Envisat FDGDR Quality Assessment Report

Cycle 072

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Prepared by :	IDEAS team	
Accepted by :		
Approved by :		

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1 Introduction

The purpose of this document is to report the major features of the FDGDR data quality from the ocean Envisat mission. The document is associated with data dissemination on a cycle by cycle basis.
This report covers the period from 8th September 2008 until 13th of October 2008, cycle 72.
The objectives of this document are :

To provide a data quality assessment
To provide users with necessary information for data processing
To report any change likely to impact data quality at any level, from instrument status to software configuration
To present the major useful results for the current cycle

It is divided into the following topics:

GENERAL QUALITY ASSESSMENT
INSTRUMENT PERFORMANCE
PRODUCT PERFORMANCE
PARTICULAR INVESTIGATIONS

2 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	Global Telecommunication System
HTL	Height Tracking Loop
ICU	Instrument Control Unit
IECF	Instrument Engineering Calibration Facility
IF	Intermediate Frequency
IE	Individual Echoes
IPF	Instrument Processing Facility
HSM	High Speed Multiplexer
LUT	Look Up Table
MCMD	MacroCommand
MPH	Main Product Header
MSS	Mean Sea Surface
MWR	MicroWave Radiometer
MPS	Mission Planning System
MR	Microwave Receiver
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

3 Reference documents

References

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[3] EOO/EOX, October 2005, Information to the Users regarding the Envisat RA2/MWR IPF version 5.02 and CMA 7.1 Available at http://earth.esa.int/pcs/envisat/ra2/articles/

[4] Martini A., 2003: Envisat RA-2 Range instrumental correction : USO clock period variation and associated auxiliary file, Technical Note ENVI-GSEG-EOPG-TN-03-0009 Available at http://earth.esa.int/pcs/envisat/ra2/articles/USO_clock_corr_aux_file.pdf http://earth.esa.int/pcs/envisat/ra2/auxdata/

[5] Labroue S., 2005: RA2 ocean and MWR measurement long term monitoring 2005 report for WP3, Task 2 SSB estimation for RA2 altimeter, Technical Note CLS-DOS-NT-05-200

[6] Envisat Cyclic Report Cycle 28, ENVI-GSOP-EOPG-03-0011

[7] F-PAC Monthly Report,SALP-RP-M-OP-XXXX-CN

[8] RA-2 Performance Results, Paper presented at the ENVISAT Calibration Review in September 2002

[9] Instrument Performance Evaluation and Analysis Summary, PO-TR-ALS-RA-0042

[10] ENVISAT RA-2 IF MASK AUX FILE - Updating Strategy: Investigation Report; C.Bignami and C.Loddo and N. Pierdicca.

[11] Envisat RA-2 IF Mask weird behavior: Investigation Report

[12] Defining a rain flag for the Envisat altimeter, G. Quartly, study presented to the final CCVT plenary meeting, http://earth.esa.int/pcs/envisat/ra2/articles.

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4 General quality assessment

4.1 Cycle overview

- The S-band parameters, as well as the dual ionospheric correction in Ku Band are not relevant and must not be used from Cycle 65 pass 289. Users are advised to use the Ionospheric correction from BENT model, which is available in FDGDR data products (see section 7).
- During the period covered by cycle 72 three manouvres were executed as planned, on 9th, 10th and 19th of September 2008, for more details please refer to Orbit Quality part 4.4
- During cycle 72, Artemis was unavailable several times. The impact of this was that some part or entire passes were missing.

Artemis unavaibility	
From	To
11/09/2008 21:37	11/09/2008 21:58
11/09/2008 23:16	11/09/2008 23:40
12/09/2008 00:49	12/09/2008 01:19
17/09/2008 22:32	17/09/2008 23:35
17/09/2008 22:32	17/09/2008 23:35
29/09/2008 09:46	29/09/2008 10:11
29/09/2008 11:14	29/09/2008 12:08
03/10/2008 11:56	03/10/2008 14:32

Figure 1: *Artemis unavailability during cycle 72*

4.2 Payload status

4.2.1 Altimeter events

The Radar Altimeter 2, during cycle 72, was never unavailable.
On cycle 72, IF Calibration has been performed over the Himalaya site. The operational acquisition has been performed on ascending passes only. In Figure1 a map is reported indicating the calibration site.

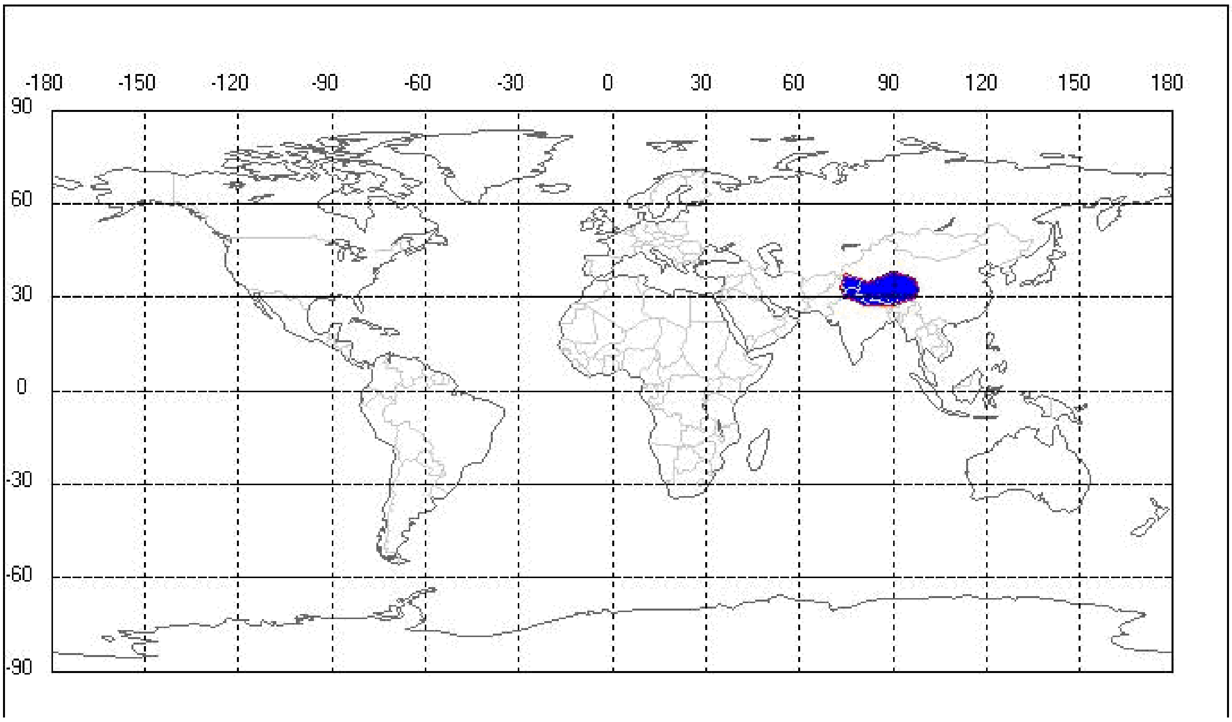


Figure 2: *IF Calibration Acquisition sites*

The RA-2 instrument planning was performed as follows:

- New procedure for IF calibration (through Digital BITE Mode command) over Himalaya for the entire cycle, 1 ascending pass per day
- No IF calibration on Rocky Mountains.
- 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.

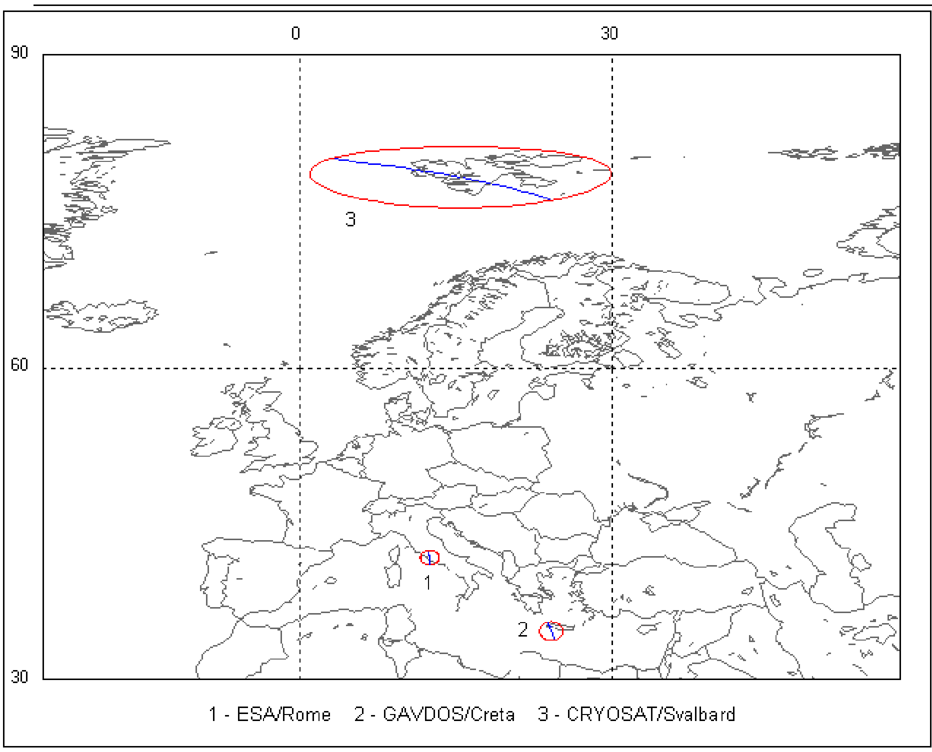


Figure 3: *Transponder Acquisition sites*

4.2.2 MWR events

The radiometer MWR, during cycle 72, was never unavailable.

4.2.3 Doris events

Doris, during cycle 72, was never unavailable.

4.3 Availability

The summary of the RA-2 data products availability for the current cycle is reported in Appendix 8.2. Data availability was around 99.29% for RA-2 products, 99.21% for MWR products and 93.96% for DORIS products

4.4 Orbit quality

During the period covered by cycle 72 three manouvres were executed as planned. See details below.

- On September 9th 2008 a single burn OCM out-of-plane orbit inclination maintenance manoeuvre took place. The characteristics of this manoeuvre were:
  - Planned delta V size: 1.590 m/s, increasing orbit inclination by approximately 0.01 degree
  - Mid thrust time: 04:42:00 utc at ascending node
  - Thrust duration: 964.030 seconds
  - Measured delta V: 1.591 m/s across track, 0.0022 m/s along track (towards flight direction), -0.0412 m/s radial (towards downward vertical)

  The scope of this inclination correction was threefold:

  - keep the ground track within its deadband around the reference one in the high latitudes regions
  - keep the local time of ascending node crossings within the allowed range
  - continue a series of inclination control cycles to allow interferometric applications over 2007 and 2008, started with the inclination correction performed on January 23, 2007 and carried over with subsequent manoeuvres on April 3rd, 2007, July 17th, 2007, September 27th, 2007, December 4th, 2007 , February 12, 2008 , April 22, 2008 and July 1st, 2008.

  In order to fulfill the requirements for this 2 year interferometry campaign the next inclination correction manoeuvre is now expected to take place on 18-Nov-08.

- On September 10th 2008 a one-burn orbit in-plane correction manoeuvre took place. The characteristics of this manoeuvre were:
  - Planned delta V size: 0.0077 m/s, increasing the semi major axis by approximately 15 metres

  - Mid thrust times: 02:41:13 utc at PSO 41.5 degrees
  - Thrust duration: 5 seconds
  - Measured delta V: 0.0078 m/s along track (in the flight direction)
  - The scope of this in plane correction manoeuvre was to keep the s/c ground track within 200 metres from the reference ground track at ascending node over the next few weeks.

- On September 19th 2008 a SFCM orbit correction manoeuvre took place. The characteristics of this manoeuvre were:
  - Planned delta V size: -0.0009 m/s (against the flight direction)
  - Mid thrust time: 02:53:51.0 utc at PSO 24.9 degrees
  - Thrust duration: 1 second
  - Measured delta V: -0.0008 m/s (against the flight direction)

During the period covered by this report the spacecraft ground track remained within the +/- 200 m deadband around the reference ground track at ascending node.

4.5 Ground segment processing chain Status

4.5.1 IPF processing chain

Cycle 72 has been processed with IPF processing chain V5.06, installed in both PDHS-E and PDHS-K on 20th June 2007, orbit 27729.

IPF V5.06 contains the following main evolutions:

- 1. Increase performance in the usage of DORIS Navigator in NRT products due to DORIS Navigator threshold update to 900 seconds coverage RA2/DORIS;
- 2. Alignment of Chain B to Prod Spec 3/N

A complete table of IPF Level1b and Level2 upgrades is reported in Appendix 8.1.

4.5.2 Auxiliary data file

The Auxiliary files actually used by the IPF ground processing are reported in Appendix 8.3. 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 . 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/current/

5 Instrument Performance

This section presents results that illustrate data quality during this cycle. These verification products are produced operationally so that they allow systematic monitoring of the main relevant parameters.

5.1 RA2 Performance

5.1.1 Tracking capability

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 REF[8].

Surface type	320 MHz	Commissioning Phase objective 320 MHz	80 MHz	20 MHz
Open Ocean	99.82	> 99%	0.17	0.01
Coastal water	98.93	No specific requierement	1	0.07
Sea ice	98.95	> 95%	0.95	0.09
Ice sheet	95.49	> 95%	3.79	0.70
Land	81.86	No specific requierement	14.19	3.54
All world	95.25		3.84	0.89

In figure 4 the daily 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.

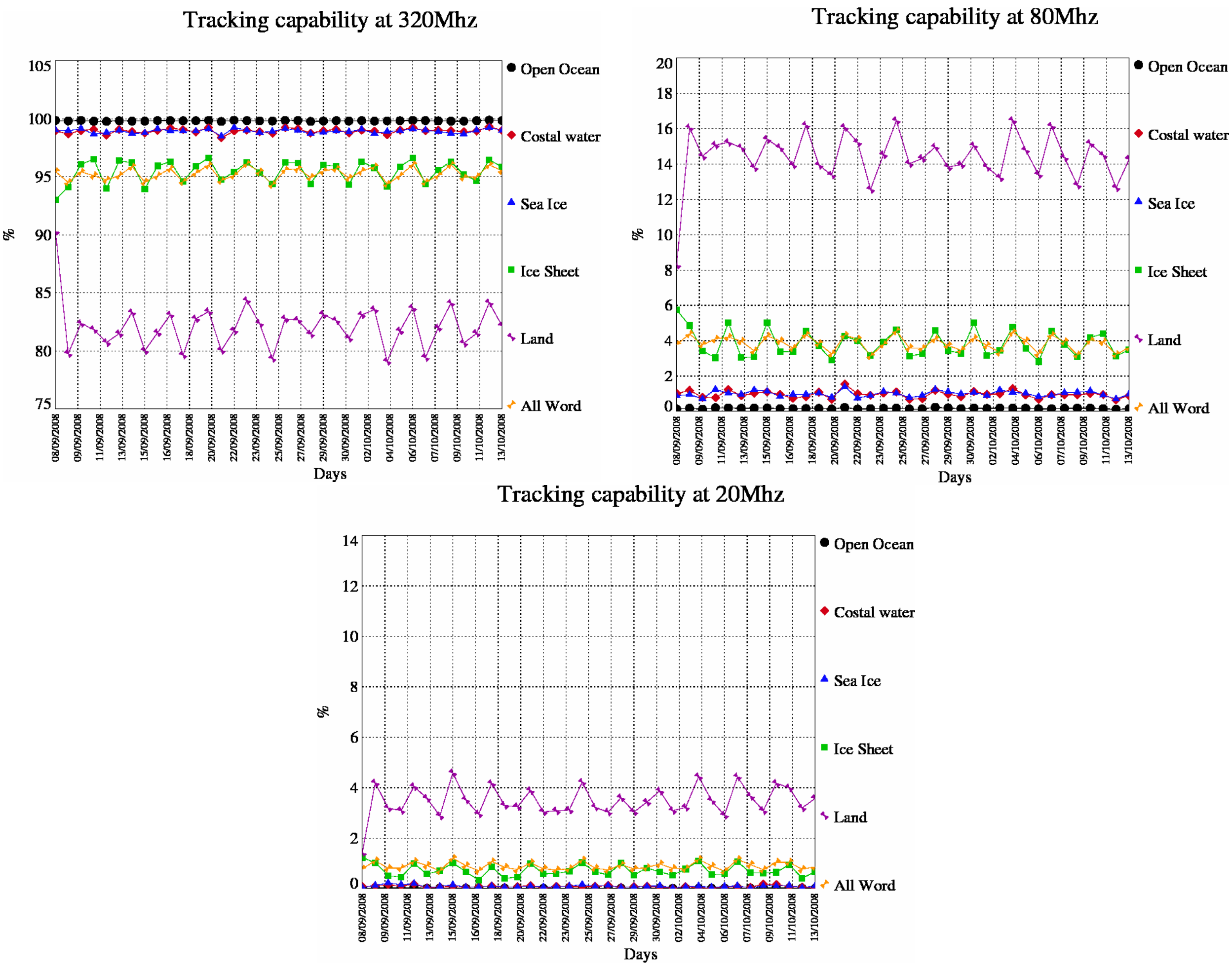


Figure 4: *RA-2 Tracking percentage for different surfaces*

5.1.2 IF filter mask

In Figure 5 all valid IF masks retrieved during the current cycle are plotted in the left panel. The on-ground measured IF mask (ref [10] and ref [11]) 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 0.1 db, the mask is considered valid.

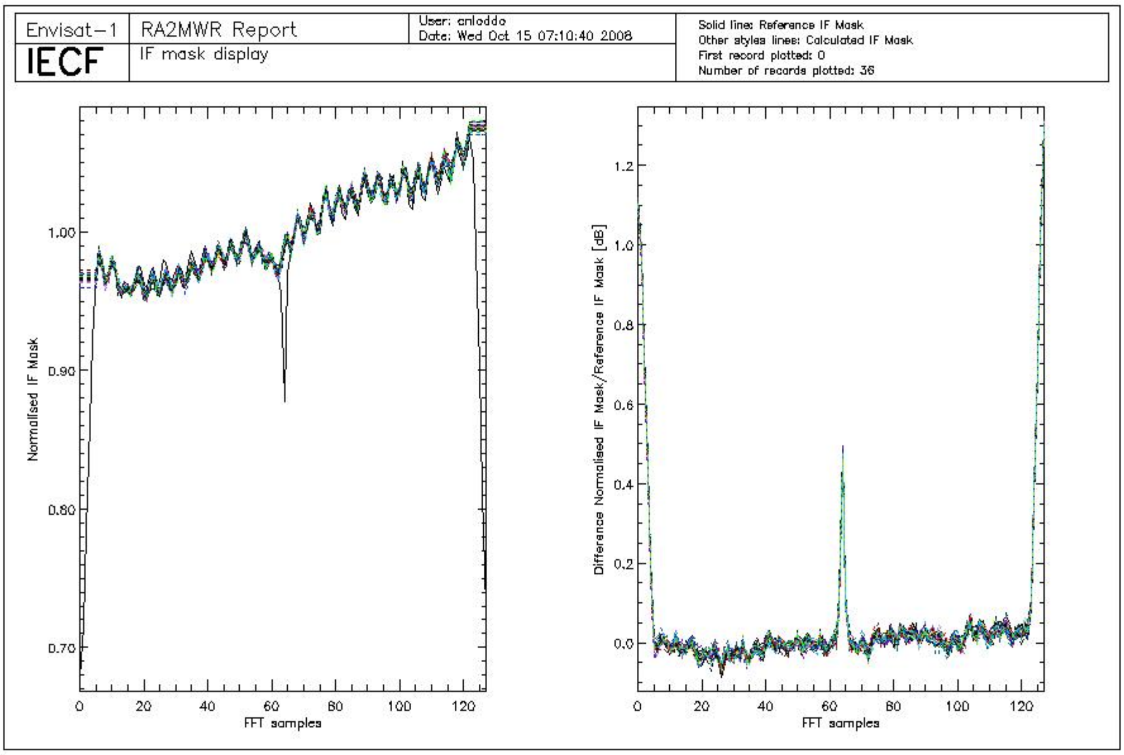


Figure 5: *Valid IF masks retrieved during cycle 72 plotted together with the on-ground reference*

In Figure 6 the new updated IF mask, and the previous one used for processing are plotted.

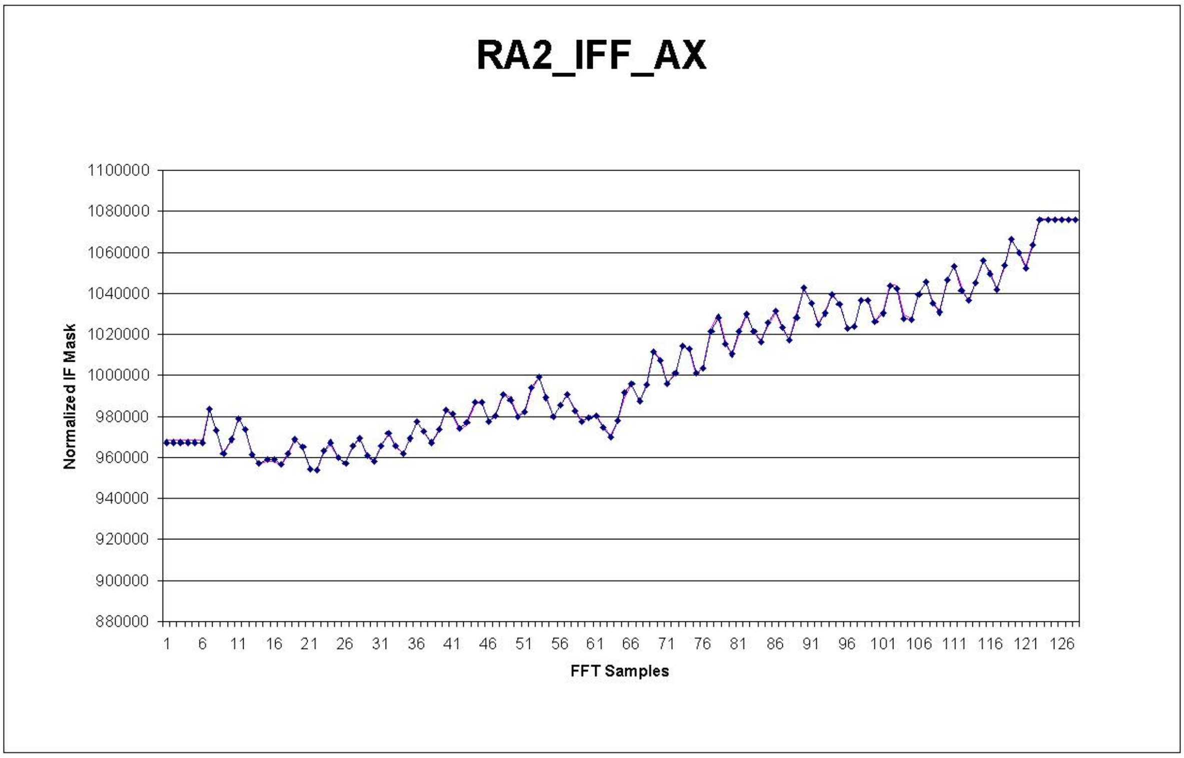


Figure 6: *Previous and new IF Mask updated*

In Figure 7 the evolution of the IF mask quality parameters evaluated as in REF[9] is reported only for valid data. It can be observed that the difference with respect to the on-ground reference presents an increasing trend due to the ageing of the instrument. These differences have significantly increased since cycle 56. The masks obtained on the Rocky Mountains present a higher difference with respect to the on-ground mask. This is probably due to the fact that the calibration segments are shorter on this new site and therefore with more noise. However, the difference is always lower then 0.1 db and for this reason the masks are still valid. Some 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, on April 9th 2006, on December 16th 2006 and on September 27th. 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 two last cases 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 the current cycle the IF Calibration Mode was nominal. The weird behavior described in REF[11] was no more present. According to the In-Flight Tests performed on cycle 62 63, 64 and 65 this problem, present since the beginning of the mission, seems to be related to the AGC used for the calibration mode.

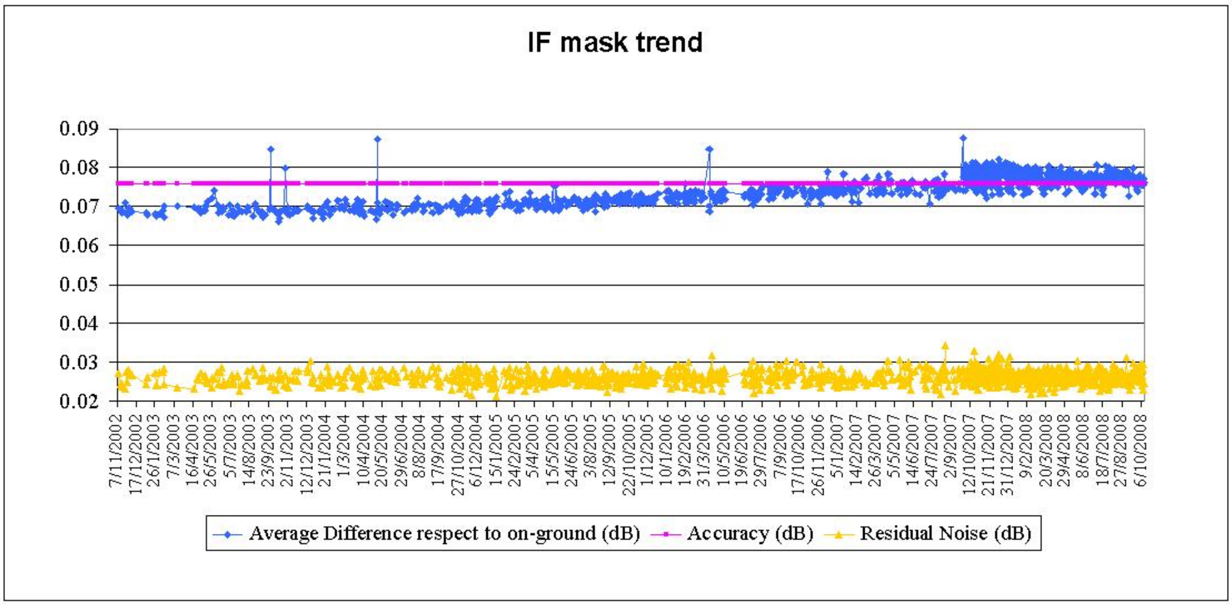


Figure 7: *Evolution of the IF mask related parameters for valid IF masks retrieved up to cycle 72*

In Figure 8 the percentages of valid IF masks from cycle 20 onwards is 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 when the altimeter was on its side B. The number of valid IF Masks has decrease from cycle 56 until cycle 61. The high number of valid IF Masks in the last five cycles is related to the NEW procedure for IF Calibration Mode applied from cycle 62 onwards. Starting on cycle 66, 100 % of IF Masks were valid because all IF Calibrations were performed using this new procedure.

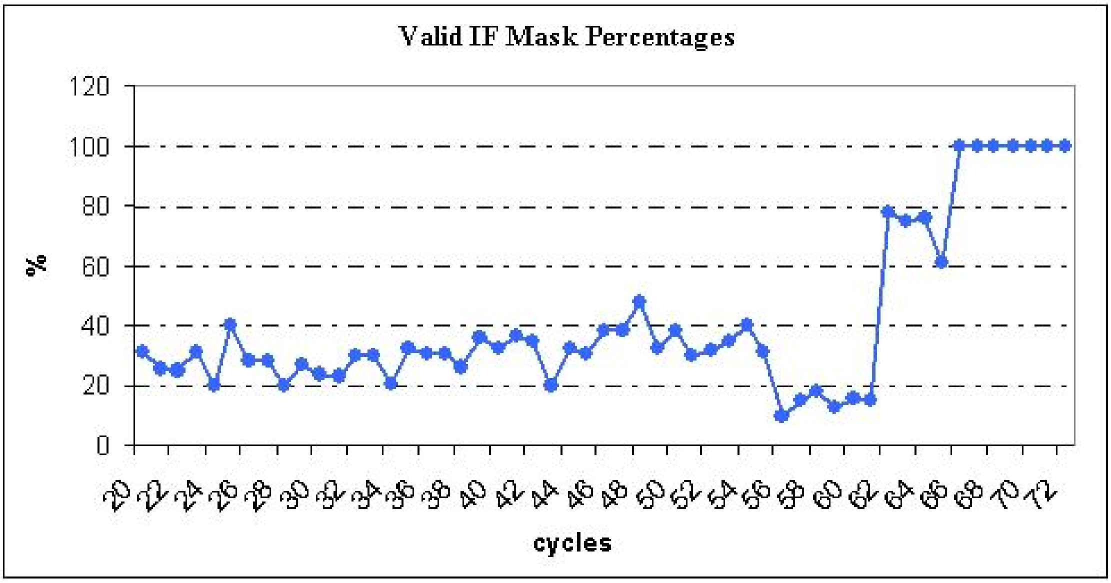


Figure 8: *Percentages of valid IF Mask up to cycle 72*

5.1.3 USO

The RA-2 Ultra-Stable Oscillator (USO) was nominal on cycle 72.

The Ultra Stable Oscilator (USO) onboard ENVISAT has gone threw different behaviours since the beginning of the mission. Figure 9 synthesises the periods when it was affected by the anomaly detailled in section 7.

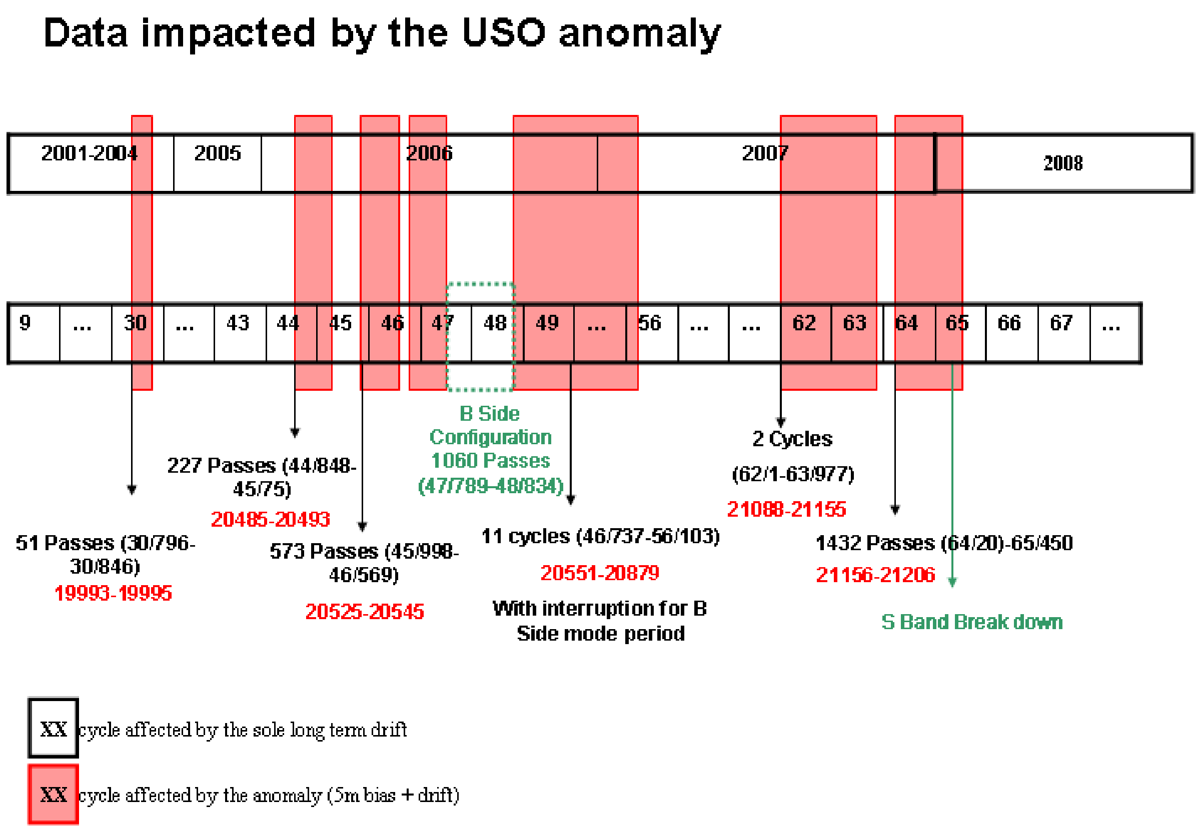


Figure 9: *USO anomalies chronology*

The USO Clock Period anomaly was almost permanently present during 2006 and 2007. It started in cycle 44, on date 1 Feb 2006 12:04:30, Orbit = 205181. It directly happened after the recovery of the RA-2 on-board anomaly which occurred on the 2006/02/01 at 05:17:56. During the anomalous period, the altimetric range jumped by several meters (about 5.6m) w.r.t. the Mean Sea Surface due to an anomaly in the USO clock period. Moreover, oscillations at the orbital period with an amplitude of 20-30 cm affect the Sea Level Anomaly making the range unusable for both Ku and S Band. The anomaly persisted intermittently until the 15th of May 2006 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 2006 13:20:15, Orbit = 22523. The anomaly reappeared after the instrument recovery on date 27th of September 2007 11:13:30 and disappeared again for an unknown reason on date 3rd of December 2007 03:00:00. The anomaly was back again on the 4th of December 2007 13:50:00 and it lasted until the 23rd January 2008 14:11:35, orbit nb 30840.
Note that the correction comes back to its nominal value in several steps, causing small uncertainties on the associated correction.

In Figure 10, the USO clock period trend retrieved from the beginning of the mission until the last week of cycle 49 is reported. In Figure 11, the USO clock period trend retrieved from cycle 50 onwards is reported. The method to coompute the data from the USO period is detailed in **Particular investigations**.

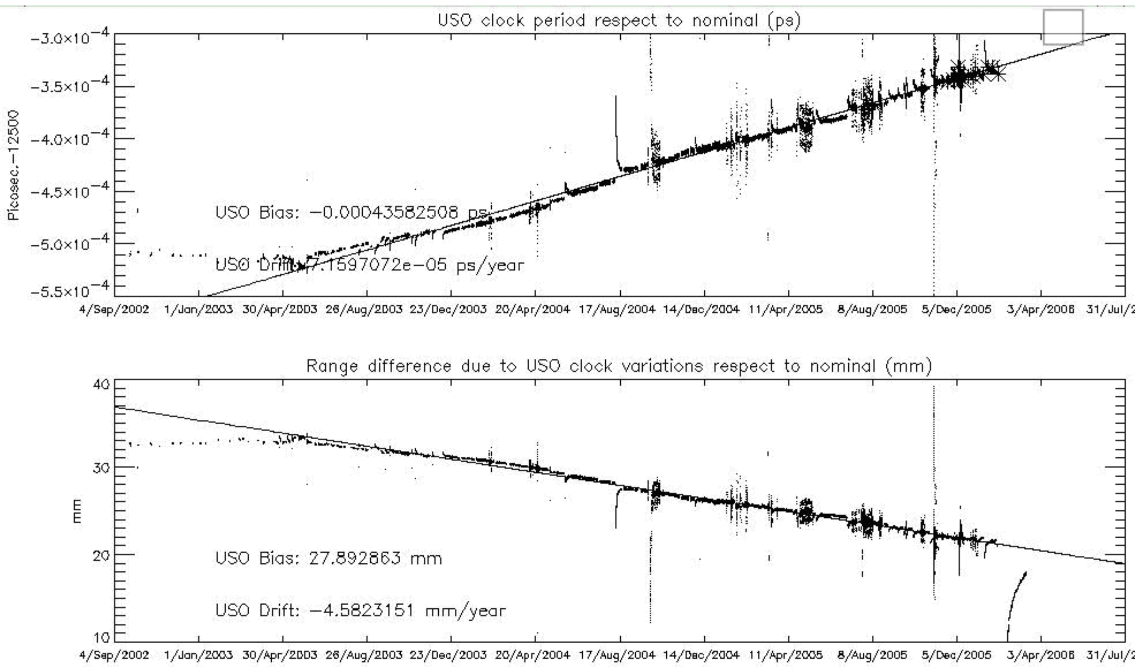


Figure 10: *USO clock period (top) and associated range difference (bottom) until cycle 49*

In Figure 12 the USO clock period trend is reported. In order to make the variability visible, the difference of the actual USO clock period with respect to the nominal one has been plotted in the upper panel. In the lower panel the Range error due to the USO clock variability has been reported taking a satellite altitude of 800 Km as a nominal value.

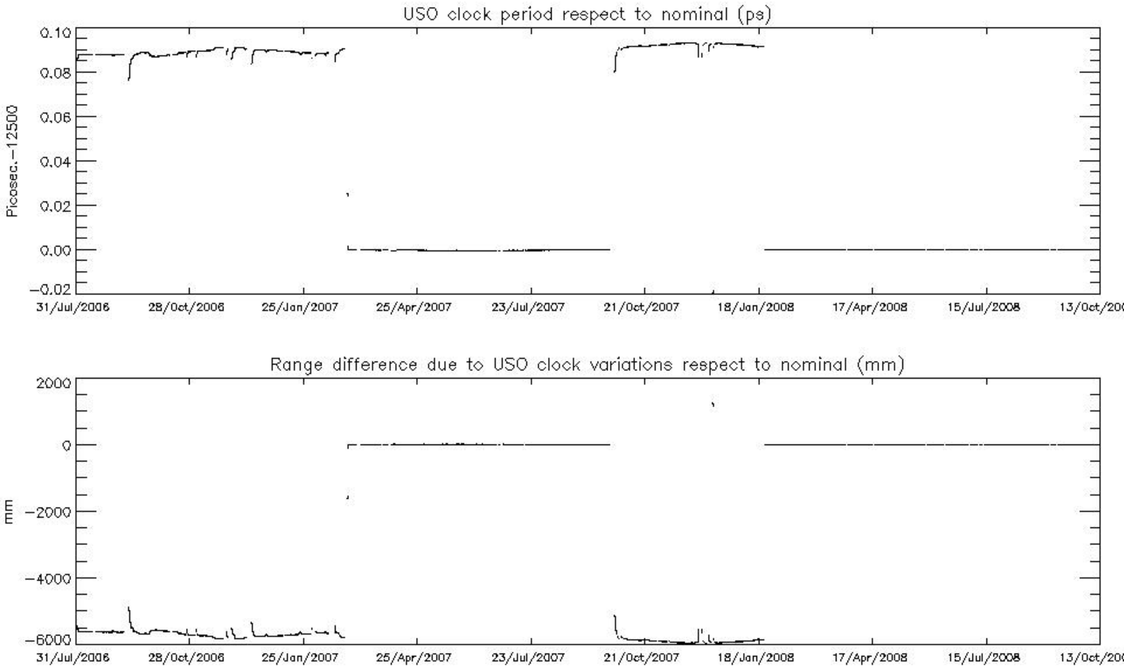


Figure 11: *USO clock period (top) and associated range difference (bottom) from cycle 50 onwards*

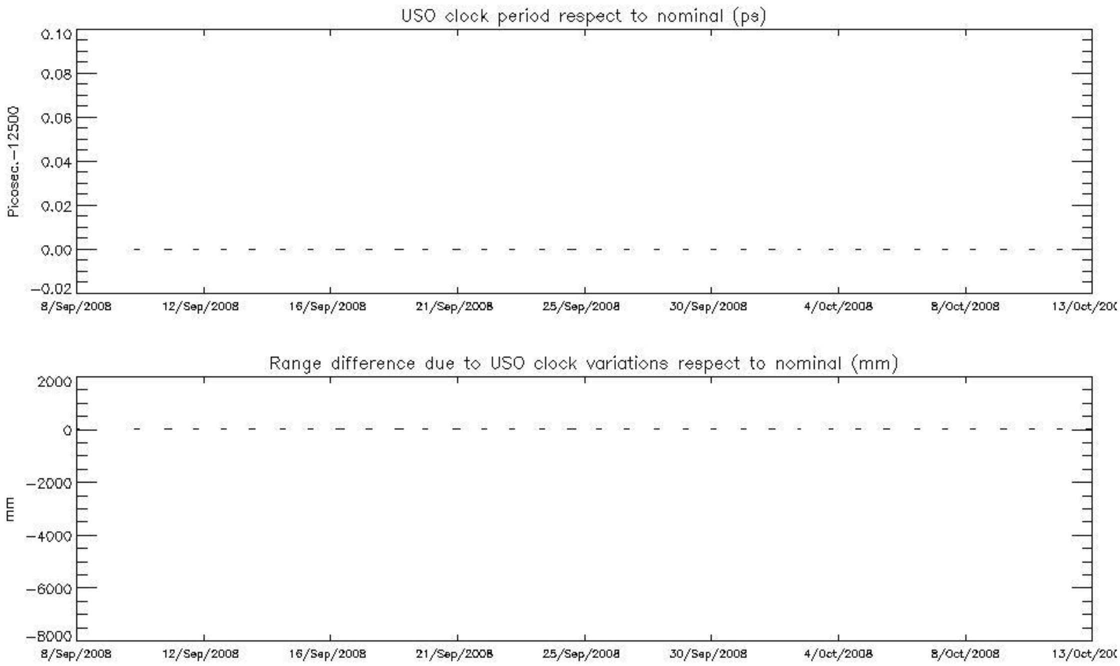


Figure 12: *USO clock period for cycle 72*

5.1.4 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 13, the differences between the extrapolated UTC values and the corresponding real UTC values measured at the next Kiruna dump, are reported. No anomalous events can be observed in the current cycle. In the lower panel, the ICU clock step for the same period is shown.

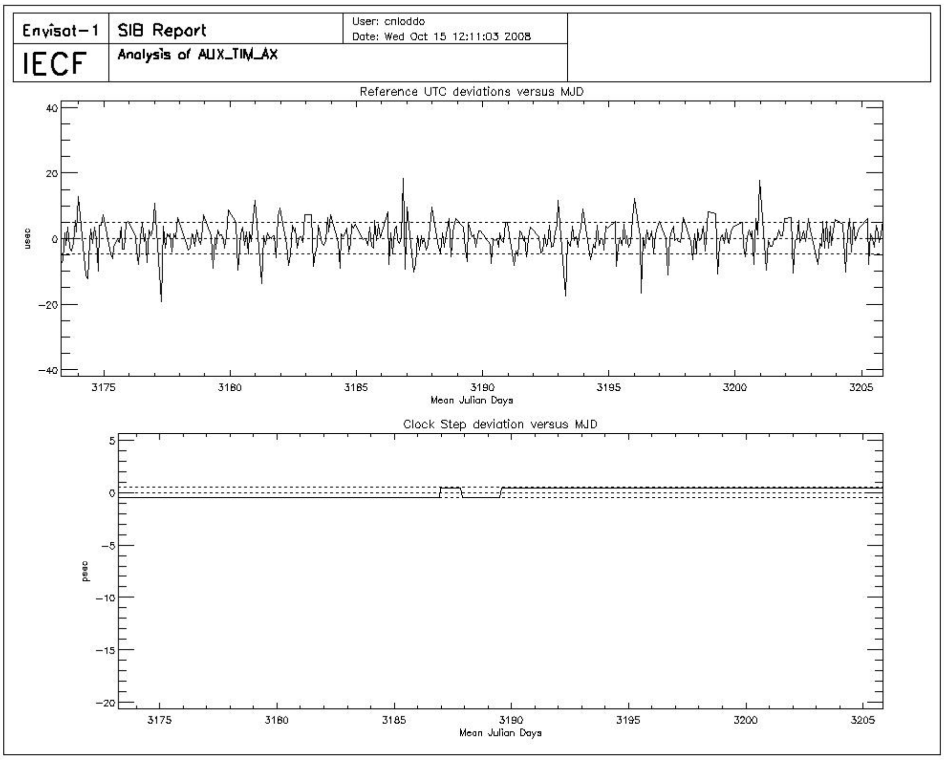


Figure 13: *UTC deviations and ICU clock period for cycle 72*

In Figure 14 (upper panel) the differences between the extrapolated UTC values and the corresponding real UTC values measured at the next Kiruna dump, are reported for data up to cycle 32. The UTC deviations for cycle 33 onwards reported in Figure 15. 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 14); 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 15 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.

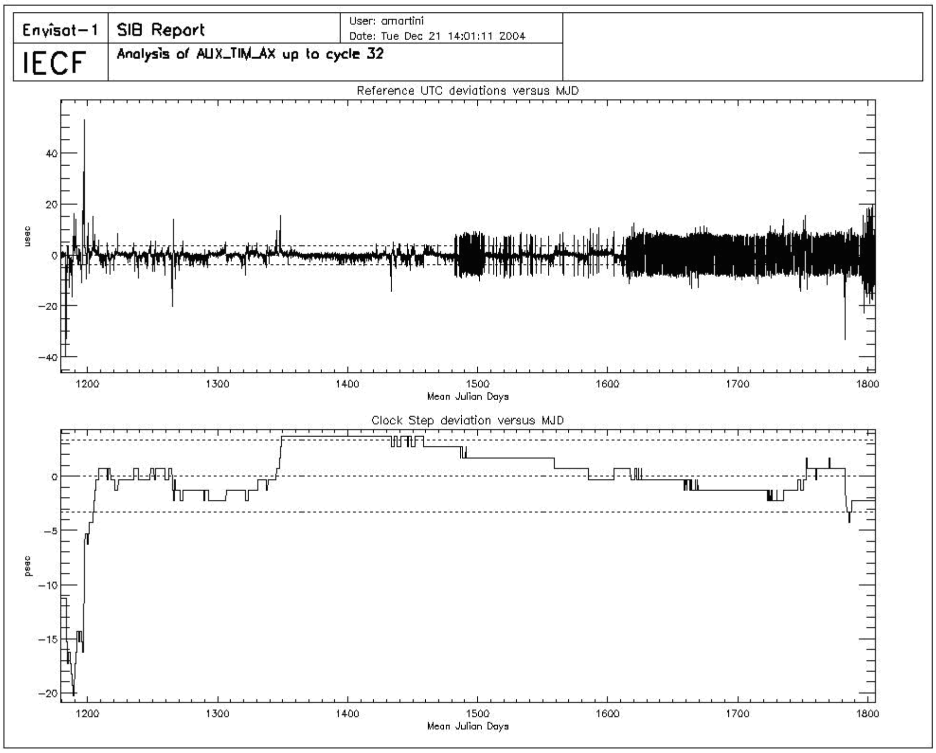


Figure 14: *UTC deviations and ICU clock period up to cycle 32*

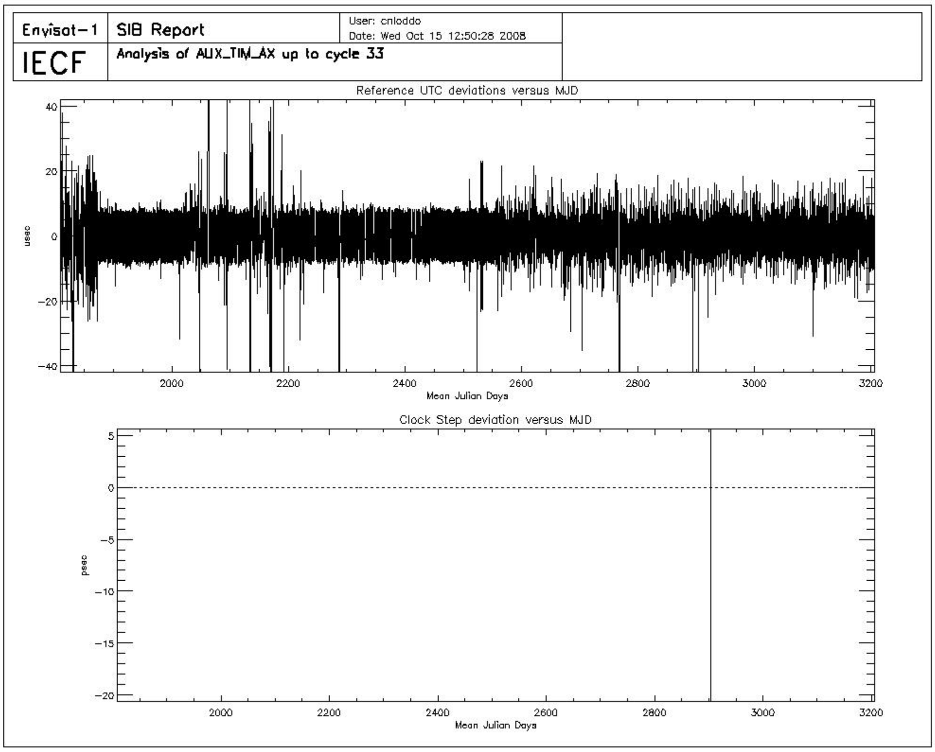


Figure 15: *UTC deviations and ICU clock period from cycle 33 onwards*

5.1.5 In-fligth 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 the current cycle (averaged per day) are reported in the next figures. The correction factors on S Band are no more being monitored from cycle 65 onwards due to the lost of the S-band transmission power, occurred on 17 January 2008, 23:23:40 (orbit 30759), see section 7.1.

The Ku Band Time delay in-flight calibration factor, reported in Figure 16, shows a regular behavior as observed on previous cycles.

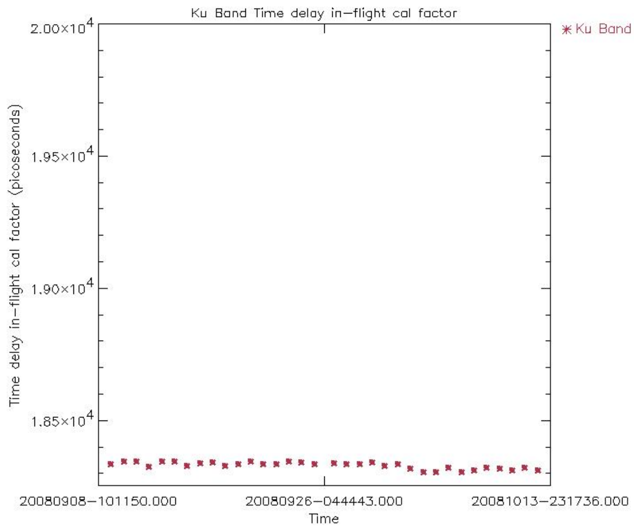


Figure 16: *Ku Band in-flight time delay calibration factor for cycle 72 (averaged per day)*

The Ku band Sigma0 calibration factor, reported in red in Figure 17, shows a drop of about 0.1dB on the 2nd of October. This drop has no impact on the data but it still under investigation.

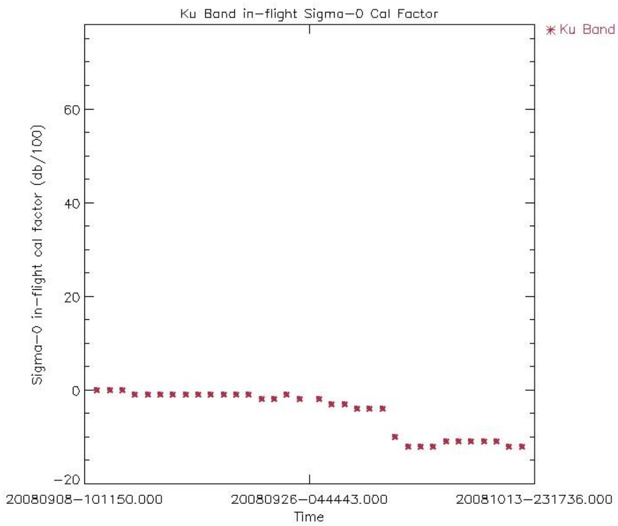


Figure 17: *Ku Band in-flight Sigma0 calibration factor for cycle 72 (averaged per day)*

Figure 18 and Figure 20 report Ku and S Band in-flight calibration factors for Time Delay and Sigma0 respectively, daily averaged, up to the current cycle. The Time Delay factor is shown to be very stable for both the working frequencies. The Ku band Sigma0 factor reveals a decrease of about 0.5 dBs over the period starting from cycle 16 to cycle 72, then on 2nd of October 2008 a cecrease of about 0.1dB is observed again. 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.

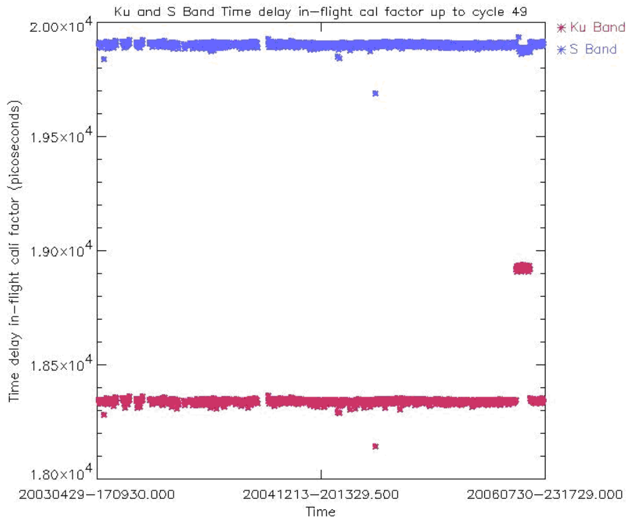


Figure 18: *Ku and S Band in-flight time delay calibration factor up to cycle 49 (averaged per day)*

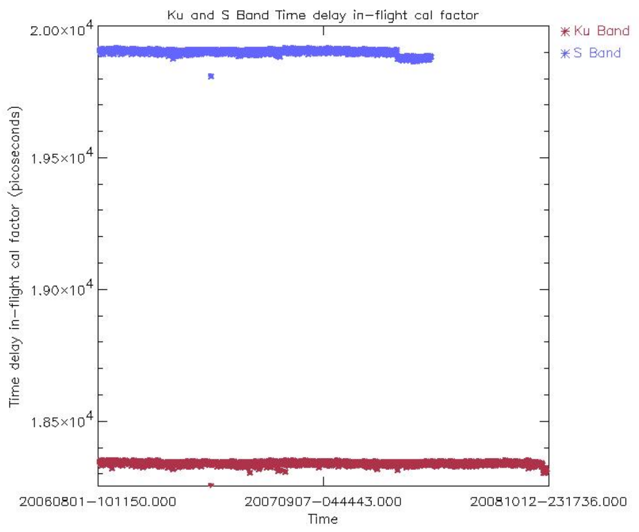


Figure 19: *Ku and S Band in-flight time delay calibration factor from cycle 50 onwards (averaged per day)*

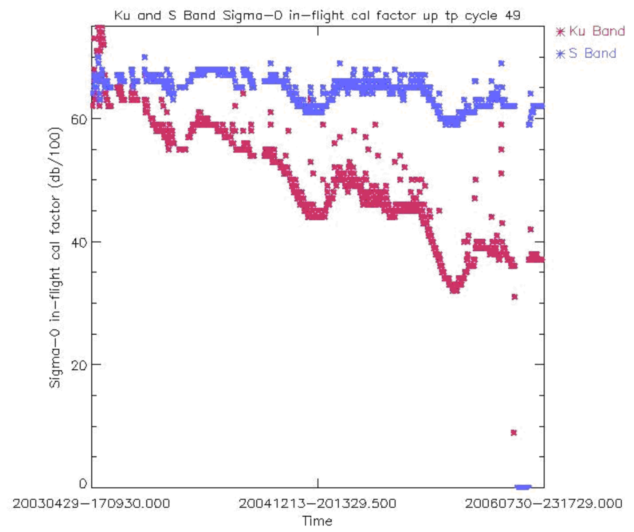


Figure 20: *Ku and S Band in-flight Sigma0 calibration factor up to cycle 49 (averaged per day)*

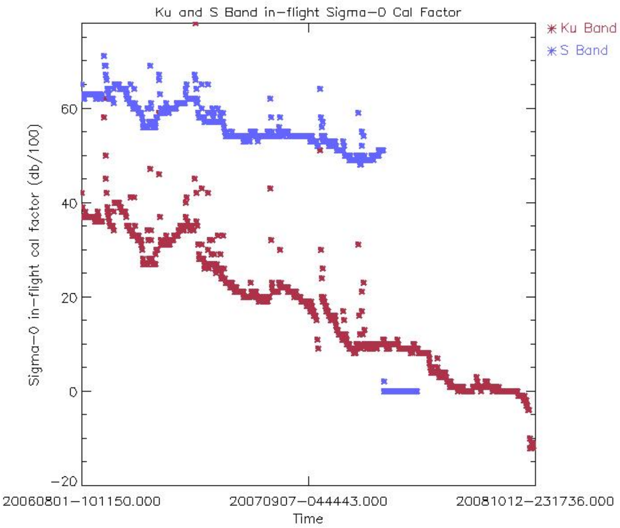


Figure 21: *Ku and S Band in-flight Sigma0 calibration factor from cycle 50 onwards (averaged per day)*

5.1.6 Sigma0 Transponder

The Sigma0 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 Sigma0 during the Envisat lifetime, continual monitoring is accomplished by operating the transponder for as many Envisat overpasses as possible.
Since the 11th of October 2005 the transponder has been moved to a permanent site located in Rome.
The acquisition planned for the 30th of September 2008 has been successfully performed but due to operational problems the data could not be processed.

Appendix 8.4 reports the transponder measurements from cycle 24 onwards.

The mean value of the estimated bias at High Resolution is 1.02 dB with a standard deviation of 0.12 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 22, 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.

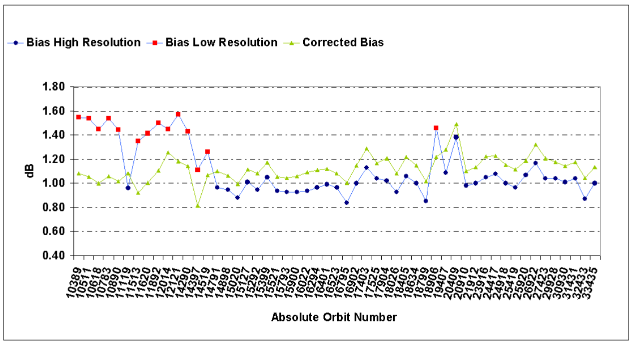


Figure 22: *Time behavior of the transponder bias*

5.2 MWR performance

For MWR performance please refer to the Reference CLS Cyclic Report of the type of REF[2]. http://earth.esa.int/pcs/envisat/mwr/reports/

5.3 Doris performance

For DORIS performance please refer to the Reference F-PAC Monthly Report of the type of REF[7].

6 Level2 Product performance

6.1 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/

6.2 Data handling recommendations

6.2.1 S-Band power drop

Ten hours after the recovery of the HSM anomaly on the 17 January 2008, a drop of the RA2 S-Band transmission power occurred. The drop occurred in the South Atlantic Anomaly, showing similar characteristics as for the RA-2 RFSS Side B S-band power drop anomaly occurred in May 2006. Investigations have been conducted and the failure of the S-Band power stage is considered to be permanent.

WARNING: Consequently, the S-Band parameters, including the dual ionospheric correction are not relevant anymore and MUST NOT be used from the following date: 17 January 2008, 23:23:40, UTC, orbit number 30759 (cycle 65). Users are advised to use the Ionospheric correction from Bent model, which is available in FDGDR data products: FDGDR Ionospheric correction from model on Ku-band (field 47).

6.2.2 USO range correction

The Ultra Stable Oscillator (USO) onboard ENVISAT has gone threw different behaviors since the beginning of the mission. Users are advised that a correction needs to be applied on this parameter before using the range. The protocole is different according to the period concerned. Three different periods can be distinguished and are detailled in part 7.
Since July 2005, a USO correction has been developed to correct the abnormal RA-2 USO behavior affecting the Altimetric Range by few meters w.r.t. the Mean Sea Surface. Since then, the oscillator changed from anomalous to non-anomalous period (see part 5.1.3).

For this cycle, the range in FDGDR products is NOT CORRECTED and needs to be corrected using the new correction files available from:
http://earth.esa.int/pcs/envisat/ra2/auxdata/NewCorrection.html
or ftp://ftp.esrin.esa.it/pub/RA2_MWR/USO/auxdata/
.
A software routine has also 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 than the new correction files.

WARNING: Users are advised to apply the correction auxiliary files even during the non-anomalous period in order to correct for the nominal ageing drift of the USO device.

WARNING: For data acquired after 1st February 2006: This correction has to be ADDED to the Ku and S-Band altimetric range.

6.2.3 Ice Flag

No Ice Flag is currently available in RA-2 FDGDR products. If needed, it can be computed with the following data combination (See REF[12]).
A measurement is set to ice if, at high latitudes (> |50| deg), one of the following criteria is valid:
- Number of 20Hz measurement < 17
- $|MWR - ECMWF|$ wet tropospheric correction > 10cm
- Peakiness > 2

6.3 Availability of data

6.3.1 RA-2

FDGDR Level2 data availability was around 98.7% for RA-2 products: 35317 out of 2679225 points are missing (1.3%). The maps below illustrate missing 1Hz measurements in the FDGDRs, with respect to a 1 Hz sampling of a nominal repeat track.

In Figure 23 and in part 8.2, the summary of unavailable RA2 Level2 products is given.
- It is easy to notice that close to the Himalaya region small gaps of less than 300 seconds are missing on ascending passes (once a day). This is due to the daily instrument switch-offs (Heater 2 mode) performed as part of the IF calibration commands sequence.
- Three other recurrent gaps are also explained by the transponder acquisition (ESA/Rome, GAV-DOS/Creta and CRYOSAT/Svalbard).
- Another recurrent gap of around 179 seconds (descending track, West of Peru) can also be visible (not systematically, though). It is due to an instrument anomaly under investigation.
- Local points irregularly spread over the globe are also seen to be missing on descending passes. This is yet unexplained but under investigation.

Note that during cycle 72, part or entire passes are missing. This is due to several Artemis unavailability (see detail in table 1).

6.3.2 MWR

In Figure 24 the map of unavailable MWR L0 products is given. The other levels availability is also summed up in part 8.2.

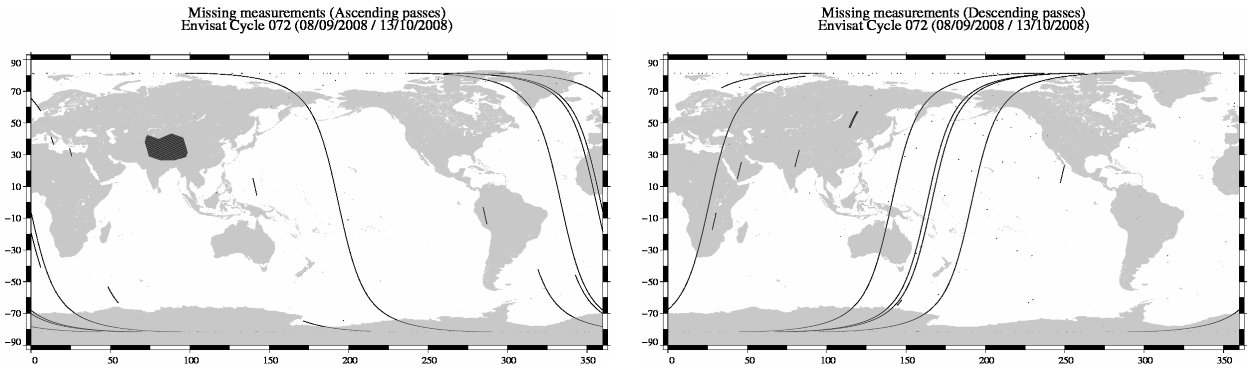


Figure 23: *Missing measurements on ascending and descending passes on cycle 072*

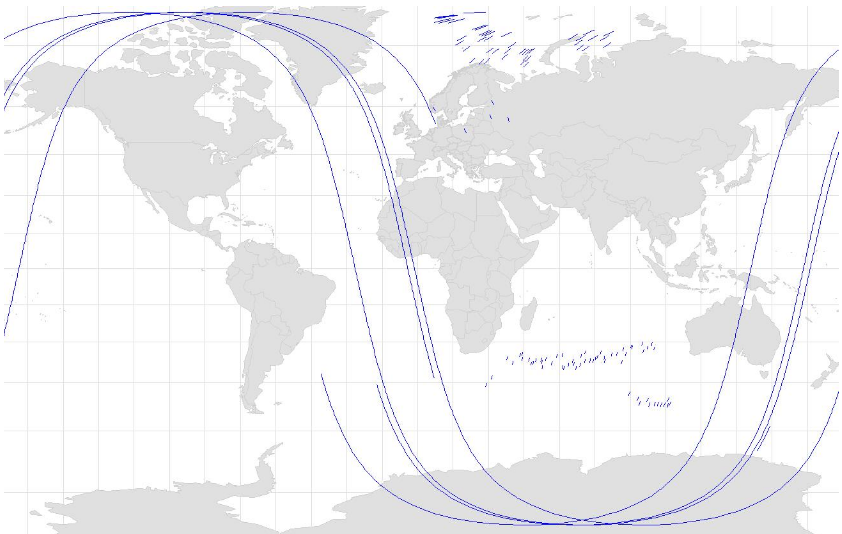


Figure 24: *Missing Level0 MWR FDGDR measurements on cycle 072*

6.4 Generic data editing over ocean

To evaluate the performances of the Envisat's altimetric system, data over ocean only are selected. For this, an editing is necessary to remove altimeter measurements having a too low accuracy.
It is performed in two steps :
- An editing using flag
- An editing using thresholds

6.4.1 Statistics

The tables below give the number and percentage of measurement rejected by each step of these editings.

- The editing per flag uses 3 flags read from the FDGDR product, plus the additionnal Ice Flag computed as defined in part 6.2.3.

Parameter	Nb rejected	% rejected
Land/ocean mask	908131	38.14
Radiometer land flag	913995	38.38
Ice flag	704881	29.60

- The editing per thresholds is applied on several criteria. These thresholds are expected to remain constant throughout the Envisat mission, so that monitoring the number of edited measurements allows a survey of data quality.
  Next table gives, for each tested parameter, the minimum and maximum thresholds, the number and the percentage of points removed.

Parameters	Min Thres.	Max Thres.	Nb rejected	% rejected
Number of 18Hz valid points	10.000	-	172	0.01
Std. deviation of 18Hz range (m)	0.000	0.250	17866	1.26
Off nadir angle from waveform (deg2)	-0.200	0.160	7134	0.50
Dry tropospheric correction (m)	-2.500	-1.900	21069	1.49
Inverted barometer (m)	-2.000	2.000	21069	1.49
MWR wet tropospheric correction (m)	-0.500	-0.001	11955	0.84
BENT Ionospheric correction (m)	-0.400	0.040	0	0.00
Significant wave height (m)	0.000	11.000	2498	0.18
Sea state Bias (m)	-0.500	0.000	3577	0.25
Backscatter coefficient (dB)	7.000	30.000	3320	0.23
GOT00 ocean tide height (m)	-5.000	5.000	1452	0.10
Long period tide height (m)	-0.500	0.500	0	0.00
.../...				

Parameters	Min Thres.	Max Thres.	Nb rejected	% rejected
Earth tide (m)	-1.000	1.000	0	0.00
Pole tide (m)	-5.000	5.000	0	0.00
RA2 wind speed (m/s)	0.000	30.000	758	0.05
USO correction (m)	-10.000	10.000	10	0.00

6.4.2 Removed and selected measurements maps

The following maps are complementary: they show respectively the removed and selected measurements in the generic editing procedure.

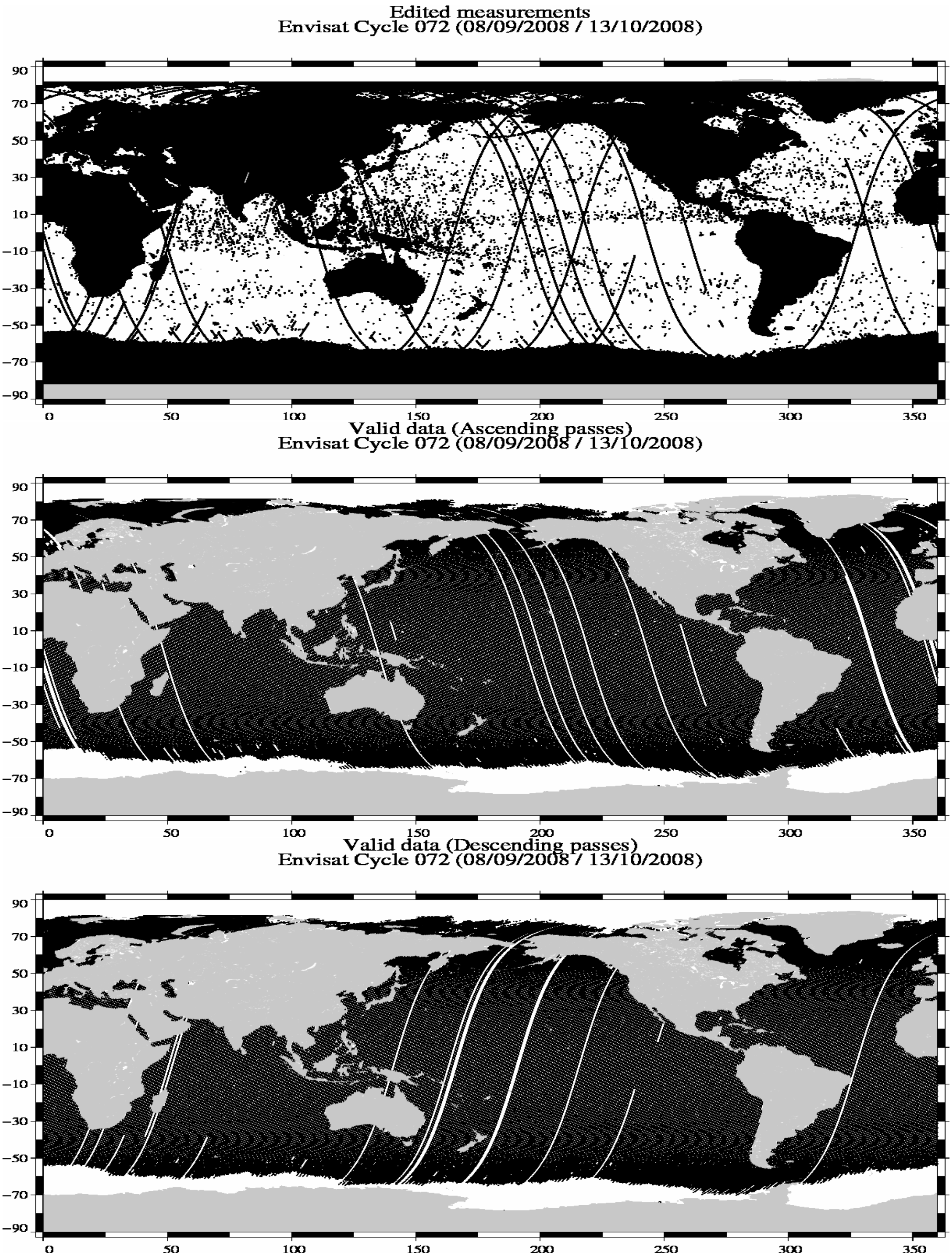


Figure 25: *Removed and selected measurements in the generic editing procedure on cycle 072*

6.5 Sea Surface Heigh (SSH) and Sea Surface Anomaly (SLA)

The major parameters monitored over ocean are the Sea Surface Heigh (SSH) and the Sea Surface Anomaly (SLA). They are defined as :

$$SSH = Orbit - Range - Corrections \quad (1)$$
$$SLA = SSH - MeanSeaLevel \quad (2)$$

The Ku Band SSH has been computed with the following terms:
- Ku range (ocean retracking)
- Doris navigator orbit

The Ku Band Corrections have been computed with the following terms:

- BENT model ionospheric correction. Due to the S-Band Power drop anomaly, started on the 17th of January, the bi-frequency ionospheric correction can not be used anymore see section 7
- MWR derived wet troposphere correction
- ECMWF dry tropospheric correction
- Non parametric sea state bias
- Inverted barometer
- Total geocentric GOT00 ocean tide height
- Geocentric pole tide height
- Solid earth tide height

6.6 Specific Sea Surface Heigh editing

Monitoring the quality of the Sea Surface Heigh (SSH) (and further the Sea Surface Anomaly (SLA) requires to complete the generic editing by an additionnal specific editing.
It is performed in 4 steps:
- An editing using Valid DORIS flag
- An editing using thresholds
- An editing using spline fitting
- An editing using statistics per track

6.6.1 Statistics

The tables below give the number and percentage of measurement rejected by this editing.

- Valid DORIS flag editing is applied on measurements selected with generic editing:

Parameter	Nb rejected	% rejected
First generic editing	1268194	49.18
Valid doris flag	266698	10.34

- Thresholds are applied on both Orbit - Range and Sea Level Anomaly:

Parameters	Min Thres. (m)	Max Thres. (m)	Nb rejected	% rejected
Orbit - Range	-130.000	100.000	0	0.00
Sea Level Anomaly	-2.000	2.000	69	0.01

- A spline is then fitted on the selected measurements in order to remove isolated spurious points.

Parameters	Nb rejected	% rejected
Sea Level Anomaly	620	0.05

- Finally statistics per track are performed to remove tracks for which mean or standard deviation are out of range.

Parameters	Moy Thres. (m)	Std Dev Thres. (m)	Nb rejected	% rejected
Sea Level Anomaly with variability $< 0.3m$ and bathymetry$< -1000m$	0.400	0.300	11614	0.89

6.6.2 Removed and selected measurements maps

The following maps are complementary: they show respectively the removed and selected measurements in the specific editing procedure.

The edited data maps show that :
- Land and ice are removed.
- Wet areas are visible on the first map.
- Series of passes are also removed on various criteria.
- Patches of data are also recurrently removed on descending tracks in the South Indian Ocean and ascending tracks in the South Altlantic. These zones correspond to the end of FDGDR products. They are removed by the Doris Flag (see Figure 27), giving an indication on the orbit quality. After a first investigation, the zones considered as bad by this flag are suspected to be over-estimated. This is still under investigation.

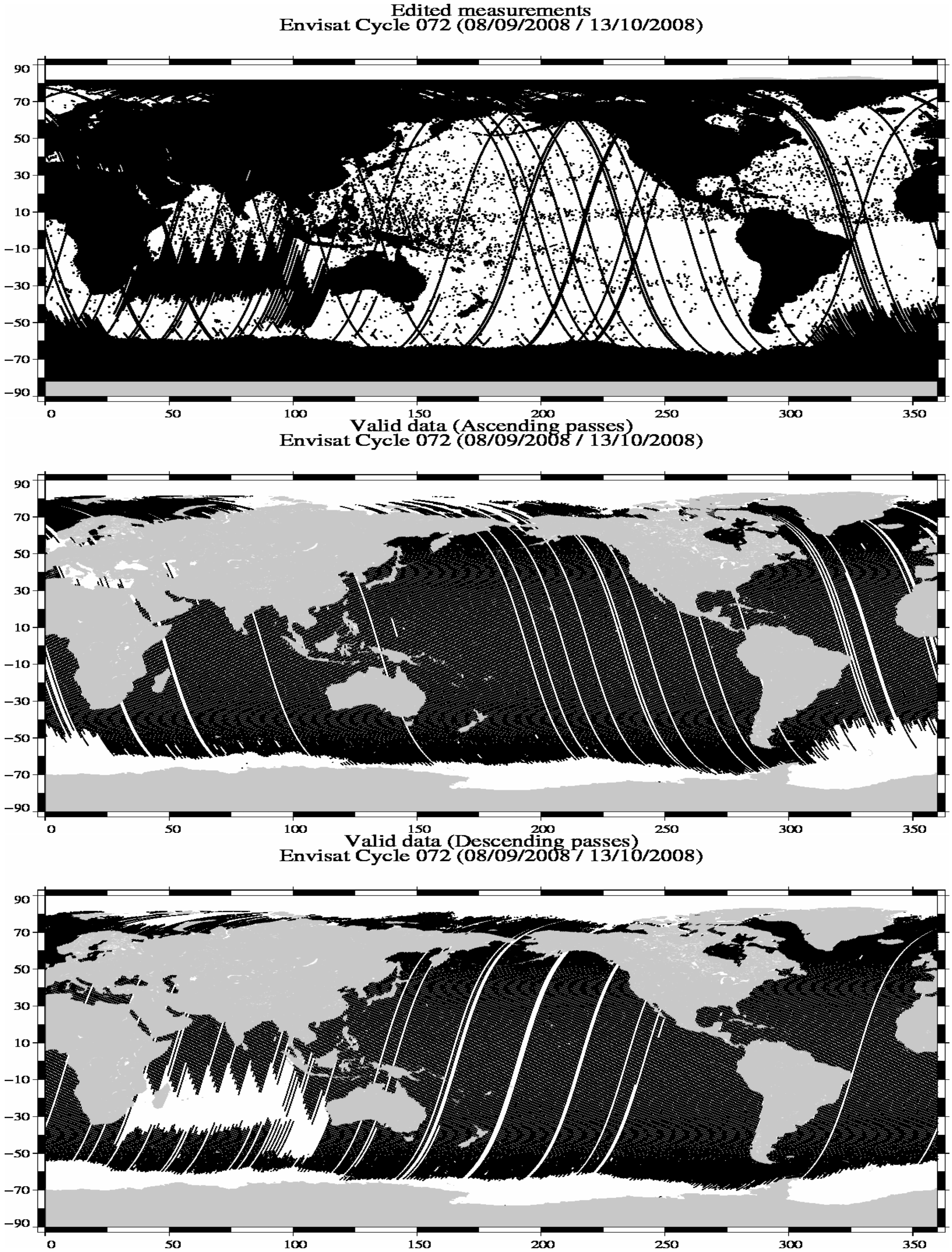


Figure 26: *Removed and selected measurements in the specific editing procedure on cycle 072*

6.7 RA-2 Altimeter parameters

Hereafter a summary of the main altimetric parameters performances is reported.
This part consists in an overview of the missing measurements, a point on the selection applied on data over ocean and a monitoring of the main altimeter and radiometer parameters concerning the selected data.

For information purpose, GDR (in black) monitoring of completed cycles have been superimposed to FDGDR (in red) monitoring.
This enables to have an historic of the data from the beginning of the mission with a "best quality" product taken as a reference.
Differences are generally due to differences of :
- orbit
- corrections
- IPF version's homogeneity

For GDR performance please refer to the Reference CLS Cyclic Report in [13].

6.7.1 Orbit

Since the 20th of June 2007, operations date of IPF version 5.06, the DORIS Navigator usage on NRT processing has increased. The usage of DORIS on NRT processing increases the quality of FDGDR SLA. The SLA variability has decreased from 20 m to about 50 cm.

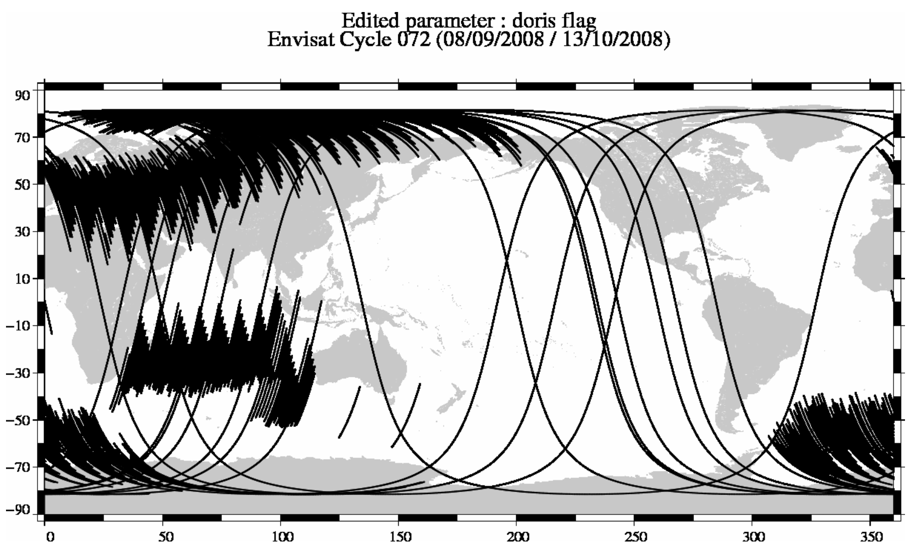


Figure 27: *Passes not processed with DORIS on cycle 072*

Around five minutes of data are seen to be recurrently removed on descending tracks in the South Indian Ocean and ascending tracks in the South Altlantic. These zones correspond to the end of

FDGDR products. They are removed by the Doris Flag (see Figure 27), giving an indication on the orbit quality. The zones considered as bad by this flag are suspected to be over-estimated. This is under investigation.

Figure 28 shows the [Doris navigator-MOE] radial differences on ascending and descending passes. We can observe that the differences are between -40cm and 40cm with systematic ascending/descending and North/South differences.
The statistics of differences are:

Number	Mean (m)	Std. dev. (m)
1298328	-1.24	16.86

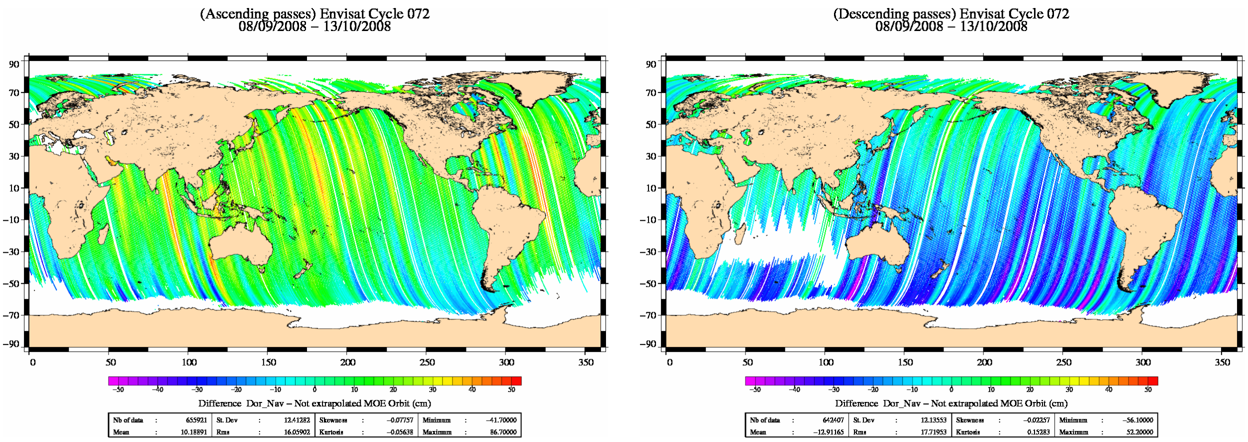


Figure 28: *[Doris navigator - MOE] differences on ascending and descending passes on cycle 072*

6.7.2 Sea Level Anomaly

The quality of Ku Band SLA using specific Sea Surface Heigh editing is monitored here.

In Figure 29 the Histogram of Sea Level Anomaly is reported for the Ku Band.

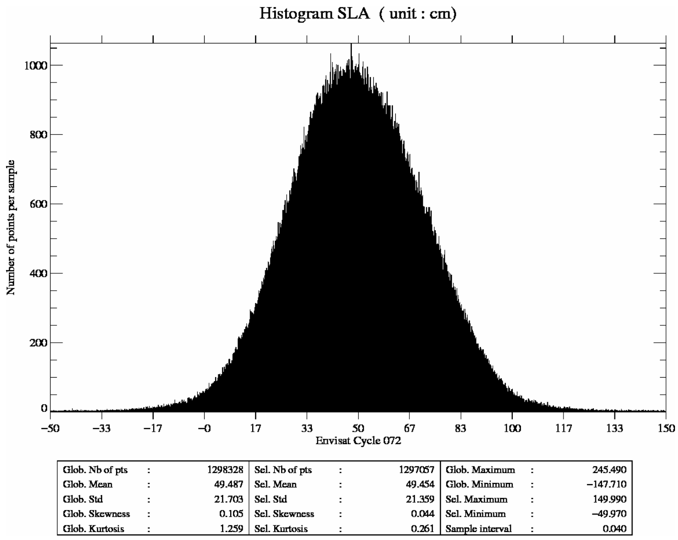


Figure 29: *Histogram of Sea Level Anomaly for cycle 072*

On Figure 30, it can be observed that the altimetric range was nominal on cycle 072. The peak of the histogram is slightly less than 50 centimeters as expected.

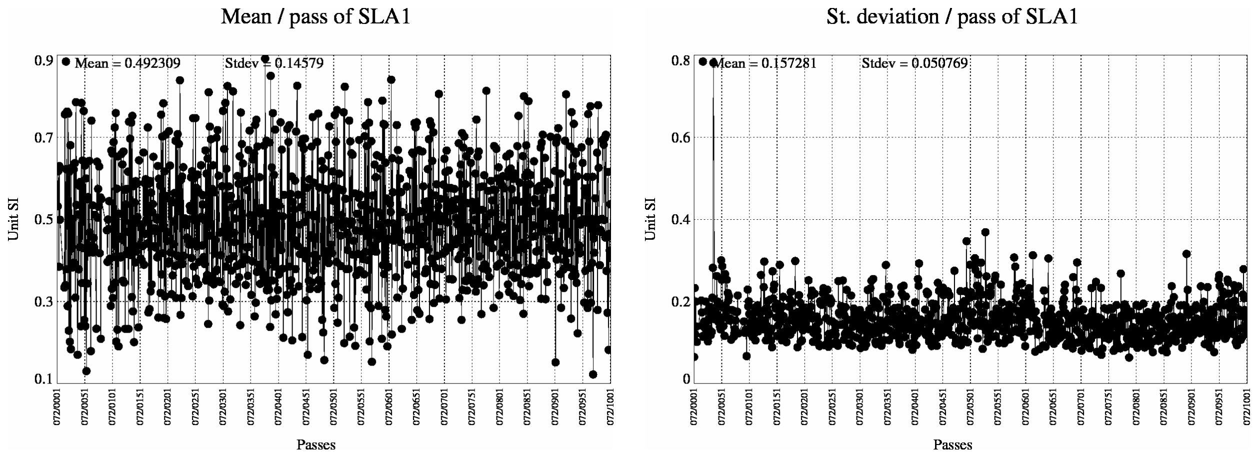


Figure 30: *Sea Level Anomaly : mean and standard deviation per track for cycle 072*

Figure 31 shows the monitoring per day of Sea Level Anomaly from the beginning of the mission. In red, FDGDR data are superimposed to GDR data (in black).

No particular behavior is noticed for this cycle, the continuity is insured. Due to the real time constraints, FDGDR products' quality is lower than the GDR's. However both quality are good and both keeps on improving. Note that the bump around cycle 61 (october 2007) was due to the year 2007's low ice extent record. For the first time, an altimetric satellite measured open water sea surface height North East Siberia until 82 degrees during September-October 2007. Inaccurate Mean Sea Surface in this area might explain these low SLA performances.

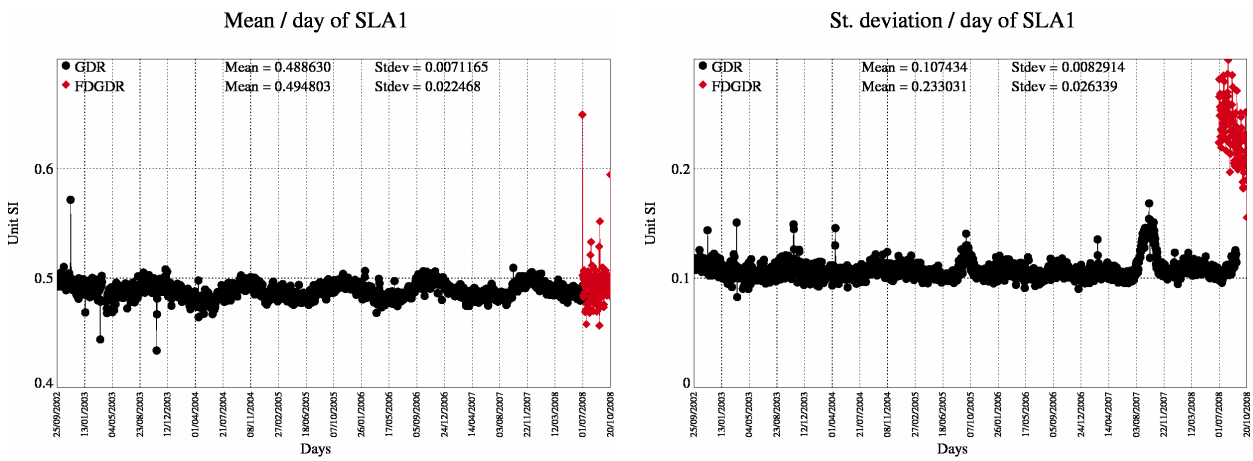


Figure 31: *Sea Level Anomaly : mean and standard deviation per day from cycle 009 to cycle 072*

When using an additionnal selection to remove shallow waters (1000 m), areas of high ocean variability and high latitudes (> |50| deg) statistics are:

Number	Mean (m)	Std. dev. (m)
1298328	-1.24	16.86

Figures 32 and 33 show the map of Envisat SLA relative to the MSS and the map of the measurements where the differences centered on the mean value are greater than 60 cm. Figure 33 shows that apart from strong orbit track effects, the highest differences are located in high ocean variability areas, as expected.

In order to have a long term monitoring of the SLA quality, the Sea Level Anomaly the cycle per cycle standard deviation of the SLA is plotted as a function of time.

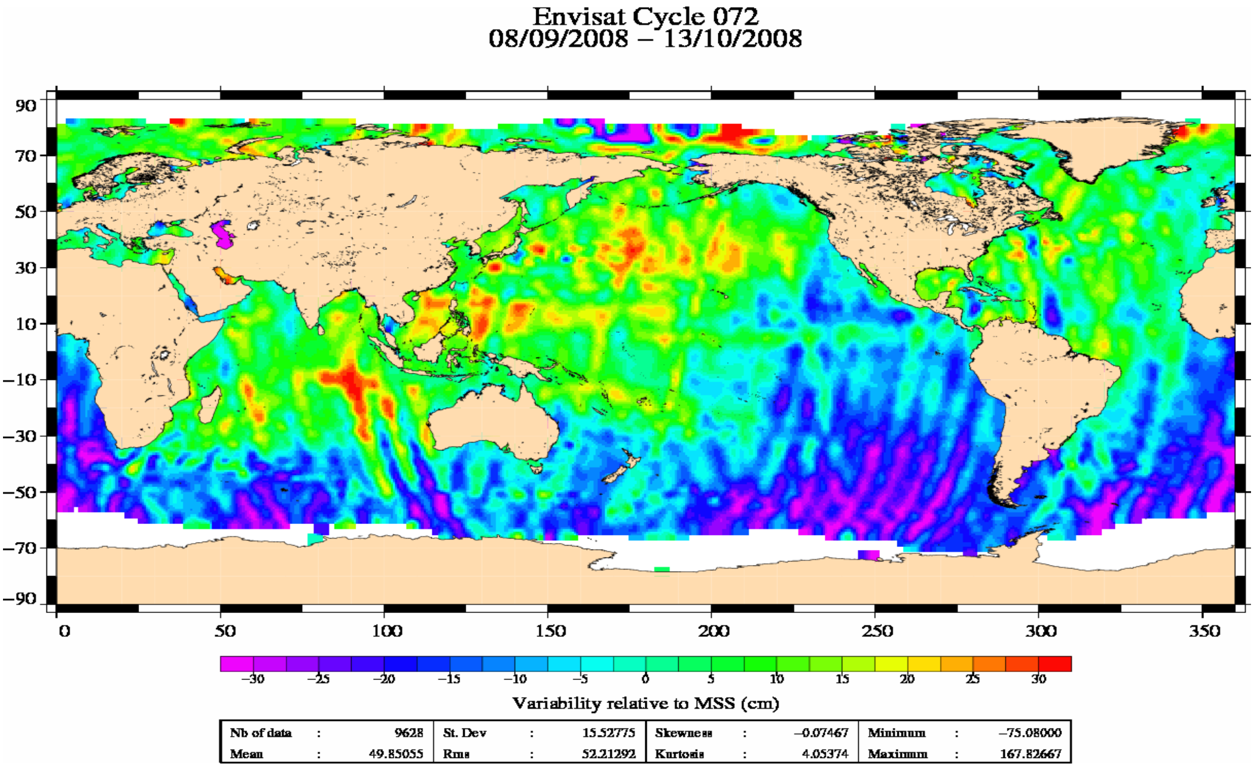


Figure 32: *Map of Sea Level Anomaly relative to the MSS*

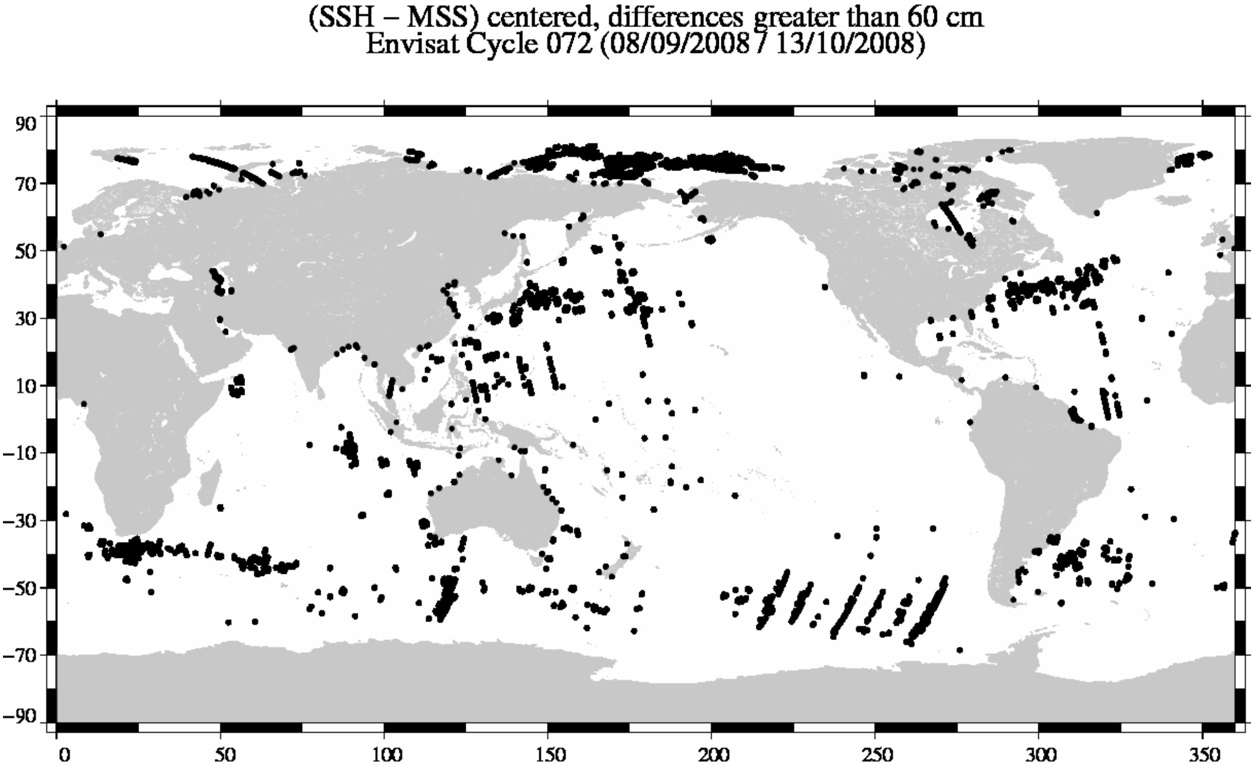


Figure 33: *Map of Sea Level Anomaly higher than a 60 cm threshold*

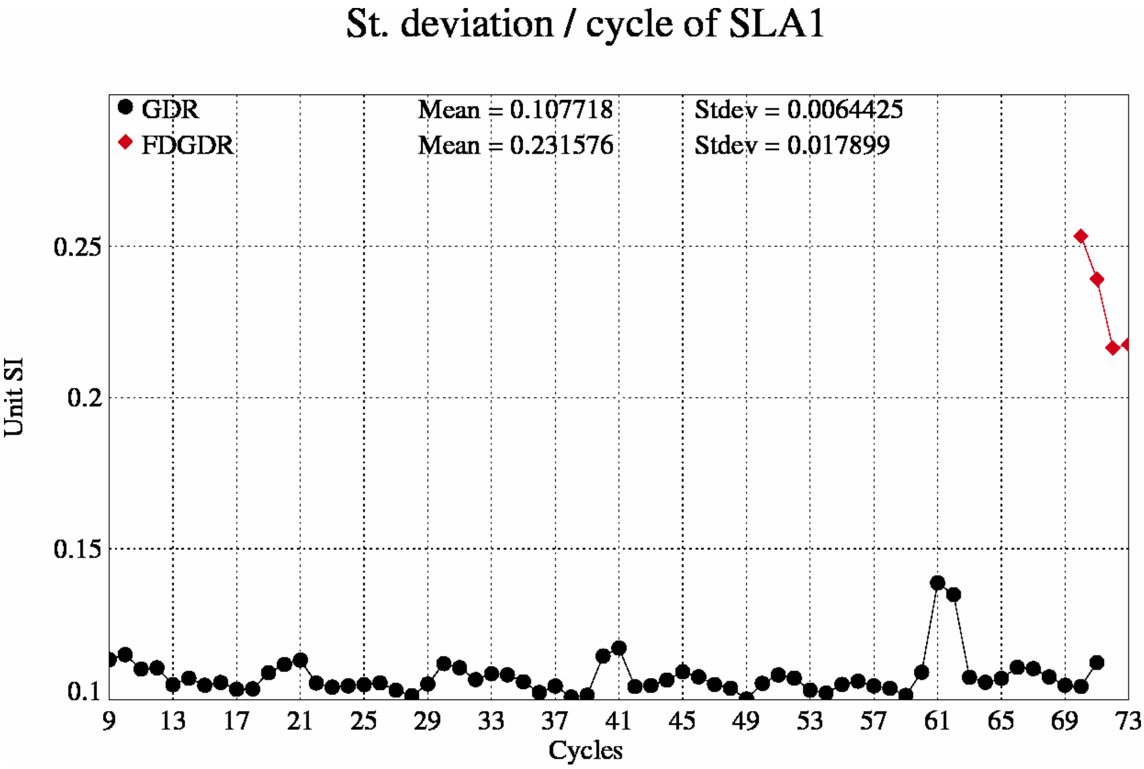
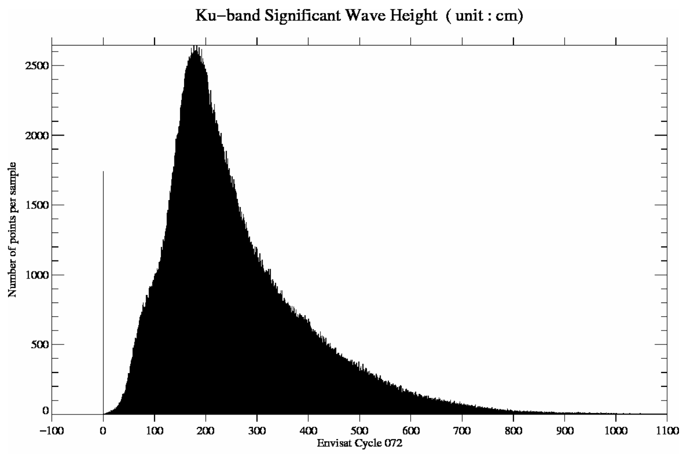


Figure 34: *Sea Level Anomaly monitoring per cycle*

6.7.3 Significant wave height

The Significant Wave Height (SWH) monitored here are edited with generic editing detailled in part 6.4 The histogram of the SWH reported in Figure 35 shows a nominal behavior on the Ku Band. The S-Band is not monitored anymore due to the S-Band Power drop, which started on cycle 65, 17th January 2008.
Figure 36 shows the Ku Band SWH mean per track. Its behavior is nominal. No particular behavior is noticed for this cycle, the continuity is insured.



Glob. Nb of pts	:	1417844	Sel. Nb of pts	:	1417844	Glob. Maximum	:	1099.300
Glob. Mean	:	258.578	Sel. Mean	:	258.578	Glob. Minimum	:	0.000
Glob. Std	:	138.553	Sel. Std	:	138.553	Sel. Maximum	:	1099.300
Glob. Skewness	:	1.294	Sel. Skewness	:	1.294	Sel. Minimum	:	0.000
Glob. Kurtosis	:	2.140	Sel. Kurtosis	:	2.140	Sample interval	:	0.400

Figure 35: *Histogram of KU band SWH for cycle 072*

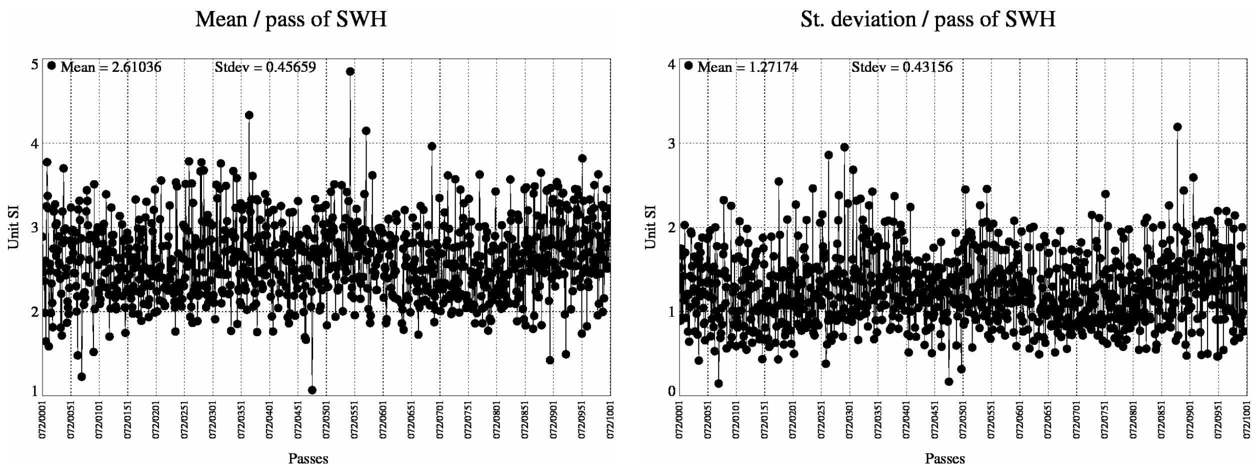


Figure 36: *KU band SWH : mean and standard deviation per track for cycle 072*

Figure 37 shows the monitoring per day of Ku band SWH. from the beginning of the mission. In red, FDGDR data are superimposed to GDR data (in black)

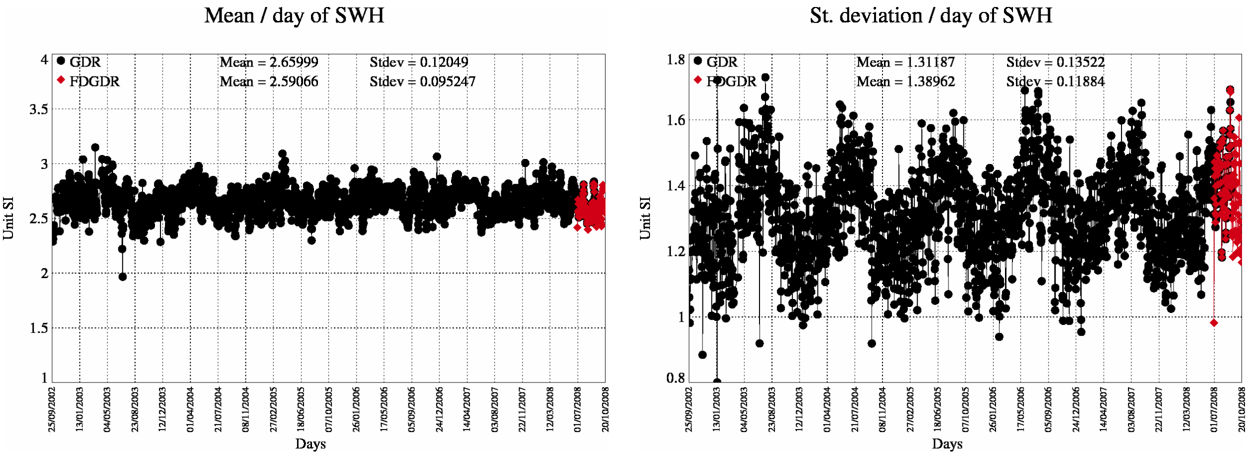


Figure 37: *KU band SWH : mean and standard deviation per day from cycle 009 to cycle 072*

Finally, figure 38 shows a map of significant wave height estimation derived from 35 days of altimeter measurements.

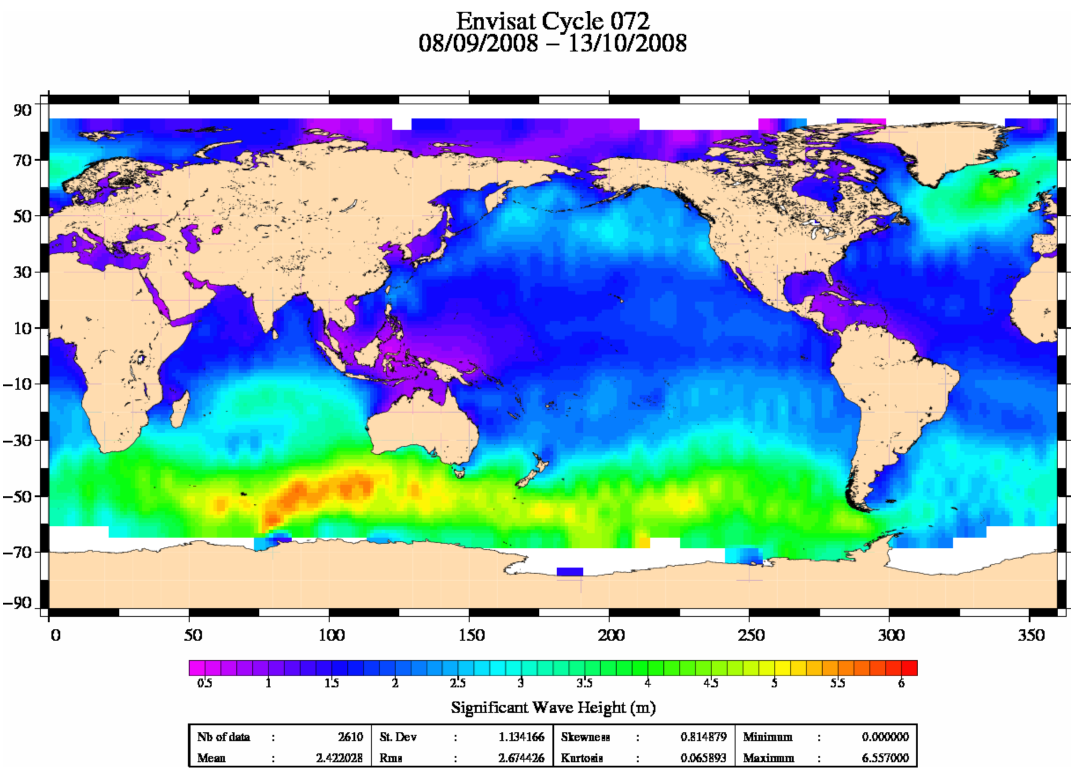
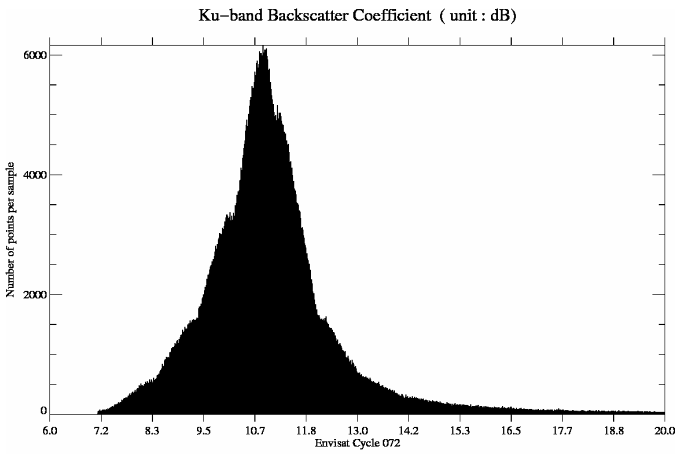


Figure 38: *Significant wave height derived from 35 days of altimeter measurements*

6.7.4 Backscatter coefficient - Wind speed

Sigma_0 and wind speed monitored here are edited with generic editing detailled in part 6.4
The Sigma_0 histogram in Ku Band is reported in Figure 39. The S-Band is not being monitored anymore due to the S-Band Power drop, started on date 17th of January 2008. The Sigma_0 histogram in Ku Band is nominal. It shows secondary peaks as in the previous cycles.



Glob. Nb of pts	:	1417844	Sel. Nb of pts	:	1405775	Glob. Maximum	:	29.980
Glob. Mean	:	11.109	Sel. Mean	:	11.009	Glob. Minimum	:	7.080
Glob. Std	:	1.914	Sel. Std	:	1.579	Sel. Maximum	:	19.990
Glob. Skewness	:	2.819	Sel. Skewness	:	1.506	Sel. Minimum	:	7.080
Glob. Kurtosis	:	14.563	Sel. Kurtosis	:	5.195	Sample interval	:	0.010

Figure 39: *Histogram of KU band Sigma_0 for cycle 072*

Figure 40, show the Ku band backscattering coefficient daily average and standard deviation per track. Its behavior is nominal.

Figure 41 shows the monitoring per day of Ku band Sigma_0. from the beginning of the mission. In red, FDGDR data are superimposed to GDR data (in black)
No particular behavior is noticed for this cycle, the continuity is insured.

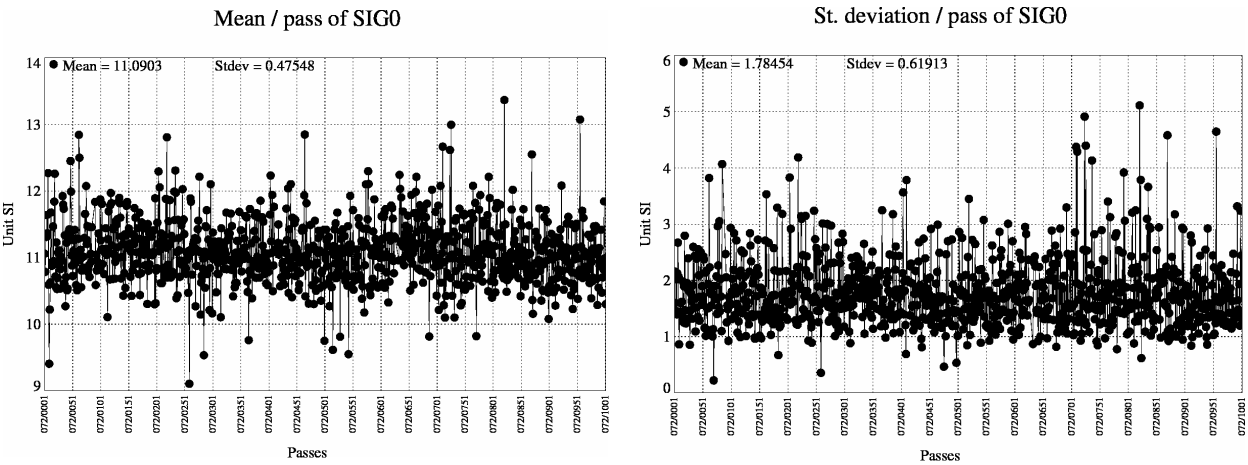


Figure 40: *KU band Sigma_0 : mean and standard deviation per track for cycle 072*

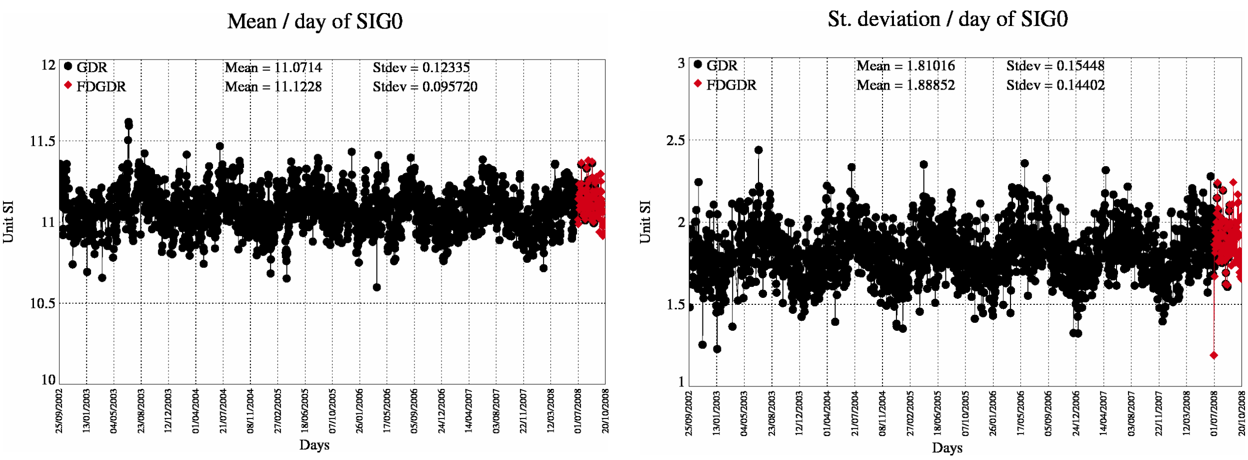


Figure 41: *KU band Sigma_0 : mean and standard deviation per day from cycle 009 to cycle 072*

The histograms of Wind Speed computed for the Ku-band and the time behavior during the current cycle are reported in Figure 43 and 42, respectively.

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.

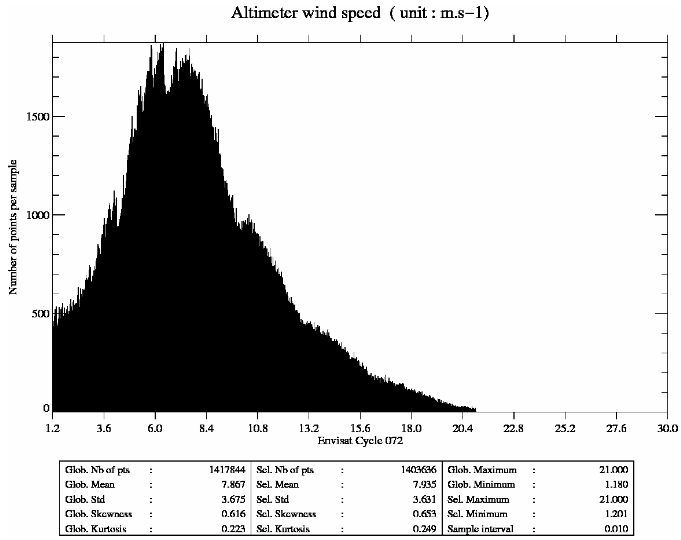


Figure 42: *Histogram of KU band Wind Speed for cycle 072*

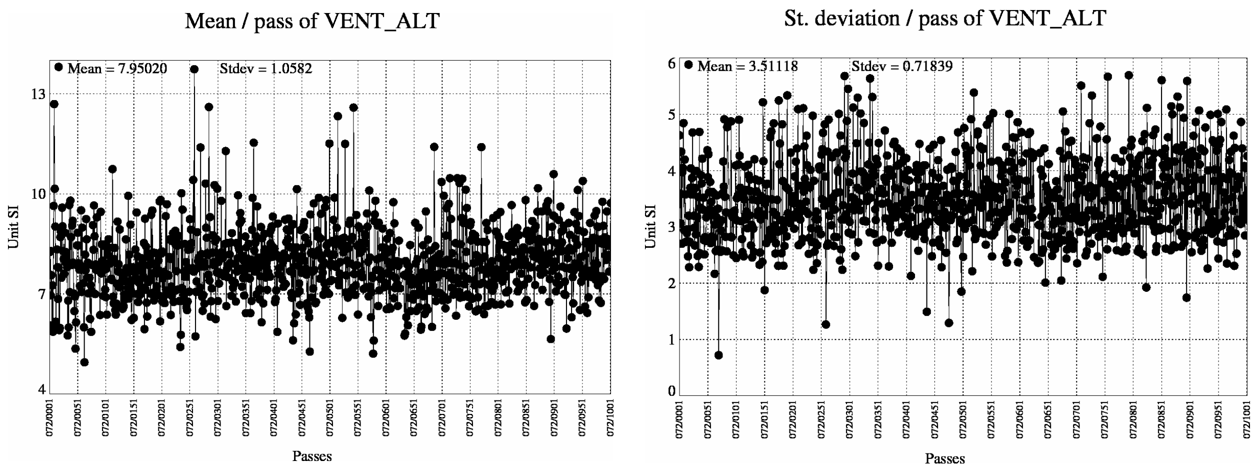


Figure 43: *KU band Wind Speed : mean and standard deviation per track for cycle 072*

Figure 44 shows the monitoring per day of Ku band wind speed. from the beginning of the mission. In red, FDGDR data are superimposed to GDR data (in black).
A jump can be noticed around beginning of September 2005. Since then (since IPF version 5.02) the wind table was updated using S.Abdallah Table. The wind now takes values between around 1 m/s and 22 m/s.

No particular behavior is noticed for this cycle, the continuity is insured.

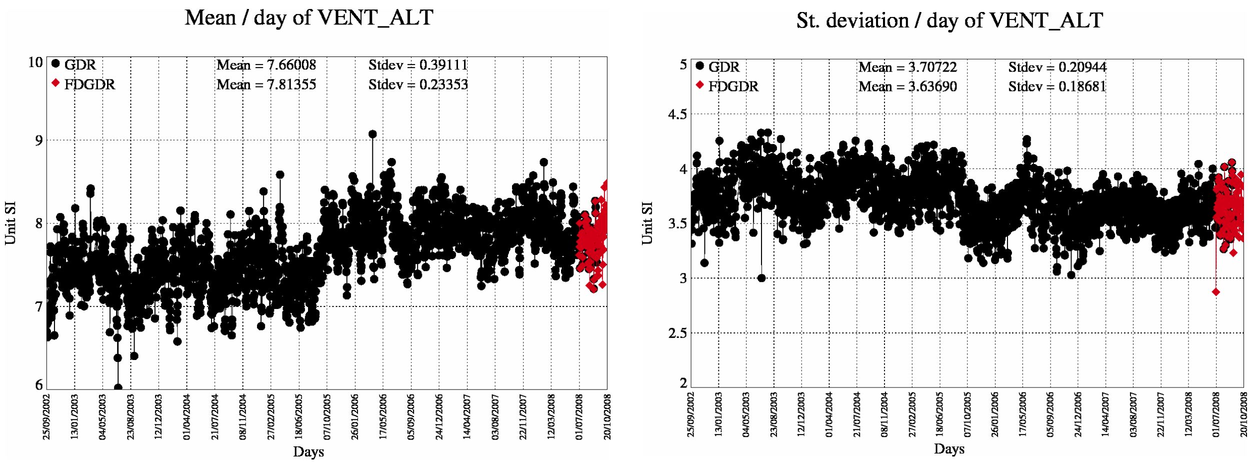


Figure 44: *KU band Wind Speed : mean and standard deviation per day from cycle 009 to cycle 072*

Finally, figure 45 shows a map of wind speed estimation derived from 35 days of altimeter measurements.

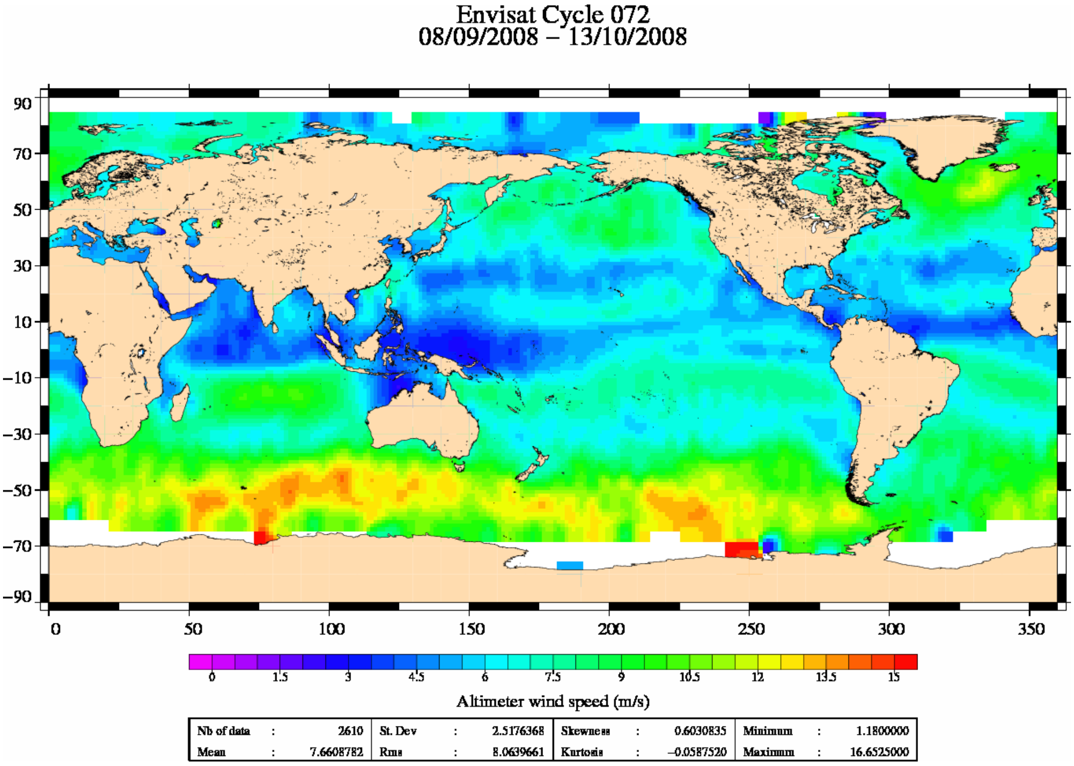


Figure 45: *Wind speed estimation derived from 35 days of altimeter measurements*

6.7.5 Mispointing

The histogram of the mispointing estimated from waveform reported in Figure 46, shows a nominal behavior on the Ku Band.

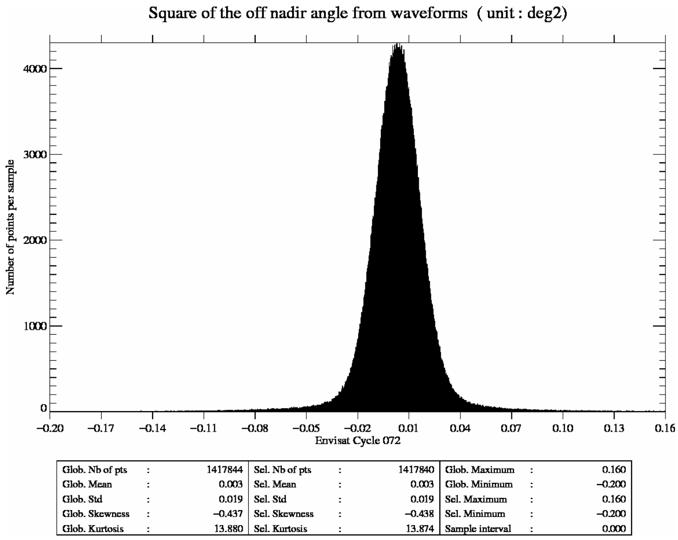


Figure 46: *Histogram of KU band mispointing for cycle 072*

Figure 47 shows the Ku Band mispointing mean per track. Its behavior is nominal.

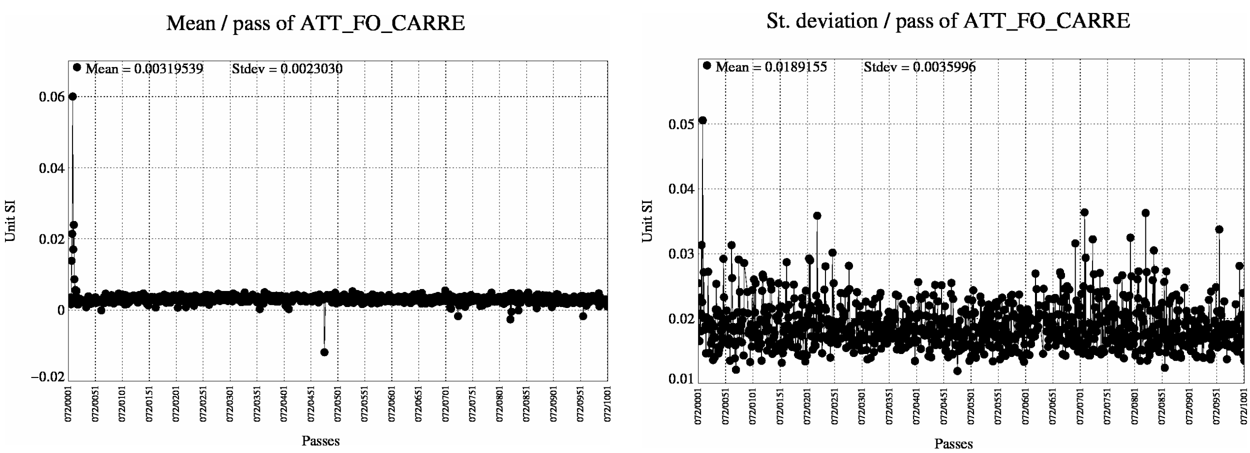


Figure 47: *KU band mispointing : mean and standard deviation per track for cycle 072*

Figure 48 shows the monitoring per day of Ku band mispointing. from the beginning of the mission. In red, FDGDR data are superimposed to GDR data (in black).

For this particular Cycle, a peak is noticed between tracks and 3 and 23, linked to the 09-September-2008 single burn OCM out-of-plane orbit inclination maintenance manoeuvre (see detail in part 4.3).

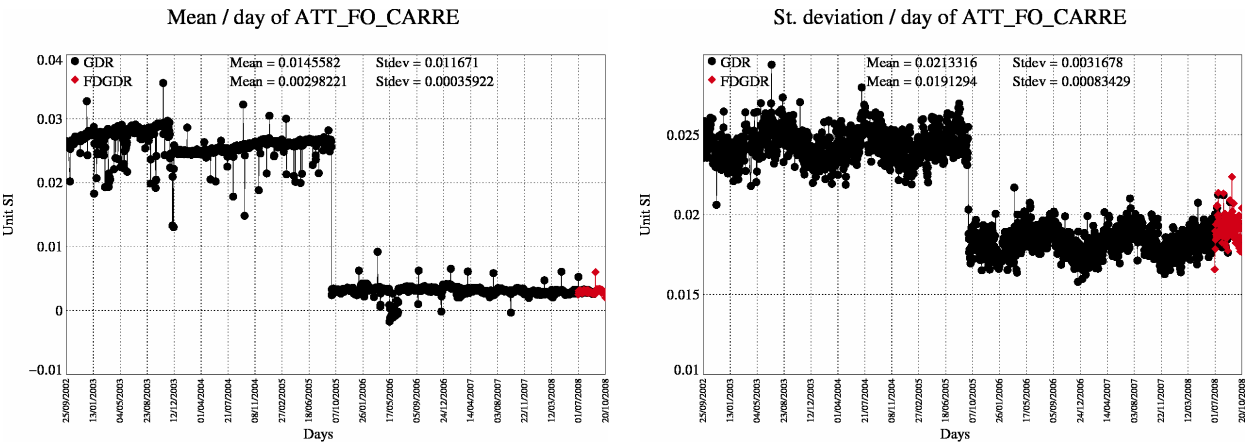


Figure 48: *KU band mispointing : mean and standard deviation per day from cycle 009 to cycle 072*

The jump which occurred on date October 24th 2005 is related to the upload of IPF version 5.02. The abrupt decreasing of the mispointing squared value is related to the new algorithm, used since then.

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 is updated regularly, once per month.

6.8 Radiometer

In order to assess and to monitor radiometer measurements, a scatter plot between the radiometer wet troposphere correction and the ECMWF model is computed for the generic valid data set previously defined.

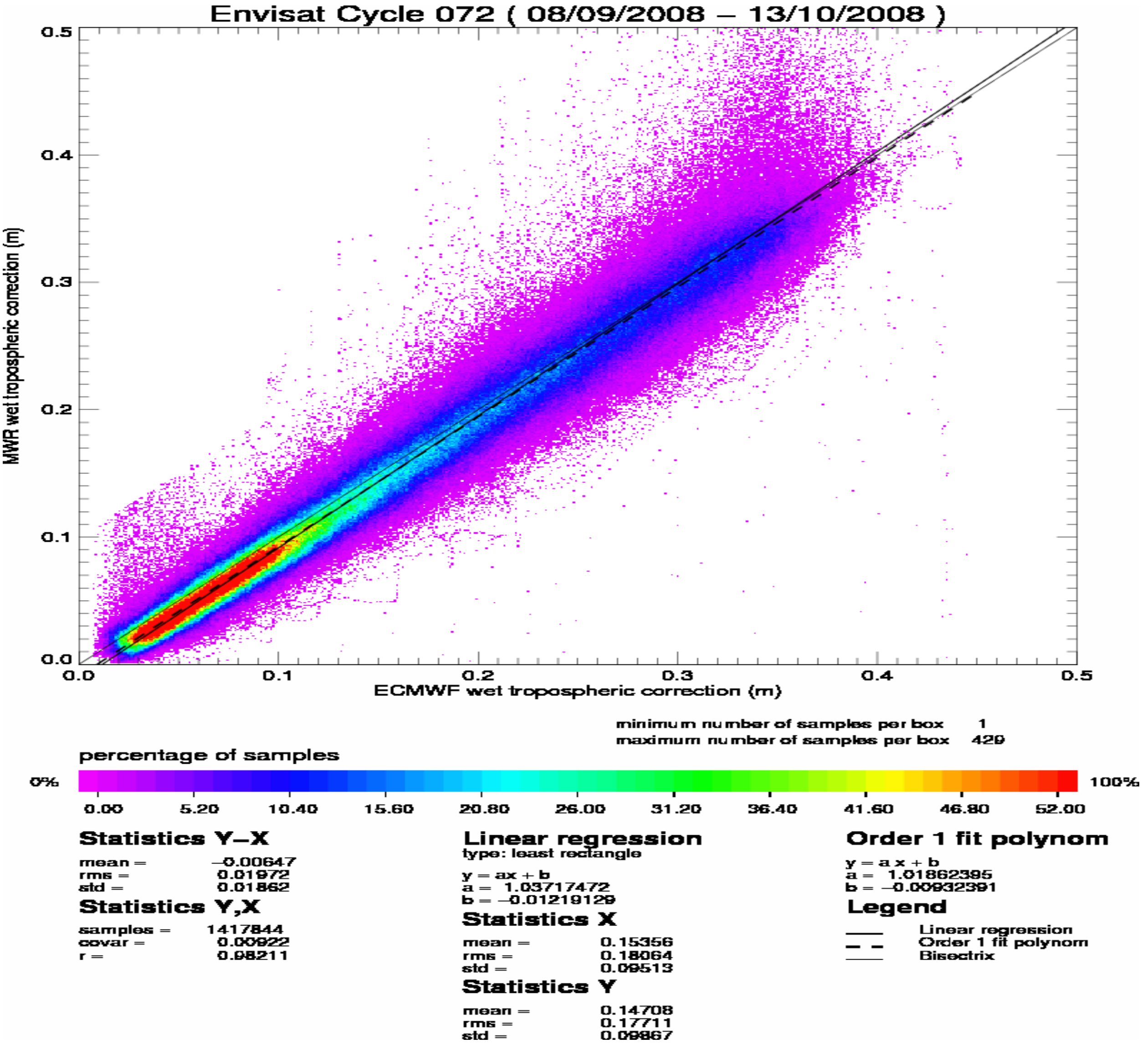


Figure 49: *Radiometer wet troposphere correction and the ECMWF model*

The radiometer-model mean difference is $0.6cm$. A drift on the Envisat 23.8GHz brightness temperature has been detected and is monitored on the long term. Note that the neural algorithm is now implemented on Envisat. For MWR performance please refer to the Reference CLS Cyclic Report in [2].

7 Particular investigations

7.1 S-Band power drop

Ten hours after the recovery of the HSM anomaly on the 17 January 2008, a drop of the RA2 S-Band transmission power occurred. The drop occurred in the South Atlantic Anomaly, showing similar characteristics as for the RA-2 RFSS Side B S-Band power drop anomaly occurred in May 2006. Consequently, all the S-Band parameters, as well as the dual ionospheric correction are not relevant and MUST NOT be used from the following date: 17 January 2008, 23:23:40, UTC, orbit nb 30759. Users are advised to use the Ionospheric correction from Bent model, which is available in FGDR data products: FGDR (Ionospheric correction from model on Ku-band: field 47) Investigations have been conducted and the failure of the S-Band power stage is considered to be permanent.

7.2 USO range correction

Three different periods can be distinguished:

- 1st period From the beginning of the mission until the 24th of October 2005 the Nominal USO clock period has been used in the processing. The data was not corrected for the bias and the drift correlated to the actual USO clock period. All data acquired before 24th October 2005, beginning of cycle 42, have thus to be corrected using the old correction files available on the web site: http://earth.esa.int/pcs/envisat/ra2/auxdata/OldCorrection.html. The measured Range shall be corrected considering a drift of $-4.58mm$ per year and a bias of $29.6mm$. 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.

- 2nd period From the 24th of October 2005 until the 13th of March 2006, outside of the anomaly periods, the actual USO clock period has been used within the processing. The data was corrected for the bias and the drift correlated to the actual USO clock period. Those values, translated into altimetric range figures, are respectively of $28.5mm$ and $-4.58mm/year$ as calculated with data covering the period 13 June 2003 to 01 February 2006.

- 3rd period From the 13th of March 2006 onwards, and during the early occurrences of the USO anomaly, data have not been corrected with the proper value of the USO Clock period. All data acquired during this period have thus to be corrected using the new correction files. Three USO corrections have been developed for the different Envisat Level 2 altimetry data products for correcting the abnormal RA-2 USO behavior affecting the Altimetric Range by few meters w.r.t. the Mean Sea Surface:

  - A NRT orbit based USO correction for FDGDR products , available from `http://earth.esa.int/pcs/envisat/ra2/auxdata/NewCorrection.html` or `ftp://ftp.esrin.esa.it/pub/RA2_MWR/USO/auxdata/`
  - An Interim daily USO correction for IGDR products, available at the same F-PAC location as for IGDR, in the directory igdr_ous_corr
  - An OFL cycle USO correction for GDR products, available at the same F-PAC location as for GDR, in the directory gdr_ous_corr.

  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 than the new correction files.

  WARNING: Users are still advised to apply the correction auxiliary files even during the non-anomalous period in order to correct for the nominal ageing drift of the USO device.

7.3 MWR

No particular investigation

8 APPENDIX

8.1 IPF upgrades

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) Orbit Flag not well implemented: when a DORIS product is used for the processing, the Orbit flag is set to 1 for the whole length of the RA2 L1b product file while it should be set to 1 only for the part of the RA2 product overlapping with the DORIS one. Problem has been traced on OAR 1938 to be solved on next IPF delivery.	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

		Correction of the Rx_dist_fine from the Level 0 product, leading to an error in the calculation of the Window_delay (SPR-058).		
V5.03	Sep. 19, 2006	Level 1B S-Band anomaly flag well implemented Orbit Flag well implemented Correction of the Rx_dist_fine (for 80 and 20 MHz) from the Level 0 product, leading to an error when applying the IF mask correction on to the waveforms (SPR-059)		
V 5.06	Jun. 20, 2007	DORIS Navigator threshold update to 900 seconds coverage RA2/DORIS Alignment of Chain B to Prod Spec 3/N		

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		

	Oct. 24, 2005	- Handling of the new RA2_CHD_AX ADF - Rain Flag tuning to compensate for the increase of the S band Sigma0 - Improving the mispointing estimation - Export of the Level 1B S-band flag into the Level 2 data product - Export of the Level 1B NRT orbit quality flag - Addition of a Pass Number Field in FD Level 2 SPH product - Addition of peakiness in Ku and S band in FDMAR - Addition of square of the SWH in Ku and S band - Correction of MCD flag - SPH pass number (field 8) set to 0 in SPH NRT Level 2 data products	New table in SOI file Two needed parameters in SOI file New format Addition of GOT2000.2 TLD New DEM AUX file (MACESS) merge of ACE land elevation data and Smith and Sandwell ocean bathymetry	RA2_CHD_AX RA2_SOI_AX RA2_SOI_AX RA2_SOI_AX RA2_TLG_AX AUX_DEM_AX
V 5.03	Sep. 19, 2006			
V 5.06	Jun. 20, 2007			

8.2 Availibility

RA-2 L0, L1b and L2 FGD Data products availability summary

RA-2 L0, L1b and L2 FGD Data products availability summary for Cycle 72										
Start Orbit	Stop Orbit	Instrument Unav Time (sec)	Data Unav Time (sec)	Time L0 gaps (sec)	Time L1b gaps (sec)	Time L2 FGD gaps (sec)	Instrument Avail %	Data Avail %	L0 Avail %	L1b Avail %	L2 FGD Avail %
34123	34223	0	17655	17655	17656	17671	100	97,99	97,08	97,08	97,07
34223	34323	0	6592	6592	6594	6603	100	98,92	98,91	98,91	98,91
34323	34423	0	1178	1178	1178	1192	100	99,82	99,81	99,81	99,81
34423	34523	0	821	821	822	837	100	99,88	99,86	99,86	99,86
34523	34623	0	1178	1178	1179	1190	100	99,82	99,8	99,80	99,80
						Cycle	100	**99,29**	**99,09**	**99,09**	**99,09**

MWR L0 Data products availability summary

MWR L0 Data products availability for Cycle 72					
Start Orbit	Stop Orbit	Time Instrumen Unavailability (sec)	Time L0 gaps (sec)	Instrument Availability %	L0 Availability %
34123	34223	0	17208	100	97,26
34223	34323	0	6696	100	99,01
34323	34423	0	696	100	99,88
34423	34523	0	312	100	99,95
34523	34623	0	288	100	99,95
				Cycle	**99,21**

DORIS L0 Data products availability summary

DORIS L0 Data products availability for Cycle 72					
Start Orbit	Stop Orbit	Time Instrumen Unavailability (sec)	Time L0 gaps (sec)	Instrument Availability %	L0 Availability %
34123	34223	0	48463	100	91,28
34223	34323	0	37298	100	93,68
34323	34423	0	31242	100	94,83
34423	34523	0	29964	100	95,05
34523	34623	0	30606	100	94,94
				Cycle	93.96

The list below only contains gaps higher then 200 seconds. Small gaps occurring everyday due to calibration or PDS anomalies have been suppressed

RA2_ME__0P			
start time	stop time	duration	downlink
11/09/2008 20:43	11/09/2008 21:54	4243	34165@ES
11/09/2008 23:36	12/09/2008 01:14	5856	34166@ES
17/09/2008 22:06	17/09/2008 23:44	5888	34251@ES
11/09/2008 21:54	11/09/2008 23:36	6134	34165@ES

The list below only contains gaps higher then 200 seconds

MWR_NL__0P			
start time	stop time	duration	downlink
11/09/2008 20:39	11/09/2008 20:43	239	34164@KS
11/09/2008 20:43	11/09/2008 21:54	4243	34165@ES
11/09/2008 23:36	12/09/2008 01:14	5847	34166@ES
17/09/2008 22:06	17/09/2008 23:44	5875	34251@ES
11/09/2008 21:54	11/09/2008 23:36	6134	34165@ES

RA2_MW__1P				
predecessor name	start time	stop time	coverage missing	ancestor coverage missing
RA2_ME__0PNPDK20080913_065727_000040712072_00063_34185_0056.N1	13/09/2008 06:57	13/09/2008 06:57	1	0,02 %
RA2_ME__0PNPDK20080917_075113_000054392072_00121_34243_0112.N1	17/09/2008 07:51	17/09/2008 07:51	1	0,02 %
RA2_ME__0PNPDK20080921_060533_000040942072_00177_34299_0157.N1	21/09/2008 06:05	21/09/2008 06:05	1	0,02 %
RA2_ME__0PNPDK20080930_075746_000045152072_00307_34429_0248.N1	30/09/2008 07:57	30/09/2008 07:57	1	0,02 %
RA2_ME__0PNPDE20081010_202808_000042882072_00458_34580_7595.N1	10/10/2008 20:28	10/10/2008 20:28	1	0,02 %

8.3 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

8.4 Sigma0 Absolute Calibration

Transponder measurement results up to cycle 69

Absolute Orbit nb	Date of Measurement	Location / Rel. track	RA-2 resolution	Transponder Bias [dB]	ECMWF Wet Tropo. Corr. [dB]
10389	24-feb-04	Rome / 315	Low	1,552	0,120
10511	04-mar-04	Valmontone / 437	Low	1,542	0,102
10618	11-mar-04	Fiuggi / 43	Low	1,447	0,135
10783	23-mar-04	Maccarese / 208	Low	1,540	0,142
10890	30-mar-04	Rome / 315	Low	1,442	0,152
11119	15-apr-04	Fiuggi / 43	High	0,963	0,122
11513	13-mag-04	Valmontone / 437	Low	1,353	0,133
11620	20-mag-04	Fiuggi / 43	Low	1,427	0,139
11892	08-giu-04	Rome / 315	Low	1,504	0,154
12014	17-giu-04	Valmontone / 437	Low	1,448	0,348
12121	24-giu-04	Fiuggi / 43	Low	1,576	0,149
14290	23-nov-04	Maccarese / 208	Low	1,43	0,164
14397	30-nov-04	Rome / 315	Low	1,11	0,142
14519	9-dic-04	Valmontone / 437	Low	1,26	0,248
14791	28-dic-04	Maccarese / 208	High	0,97	0,134
14898	4-gen-05	Rome / 315	High	0,95	0,114
15020	13-gen-05	Valmontone / 437	High	0,88	0,118
15127	20-gen-05	Fiuggi / 43	High	1,01	0,108
15292	1-feb-05	Maccarese / 208	High	0,95	0,132
15399	8-feb-05	Rome / 315	High	1,05	0,124
15521	17-feb-05	Valmontone / 437	High	0,94	0,115
15793	8-mar-05	Maccarese / 208	High	0,93	0,116
15900	15-mar-05	Rome / 315	High	0,93	0,128
16022	24-mar-05	Valmontone / 437	High	0,94	0,154
16294	12-apr-05	Maccarese / 208	High	0,97	0,140
16401	19-apr-05	Rome / 315	High	0,99	0,134
16523	28-apr-05	Valmontone / 437	High	0,97	0,114
16795	17-may-05	Maccarese / 208	High	0,84	0,168
16902	24-may-05	Rome / 315	High	1,00	0,152
17403	28-jun-05	Rome / 315	High	1,13	0,16
17525	7-jul-05	Valmontone / 437	High	1,04	0,13
17904	02-aug-05	Rome / 315	High	1,02	0,188
18026	11-aug-05	Valmontone / 437	High	0,93	0,154
18405	06-sep-05	Rome / 315	High	1,06	0,16
18634	22-Sep-05	Fiuggi/43	High	1,00	0,152
18799	04-Oct-05	Maccarese/208	High	0,85	0,164
18906	11-Oct-05	Perm site Rome / 315	Low	1,46	0,156
19407	15-Nov-05	Perm site Rome / 315	High	1,09	0,19
20409	24-Jan-06	Perm site Rome / 315	High	1,38	0,110
20910	28-Feb-06	Perm site Rome / 315	High	0,98	0,124
21912	9-May-06	Perm site Rome / 315	High	1,0	0,138
23916	26-Sep-06	Perm site Rome / 315	High	1,05	0,172
24417	31-Oct-06	Perm site Rome / 315	High	1,08	0,146
24918	05-Dec-06	Perm site Rome / 315	High	1,00	0,156
25419	09-Jan-2007	Perm site Rome / 315	High	0,97	0,148
25929	13-Feb-2007	Perm site Rome / 315	High	1,07	0,118
26922	24-Apr-2007	Perm site Rome / 315	High	1,17	0,154
27423	29-May-2007	Perm site Rome / 315	High	1,04	0,168
29928	20-Nov-2007	Perm site Rome / 315	High	1,04	0,139
30930	29-Jan-2008	Perm site Rome / 315	High	1,01	0,013
31431	04-Mar-2008	Perm site Rome / 315	High	1,04	0,139

8.5 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