 respectively, daily averaged, up to cycle 49. 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 dB 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.

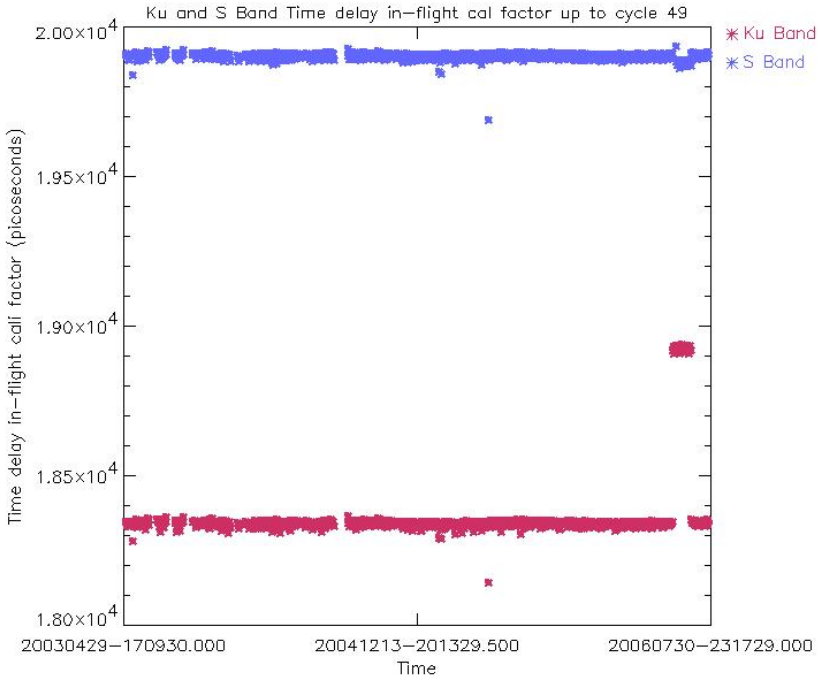


Figure 16: Ku and S Band in-flight time delay calibration factor up to cycle 49

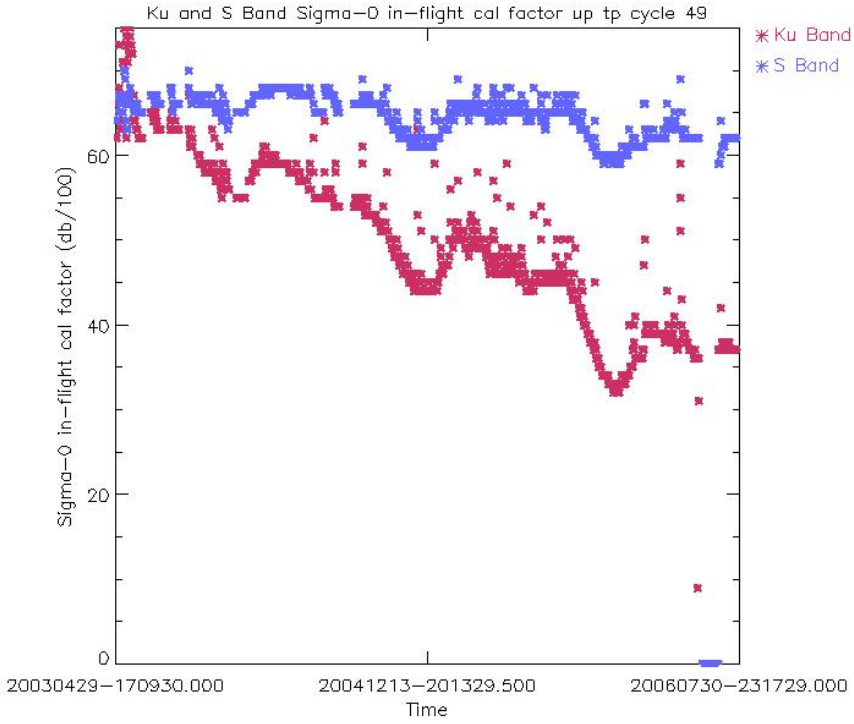


Figure 17: Ku and S Band in-flight Sigma0 calibration factor up to cycle 49

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 22th of August has been performed but the estimated bias was much higher then expected probably due to some problems with the attenuator setting of the transponder, currently under investigation. The acquisition planned for the 26th of September has been successfully performed, see results on table bellow.

Abs orb nb	**Date**	**Site**	**RA-2 Resolution**	**Bias (dB)**	**ECMWF Wet Tropo corr one way (dB)**
23916	26-Sep-06	Perm site Rome/315	High	1.05	0.086

Appendix 4 reports the transponder measurements from cycle 24 up to cycle 51.
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.

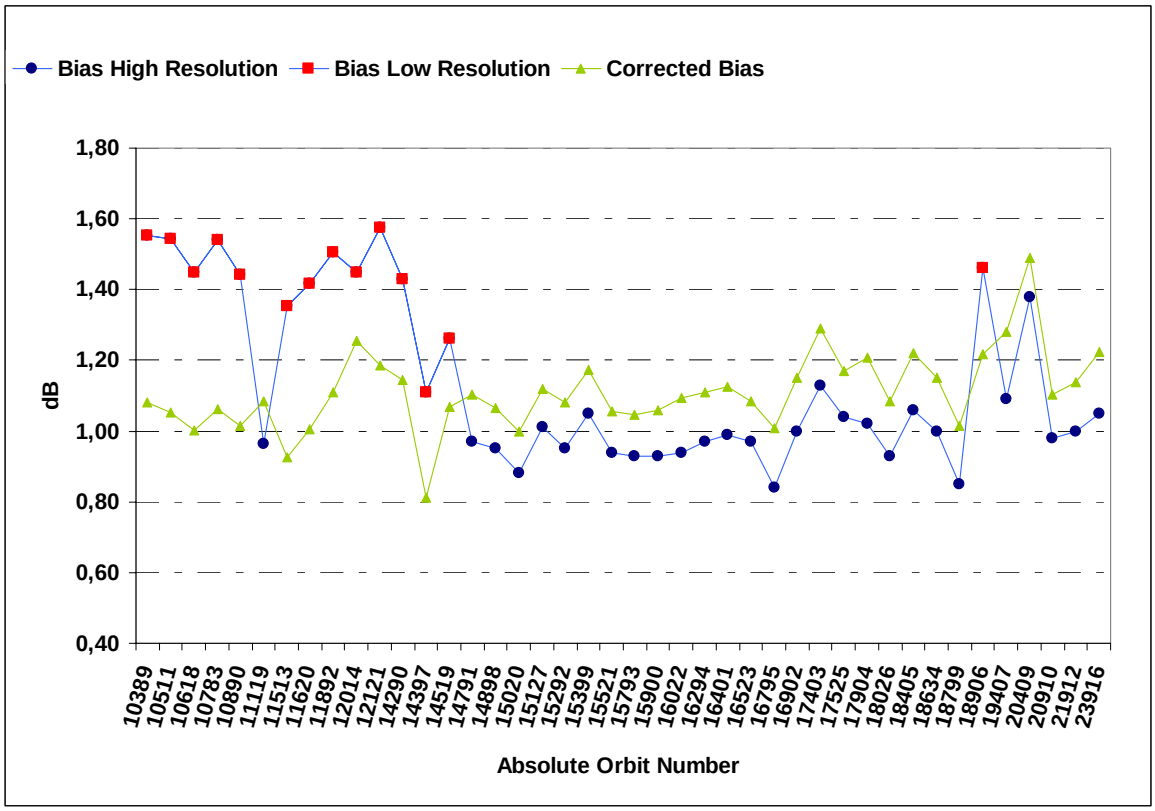


Figure 18: Time behavior of the transponder bias

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.

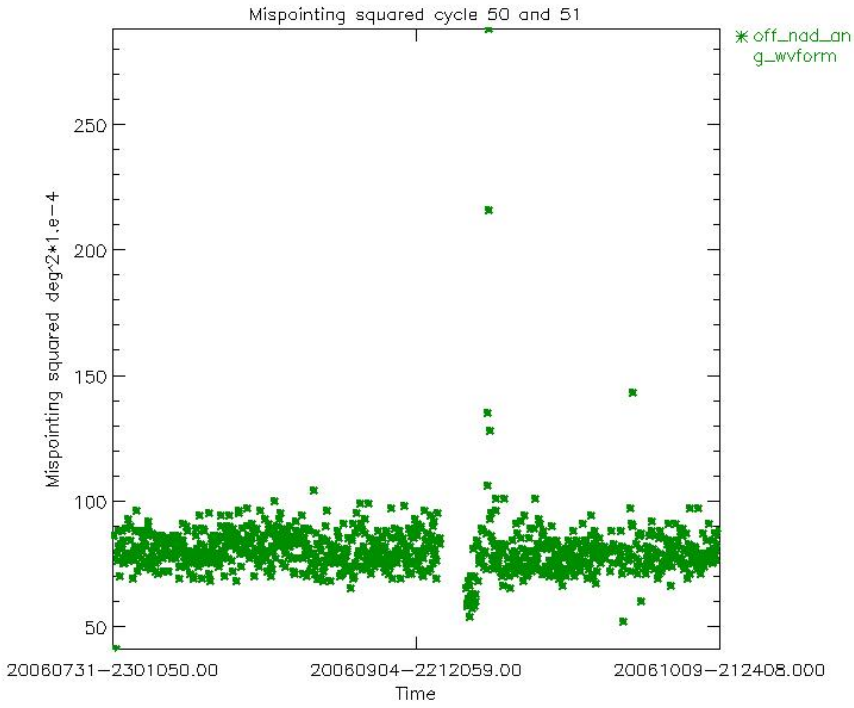


Figure 19: Smoothed mispointing squared trend for cycle 50 and 51 (deg^2*10^4)

In Figure 20, the overall mispointing squared trend (averaged over each orbit) is plotted for cycles 16 to 49.
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.

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 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.

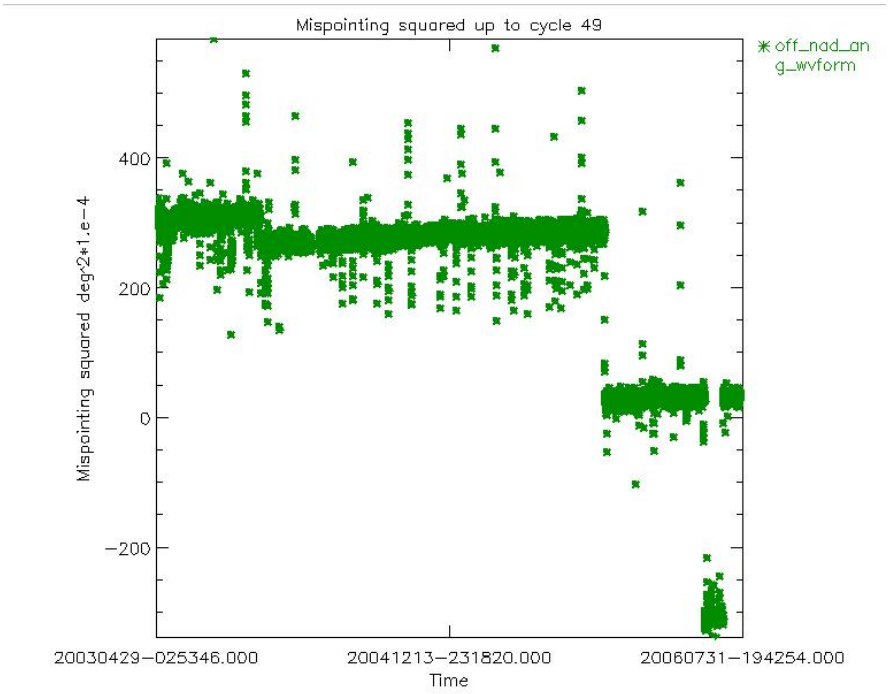


Figure 20: Smoothed mispointing squared trend until end of cycle 49 (deg^2*10e-4)

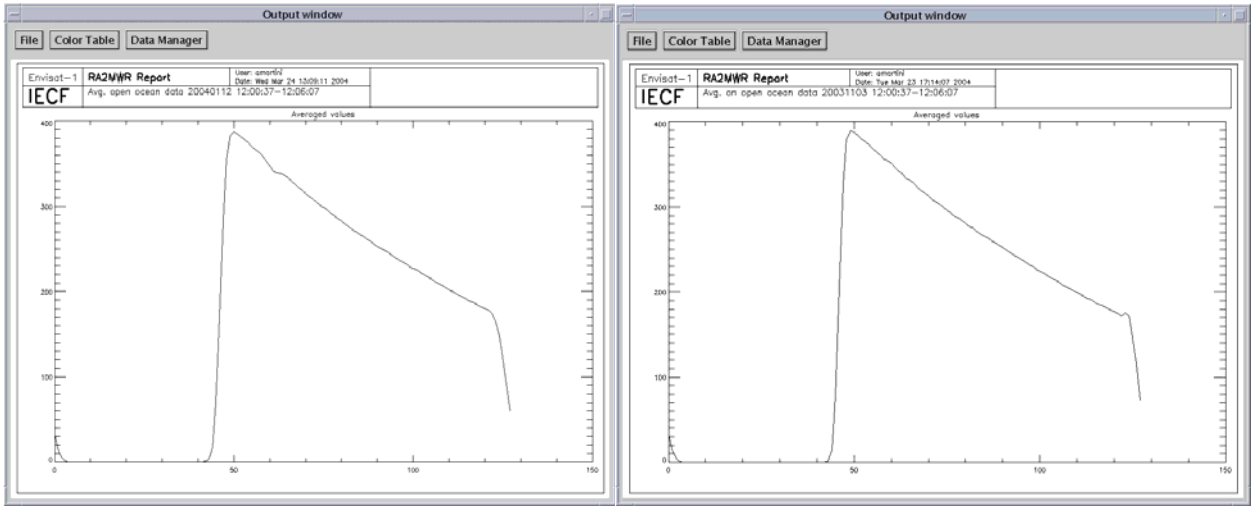


Figure 21: Open Ocean average waveforms before (left) and after an anomaly (right)

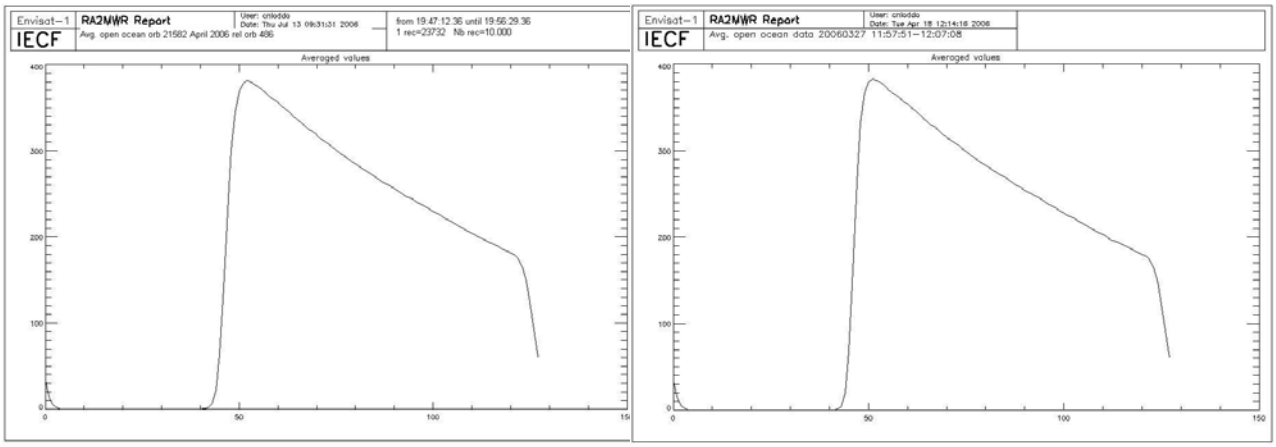


Figure 21_A: Open Ocean average waveforms before (left) and after an anomaly (right)

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 50 and 51 is reported in appendix 5. During the reporting period, the S Band Anomaly only occurred once per cycle, affecting six consecutive orbits on cycle 50, corresponding to 1.2% of data, and seven consecutive orbits during cycle 51, corresponding to 1.5% of data.

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.

The method used so far 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.

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. No occurrence has been reported for cycle 48 given the S Band Power drop anomaly of the instrument on the RFSS redundancy side. During the last three cycles the number of occurrences has decreased, being always lower then 1.5%.

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.

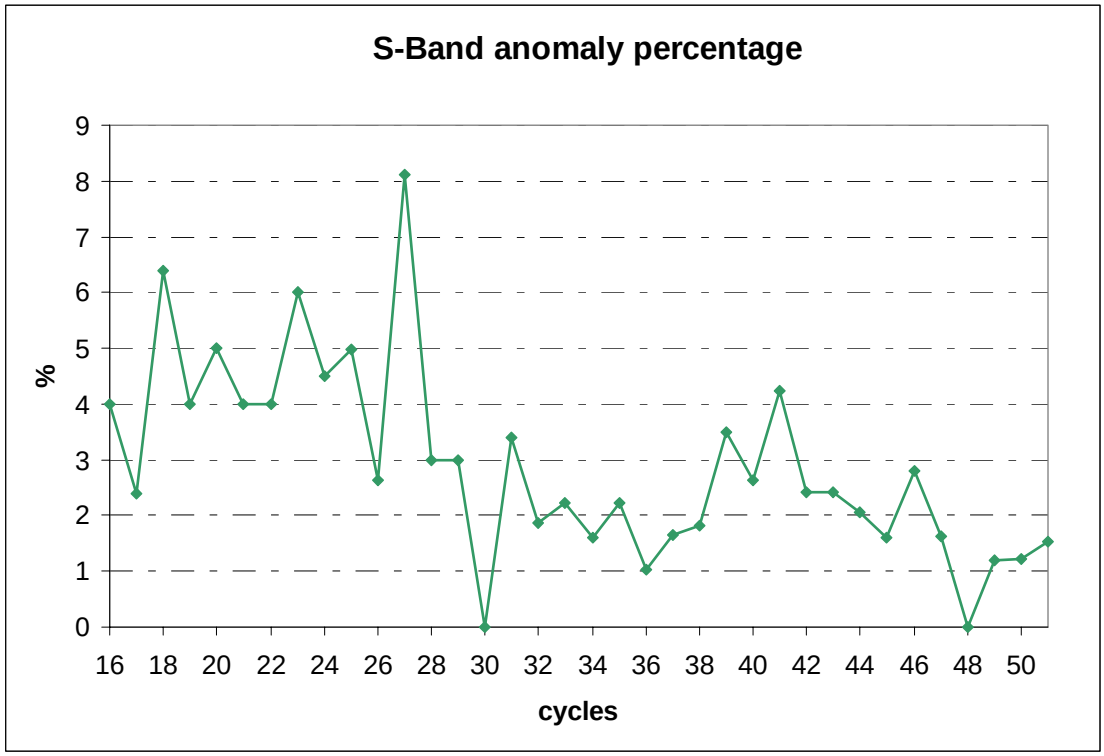


Figure 22: Percentage of data affected by the "S-Band Anomaly" for cycles 16-51

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 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 dB 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 dB 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 50 and 51 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 12, 13 (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.

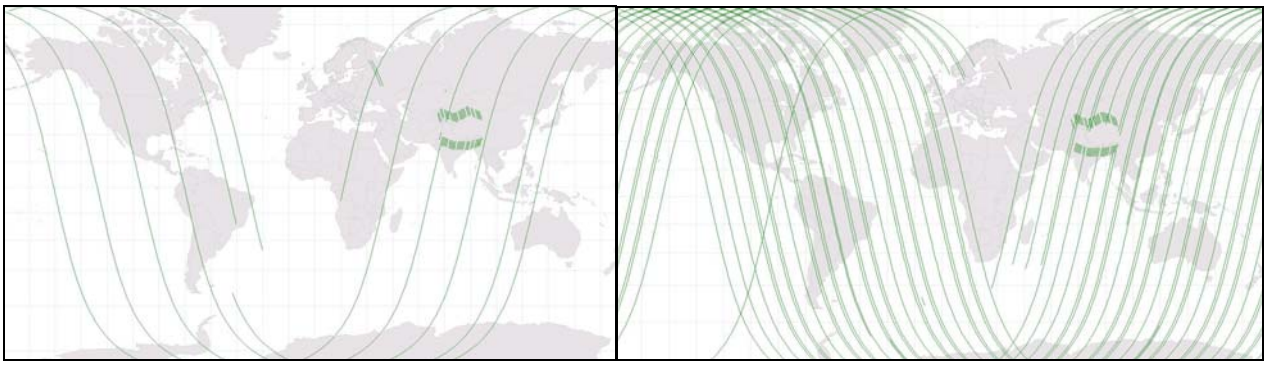


Figure 23: RA-2 L0 unavailable products for cycle 50 (left) and cycle 51 (right)

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

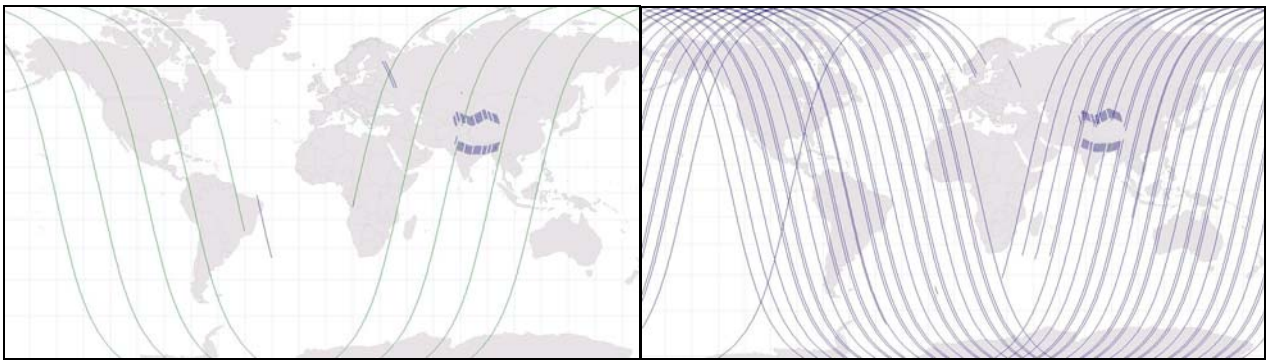


Figure 24: RA-2 L1b unavailable products for cycle 50 (left) and cycle 51 (right)

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. The low data availability on cycle 48 is related to the planned instrument unavailabilities to support investigation on S Band Power drop anomaly when

the instrument was reconfigured to its B-side. On cycle 51 the availability of data decreased due to the interruption of the Envisat data transmission via the ESA Data Relay Satellite Artemis (anomaly with Envisat Ka-band antenna) from 26 September until 1 October.

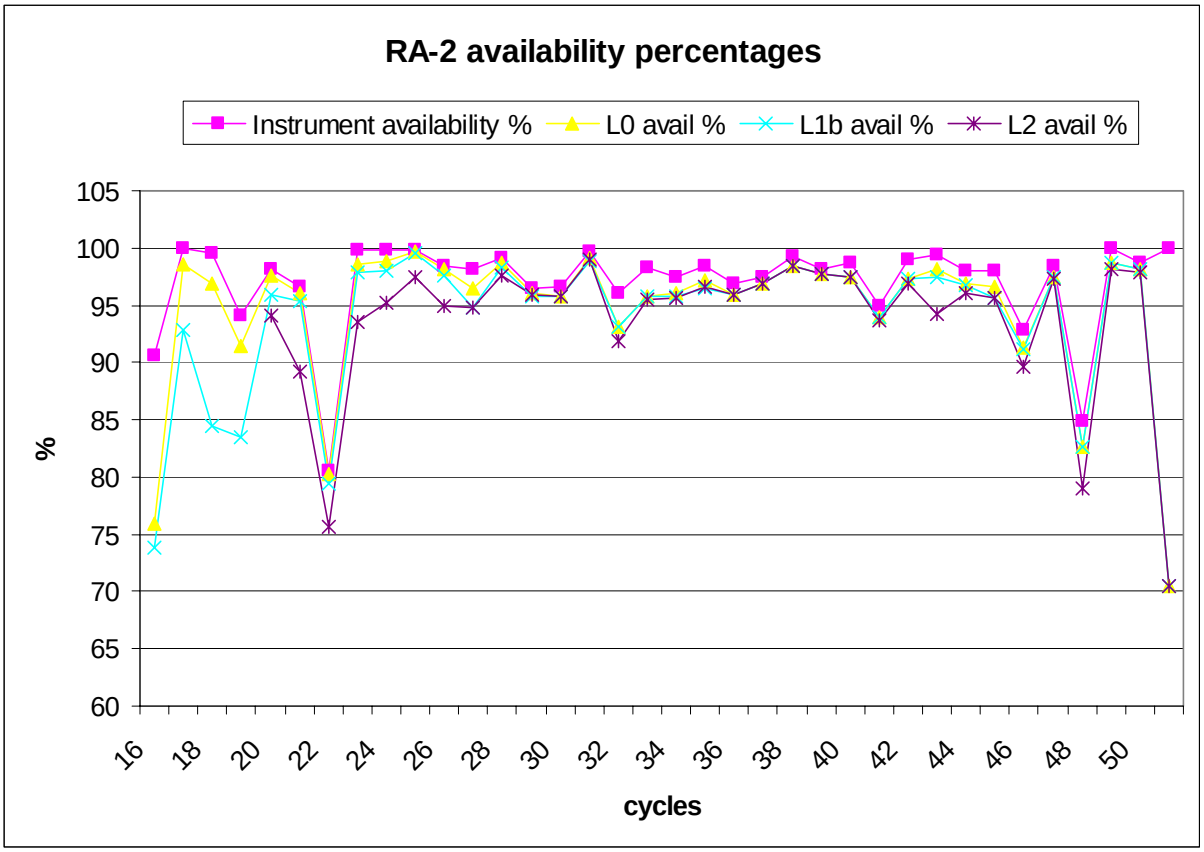
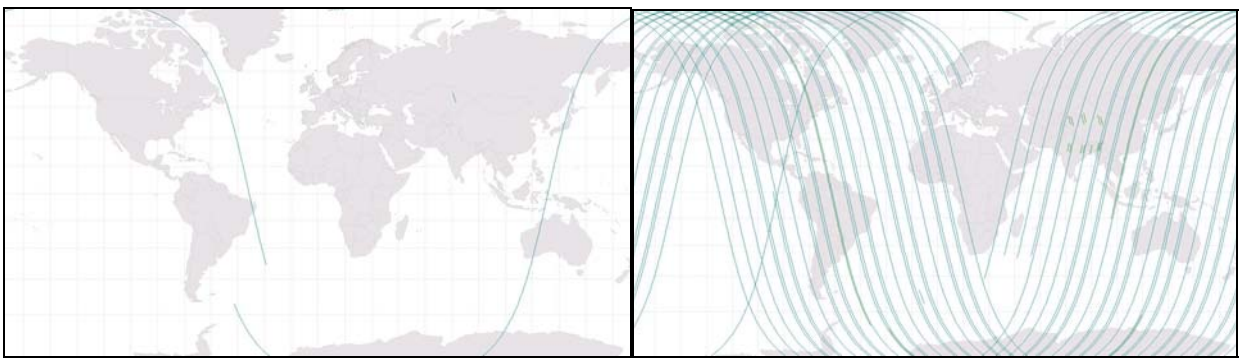


Figure 25: Percentage of Products unavailability up to cycle 51

7.3.2 MWR



In

Figure 26 and Table 14 and 15 (Appendix 2) the summary of unavailable MWR L0 products is given.

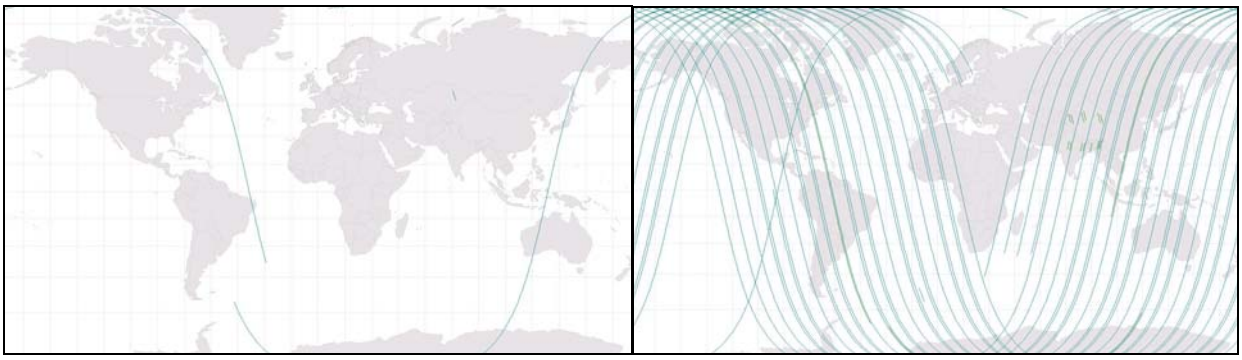


Figure 26: MWR L0 unavailable products for cycle 50 (left) and cycle 51 (right)

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

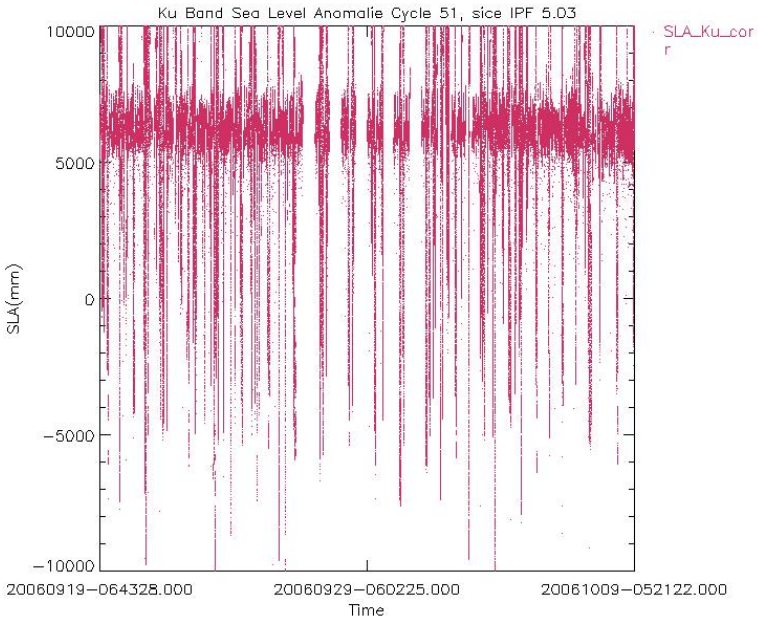


Figure 27: Sea Level Anomalies since IPF 5.03, 19 September 2006

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

<u>WARNING:</u> 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 50 and 51. 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).

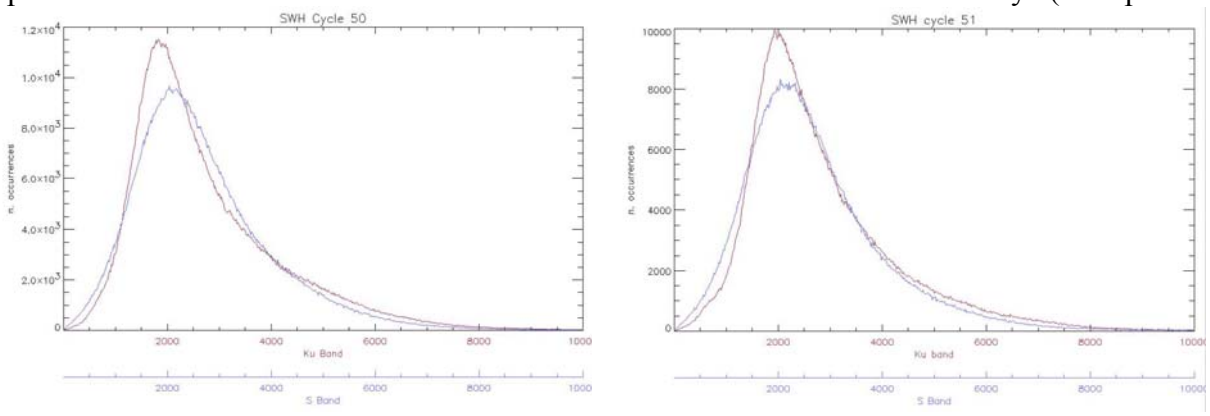


Figure 28: Histogram of Ku and S Band SWH for cycle 50 (left) and 51(right)

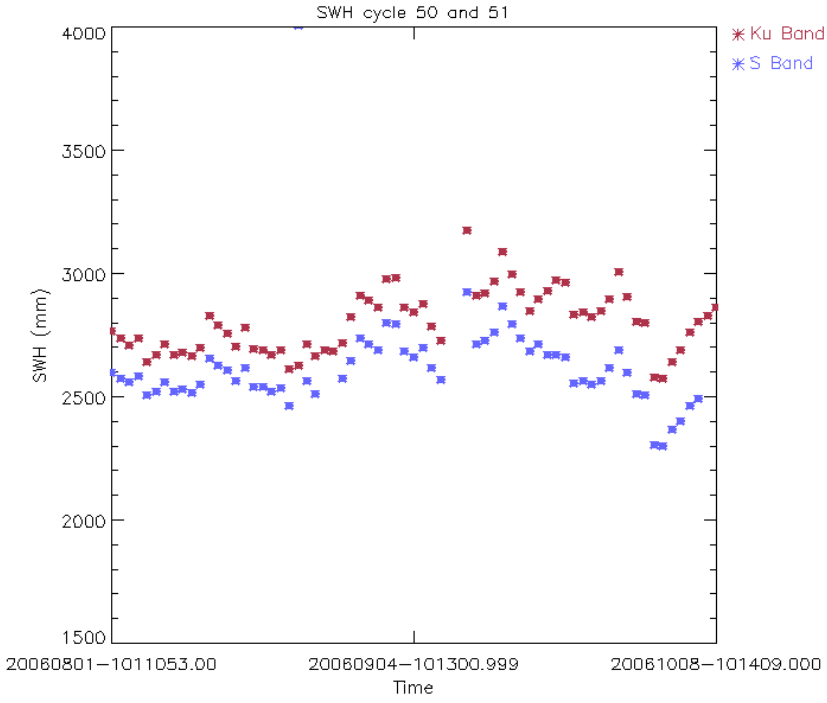


Figure 29: Ku and S SWH daily average for cycle 50 and 51 (mm)

In Figure 30, the SWH is reported from cycle 16 until cycle 49. 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).

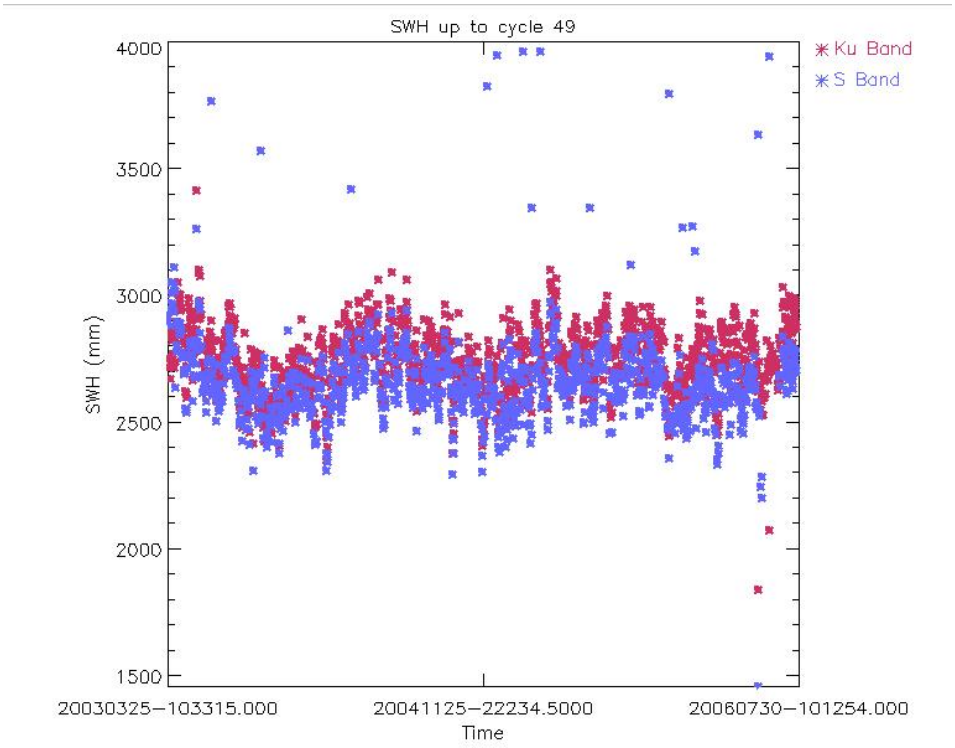


Figure 30: Ku and S SWH daily average up to cycle 49 (mm)

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).

In Figure 31, 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). The Sigma_0 histogram is not reported due to operational problems.

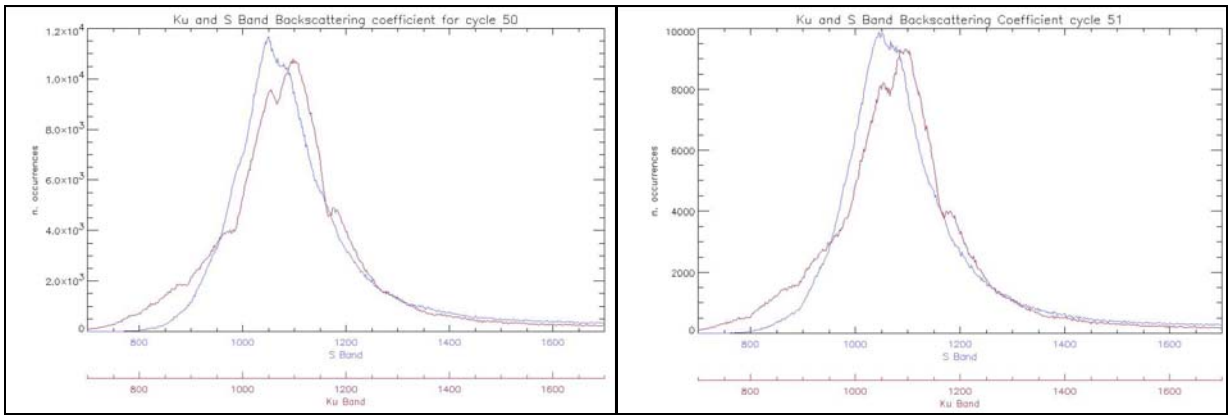


Figure 31: Histogram of Ku and S Band Backscattering Coefficient for cycle 50 (left) and 51(right) (dB/100)

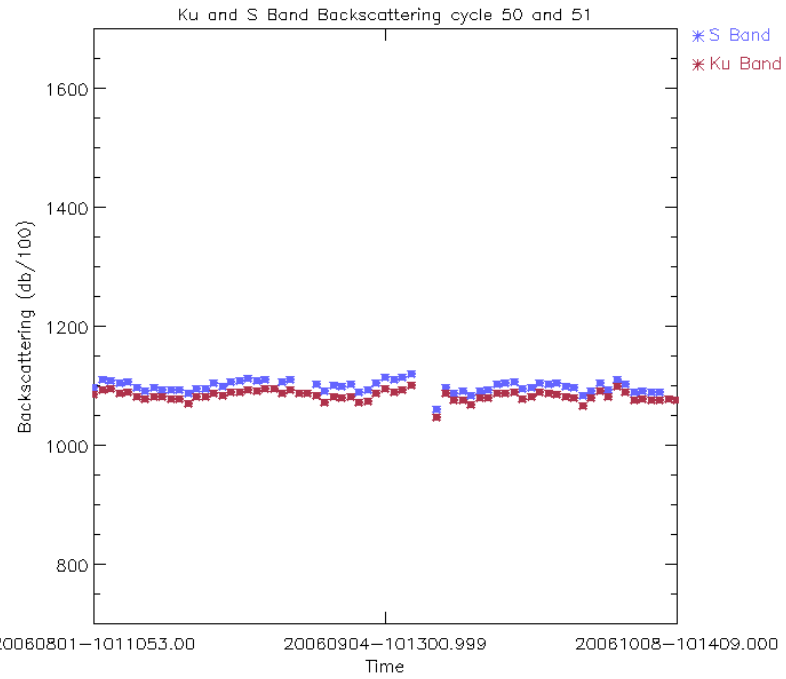


Figure 32: Ku and S Sigma_0 daily average for cycle 50 and 51 (dB/100)

The histograms of Wind Speed computed for the Ku-band and the time behavior during cycle 50 and 51 are reported in Figure 33 and Figure 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.

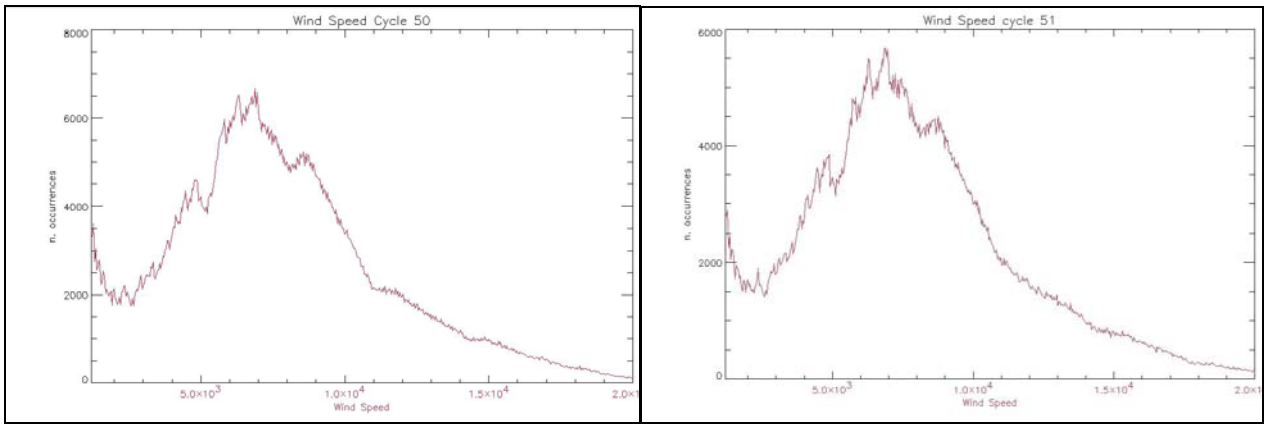


Figure 33: Histogram of Ku Wind Speed for cycle 50 (left) and 51 (right) (mm/s)

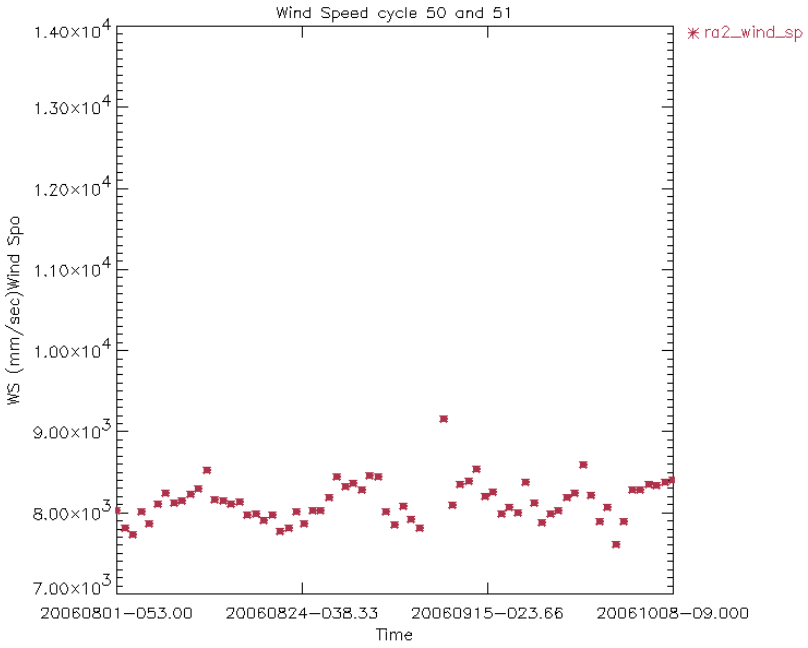


Figure 34: Ku Band Wind Speed daily average for cycle 50 and 51 (mm/s)

The Ku-Band Sigma_0 trend, reported hereafter, is characterized by a jump of on average 3.24 dB 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 dB, 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.

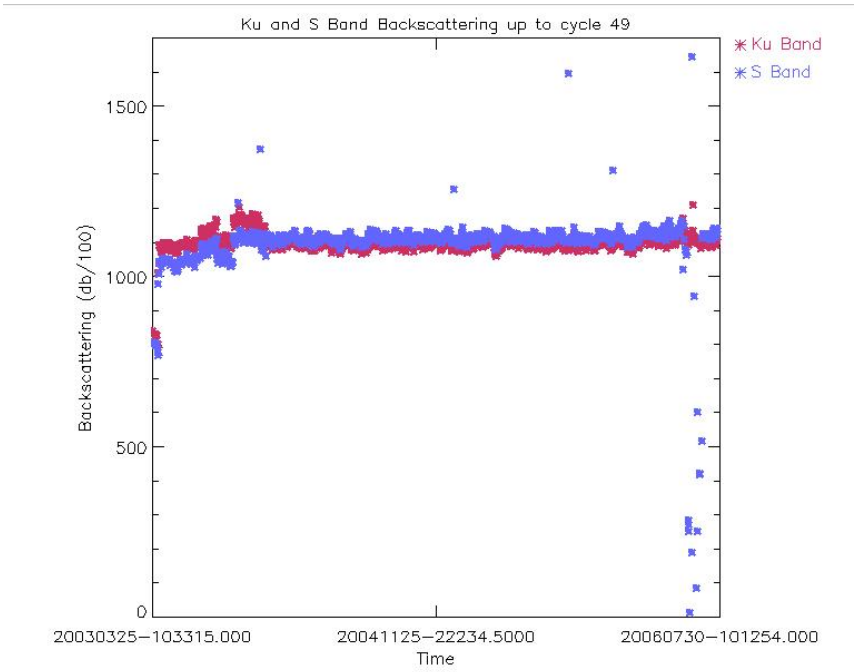


Figure 35: Ku and S band Backscattering daily averages up to cycle 49 (dB/100)

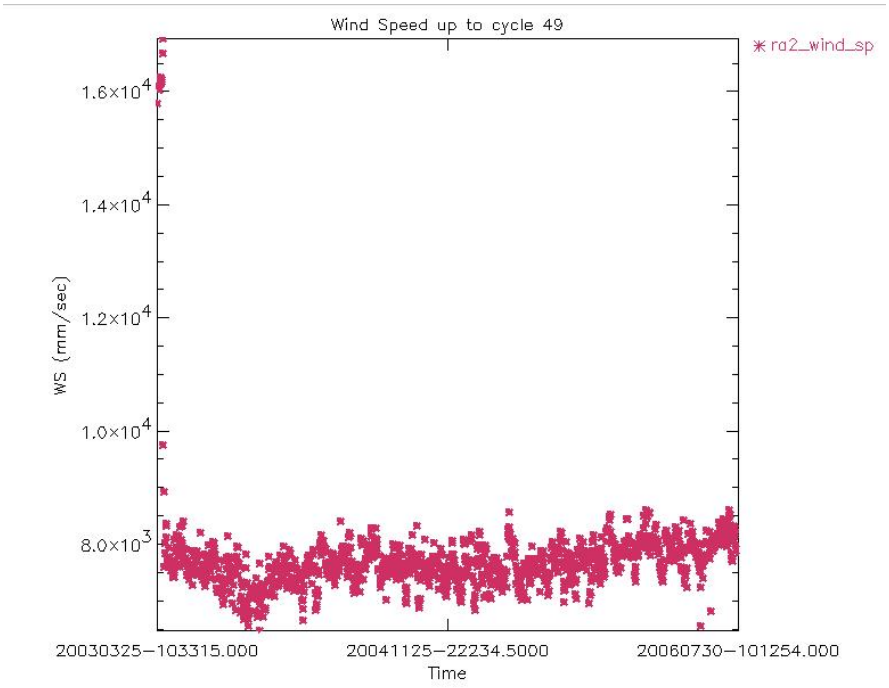


Figure 36: Wind Speed daily averages up to cycle 49 (mm/s)

8 PARTICULAR INVESTIGATIONS

The un-expected behavior of the Envisat RA-2 sensor observed since cycle 44 is still present on cycle 50 and 51.
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	RA2_CHD_AX RA2_SOI_AX RA2_SOI_AX RA2_SOI_AX RA2_TLG_AX

			TLD New DEM AUX file (MACESS) merge of ACE land elevation data and Smith and Sandwell ocean bathymetry	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 50

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.
23101	23201	27460,02	29429,94	1098,09	1097,09	1111,60	95,46	95,13	94,95	94,95	94,95
23201	23301	8102,00	10223,04	1663,97	1659,47	1674,86	98,66	98,31	98,03	98,04	98,03
23301	23402	0,00	2110,66	1099,30	1091,13	1110,24	100,00	99,65	99,47	99,47	99,47
23402	23502	1509,00	3576,75	1273,75	1265,31	7351,90	99,75	99,41	99,20	99,20	98,19
23502	23602	0,00	2148,02	1280,34	1269,79	7232,70	100,00	99,64	99,43	99,43	98,45

Table 7: RA-2 L0, L1b and L2 FGD Data products availability summary for cycle 51

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.
23602	23702	0	268095,95	7468,65	7458,46	7472,93	100,00	55,67	54,44	54,44	54,44
23702	23802	0	2121,03	5496,09	5485,31	5507,19	100,00	99,65	98,74	98,74	98,74
23802	23903	0	2110,66	1092,07	1089,63	1108,16	100,00	99,65	99,47	99,47	99,47
23903	24003	0	2067,75	188308,59	188302,59	188318,93	100,00	99,66	68,52	68,52	68,52
24003	24103	0	2148,02	413869,79	413867,79	413875,06	100,00	99,64	31,21	31,21	31,21

Table 8: MWR L0 Data products availability summary for cycle 50

Start orbit	Stop orbit	Time [sec] instrum. unavailability	Time [sec] L0 gaps	% instrum. avail.	% L0 avail.
23101	23201	0,00	120,00	100,00	99,98
23201	23301	8102,00	771,00	98,66	98,53
23301	23402	0,00	96,00	100,00	99,98
23402	23502	1509,00	96,00	99,75	99,73
23502	23602	0,00	96,00	100,00	99,98

Table 9: MWR L0 Data products availability summary for cycle 51

Start	Stop	Time [sec]	Time [sec]	%	% L0

orbit	orbit	instrum. unavailability	L0 gaps	instrum. avail.	avail.
23602	23702	266956,21	53381,79	55,86	47,03
23702	23802	0,00	4464,00	100,00	99,26
23802	23903	0,00	0,00	100,00	100,00
23903	24003	0,00	188476,00	100,00	68,84
24003	24103	0,00	390640,08	100,00	35,41

Table 10: DORIS L0 Data products availability summary for cycle 50

Start orbit	Stop orbit	Time [sec] instrum. unavailability	Time [sec] L0 gaps	% instrum. avail.	% L0 avail.
23101	23201	0	2423,00	100,00	99,80
23201	23301	16204	3681,00	98,66	98,36
23301	23402	0	2996,00	100,00	99,75
23402	23502	3018	4017,00	99,75	99,42
23502	23602	0	3123,00	100,00	99,74

Table 11: DORIS L0 Data products availability summary for cycle 51

Start orbit	Stop orbit	Time [sec] instrum. unavailability	Time [sec] L0 gaps	% instrum. avail.	% L0 avail.
23602	23702	0	9272,88	100	98,34
23702	23802	0	11989,00	100	99,01
23802	23903	0	1914,00	100	99,84
23903	24003	0	381341,00	100	68,47
24003	24103	0	762317,16	100	36,98

Table 12: List of gaps for RA-2 L0 cycle 50

Start date	Start time	Stop date	Stop time	Duration [sec]	Start orbit	Stop orbit	Reason
01-AUG-2006	1.14.33	01-AUG-2006	1.14.40	7	23102	23102	PDS_UNKNOWN_FAILURE
01-AUG-2006	8.54.30	01-AUG-2006	8.55.36	66	23107	23107	PDS_UNKNOWN_FAILURE
05-AUG-2006	16.10.24	05-AUG-2006	16.11.41	77	23169	23169	PDS_UNKNOWN_FAILURE
05-AUG-2006	16.14.27	05-AUG-2006	16.14.42	15	23169	23169	PDS_UNKNOWN_FAILURE
01-AUG-2006	16.36.44	01-AUG-2006	16.38.02	78	23112	23112	PDS_UNKNOWN_FAILURE
02-AUG-2006	4.53.02	02-AUG-2006	4.54.20	78	23119	23119	PDS_UNKNOWN_FAILURE
02-AUG-2006	16.04.41	02-AUG-2006	16.05.59	78	23126	23126	PDS_UNKNOWN_FAILURE
03-AUG-2006	4.21.25	03-AUG-2006	4.22.43	78	23133	23133	PDS_UNKNOWN_FAILURE
03-AUG-2006	15.33.56	03-AUG-2006	15.35.14	78	23140	23140	PDS_UNKNOWN_FAILURE
04-AUG-2006	5.28.56	04-AUG-2006	5.30.14	78	23148	23148	PDS_UNKNOWN_FAILURE

04-AUG-2006	16.42.08	04-AUG-2006	16.43.26	78	23155	23155	PDS_UNKNOWN_FAILURE
05-AUG-2006	4.58.41	05-AUG-2006	4.59.58	77	23162	23162	PDS_UNKNOWN_FAILURE
01-AUG-2006	1.14.40	01-AUG-2006	5.21.47	14827	23102	23105	UNAV_RA2
01-AUG-2006	5.23.57	01-AUG-2006	8.54.30	12633	23105	23107	UNAV_RA2
07-AUG-2006	3.55.04	07-AUG-2006	3.56.22	78	23190	23190	PDS_UNKNOWN_FAILURE
07-AUG-2006	15.07.23	07-AUG-2006	15.08.41	78	23197	23197	PDS_UNKNOWN_FAILURE
12-AUG-2006	0.24.41	12-AUG-2006	0.34.11	570	23259	23259	PDS_UNKNOWN_FAILURE
12-AUG-2006	4.38.39	12-AUG-2006	4.39.57	78	23262	23262	PDS_UNKNOWN_FAILURE
12-AUG-2006	15.50.42	12-AUG-2006	15.52.00	78	23269	23269	PDS_UNKNOWN_FAILURE
08-AUG-2006	5.04.17	08-AUG-2006	5.05.35	78	23205	23205	PDS_UNKNOWN_FAILURE
08-AUG-2006	16.16.18	08-AUG-2006	16.17.36	78	23212	23212	PDS_UNKNOWN_FAILURE
09-AUG-2006	4.32.54	09-AUG-2006	4.34.12	78	23219	23219	PDS_UNKNOWN_FAILURE
09-AUG-2006	15.45.07	09-AUG-2006	15.46.24	77	23226	23226	PDS_UNKNOWN_FAILURE
10-AUG-2006	4.00.56	10-AUG-2006	4.02.14	78	23233	23233	PDS_UNKNOWN_FAILURE
10-AUG-2006	15.13.17	10-AUG-2006	15.14.35	78	23240	23240	PDS_UNKNOWN_FAILURE
11-AUG-2006	5.09.54	11-AUG-2006	5.11.12	78	23248	23248	PDS_UNKNOWN_FAILURE
11-AUG-2006	16.22.12	11-AUG-2006	16.23.30	78	23255	23255	PDS_UNKNOWN_FAILURE
12-AUG-2006	0.34.11	12-AUG-2006	1.59.36	5125	23259	23260	UNAV_ARTEMIS
14-AUG-2006	5.13.18	14-AUG-2006	5.13.21	3	23291	23291	PDS_UNKNOWN_FAILURE
14-AUG-2006	5.15.31	14-AUG-2006	5.16.48	77	23291	23291	PDS_UNKNOWN_FAILURE
18-AUG-2006	4.47.31	18-AUG-2006	4.47.34	3	23348	23348	PDS_UNKNOWN_FAILURE
18-AUG-2006	4.50.08	18-AUG-2006	4.51.26	78	23348	23348	PDS_UNKNOWN_FAILURE
18-AUG-2006	15.59.23	18-AUG-2006	15.59.25	2	23355	23355	PDS_UNKNOWN_FAILURE
18-AUG-2006	16.01.52	18-AUG-2006	16.03.10	78	23355	23355	PDS_UNKNOWN_FAILURE
19-AUG-2006	4.18.31	19-AUG-2006	4.19.49	78	23362	23362	PDS_UNKNOWN_FAILURE
19-AUG-2006	15.28.01	19-AUG-2006	15.28.04	3	23369	23369	PDS_UNKNOWN_FAILURE
19-AUG-2006	15.31.00	19-AUG-2006	15.32.18	78	23369	23369	PDS_UNKNOWN_FAILURE
14-AUG-2006	16.28.07	14-AUG-2006	16.29.24	77	23298	23298	PDS_UNKNOWN_FAILURE
15-AUG-2006	4.44.24	15-AUG-2006	4.45.41	77	23305	23305	PDS_UNKNOWN_FAILURE
15-AUG-2006	15.56.17	15-AUG-2006	15.57.35	78	23312	23312	PDS_UNKNOWN_FAILURE
16-AUG-2006	4.12.40	16-AUG-2006	4.13.57	77	23319	23319	PDS_UNKNOWN_FAILURE
16-AUG-2006	15.22.23	16-AUG-2006	15.22.25	2	23326	23326	PDS_UNKNOWN_FAILURE
16-AUG-2006	15.25.06	16-AUG-2006	15.26.24	78	23326	23326	PDS_UNKNOWN_FAILURE
17-AUG-2006	5.21.07	17-AUG-2006	5.22.25	78	23334	23334	PDS_UNKNOWN_FAILURE
17-AUG-2006	16.34.01	17-AUG-2006	16.35.18	77	23341	23341	PDS_UNKNOWN_FAILURE
21-AUG-2006	4.55.50	21-AUG-2006	4.57.08	78	23391	23391	PDS_UNKNOWN_FAILURE
21-AUG-2006	16.07.27	21-AUG-2006	16.08.45	78	23398	23398	PDS_UNKNOWN_FAILURE
25-AUG-2006	15.39.17	25-AUG-2006	15.39.20	3	23455	23455	PDS_UNKNOWN_FAILURE
25-AUG-2006	15.42.17	25-AUG-2006	15.43.34	77	23455	23455	PDS_UNKNOWN_FAILURE
26-AUG-2006	3.57.58	26-AUG-2006	3.59.15	77	23462	23462	PDS_UNKNOWN_FAILURE
26-AUG-2006	15.10.18	26-AUG-2006	15.11.35	77	23469	23469	PDS_UNKNOWN_FAILURE

26-AUG-2006	18.35.58	26-AUG-2006	18.38.58	180	23471	23471	PDS_UNKNOWN_FAILURE
22-AUG-2006	4.24.15	22-AUG-2006	4.25.33	78	23405	23405	PDS_UNKNOWN_FAILURE
22-AUG-2006	15.36.42	22-AUG-2006	15.37.59	77	23412	23412	PDS_UNKNOWN_FAILURE
23-AUG-2006	3.52.06	23-AUG-2006	3.53.24	78	23419	23419	PDS_UNKNOWN_FAILURE
23-AUG-2006	16.44.48	23-AUG-2006	16.46.06	78	23427	23427	PDS_UNKNOWN_FAILURE
24-AUG-2006	4.59.14	24-AUG-2006	4.59.16	2	23434	23434	PDS_UNKNOWN_FAILURE
24-AUG-2006	5.01.27	24-AUG-2006	5.02.44	77	23434	23434	PDS_UNKNOWN_FAILURE
24-AUG-2006	16.13.19	24-AUG-2006	16.14.36	77	23441	23441	PDS_UNKNOWN_FAILURE
25-AUG-2006	4.30.00	25-AUG-2006	4.31.18	78	23448	23448	PDS_UNKNOWN_FAILURE
28-AUG-2006	4.35.44	28-AUG-2006	4.37.02	78	23491	23491	PDS_UNKNOWN_FAILURE
28-AUG-2006	15.44.59	28-AUG-2006	15.45.01	2	23498	23498	PDS_UNKNOWN_FAILURE
31-AUG-2006	4.41.28	31-AUG-2006	4.42.46	78	23534	23534	PDS_UNKNOWN_FAILURE
31-AUG-2006	15.50.43	31-AUG-2006	15.50.45	2	23541	23541	PDS_UNKNOWN_FAILURE
31-AUG-2006	15.53.26	31-AUG-2006	15.54.44	78	23541	23541	PDS_UNKNOWN_FAILURE
28-AUG-2006	15.47.52	28-AUG-2006	15.49.09	77	23498	23498	PDS_UNKNOWN_FAILURE
29-AUG-2006	4.03.49	29-AUG-2006	4.05.07	78	23505	23505	PDS_UNKNOWN_FAILURE
29-AUG-2006	15.16.12	29-AUG-2006	15.17.29	77	23512	23512	PDS_UNKNOWN_FAILURE
29-AUG-2006	18.41.45	29-AUG-2006	18.44.44	179	23514	23514	PDS_UNKNOWN_FAILURE
30-AUG-2006	5.10.27	30-AUG-2006	5.10.29	2	23520	23520	PDS_UNKNOWN_FAILURE
30-AUG-2006	5.12.39	30-AUG-2006	5.13.57	78	23520	23520	PDS_UNKNOWN_FAILURE
30-AUG-2006	16.25.07	30-AUG-2006	16.26.24	77	23527	23527	PDS_UNKNOWN_FAILURE
31-AUG-2006	4.38.33	31-AUG-2006	4.38.36	3	23534	23534	PDS_UNKNOWN_FAILURE
01-SEP-2006	4.09.41	01-SEP-2006	4.10.59	78	23548	23548	PDS_UNKNOWN_FAILURE
01-SEP-2006	15.19.31	01-SEP-2006	15.19.33	2	23555	23555	PDS_UNKNOWN_FAILURE
01-SEP-2006	15.22.06	01-SEP-2006	15.23.24	78	23555	23555	PDS_UNKNOWN_FAILURE

Table 13: List of gaps for RA-2 L0 cycle 51

Start date	Start time	Stop date	Stop time	Duration [sec]	Start orbit	Stop orbit	Reason
04-SEP-2006	4.15.32	04-SEP-2006	4.16.50	78	23591	23591	PDS_UNKNOWN_FAILURE
04-SEP-2006	15.28.00	04-SEP-2006	15.29.18	78	23598	23598	PDS_UNKNOWN_FAILURE
07-SEP-2006	15.46.17	07-SEP-2006	16.40.32	3255	23641	23641	PDS_UNKNOWN_FAILURE
04-SEP-2006	23.24.42	04-SEP-2006	23.25.40	58	23602	23602	PDS_UNKNOWN_FAILURE
05-SEP-2006	5.23.52	05-SEP-2006	5.25.10	78	23606	23606	PDS_UNKNOWN_FAILURE
05-SEP-2006	16.36.39	05-SEP-2006	16.37.57	78	23613	23613	PDS_UNKNOWN_FAILURE
06-SEP-2006	4.52.57	06-SEP-2006	4.54.15	78	23620	23620	PDS_UNKNOWN_FAILURE
06-SEP-2006	16.04.36	06-SEP-2006	16.05.54	78	23627	23627	PDS_UNKNOWN_FAILURE
07-SEP-2006	4.21.20	07-SEP-2006	4.22.37	77	23634	23634	PDS_UNKNOWN_FAILURE
07-SEP-2006	15.30.47	07-SEP-2006	15.30.49	2	23641	23641	PDS_UNKNOWN_FAILURE
07-SEP-2006	15.33.51	07-SEP-2006	15.35.08	77	23641	23641	PDS_UNKNOWN_FAILURE
11-SEP-2006	0.59.11	11-SEP-2006	1.13.09	838	23689	23689	PDS_UNKNOWN_FAILURE
11-SEP-2006	3.54.57	11-SEP-2006	3.56.15	78	23691	23691	PDS_UNKNOWN_FAILURE

14-SEP-2006	15.13.11	14-SEP-2006	15.14.28	77	23741	23741	PDS_UNKNOWN_FAILURE
15-SEP-2006	5.09.48	15-SEP-2006	5.11.05	77	23749	23749	PDS_UNKNOWN_FAILURE
15-SEP-2006	16.22.06	15-SEP-2006	16.23.24	78	23756	23756	PDS_UNKNOWN_FAILURE
16-SEP-2006	4.38.33	16-SEP-2006	4.39.51	78	23763	23763	PDS_UNKNOWN_FAILURE
16-SEP-2006	15.47.48	16-SEP-2006	15.47.50	2	23770	23770	PDS_UNKNOWN_FAILURE
16-SEP-2006	15.50.36	16-SEP-2006	15.51.54	78	23770	23770	PDS_UNKNOWN_FAILURE
11-SEP-2006	15.07.16	11-SEP-2006	15.08.34	78	23698	23698	PDS_UNKNOWN_FAILURE
12-SEP-2006	5.04.10	12-SEP-2006	5.05.28	78	23706	23706	PDS_UNKNOWN_FAILURE
12-SEP-2006	16.16.11	12-SEP-2006	16.17.29	78	23713	23713	PDS_UNKNOWN_FAILURE
13-SEP-2006	1.50.49	13-SEP-2006	3.04.08	4399	23718	23719	PDS_UNKNOWN_FAILURE
13-SEP-2006	4.32.47	13-SEP-2006	4.34.05	78	23720	23720	PDS_UNKNOWN_FAILURE
13-SEP-2006	15.42.02	13-SEP-2006	15.42.04	2	23727	23727	PDS_UNKNOWN_FAILURE
13-SEP-2006	15.45.00	13-SEP-2006	15.46.17	77	23727	23727	PDS_UNKNOWN_FAILURE
14-SEP-2006	4.00.49	14-SEP-2006	4.02.07	78	23734	23734	PDS_UNKNOWN_FAILURE
18-SEP-2006	5.13.13	18-SEP-2006	5.13.15	2	23792	23792	PDS_UNKNOWN_FAILURE
18-SEP-2006	5.15.25	18-SEP-2006	5.16.43	78	23792	23792	PDS_UNKNOWN_FAILURE
22-SEP-2006	4.50.04	22-SEP-2006	4.51.22	78	23849	23849	PDS_UNKNOWN_FAILURE
22-SEP-2006	16.01.48	22-SEP-2006	16.03.06	78	23856	23856	PDS_UNKNOWN_FAILURE
23-SEP-2006	4.18.28	23-SEP-2006	4.19.45	77	23863	23863	PDS_UNKNOWN_FAILURE
23-SEP-2006	15.27.58	23-SEP-2006	15.28.00	2	23870	23870	PDS_UNKNOWN_FAILURE
23-SEP-2006	15.30.57	23-SEP-2006	15.32.15	78	23870	23870	PDS_UNKNOWN_FAILURE
18-SEP-2006	16.28.02	18-SEP-2006	16.29.19	77	23799	23799	PDS_UNKNOWN_FAILURE
19-SEP-2006	4.44.19	19-SEP-2006	4.45.36	77	23806	23806	PDS_UNKNOWN_FAILURE
19-SEP-2006	15.56.12	19-SEP-2006	15.57.30	78	23813	23813	PDS_UNKNOWN_FAILURE
20-SEP-2006	4.12.35	20-SEP-2006	4.13.53	78	23820	23820	PDS_UNKNOWN_FAILURE
20-SEP-2006	15.22.18	20-SEP-2006	15.22.21	3	23827	23827	PDS_UNKNOWN_FAILURE
20-SEP-2006	15.25.02	20-SEP-2006	15.26.19	77	23827	23827	PDS_UNKNOWN_FAILURE
21-SEP-2006	5.21.03	21-SEP-2006	5.22.21	78	23835	23835	PDS_UNKNOWN_FAILURE
21-SEP-2006	16.33.57	21-SEP-2006	16.35.14	77	23842	23842	PDS_UNKNOWN_FAILURE
25-SEP-2006	4.55.48	25-SEP-2006	4.57.05	77	23892	23892	PDS_UNKNOWN_FAILURE
25-SEP-2006	16.07.24	25-SEP-2006	16.08.42	78	23899	23899	PDS_UNKNOWN_FAILURE
28-SEP-2006	19.41.48	29-SEP-2006	4.26.44	31496	23944	23949	PDS_UNKNOWN_FAILURE
29-SEP-2006	4.29.59	29-SEP-2006	6.28.42	7123	23949	23950	PDS_UNKNOWN_FAILURE
29-SEP-2006	15.42.16	29-SEP-2006	15.43.33	77	23956	23956	PDS_UNKNOWN_FAILURE
29-SEP-2006	20.51.01	30-SEP-2006	3.55.57	25496	23959	23963	PDS_UNKNOWN_FAILURE
30-SEP-2006	3.57.57	30-SEP-2006	5.56.36	7119	23963	23964	PDS_UNKNOWN_FAILURE
30-SEP-2006	15.10.17	30-SEP-2006	15.11.35	78	23970	23970	PDS_UNKNOWN_FAILURE
30-SEP-2006	20.17.41	01-OCT-2006	5.04.52	31631	23973	23978	PDS_UNKNOWN_FAILURE
26-SEP-2006	4.24.13	26-SEP-2006	4.25.31	78	23906	23906	PDS_UNKNOWN_FAILURE
26-SEP-2006	15.36.40	26-SEP-2006	15.37.57	77	23913	23913	PDS_UNKNOWN_FAILURE
26-SEP-2006	20.44.10	27-SEP-2006	3.50.50	25600	23916	23920	PDS_UNKNOWN_FAILURE

27-SEP-2006	3.52.04	27-SEP-2006	7.34.27	13343	23920	23922	PDS_UNKNOWN_FAILURE
27-SEP-2006	16.44.46	27-SEP-2006	16.46.04	78	23928	23928	PDS_UNKNOWN_FAILURE
27-SEP-2006	20.12.23	28-SEP-2006	4.59.15	31612	23930	23935	PDS_UNKNOWN_FAILURE
28-SEP-2006	5.01.25	28-SEP-2006	6.59.47	7102	23935	23936	PDS_UNKNOWN_FAILURE
28-SEP-2006	16.13.17	28-SEP-2006	16.14.35	78	23942	23942	PDS_UNKNOWN_FAILURE
02-OCT-2006	4.32.36	02-OCT-2006	4.32.39	3	23992	23992	PDS_UNKNOWN_FAILURE
02-OCT-2006	4.35.44	02-OCT-2006	4.37.02	78	23992	23992	PDS_UNKNOWN_FAILURE
05-OCT-2006	15.53.27	05-OCT-2006	15.54.45	78	24042	24042	PDS_UNKNOWN_FAILURE
06-OCT-2006	4.09.42	06-OCT-2006	4.11.00	78	24049	24049	PDS_UNKNOWN_FAILURE
06-OCT-2006	15.22.07	06-OCT-2006	15.23.25	78	24056	24056	PDS_UNKNOWN_FAILURE
07-OCT-2006	5.18.17	07-OCT-2006	5.19.35	78	24064	24064	PDS_UNKNOWN_FAILURE
07-OCT-2006	16.31.03	07-OCT-2006	16.32.20	77	24071	24071	PDS_UNKNOWN_FAILURE
08-OCT-2006	4.47.15	08-OCT-2006	4.48.32	77	24078	24078	PDS_UNKNOWN_FAILURE
08-OCT-2006	15.59.03	08-OCT-2006	16.00.21	78	24085	24085	PDS_UNKNOWN_FAILURE
02-OCT-2006	15.47.52	02-OCT-2006	15.49.09	77	23999	23999	PDS_UNKNOWN_FAILURE
03-OCT-2006	4.03.49	03-OCT-2006	4.05.07	78	24006	24006	PDS_UNKNOWN_FAILURE
03-OCT-2006	15.16.12	03-OCT-2006	15.17.30	78	24013	24013	PDS_UNKNOWN_FAILURE
03-OCT-2006	18.41.45	03-OCT-2006	18.44.44	179	24015	24015	PDS_UNKNOWN_FAILURE
04-OCT-2006	5.12.40	04-OCT-2006	5.13.58	78	24021	24021	PDS_UNKNOWN_FAILURE
04-OCT-2006	16.25.07	04-OCT-2006	16.26.25	78	24028	24028	PDS_UNKNOWN_FAILURE
05-OCT-2006	4.41.29	05-OCT-2006	4.42.47	78	24035	24035	PDS_UNKNOWN_FAILURE
05-OCT-2006	15.50.43	05-OCT-2006	15.50.46	3	24042	24042	PDS_UNKNOWN_FAILURE

Table 14: List of gaps for MWR L0 cycle 50

Start date	Start time	Stop date	Stop time	Duration [sec]	Start orbit	Stop orbit	Reason
02-AUG-2006	12.59.23	02-AUG-2006	13.00.11	48	23124	23124	PDS_UNKNOWN_FAILURE
05-AUG-2006	16.13.30	05-AUG-2006	16.14.42	72	23169	23169	PDS_UNKNOWN_FAILURE
08-AUG-2006	11.29.36	08-AUG-2006	11.30.24	48	23209	23209	PDS_UNKNOWN_FAILURE
10-AUG-2006	7.07.41	10-AUG-2006	7.08.29	48	23235	23235	PDS_UNKNOWN_FAILURE
11-AUG-2006	13.15.19	11-AUG-2006	13.16.07	48	23253	23253	PDS_UNKNOWN_FAILURE
12-AUG-2006	0.23.44	12-AUG-2006	0.34.11	627	23259	23259	PDS_UNKNOWN_FAILURE
12-AUG-2006	0.34.11	12-AUG-2006	1.59.21	5110	23259	23260	UNAV_ARTEMIS
15-AUG-2006	12.50.40	15-AUG-2006	12.51.28	48	23310	23310	PDS_UNKNOWN_FAILURE
28-AUG-2006	12.41.58	28-AUG-2006	12.42.46	48	23496	23496	PDS_UNKNOWN_FAILURE
29-AUG-2006	13.48.48	29-AUG-2006	13.49.36	48	23511	23511	PDS_UNKNOWN_FAILURE
01-SEP-2006	7.16.06	01-SEP-2006	7.16.54	48	23550	23550	PDS_UNKNOWN_FAILURE

Table 15: List of gaps for MWR L0 cycle 51

Start date	Start time	Stop date	Stop time	Duration [sec]	Start orbit	Stop orbit	Reason
04-SEP-2006	4.15.32	04-SEP-2006	4.16.50	78	23591	23591	PDS_UNKNOWN_FAILURE
04-SEP-2006	23.23.50	04-SEP-2006	23.25.26	96	23602	23602	PDS_UNKNOWN_FAILURE

07-SEP-2006	14.07.08	07-SEP-2006	14.07.56	48	23640	23640	PDS_UNKNOWN_FAILURE
07-SEP-2006	15.45.08	07-SEP-2006	16.40.36	3328	23641	23641	PDS_UNKNOWN_FAILURE
11-SEP-2006	0.59.11	11-SEP-2006	1.13.09	838	23689	23689	PDS_UNKNOWN_FAILURE
11-SEP-2006	3.54.57	11-SEP-2006	3.56.15	78	23691	23691	PDS_UNKNOWN_FAILURE
14-SEP-2006	15.13.11	14-SEP-2006	15.14.28	77	23741	23741	PDS_UNKNOWN_FAILURE
15-SEP-2006	5.09.48	15-SEP-2006	5.11.05	77	23749	23749	PDS_UNKNOWN_FAILURE
15-SEP-2006	16.22.06	15-SEP-2006	16.23.24	78	23756	23756	PDS_UNKNOWN_FAILURE
16-SEP-2006	4.38.33	16-SEP-2006	4.39.51	78	23763	23763	PDS_UNKNOWN_FAILURE
16-SEP-2006	15.47.48	16-SEP-2006	15.47.50	2	23770	23770	PDS_UNKNOWN_FAILURE
16-SEP-2006	15.50.36	16-SEP-2006	15.51.54	78	23770	23770	PDS_UNKNOWN_FAILURE
11-SEP-2006	15.07.16	11-SEP-2006	15.08.34	78	23698	23698	PDS_UNKNOWN_FAILURE
12-SEP-2006	5.04.10	12-SEP-2006	5.05.28	78	23706	23706	PDS_UNKNOWN_FAILURE
12-SEP-2006	16.16.11	12-SEP-2006	16.17.29	78	23713	23713	PDS_UNKNOWN_FAILURE
13-SEP-2006	1.50.49	13-SEP-2006	3.04.08	4399	23718	23719	PDS_UNKNOWN_FAILURE
13-SEP-2006	4.32.47	13-SEP-2006	4.34.05	78	23720	23720	PDS_UNKNOWN_FAILURE
13-SEP-2006	15.42.02	13-SEP-2006	15.42.04	2	23727	23727	PDS_UNKNOWN_FAILURE
13-SEP-2006	15.45.00	13-SEP-2006	15.46.17	77	23727	23727	PDS_UNKNOWN_FAILURE
14-SEP-2006	4.00.49	14-SEP-2006	4.02.07	78	23734	23734	PDS_UNKNOWN_FAILURE
26-SEP-2006	20.43.04	27-SEP-2006	7.34.17	39073	23916	23922	PDS_UNKNOWN_FAILURE
27-SEP-2006	20.11.30	28-SEP-2006	6.59.31	38881	23930	23936	PDS_UNKNOWN_FAILURE
28-SEP-2006	19.40.44	29-SEP-2006	6.28.21	38857	23944	23950	PDS_UNKNOWN_FAILURE
29-SEP-2006	20.49.59	30-SEP-2006	5.56.23	32784	23959	23964	PDS_UNKNOWN_FAILURE
30-SEP-2006	20.16.49	01-OCT-2006	7.04.50	38881	23973	23979	PDS_UNKNOWN_FAILURE

Table 16: List of gaps for RA-2 L1b cycle 50

Start date	Start time	Stop date	Stop time	Duration [sec]	Start orbit	Stop orbit	Reason
01-AUG-2006	1.14.34	01-AUG-2006	1.14.40	6	23102	23102	PDS_UNKNOWN_FAILURE
01-AUG-2006	8.54.30	01-AUG-2006	8.55.36	66	23107	23107	PDS_UNKNOWN_FAILURE
05-AUG-2006	16.10.24	05-AUG-2006	16.11.41	77	23169	23169	PDS_UNKNOWN_FAILURE
05-AUG-2006	16.14.28	05-AUG-2006	16.14.42	14	23169	23169	PDS_UNKNOWN_FAILURE
01-AUG-2006	16.36.44	01-AUG-2006	16.38.02	78	23112	23112	PDS_UNKNOWN_FAILURE
02-AUG-2006	4.53.02	02-AUG-2006	4.54.20	78	23119	23119	PDS_UNKNOWN_FAILURE
02-AUG-2006	16.04.41	02-AUG-2006	16.05.59	78	23126	23126	PDS_UNKNOWN_FAILURE
03-AUG-2006	4.21.25	03-AUG-2006	4.22.43	78	23133	23133	PDS_UNKNOWN_FAILURE
03-AUG-2006	15.33.56	03-AUG-2006	15.35.14	78	23140	23140	PDS_UNKNOWN_FAILURE
04-AUG-2006	5.28.56	04-AUG-2006	5.30.14	78	23148	23148	PDS_UNKNOWN_FAILURE
04-AUG-2006	16.42.08	04-AUG-2006	16.43.26	78	23155	23155	PDS_UNKNOWN_FAILURE
05-AUG-2006	4.58.41	05-AUG-2006	4.59.58	77	23162	23162	PDS_UNKNOWN_FAILURE
07-AUG-2006	3.55.04	07-AUG-2006	3.56.22	78	23190	23190	PDS_UNKNOWN_FAILURE
07-AUG-2006	15.07.23	07-AUG-2006	15.08.41	78	23197	23197	PDS_UNKNOWN_FAILURE

12-AUG-2006	0.24.42	12-AUG-2006	0.34.11	569	23259	23259	PDS_UNKNOWN_FAILURE
12-AUG-2006	4.38.39	12-AUG-2006	4.39.57	78	23262	23262	PDS_UNKNOWN_FAILURE
12-AUG-2006	15.50.42	12-AUG-2006	15.52.00	78	23269	23269	PDS_UNKNOWN_FAILURE
08-AUG-2006	5.04.17	08-AUG-2006	5.05.35	78	23205	23205	PDS_UNKNOWN_FAILURE
08-AUG-2006	16.16.18	08-AUG-2006	16.17.36	78	23212	23212	PDS_UNKNOWN_FAILURE
09-AUG-2006	4.32.54	09-AUG-2006	4.34.12	78	23219	23219	PDS_UNKNOWN_FAILURE
09-AUG-2006	15.45.07	09-AUG-2006	15.46.24	77	23226	23226	PDS_UNKNOWN_FAILURE
10-AUG-2006	4.00.56	10-AUG-2006	4.02.14	78	23233	23233	PDS_UNKNOWN_FAILURE
10-AUG-2006	15.13.17	10-AUG-2006	15.14.35	78	23240	23240	PDS_UNKNOWN_FAILURE
11-AUG-2006	5.09.54	11-AUG-2006	5.11.12	78	23248	23248	PDS_UNKNOWN_FAILURE
11-AUG-2006	16.22.12	11-AUG-2006	16.23.30	78	23255	23255	PDS_UNKNOWN_FAILURE
14-AUG-2006	5.15.31	14-AUG-2006	5.16.48	77	23291	23291	PDS_UNKNOWN_FAILURE
14-AUG-2006	16.28.07	14-AUG-2006	16.29.24	77	23298	23298	PDS_UNKNOWN_FAILURE
18-AUG-2006	16.01.52	18-AUG-2006	16.03.10	78	23355	23355	PDS_UNKNOWN_FAILURE
19-AUG-2006	4.18.31	19-AUG-2006	4.19.49	78	23362	23362	PDS_UNKNOWN_FAILURE
19-AUG-2006	15.31.00	19-AUG-2006	15.32.18	78	23369	23369	PDS_UNKNOWN_FAILURE
15-AUG-2006	4.44.24	15-AUG-2006	4.45.41	77	23305	23305	PDS_UNKNOWN_FAILURE
15-AUG-2006	15.56.17	15-AUG-2006	15.57.35	78	23312	23312	PDS_UNKNOWN_FAILURE
16-AUG-2006	4.12.40	16-AUG-2006	4.13.57	77	23319	23319	PDS_UNKNOWN_FAILURE
16-AUG-2006	15.25.06	16-AUG-2006	15.26.24	78	23326	23326	PDS_UNKNOWN_FAILURE
17-AUG-2006	5.21.07	17-AUG-2006	5.22.25	78	23334	23334	PDS_UNKNOWN_FAILURE
17-AUG-2006	16.34.01	17-AUG-2006	16.35.18	77	23341	23341	PDS_UNKNOWN_FAILURE
18-AUG-2006	4.47.32	18-AUG-2006	4.47.34	2	23348	23348	PDS_UNKNOWN_FAILURE
18-AUG-2006	4.50.08	18-AUG-2006	4.51.26	78	23348	23348	PDS_UNKNOWN_FAILURE
21-AUG-2006	4.55.50	21-AUG-2006	4.57.08	78	23391	23391	PDS_UNKNOWN_FAILURE
21-AUG-2006	16.07.27	21-AUG-2006	16.08.45	78	23398	23398	PDS_UNKNOWN_FAILURE
26-AUG-2006	3.57.58	26-AUG-2006	3.59.15	77	23462	23462	PDS_UNKNOWN_FAILURE
26-AUG-2006	15.10.18	26-AUG-2006	15.11.35	77	23469	23469	PDS_UNKNOWN_FAILURE
26-AUG-2006	18.35.59	26-AUG-2006	18.38.58	179	23471	23471	PDS_UNKNOWN_FAILURE
22-AUG-2006	4.24.15	22-AUG-2006	4.25.33	78	23405	23405	PDS_UNKNOWN_FAILURE
22-AUG-2006	15.36.42	22-AUG-2006	15.37.59	77	23412	23412	PDS_UNKNOWN_FAILURE
23-AUG-2006	3.52.06	23-AUG-2006	3.53.24	78	23419	23419	PDS_UNKNOWN_FAILURE
23-AUG-2006	16.44.48	23-AUG-2006	16.46.06	78	23427	23427	PDS_UNKNOWN_FAILURE
24-AUG-2006	5.01.27	24-AUG-2006	5.02.44	77	23434	23434	PDS_UNKNOWN_FAILURE
24-AUG-2006	16.13.19	24-AUG-2006	16.14.36	77	23441	23441	PDS_UNKNOWN_FAILURE
25-AUG-2006	4.30.00	25-AUG-2006	4.31.18	78	23448	23448	PDS_UNKNOWN_FAILURE
25-AUG-2006	15.42.17	25-AUG-2006	15.43.34	77	23455	23455	PDS_UNKNOWN_FAILURE
28-AUG-2006	4.35.44	28-AUG-2006	4.37.02	78	23491	23491	PDS_UNKNOWN_FAILURE
28-AUG-2006	15.47.52	28-AUG-2006	15.49.09	77	23498	23498	PDS_UNKNOWN_FAILURE
01-SEP-2006	4.09.41	01-SEP-2006	4.10.59	78	23548	23548	PDS_UNKNOWN_FAILURE
01-SEP-2006	15.22.06	01-SEP-2006	15.23.24	78	23555	23555	PDS_UNKNOWN_FAILURE

02-SEP-2006	5.18.16	02-SEP-2006	5.19.34	78	23563	23563	PDS_UNKNOWN_FAILURE
02-SEP-2006	16.31.01	02-SEP-2006	16.32.19	78	23570	23570	PDS_UNKNOWN_FAILURE
29-AUG-2006	4.03.49	29-AUG-2006	4.05.07	78	23505	23505	PDS_UNKNOWN_FAILURE
29-AUG-2006	15.16.12	29-AUG-2006	15.17.29	77	23512	23512	PDS_UNKNOWN_FAILURE
29-AUG-2006	18.41.46	29-AUG-2006	18.44.44	178	23514	23514	PDS_UNKNOWN_FAILURE
30-AUG-2006	5.12.39	30-AUG-2006	5.13.57	78	23520	23520	PDS_UNKNOWN_FAILURE
30-AUG-2006	16.25.07	30-AUG-2006	16.26.24	77	23527	23527	PDS_UNKNOWN_FAILURE
31-AUG-2006	4.38.34	31-AUG-2006	4.38.36	2	23534	23534	PDS_UNKNOWN_FAILURE
31-AUG-2006	4.41.28	31-AUG-2006	4.42.46	78	23534	23534	PDS_UNKNOWN_FAILURE
31-AUG-2006	15.53.26	31-AUG-2006	15.54.44	78	23541	23541	PDS_UNKNOWN_FAILURE
01-AUG-2006	1.14.40	01-AUG-2006	5.21.47	14827	23102	23105	UNAV_RA2
01-AUG-2006	5.23.57	01-AUG-2006	8.54.30	12633	23105	23107	UNAV_RA2

Table 17: List of gaps for RA-2 L1b cycle 51

Start date	Start time	Stop date	Stop time	Duration [sec]	Start orbit	Stop orbit	Reason
04-SEP-2006	4.15.32	04-SEP-2006	4.16.50	78	23591	23591	PDS_UNKNOWN_FAILURE
04-SEP-2006	4.15.32	04-SEP-2006	4.16.50	78	23591	23591	PDS_UNKNOWN_FAILURE
04-SEP-2006	15.28.00	04-SEP-2006	15.29.18	78	23598	23598	PDS_UNKNOWN_FAILURE
04-SEP-2006	23.24.43	04-SEP-2006	23.25.40	57	23602	23602	PDS_UNKNOWN_FAILURE
05-SEP-2006	5.23.52	05-SEP-2006	5.25.10	78	23606	23606	PDS_UNKNOWN_FAILURE
05-SEP-2006	16.36.39	05-SEP-2006	16.37.57	78	23613	23613	PDS_UNKNOWN_FAILURE
06-SEP-2006	4.52.57	06-SEP-2006	4.54.15	78	23620	23620	PDS_UNKNOWN_FAILURE
06-SEP-2006	16.04.36	06-SEP-2006	16.05.54	78	23627	23627	PDS_UNKNOWN_FAILURE
07-SEP-2006	4.21.20	07-SEP-2006	4.22.37	77	23634	23634	PDS_UNKNOWN_FAILURE
07-SEP-2006	15.33.51	07-SEP-2006	15.35.08	77	23641	23641	PDS_UNKNOWN_FAILURE
07-SEP-2006	15.46.18	07-SEP-2006	16.40.32	3254	23641	23641	PDS_UNKNOWN_FAILURE
15-SEP-2006	5.09.48	15-SEP-2006	5.11.05	77	23749	23749	PDS_UNKNOWN_FAILURE
15-SEP-2006	16.22.06	15-SEP-2006	16.23.24	78	23756	23756	PDS_UNKNOWN_FAILURE
16-SEP-2006	4.38.33	16-SEP-2006	4.39.51	78	23763	23763	PDS_UNKNOWN_FAILURE
16-SEP-2006	15.50.36	16-SEP-2006	15.51.54	78	23770	23770	PDS_UNKNOWN_FAILURE
17-SEP-2006	4.06.42	17-SEP-2006	4.08.00	78	23777	23777	PDS_UNKNOWN_FAILURE
17-SEP-2006	15.19.06	17-SEP-2006	15.20.24	78	23784	23784	PDS_UNKNOWN_FAILURE
12-SEP-2006	5.04.10	12-SEP-2006	5.05.28	78	23706	23706	PDS_UNKNOWN_FAILURE
12-SEP-2006	16.16.11	12-SEP-2006	16.17.29	78	23713	23713	PDS_UNKNOWN_FAILURE
13-SEP-2006	1.50.50	13-SEP-2006	3.04.08	4398	23718	23719	PDS_UNKNOWN_FAILURE
13-SEP-2006	4.32.47	13-SEP-2006	4.34.05	78	23720	23720	PDS_UNKNOWN_FAILURE
13-SEP-2006	15.45.00	13-SEP-2006	15.46.17	77	23727	23727	PDS_UNKNOWN_FAILURE
14-SEP-2006	4.00.49	14-SEP-2006	4.02.07	78	23734	23734	PDS_UNKNOWN_FAILURE
14-SEP-2006	15.13.11	14-SEP-2006	15.14.28	77	23741	23741	PDS_UNKNOWN_FAILURE
18-SEP-2006	5.15.25	18-SEP-2006	5.16.43	78	23792	23792	PDS_UNKNOWN_FAILURE
18-SEP-2006	16.28.02	18-SEP-2006	16.29.19	77	23799	23799	PDS_UNKNOWN_FAILURE

22-SEP-2006	4.50.04	22-SEP-2006	4.51.22	78	23849	23849	PDS_UNKNOWN_FAILURE
22-SEP-2006	16.01.48	22-SEP-2006	16.03.06	78	23856	23856	PDS_UNKNOWN_FAILURE
23-SEP-2006	4.18.28	23-SEP-2006	4.19.45	77	23863	23863	PDS_UNKNOWN_FAILURE
23-SEP-2006	15.30.57	23-SEP-2006	15.32.15	78	23870	23870	PDS_UNKNOWN_FAILURE
19-SEP-2006	4.44.19	19-SEP-2006	4.45.36	77	23806	23806	PDS_UNKNOWN_FAILURE
19-SEP-2006	4.45.36	19-SEP-2006	4.45.37	1	23806	23806	PDS_UNKNOWN_FAILURE
19-SEP-2006	15.56.12	19-SEP-2006	15.57.30	78	23813	23813	PDS_UNKNOWN_FAILURE
20-SEP-2006	4.12.35	20-SEP-2006	4.13.53	78	23820	23820	PDS_UNKNOWN_FAILURE
20-SEP-2006	15.22.19	20-SEP-2006	15.22.21	2	23827	23827	PDS_UNKNOWN_FAILURE
20-SEP-2006	15.25.02	20-SEP-2006	15.26.19	77	23827	23827	PDS_UNKNOWN_FAILURE
21-SEP-2006	5.21.03	21-SEP-2006	5.22.21	78	23835	23835	PDS_UNKNOWN_FAILURE
21-SEP-2006	16.33.57	21-SEP-2006	16.35.14	77	23842	23842	PDS_UNKNOWN_FAILURE
25-SEP-2006	4.55.48	25-SEP-2006	4.57.05	77	23892	23892	PDS_UNKNOWN_FAILURE
25-SEP-2006	16.07.24	25-SEP-2006	16.08.42	78	23899	23899	PDS_UNKNOWN_FAILURE
28-SEP-2006	19.41.49	29-SEP-2006	4.26.44	31495	23944	23949	PDS_UNKNOWN_FAILURE
29-SEP-2006	4.29.59	29-SEP-2006	6.28.42	7123	23949	23950	PDS_UNKNOWN_FAILURE
29-SEP-2006	15.42.16	29-SEP-2006	15.43.33	77	23956	23956	PDS_UNKNOWN_FAILURE
29-SEP-2006	20.51.02	30-SEP-2006	3.55.57	25495	23959	23963	PDS_UNKNOWN_FAILURE
30-SEP-2006	3.57.57	30-SEP-2006	5.56.36	7119	23963	23964	PDS_UNKNOWN_FAILURE
30-SEP-2006	15.10.17	30-SEP-2006	15.11.35	78	23970	23970	PDS_UNKNOWN_FAILURE
30-SEP-2006	20.17.42	01-OCT-2006	5.04.52	31630	23973	23978	PDS_UNKNOWN_FAILURE
26-SEP-2006	4.24.13	26-SEP-2006	4.25.31	78	23906	23906	PDS_UNKNOWN_FAILURE
26-SEP-2006	15.36.40	26-SEP-2006	15.37.57	77	23913	23913	PDS_UNKNOWN_FAILURE
26-SEP-2006	20.44.11	27-SEP-2006	3.50.50	25599	23916	23920	PDS_UNKNOWN_FAILURE
27-SEP-2006	3.52.04	27-SEP-2006	7.34.27	13343	23920	23922	PDS_UNKNOWN_FAILURE
27-SEP-2006	16.44.46	27-SEP-2006	16.46.04	78	23928	23928	PDS_UNKNOWN_FAILURE
27-SEP-2006	20.12.24	28-SEP-2006	4.59.15	31611	23930	23935	PDS_UNKNOWN_FAILURE
28-SEP-2006	5.01.25	28-SEP-2006	6.59.47	7102	23935	23936	PDS_UNKNOWN_FAILURE
28-SEP-2006	16.13.17	28-SEP-2006	16.14.35	78	23942	23942	PDS_UNKNOWN_FAILURE
02-OCT-2006	4.32.37	02-OCT-2006	4.32.39	2	23992	23992	PDS_UNKNOWN_FAILURE
02-OCT-2006	4.35.44	02-OCT-2006	4.37.02	78	23992	23992	PDS_UNKNOWN_FAILURE
06-OCT-2006	4.09.42	06-OCT-2006	4.11.00	78	24049	24049	PDS_UNKNOWN_FAILURE
06-OCT-2006	15.22.07	06-OCT-2006	15.23.25	78	24056	24056	PDS_UNKNOWN_FAILURE
07-OCT-2006	5.18.17	07-OCT-2006	5.19.35	78	24064	24064	PDS_UNKNOWN_FAILURE
07-OCT-2006	16.31.03	07-OCT-2006	16.32.20	77	24071	24071	PDS_UNKNOWN_FAILURE
08-OCT-2006	4.47.15	08-OCT-2006	4.48.32	77	24078	24078	PDS_UNKNOWN_FAILURE
08-OCT-2006	15.59.03	08-OCT-2006	16.00.21	78	24085	24085	PDS_UNKNOWN_FAILURE
02-OCT-2006	15.47.52	02-OCT-2006	15.49.09	77	23999	23999	PDS_UNKNOWN_FAILURE
03-OCT-2006	4.03.49	03-OCT-2006	4.05.07	78	24006	24006	PDS_UNKNOWN_FAILURE
03-OCT-2006	15.16.12	03-OCT-2006	15.17.30	78	24013	24013	PDS_UNKNOWN_FAILURE
03-OCT-2006	18.41.46	03-OCT-2006	18.44.44	178	24015	24015	PDS_UNKNOWN_FAILURE

04-OCT-2006	5.12.40	04-OCT-2006	5.13.58	78	24021	24021	PDS_UNKNOWN_FAILURE
04-OCT-2006	16.25.07	04-OCT-2006	16.26.25	78	24028	24028	PDS_UNKNOWN_FAILURE
05-OCT-2006	4.41.29	05-OCT-2006	4.42.47	78	24035	24035	PDS_UNKNOWN_FAILURE
05-OCT-2006	15.53.27	05-OCT-2006	15.54.45	78	24042	24042	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	Date of Measurement	Location / Rel.	RA-2	Transponder	ECMWF Wet

Orbit nb		track	resolution	Bias [dB]	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

APPENDIX 5: S-BAND ANOMALY

Table 19: List of L2 FGD Files affected by S-Band anomaly during cycle 50 and 51

File name	Start date	Start time	Stop date	Stop time
RA2_FGD_2PNPDK20060822_140906_000050742050_00311_23411_0595.N1	22-AUG-2006	14.09.07	22-AUG-2006	15.33.41
RA2_FGD_2PNPDK20060825_190754_000061072050_00357_23457_0641.N1	25-AUG-2006	19.07.55	25-AUG-2006	20.49.42
RA2_FGD_2PNPDE20060825_204831_000043172050_00358_23458_0550.N1	25-AUG-2006	20.48.31	25-AUG-2006	22.00.28
RA2_FGD_2PNPDE20060825_215919_000062152050_00358_23458_0551.N1	25-AUG-2006	21.59.19	25-AUG-2006	23.42.54
RA2_FGD_2PNPDE20060825_234139_000060262050_00359_23459_0552.N1	25-AUG-2006	23.41.40	26-AUG-2006	1.22.05
RA2_FGD_2PNPDE20060826_012058_000044672050_00360_23460_0553.N1	26-AUG-2006	1.20.58	26-AUG-2006	2.35.25
RA2_FGD_2PNPDE20060826_023448_000048692050_00361_23461_0554.N1	26-AUG-2006	2.34.49	26-AUG-2006	3.55.58
RA2_FGD_2PNPDK20061007_181930_000059632051_00471_24072_1172.N1	07-OCT-2006	18.19.31	07-OCT-2006	19.58.54
RA2_FGD_2PNPDK20061007_195817_000061662051_00472_24073_1173.N1	07-OCT-2006	19.58.17	07-OCT-2006	21.41.03
RA2_FGD_2PNPDK20061007_181930_000059632051_00471_24072_1172.N1	07-OCT-2006	18.19.31	07-OCT-2006	19.58.54
RA2_FGD_2PNPDK20061007_195817_000061662051_00472_24073_1173.N1	07-OCT-2006	19.58.17	07-OCT-2006	21.41.03
RA2_FGD_2PNPDE20061007_214025_000062552051_00473_24074_0840.N1	07-OCT-2006	21.40.25	07-OCT-2006	23.24.41
RA2_FGD_2PNPDE20061007_232342_000061822051_00474_24075_0841.N1	07-OCT-2006	23.23.43	08-OCT-2006	1.06.44
RA2_FGD_2PNPDE20061008_010547_000062372051_00475_24076_0842.N1	08-OCT-2006	1.05.48	08-OCT-2006	2.49.45
RA2_FGD_2PNPDE20061008_024839_000061832051_00476_24077_0843.N1	08-OCT-2006	2.48.39	08-OCT-2006	4.31.42
RA2_FGD_2PNPDE20061008_043041_000008332051_00477_24078_0845.N1	08-OCT-2006	4.30.42	08-OCT-2006	4.44.35

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