Envisat Cyclic Altimetric Report

Cycle 65 from 07-01-2008 to 11-02-2008

Quality Assessment Report

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# Table Of Contents

1 INTRODUCTION ........................................................................................................... 1

2 DISTRIBUTION LIST ................................................................................................... 1

3 ACRONYMS ..................................................................................................................... 1

4 REFERENCE DOCUMENTS .............................................................................................. 2

5 GENERAL QUALITY ASSESSMENT .............................................................................. 3
   5.1 Cycle Overview ........................................................................................................... 3
   5.2 Payload status ............................................................................................................ 4
   5.2.1 Altimeter Events .................................................................................................... 4
   5.2.1.1 RA-2 instrument planning .............................................................................. 5
   5.2.2 MWR Events ......................................................................................................... 6
   5.2.3 DORIS Events ...................................................................................................... 7
   5.3 Availability ................................................................................................................ 7
   5.4 Orbit quality .............................................................................................................. 7
   5.5 Ground Segment Processing Chain Status .............................................................. 8
   5.5.1 IPF Processing Chain ........................................................................................... 8
   5.5.1.1 Version ........................................................................................................... 8
   5.5.1.2 Auxiliary Data File ......................................................................................... 8

6 INSTRUMENT PERFORMANCE ...................................................................................... 8
   6.1 RA-2 Performance .................................................................................................... 8
   6.1.1 Tracking capability ............................................................................................... 8
   6.1.2 IF Filter MASK .................................................................................................... 11
   6.1.3 USO ...................................................................................................................... 15
   6.1.4 Datation ............................................................................................................... 17
   6.1.5 In-Flight Internal Calibration .............................................................................. 20
   6.1.6 Sigma0 Transponder .......................................................................................... 24
   6.1.7 Mispointing .......................................................................................................... 25
   6.1.8 S-Band anomaly ................................................................................................. 29
   6.2 MWR Performance .................................................................................................. 30
   6.3 DORIS Performance ............................................................................................... 30

7 PRODUCT PERFORMANCE .......................................................................................... 31
   7.1 Product disclaimer ................................................................................................... 31
7.2 Data handling recommendations.................................................................................................................31
  7.2.1 S Band Power Drop................................................................................................................................31
  7.2.2 Sea-Ice flag ..............................................................................................................................................31
  7.2.3 Ocean S-Band anomalies detection.........................................................................................................32
  7.2.4 Warning on IPF 4.56 Version Identification field ....................................................................................32
  7.2.5 S-Band Backscattering Coefficient .........................................................................................................32
  7.2.6 USO Range Correction ............................................................................................................................32
  7.2.7 Ku-Band Backscattering Coefficient calibration ......................................................................................33
  7.2.8 RA-2 Radio Frequency Module switched BACK to a-side ......................................................................34

7.3 Availability of data..........................................................................................................................................34
  7.3.1 RA-2.........................................................................................................................................................34
  7.3.2 MWR......................................................................................................................................................36

7.4 RA-2 Altimeter Parameters............................................................................................................................37
  7.4.1 Orbit .........................................................................................................................................................37
  7.4.2 Altimeter range .......................................................................................................................................38
  7.4.3 Significant Wave Height .........................................................................................................................40
  7.4.4 Backscatter coefficient – Wind Speed .....................................................................................................43

8 PARTICULAR INVESTIGATIONS .........................................................................................................................48

APPENDIX 1: IPF UPGRADES .............................................................................................................................49

APPENDIX 2: AVAILABILITY: ..............................................................................................................................51

APPENDIX 3: LEVEL 2 STATIC AUXILIARY DATA FILES ..................................................................................55

APPENDIX 4: SIGMA0 ABSOLUTE CALIBRATION ............................................................................................55

APPENDIX 5: S-BAND ANOMALY ........................................................................................................................57

APPENDIX 6: IE SITES COORDINATES ...............................................................................................................57
1 INTRODUCTION

This document aims at reporting on the performance of the EnviSat Radar Altimeter, Microwave Radiometer and DORIS sensors, on the data quality of the corresponding Fast Delivery products as well as on the main events which occurred during cycle 65.

This report covers the period from 7th of January 2008 until 11th of February 2008.

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 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 MacroComm
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  
PMO  Payload Main Computer  
PTR  Point Target Response  
RA-2  EnviSat Radar Altimeter bi-frequency  
RSL  Resolution Selection Logic  
SAD  Static Auxiliary Files  
SBT  Satellite Binary Time  
SEU  Single Event  
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

[R – 1] F-PAC MONTHLY REPORT, SALP-RP-M-OP-XXXX-CN  
GENERAL QUALITY ASSESSMENT

5.1 Cycle Overview

- The Envisat RA-2 (A-Side) S-band transmission power suddenly dropped on 17 January 2008, 23:23:40, UTC (orbit nb 30759). Investigations have been conducted and the failure of the S Band power stage for the RA-2 RFSS Side A is considered to be permanent. Consequently, all S-band parameters, as well as the dual ionospheric correction, are not relevant anymore and MUST NOT be used from this date onwards. Ionospheric corrections from model are available in RA-2 products. The RA-2 Ku Band is nominal.

- A similar event affected the redundant (B-Side) S-band on the 20 May 2006 when a switch to the RFM B-Side was performed as part of the investigation tests on the RA-2 Ultra Stable Oscillator (USO) anomaly.

- No orbits were affected by the S Band Anomaly on cycle 65.

- The RA-2 Ultra-Stable Oscillator (USO) anomaly was present until the Instrument Planned Unavailability occurred on date 23 January. From Instrument recovery, on 23 January 14:10:30, until the end of cycle 65, the USO Clock Period was nominal.

WARNING: Users are strongly advised not to use the range parameter in Ku and S Band during the current cycle without applying the USO correction.
• Three USO corrections have been developed for the different Envisat Level 2 altimetry data products for correcting the abnormal RA-2 USO behaviour affecting the Altimetric Range by few meters w.r.t. the Mean Sea Surface:
  1. NRT orbit basis USO correction for FDGDR products, available from http://earth.esa.int/pcs/envisat/ra2/auxdata/;
  2. An Interim daily USO correction for IGDR products, available at the same F-PAC location as for IGDR, in the directory igdr_ous_corr
  3. An OFL cycle USO correction for GDR products, available at the same F-PAC location as for GDR, in the directory gdr_ous_corr.
• A software routine has been developed to allow users to insert the RA-2 Ultra-Stable Oscillator (USO) corrections into Envisat Level 2 altimetry data products and is available in the same web site as the correction files, see above.
• The NRT USO correction has been made available from July 24, 2006 onwards.
• The II In-Flight Tests aimed to understand the origin of the IF Mask anomaly has been successfully concluded on cycle 65. It has been recognized that the cause of the IF Mask anomaly is the wrong setting of the AGC used for the IF Calibration Mode from time to time. The IF Calibration procedure to be used in operational IF Calibration consists in setting all the AGC’s to 3dB before entering the IF Calibration Mode.
• The overall number of valid IF masks has been 40, representing 61% of the 65 acquired and processed IF masks. The auxiliary file RA2_IFF_AX has been updated on date 22 January 2008.
• Tracking performances in the different resolutions are well in line with the output figures and objectives of the Commissioning Phase.
• During cycle 65, RA2_SOL_AX has been on date 7 February 2008.
• RA2 was unavailable three times, data availability was around 94% 
• MWR was unavailable once, data availability was around 94% 
• DORIS was unavailable once, data availability was around 89%

5.2 Payload status

On 16th January an anomaly occurred in the HSM. The implication of this anomaly is that ALL Low Rate data for ALL instruments were not available. Recovery was performed the next day, all instruments were returned to Measurement and nominal MPS planning.

1. Start: 16 Jan 2008 16:11:00 Orbit = 30741
   Stop: 17 Jan 2008 10:35:21 Orbit = 30752

5.2.1 ALTIMETER EVENTS

The Radar Altimeter 2, during cycle 65, was unavailable three times, as described below.

1. Start: 17 Jan 2008 09:37:00.000 Orbit = 30751
Stop: 17 Jan 2008 12:05:26.000 Orbit = 30753
Payload unavailability. RA2 Back to operations after HSM recovery

Stop: 23 Jan 2008 14:10:30.000, Orbit = 30840
Planned unavailability: RA-2 switched to Standby & Back to Ops for S-Band Anomaly Investigation

3. Start: 1 Feb 2008 12:00:00.000, Orbit = 30967
Stop: 1 Feb 2008 12:40:00.000, Orbit = 30968
Planned unavailability: RA-2 to HTR2 and back to OPS

5.2.1.1 RA-2 instrument planning

On cycle 65 IF Calibration has been performed only over the Himalaya site. The nominal operational acquisition has been performed on ascending passes whilst the NEW procedure for IF Calibration has been performed on descending passes. In Figure 1 a map is reported indicating the calibration sites. The II In-Flight Tests aimed to understand the origin of the IF Mask anomaly has been successfully concluded. It has been recognized that the cause of the IF Mask anomaly is the wrong setting of the AGC used for the IF Calibration Mode from time to time. The IF Calibration procedure to be used in operational IF Calibration consists in setting all the AGC’s to 3dB before entering the IF Calibration Mode. These parameters are restored to the original values when the IF Calibration mode has expires, before entering in the Measurement mode.

Figure 1: IF Calibration Acquisition sites
The RA-2 instrument planning was performed as follows:

- IF calibration over Himalaya's zone for the entire cycle, (1 ascending pass per day)
- New procedure for IF calibration (through Digital BITE Mode command) over Himalaya for the entire cycle, 1 descending 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 2A: Transponder Acquisition sites
```

5.2.2 MWR EVENTS

The MWR, during cycle 65, was unavailable once.
1. Start: 17 Jan 2008 08:50:32.000, Orbit = 30751
   Stop: 17 Jan 2008 18:40:19.000, Orbit = 30757
   MWR back in measurement mode after Payload HSM anomaly.

5.2.3 DORIS EVENTS

DORIS, during cycle 65, was unavailable once.
   Start: 17 Jan 2008 08:50:32.000, Orbit = 30751
   Stop: 17 Jan 2008 18:41:18.000, Orbit = 30757
   DORIS back in measurement mode after Payload HSM anomaly

5.3 Availability

The summary of the RA-2 data products availability for the current cycle is reported in Appendix 2. Data availability was around 94% for RA-2 products, 94% for MWR products and 89% for DORIS products.

5.4 Orbit quality

During the period covered by cycle 65, the following one maneuver took place:

1. On the 10-January-2008 (DOY 010) a single burn SFCM small-deltaV orbit correction manoeuvre was executed as planned:
   - Planned delta V size: 0.00065 m/s (towards the flight direction)
   - Mid thrust time: 20:45:00.000 utc at PSO 356.88 degrees
   - Thrust duration: 1 second
   - Measured delta V: 0.00074 m/s (towards the flight direction)

During the rest of the period covered by this report the spacecraft ground track remained within the +/- 200 m deadband around the reference ground track at ascending node without any orbit control manoeuvre.
5.5  **Ground Segment Processing Chain Status**

5.5.1  **IPF PROCESSING CHAIN**

5.5.1.1  **Version**

Cycle 64 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 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. Data are corrected with the RA2_USO_AX estimated before the USO Clock anomaly (USO_Clock_Period = 1249999726, 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/

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 below:
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 upload 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 320 MHz for different surfaces

Figure 3: RA-2 Tracking percentage at 80 MHz for different surfaces
6.1.2 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 [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 0.1 db, the mask is considered valid.

According to the planning defined for the IF Calibration acquisition on cycle 65 (ref. Par. 5.2.1.1), two daily passes over the Himalya site (ascending and descending) have been performed with different procedures:

- Old procedure for IF calibration on ascending passes, 1 per day
- New procedure for IF calibration (through Digital BITE Mode command) on descending passes, 1 per day

The II In-Flight Tests aimed to understand the origin of the IF Mask anomaly has been concluded on cycle 65. The scope of the test was to verify if the AGC used for the IF Calibration mode, sent from the SPSA to the MR, was correct. The test was performed by using a new calibration
procedure consisting in setting all the AGC’s to 3dB before entering the IF Calibration Mode and resetting all the parameters to the original values before entering in the Measurement mode. This new procedure has been successfully tested on the Rocky Mountains site on cycles 62, 63 and 64 and on cycle 65 it has been tested on the Himalaya site, descending passes. The Test was successful: all IF Masks acquired with the new procedure on descending passes on the Himalaya site were valid.

- The number of valid IF Masks acquired on the Himalaya ascending passes was 11
- The number of valid IF Masks acquired on the Himalaya descending passes was 29

The overall number of valid IF masks has been 40, representing 61 % of the 65 acquired and processed 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 during cycle 65 plotted together with the on-ground reference.](image)

In Figure 6 the IF Mask, updated on the 22nd of January 2008, and the previous IF Mask used for processing are plotted.
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 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 than 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 showed the weird behavior described in [R – 3] only in data acquired in the Himalaya site. 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. 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 as far as at least 10 of them are valid Mask.
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 four cycles is related to the NEW procedure for IF Calibration Mode applied from cycle 62 onwards, described at the beginning of this chapter.
6.1.3 USO

The RA-2 Ultra-Stable Oscillator (USO) anomaly was present on cycle 65 until the 23rd of January. It disappeared following the recovery of the RA-2 sensor from the planned instrument unavailability on 23 January 2008 at 14:11:35, orbit nb 30840.

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 USO Clock Period anomaly was almost permanently present during 2006. 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.

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 10A, the USO clock period trend retrieved from cycle 50 onwards is reported. The actual value of the USO clock period has been used within the L1b processing; only from the 24th of October 2005 (IPF V5.02) until the 1st of February 2006. This means that, during this period, the data are corrected for the bias and the drift correlated to the actual USO clock period. The evaluation of the actual USO clock period is performed off-line respect to the IPF processing and it is updated once per week in the auxiliary file RA2_USO_AX. The method to correct the data from the USO period changes outside of this period is detailed in Part 7.2.

Figure 10: USO clock period (top) and associated range difference (bottom) 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. 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 10A: USO clock period (top) and associated range difference (bottom) from cycle 50 onwards
In Figure 12 (upper panel) the differences between the extrapolated UTC values and the corresponding real UTC values measured at the next Kiruna dump, are reported for data up to cycle 32. The UTC deviations for cycle 33 onwards reported in Figure 13 could not be updated due to operational problems. Only a few anomalous events can be observed at the beginning of the period (cycles 16/17) for which the difference rises above the 20 microseconds warning threshold. However, starting from cycles 22/23, the number of small differences (10 microseconds plus or minus) has increased a lot. Furthermore, during the last ten days of the cycle 32 and for all cycle 33 and 34, the variability of the deviations has increased reporting many peaks just over the 20 microseconds threshold (first part of Figure 12); this phenomenon is now fixed. In the lower panel of both figures the ICU clock step for the same period is shown where big variations are reported. The jump observed around MJD 2288 (07-APR-2006) on Figure 13 is related to the reconfiguration of the Precise Time Correlation process, which became blocked with invalid data after the Service Module anomaly and reconfiguration occurred on 6 April 2006. This is however not a problem because the ICU clock period variations are included in the algorithm for the SBT/UTC correlation evaluation.
Figure 12: UTC deviations and ICU clock period up to cycle 32

Figure 13: UTC deviations and ICU clock period from cycle 33 onwards
6.1.5 IN-FLIGHT INTERNAL CALIBRATION

The RA-2 Range and Sigma0 measurements are corrected to take into account the internal path delay and attenuation, respectively. This is done by measuring those two variables in relation to the internal Point Target Response. The two correction factors are calculated during the L1b processing and directly applied. They are also continuously monitored and the results for the current cycle (averaged per day) are reported in the next figures.

The Time delay in-flight calibration factor, reported in Figure 14, shows a regular behavior as observed on previous cycles.

The S band Sigma0 calibration factor, reported in blue in Figure 15, presents a drop on date 17 January 2008. This is related to the Envisat RA-2 (A-Side) S-band transmission power drop occurred on 17 January 2008, 23:23:40, UTC (orbit nb 30759), see section 7.2.1

The Ku band Sigma0 calibration factor, reported in red in Figures 15, is nominal.

![Figure 14: Ku and S Band in-flight time delay calibration factor for cycle 65 (averaged per day)](image)
Figure 15: Ku and S Band in-flight Sigma0 calibration factor for cycle 65 (averaged per day)

Figure 16 and Figure 17 report Ku and S Band in-flight calibration factors for Time Delay and Sigma0 respectively, daily averaged, up to the current cycle. The Time Delay factor is shown to be very stable for both the working frequencies. The Ku band Sigma0 factor reveals a decrease of about 0.4 dBs over the period starting from cycle 16. As this instability is quite small, it is not being considered a problem for the moment, since the calibration factor is indeed introduced especially to correct for eventual instrumental changes. However, special attention is kept on the monitoring of this parameter. The jump observed on the last part of the plot is related to the period on which the instrument sub-system Radio Frequency Module (RFM) was switched to its B-side, occurred between 15 May and 21 June 2006.
Figure 16: Ku and S Band in-flight time delay calibration factor up to cycle 49 (averaged per day)

Figure 16A: Ku and S Band in-flight time delay calibration factor from cycle 50 onwards (averaged per day)
Figure 17: Ku and S Band in-flight Sigma0 calibration factor up to cycle 49 (averaged per day)

Figure 17A: Ku and S Band in-flight Sigma0 calibration factor from cycle 50 onwards (averaged per day)
6.1.6 SIGMA0 TRANSPONDER

The $\sigma^o$ 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 $\sigma^o$ 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 29th of January has been successfully performed.

<table>
<thead>
<tr>
<th>Absolute Orbit nb</th>
<th>Date of Measurement</th>
<th>Location / Rel. track</th>
<th>RA-2 resolution</th>
<th>Transponder Bias [dB]</th>
<th>ECMWF Wet Tropo. Corr. [dB]</th>
</tr>
</thead>
<tbody>
<tr>
<td>30930</td>
<td>29/01/2008</td>
<td>315</td>
<td>High</td>
<td>1.01</td>
<td>0.0668</td>
</tr>
</tbody>
</table>

Appendix 4 reports the transponder measurements from cycle 24 onwards. The mean value of the estimated bias at High Resolution is 1.01 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 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.
6.1.7 MISPOINTING

In Figure 19, the trend of the mispointing squared (averaged every orbit) is reported in deg\(^2\) \times 10^{-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 5.5.1.1.

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

The low values at the end of the plot are related to the acquisition in RFFS B-Side, occurred between 15 May and 21 June 2006.

The jump which occurred on date October 24th is related to the upload of IPF version 5.02. The abrupt decreasing of the mispointing squared value is related to the new algorithm, as described in the previous paragraph.

The jump which occurred on November the 26th 2003 is correlated to the upload of IPF version 4.56; the abrupt decrease of the mispointing squared value is due to the usage of a new RA2_IFF_AX IF mask auxiliary file. After the drop a very tiny increase of the mispointing squared could eventually be detectable. The most probable cause of this phenomenon could be a change in the Intermediate Frequency Filter slope due to ageing effects. For this reason, the RA2_IFF_AX will be updated regularly, once per month.
Figure 20: Smoothed mispointing squared trend until end of cycle 49 (deg$^2$10e-4)

Figure 20A: Smoothed mispointing squared trend until from cycle 50 onwards (deg$^2$10e-4)
It can be noticed that the mispointing squared assumes lower values just after an instrument anomaly, showing an increasing trend until it reaches a standard mispointing value. This problem has been reduced with the introduction of the updated mispointing retrieval algorithm as described in the previous paragraph.

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

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

Figure 21_A: Open Ocean average waveforms before (left) and after an anomaly (right)
6.1.8 S-BAND ANOMALY

The Patch that prevents the S Band Anomaly by correcting the SW/HW malfunctioning has been successfully uploaded on 27th of June. The Patch has been uploaded for the first time on 16th of January 2007, but it has been dismissed on 9th of April because it was causing the Instrument to switch down to Heater 0/Refuse Mode. An investigation has been carried out and some parameter monitoring thresholds causing the instrument to switch down have been modified.

No orbits were affected by the S Band Anomaly on the current cycle.

The method used for the identification of the “S-Band anomaly” is statistical and requires a minimum of 1000 seconds of data over ocean. This choice is supported by the fact that the “S-Band anomaly” is associated with a particular instrumental behavior that cannot appear and disappear within a short time frame. (ref. [R – 7])

A valuable algorithm to detect the RA-2 DSRs affected by the S-Band anomaly within the L2 products can be found in [R- 12]. Note that the algorithm is only valid for data acquired over open-ocean.

The IPF version 5.03 includes an algorithm that can detect the presence of the so-called “S-Band anomaly” over any surface. In case of S-Band anomaly detection, bit 1 of the L1b products MCD is set to one; the anomaly is properly detected in 99.9% of the cases.

In Figure 22, the percentage of data per cycle that are affected by the so-called “S-Band” anomaly is reported. The figures are variable between 0% and 8.1%.

The number of occurrences of the S Band anomaly decreased from a mean value of 4% to 2% from cycle 31 onwards due to the implementation of the IF CAL procedure (including Heater 2 for S Band anomaly suppression) twice per day over the Himalayan region. The relatively high value recorded for cycle 27 is due to the fact that on the day 1st of June 2004, the S-band anomaly started at around 14:30 while the instrument didn’t switch to mode Heater 2 when foreseen (at about 15:50). For this reason the S-Band anomaly continued for the next 24 hours until the next Heater 2 mode on June the 2nd.
6.2 **MWR Performance**

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

6.3 **DORIS Performance**

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

7.1 Product disclaimer

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

7.2 Data handling recommendations

7.2.1 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.

7.2.2 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
7.2.3 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].

7.2.4 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.

7.2.5 S-BAND BACKSCATTERING COEFFICIENT

For the data processed with IPF version 4.56 on, the S-Band Backscattering coefficient has been demonstrated to be on average about 0.65 dBs higher than for the previous versions of the processor. This is due to the algorithm used for the retrieval of the AGC in S-Band, corrected in IPF version 4.56 to be closer to the real functioning of the instrument.

An average value of 0.65 dBs is suggested to be added to the old software versions S-Band Sigma0 in order to be in line with the new IPF V4.56 version.

7.2.6 USO RANGE CORRECTION

Three different periods can be distinguished:

1\textsuperscript{st} period

From the beginning of the mission until the 24\textsuperscript{th} 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 24\textsuperscript{th} 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 -4.58 mm per year and a bias of 29.6 mm.

\textbf{Warning for data acquired before cycle 42}: bias and drift have to be \textbf{SUBTRACTED} from the original altimetric range, according to the following equation:

\[ R_{\text{true}} = R_{\text{original}} - dR \]

where \( R_{\text{original}} \) is the range in the GDR products and \( R_{\text{true}} \) is the true (corrected) range.

2\textsuperscript{nd} 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 28.5 mm and −4.58 mm/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 behaviour affecting the Altimetric Range by few meters w.r.t. the Mean Sea Surface:

- 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.

7.2.7 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 18. 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:

\[ \text{Sigma}_0\_\text{true} = \text{Sigma}_0\_\text{prod} + G_{\text{tx rx prod}} - G_{\text{tx rx real}} - \text{Bias \, [dB]} \]

Where:
Bias: Bias retrieved from the Sigma0 Absolute Calibration (see 6.1.5)
**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)

### 7.2.8 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 after a switch to RFSS B-Side on 15 May at 14:21:50 UTC Orbit=21994

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 15 May 2006 until 21 June 2006 was acquired with RFSS B-side and on-ground data processing has been performed with ADFs configured for A-side. For this reason data should be used with maximum care.

### 7.3 Availability of data

#### 7.3.1 RA-2

In Figure 23 and Table 9 (Appendix 2) the summary of unavailable RA2 L0 products is given. It is easy to notice that close to the Himalaya region one small gap, about 77 seconds, is present in the data. This is due to the daily instrument switch-offs (Heater 2 mode) performed as part of the IF calibration commands sequence. Another recurrent gap of around 179 seconds is due to an anomaly under investigation.

The high number of missing data on the current cycle is due to the Payload HSM anomaly occurred on the 16th January, see section 5.2.
In Figure 24 and Table 11 (Appendix 2) the summary of unavailable RA2 L1b products is given. Starting from cycle 65, the reported gaps are related to the RA2 L0 products and not to the DMOP.

**Figure 23: RA-2 L0 unavailable products for cycle 65**

**Figure 24: RA-2 L1b unavailable (with respect to RA2 L0) products for cycle 65**

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 percentage of data from cycle 56 until cycle 59 is due to the high number of RA-2 Instrument Unavailability occurred as side effect of the SPSA Patch uploaded to prevent the S Band anomaly.

Figure 25: Percentage of Products unavailability

7.3.2 MWR

In Figure 26 Table 10 (Appendix 2) the summary of unavailable MWR L0 products is given.
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 **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.
The quality of this Doris Navigator orbit is estimated by comparison to the MOE orbit available in the IGDR products. Figure 27A shows the [Doris navigator-MOE] radial differences on ascending and descending passes. We can observe that the differences are between -0.4 and 0.4m with systematic ascending/descending + North/South differences. The statistics of differences are

- mean [Doris navigator-MOE] ~ -0.95cm
- standard deviation [Doris navigator-MOE] ~ 14.6cm

![Figure 27A: [Doris navigator-MOE] differences on ascending and descending passes](image)

7.4.2 ALTIMETER RANGE

On Figure 27B, it can be observed that the altimetric range was anomalous in the first part of cycle 65. This anomalous range is related to the un-expected behaviour of the Envisat RA-2 sensor, the USO Clock Period Anomaly, which was present until the instrument recovery on the 23rd of January (ref.Par.6.1.3).

Some gaps can be observed in Figure 27B and are related to the Instrument Unavalabilities (ref. Par. 5.2.1). In particular, the biggest one is related to the lack of usage of DORIS after the Payload HSM anomaly occurred on the 17th January. DORIS Instrument was back to measurement on the 17th January at 18:41:18 but DOR_NAV_0P has only been used in the RA2MWR NRT data from the 23rd January at 19:23:46, orbit nb 30829, onwards. Other minor gaps observed in Figure27B are related to some PDS failures which prevented the usage of DORIS on NRT products.
The Ku Band SLA has been computed with the following corrections: MWR_WET_TROPO, DRY_TROPO, INV_BMETER_HEIGHT, SEA_KU_BIAS, IONO_CORR

Due to the S Band Power drop anomaly, started on the 17th of January, see section 7.2.1, the ionospheric correction used for the computation was:
1. RA2 ionospheric correction from the beginning of the cycle until the 17th January
2. Bent model ionospheric correction for the remaining part of the cycle.

In Figure 27C the Histogram of Sea Level Anomalies is reported for the Ku Band. Only MDSRs processed with DORIS have been considered. Two peaks can be observed, the main peak is slightly less than 0.5 meter as expected, while the secondary peak is slightly more than 6 meter due to the un-expected behaviour of the USO Clock Period, which was present from the start of the cycle until the 23rd of January (ref.Par.6.1.3).
7.4.3 SIGNIFICANT WAVE HEIGHT

The histogram of the SWH reported in Figure 28 shows a nominal behavior on the Ku Band. A lower number of occurrences is present for the S Band due to the S Band Power drop, which started on the 17th January 2008, see section 7.2.1. 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.

Figure 27C: Histogram of Sea Level Anomalies on Ku Band computed on MDSRs with valid DORIS Flag
The SWH long term plot is reported in two plots, cycle 16 until cycle 49 on Figure 30 and cycle 50 onwards on Figure 30A. It can be noticed that the SWH in both bands shows a trend which follows...
the seasonal variability. The high daily averages reported (sometimes plotted outside the figure’s range) are due to the so-called S-Band anomaly (ref. par.6.1.8).

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

Figure 30A: Ku and S SWH daily average from cycle 50 onwards (mm)
7.4.4 BACKSCATTER COEFFICIENT – WIND SPEED

The Sigma-0 histogram in Ku and S Band is reported in Figure 31. The Sigma-0 S Band presents a much lower number of occurrences due to the S Band Power drop, started on date 17th of January, see section 7.2.1.

The Sigma_0 histogram in Ku Band shows secondary peaks. 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 the majority of the data is concentrated on lower values for rough sea state (southern hemisphere, winter conditions) and on higher values for calm sea state (northern hemisphere, summer conditions).

Figure 31: Histogram of Ku and S Band Backscattering Coefficient for cycle 65

In Figure 32, the backscattering coefficient daily average, computed for only ocean data, trend is reported. The S Band trend shows an anomalous behavior from 17th of January onwards due to the S Band Power drop anomaly, see section 7.2.1. The Ku Band shows a nominal behaviour.
The histograms of Wind Speed computed for the Ku-band and the time behavior during the current cycle are reported in Figure 33 and 34, respectively. Given that the wind table has been updated since IPF version 5.02, S.Abdallah Table is now used, the wind takes values between 1.18m/s 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 65 (mm/sec)

Figure 34: Ku Band Wind Speed daily average for cycle 65 (mm/s)
The Ku-Band Sigma_0 trend, reported hereafter (Figure 35 and 35A), is characterized by a jump of on average 3.24 dBs concomitant with the operational upload of IPF version 4.54 which occurred on the 9th of April 2003. This change is due to the upload of a new RA2_CHD_AX ADF file that artificially shifted the RA-2 real Sigma_0 in order to align it with ERS-2 Sigma_0 and make it coherent with the Witter and Chelton empirical wind model. A similar change in trend, but in the opposite direction, is also visible in the Wind Speed trend reported in Figure 36. Beyond the huge jump that occurred in April 2003, the S-Band Sigma_0 reports a smaller jump occurring on November the 26th 2003. Following the installation of the IPF processing chain V4.56, the average values of the RA-2 S-Band backscattering parameter, shows an increase of ~0.65 dBs, the new S-band sigma0 being higher with respect to the previous versions. The very low values of the S Band Backscattering around 30 July 2006 are related to the S Band Power Drop Anomaly occurred when the instrument was operating on RFFS B-side from 15 May until 21 June 2006 and from the 17th of January onwards due to the S Band Power Drop Anomaly affecting RFFS A-side. The S-Band Sigma_0 daily means that are plotted outside the figure range can be traced back to the so-called S-Band anomaly (ref. par. 6.1.8).

Figure 35: Ku and S band Backscattering daily averages up to cycle 49 (dB/100)
Figure 35A: Ku and S band Backscattering daily averages from cycle 50 onwards (dB/100)

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

An anomaly occurred on the S Band starting from around ten hours after the recovery of the HSM anomaly on the 17 January 2008. A drop of the RA2 S-band transmission power started in the South Atlantic Anomaly region, 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 for the RA-2 RFSS Side A is considered to be permanent.

On Cycle 65 the II In-Flight Tests aimed to understand the origin of the IF Mask anomaly has been successfully concluded. It has been recognized that the cause of the IF Mask anomaly is the wrong setting of the AGC used for the IF Calibration Mode from time to time. The test was performed by using a new calibration procedure consisting in setting all the AGC’s to 3dB before entering the IF Calibration Mode and resetting all the parameters to the original values before entering in the Measurement mode. The new procedure was used on the Himalaya site only.
## APPENDIX 1: IPF UPGRADES

### Table 4: L1B IPF version

<table>
<thead>
<tr>
<th>IPF Version</th>
<th>Date of issue PDHSK&amp; E, LRAC</th>
<th>L1B Algorithm upgrades</th>
<th>L1B ADF updates</th>
<th>ADF filename</th>
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<td>V4.53</td>
<td>Nov. 27, 2002</td>
<td></td>
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| 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 S band.  
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  
RA-2 alignment: OBDH & USO datation, IE flags correction  
Rain Flag tuning 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 | 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
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

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<th>L2 ADF updates</th>
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APPENDIX 2: AVAILABILITY:

Table 6: RA-2 L0, L1b and L2 FGD Data products availability summary for Cycle 65

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Table 7: MWR L0 Data products availability summary for Cycle 65

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Table 8: DORIS L0 Data products availability summary for Cycle 65

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Table 9: List of gaps for RA-2 L0 Cycle 65
The list below only contains gaps higher then 200 seconds.
Small gaps occurring everyday due to calibration or PDS anomalies have been suppressed.
Gaps on date 07/02/2008 are due to Artemis Unavailability occurred during the night between 6 and 7 February 2008.
Other major gaps are due to the HSM Payload anomaly and RA-2 Instrument unavailabilities, see section 5.2.

RA2_ME__0P

<table>
<thead>
<tr>
<th>start time</th>
<th>stop time</th>
<th>Duration (seconds)</th>
<th>downlink</th>
</tr>
</thead>
<tbody>
<tr>
<td>16/01/2008 16:11</td>
<td>16/01/2008 17:36</td>
<td>5113</td>
<td>30741@KS</td>
</tr>
<tr>
<td>16/01/2008 17:36</td>
<td>16/01/2008 19:15</td>
<td>5924</td>
<td>30742@KS</td>
</tr>
<tr>
<td>16/01/2008 19:15</td>
<td>16/01/2008 20:55</td>
<td>6036</td>
<td>30743@KS</td>
</tr>
<tr>
<td>16/01/2008 20:55</td>
<td>16/01/2008 22:06</td>
<td>4243</td>
<td>30744@ES</td>
</tr>
<tr>
<td>16/01/2008 22:06</td>
<td>16/01/2008 23:48</td>
<td>6115</td>
<td>30744@ES</td>
</tr>
<tr>
<td>16/01/2008 23:48</td>
<td>17/01/2008 01:27</td>
<td>5956</td>
<td>30745@ES</td>
</tr>
</tbody>
</table>
Table 10: List of gaps for MWR L0 Cycle 65

The list below only contains gaps higher then 200 seconds.

<table>
<thead>
<tr>
<th>start time</th>
<th>stop time</th>
<th>Duration (seconds)</th>
<th>downlink</th>
</tr>
</thead>
<tbody>
<tr>
<td>17/01/2008 01:27</td>
<td>17/01/2008 02:44</td>
<td>4606</td>
<td>30746@ES</td>
</tr>
<tr>
<td>17/01/2008 02:44</td>
<td>17/01/2008 03:58</td>
<td>4451</td>
<td>30747@ES</td>
</tr>
<tr>
<td>17/01/2008 04:00</td>
<td>17/01/2008 04:21</td>
<td>1228</td>
<td>30748@ES</td>
</tr>
<tr>
<td>17/01/2008 04:21</td>
<td>17/01/2008 05:54</td>
<td>5573</td>
<td>30748@ES</td>
</tr>
<tr>
<td>17/01/2008 05:54</td>
<td>17/01/2008 07:10</td>
<td>4575</td>
<td>30749@KS</td>
</tr>
<tr>
<td>17/01/2008 07:10</td>
<td>17/01/2008 08:52</td>
<td>6114</td>
<td>30750@KS</td>
</tr>
<tr>
<td>17/01/2008 08:52</td>
<td>17/01/2008 09:37</td>
<td>2684</td>
<td>30751@KS</td>
</tr>
<tr>
<td>17/01/2008 09:37</td>
<td>17/01/2008 10:31</td>
<td>3271</td>
<td>30751@KS</td>
</tr>
<tr>
<td>17/01/2008 10:31</td>
<td>17/01/2008 12:05</td>
<td>5635</td>
<td>30752@KS</td>
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<td>17/01/2008 12:05</td>
<td>17/01/2008 12:11</td>
<td>346</td>
<td>30752@KS</td>
</tr>
<tr>
<td>17/01/2008 12:11</td>
<td>17/01/2008 13:44</td>
<td>5617</td>
<td>30753@KS</td>
</tr>
<tr>
<td>23/01/2008 13:55</td>
<td>23/01/2008 14:01</td>
<td>353</td>
<td>30839@KS</td>
</tr>
<tr>
<td>23/01/2008 14:01</td>
<td>23/01/2008 14:10</td>
<td>552</td>
<td>30840@KS</td>
</tr>
<tr>
<td>01/02/2008 12:00</td>
<td>01/02/2008 12:39</td>
<td>2357</td>
<td>30967@KS</td>
</tr>
<tr>
<td>07/02/2008 02:05</td>
<td>07/02/2008 03:22</td>
<td>4623</td>
<td>31047@ES</td>
</tr>
<tr>
<td>07/02/2008 12:50</td>
<td>07/02/2008 14:27</td>
<td>5781</td>
<td>31054@KS</td>
</tr>
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</table>
Table 11: List of gaps for RA-2 L1b Cycle 65 (gaps with respect to L0 products)
The list of gaps below is referred to the L0 production and not to the planning.

<table>
<thead>
<tr>
<th>predecessor name</th>
<th>start time</th>
<th>stop time</th>
<th>coverage missing (seconds)</th>
<th>ancestor coverage missing</th>
</tr>
</thead>
<tbody>
<tr>
<td>RA2_ME__0PNPDK20080109_065148_000040562065_00020_30635_7396.N1</td>
<td>2008-01-09 06:51:48</td>
<td>2008-01-09 06:51:49</td>
<td>1</td>
<td>0,02 %</td>
</tr>
<tr>
<td>RA2_ME__0PNPDK20080114_070136_000062062065_00092_30707_7449.N1</td>
<td>2008-01-14 07:02:33</td>
<td>2008-01-14 07:52:11</td>
<td>2978</td>
<td>47,98 %</td>
</tr>
<tr>
<td>RA2_ME__0PNPDK20080117_134449_000051692065_00139_30754_7476.N1</td>
<td>2008-01-17 13:44:49</td>
<td>2008-01-17 13:44:50</td>
<td>1</td>
<td>0,02 %</td>
</tr>
<tr>
<td>RA2_ME__0PNPDK20080205_060317_000040132065_00406_31021_7666.N1</td>
<td>2008-02-05 06:03:17</td>
<td>2008-02-05 06:03:18</td>
<td>1</td>
<td>0,02 %</td>
</tr>
<tr>
<td>RA2_ME__0PNPDE20080126_041940_000009972065_00262_30877_5982.N1</td>
<td>2008-01-26 04:19:40</td>
<td>2008-01-26 04:19:41</td>
<td>1</td>
<td>0,10 %</td>
</tr>
<tr>
<td>RA2_ME__0PNPDE20080129_030613_000044752065_00304_30919_6005.N1</td>
<td>2008-01-29 03:06:46</td>
<td>2008-01-29 03:59:24</td>
<td>3158</td>
<td>70,59 %</td>
</tr>
<tr>
<td>RA2_ME__0PNPDE20080129_030613_000044752065_00304_30919_6005.N1</td>
<td>2008-01-29 03:59:24</td>
<td>2008-01-29 04:20:47</td>
<td>1283</td>
<td>28,68 %</td>
</tr>
</tbody>
</table>
APPENDIX 3: LEVEL 2 STATIC AUXILIARY DATA FILES

APPENDIX 4: SIGMA0 ABSOLUTE CALIBRATION

<table>
<thead>
<tr>
<th>Absolute Orbit nb</th>
<th>Date of Measurement</th>
<th>Location / Rel. track</th>
<th>RA-2 resolution</th>
<th>Transponder Bias [dB]</th>
<th>ECMWF Wet Tropo. Corr. [dB]</th>
</tr>
</thead>
<tbody>
<tr>
<td>10389</td>
<td>24-feb-04</td>
<td>Rome / 315</td>
<td>Low</td>
<td>1.552</td>
<td>0.120</td>
</tr>
<tr>
<td>10511</td>
<td>04-mar-04</td>
<td>Valmontone / 437</td>
<td>Low</td>
<td>1.542</td>
<td>0.102</td>
</tr>
<tr>
<td>10618</td>
<td>11-mar-04</td>
<td>Maccarese / 208</td>
<td>Low</td>
<td>1.447</td>
<td>0.135</td>
</tr>
<tr>
<td>10783</td>
<td>23-mar-04</td>
<td>Rome / 315</td>
<td>Low</td>
<td>1.540</td>
<td>0.142</td>
</tr>
<tr>
<td>10890</td>
<td>30-mar-04</td>
<td>Rome / 315</td>
<td>Low</td>
<td>1.442</td>
<td>0.152</td>
</tr>
<tr>
<td>11119</td>
<td>15-apr-04</td>
<td>Maccarese / 208</td>
<td>Low</td>
<td>0.963</td>
<td>0.122</td>
</tr>
<tr>
<td>11513</td>
<td>13-mag-04</td>
<td>Valmontone / 437</td>
<td>Low</td>
<td>1.353</td>
<td>0.133</td>
</tr>
<tr>
<td>Code</td>
<td>Date</td>
<td>Location</td>
<td>Type</td>
<td>Value 1</td>
<td>Value 2</td>
</tr>
<tr>
<td>--------</td>
<td>------------</td>
<td>-------------------</td>
<td>--------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td>11620</td>
<td>20-mag-04</td>
<td>Fiuggi / 43</td>
<td>Low</td>
<td>1,427</td>
<td>0,139</td>
</tr>
<tr>
<td>11892</td>
<td>08-giu-04</td>
<td>Rome / 315</td>
<td>Low</td>
<td>1,504</td>
<td>0,154</td>
</tr>
<tr>
<td>12014</td>
<td>17-giu-04</td>
<td>Valmontone / 437</td>
<td>Low</td>
<td>1,448</td>
<td>0,348</td>
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<tr>
<td>12121</td>
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<td>0,149</td>
</tr>
<tr>
<td>14290</td>
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<td>Maccarese / 208</td>
<td>Low</td>
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<td>0,164</td>
</tr>
<tr>
<td>14397</td>
<td>30-nov-04</td>
<td>Rome / 315</td>
<td>Low</td>
<td>1,11</td>
<td>0,142</td>
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<tr>
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<td>Valmontone / 437</td>
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<td>1,26</td>
<td>0,248</td>
</tr>
<tr>
<td>14791</td>
<td>28-dic-04</td>
<td>Maccarese / 208</td>
<td>High</td>
<td>0,97</td>
<td>0,134</td>
</tr>
<tr>
<td>14898</td>
<td>4-gen-05</td>
<td>Rome / 315</td>
<td>High</td>
<td>0,95</td>
<td>0,114</td>
</tr>
<tr>
<td>15020</td>
<td>13-gen-05</td>
<td>Valmontone / 437</td>
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<td>0,118</td>
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<tr>
<td>15127</td>
<td>20-gen-05</td>
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<td>0,108</td>
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<tr>
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<td>0,95</td>
<td>0,132</td>
</tr>
<tr>
<td>15399</td>
<td>8-feb-05</td>
<td>Rome / 315</td>
<td>High</td>
<td>1,05</td>
<td>0,124</td>
</tr>
<tr>
<td>15521</td>
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<td>0,94</td>
<td>0,115</td>
</tr>
<tr>
<td>15793</td>
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<td>Maccarese / 208</td>
<td>High</td>
<td>0,93</td>
<td>0,116</td>
</tr>
<tr>
<td>15900</td>
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<td>0,128</td>
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<tr>
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<td>Valmontone / 437</td>
<td>High</td>
<td>0,94</td>
<td>0,154</td>
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<td>0,140</td>
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<td>16401</td>
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<td>0,134</td>
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<td>16523</td>
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<td>Valmontone / 437</td>
<td>High</td>
<td>0,97</td>
<td>0,114</td>
</tr>
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<td>0,168</td>
</tr>
<tr>
<td>16902</td>
<td>24-may-05</td>
<td>Rome / 315</td>
<td>High</td>
<td>1,00</td>
<td>0,152</td>
</tr>
<tr>
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<td>Rome / 315</td>
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<td>1,13</td>
<td>0,16</td>
</tr>
<tr>
<td>17525</td>
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<td>Valmontone / 437</td>
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<td>1,04</td>
<td>0,13</td>
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<td>0,154</td>
</tr>
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<td>High</td>
<td>1,00</td>
<td>0,152</td>
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<tr>
<td>18799</td>
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</tr>
<tr>
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<td>1,09</td>
<td>0,19</td>
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<td>Perm site Rome / 315</td>
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<td>0,110</td>
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<td>Perm site Rome / 315</td>
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<td>0,124</td>
</tr>
<tr>
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<td>0,138</td>
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<td>23916</td>
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<td>Perm site Rome / 315</td>
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<td>1,05</td>
<td>0,172</td>
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<tr>
<td>24417</td>
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<td>Perm site Rome / 315</td>
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<td>0,146</td>
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<tr>
<td>24918</td>
<td>05-dec-06</td>
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<td>0,156</td>
</tr>
<tr>
<td>25419</td>
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<td>Perm site Rome / 315</td>
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<td>0,148</td>
</tr>
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<td>25929</td>
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</tr>
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<td>26922</td>
<td>24-apr-07</td>
<td>Perm site Rome / 315</td>
<td>High</td>
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<td>0,154</td>
</tr>
<tr>
<td>27423</td>
<td>29-may-07</td>
<td>Perm site Rome / 315</td>
<td>High</td>
<td>1,04</td>
<td>0,168</td>
</tr>
<tr>
<td>29928</td>
<td>20-nov-07</td>
<td>Perm site Rome / 315</td>
<td>High</td>
<td>1,04</td>
<td>0,139</td>
</tr>
<tr>
<td>30930</td>
<td>29-jan-08</td>
<td>Perm site Rome / 315</td>
<td>High</td>
<td>1,01</td>
<td>0,013</td>
</tr>
</tbody>
</table>
APPENDIX 5: S-BAND ANOMALY

Table 13: List of L2 FGD Files affected by S-Band anomaly during the current cycle
No files affected by S Band Anomaly in the current cycle

APPENDIX 6: IE SITES COORDINATES

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<thead>
<tr>
<th>ZONE_ID</th>
<th>COORDINATES</th>
</tr>
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<tbody>
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<td></td>
<td>ENDRECORD</td>
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<td></td>
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<td>ENDRECORD</td>
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<td>RECORD polygon pt: LONG=+009.934000&lt;deg&gt; LAT=+043.166000&lt;deg&gt;</td>
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<td></td>
<td>ENDRECORD</td>
</tr>
<tr>
<td>&quot;Toulon D&quot;</td>
<td>RECORD polygon pt: LONG=+005.500000&lt;deg&gt; LAT=+043.070000&lt;deg&gt;</td>
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<td></td>
<td>ENDRECORD</td>
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<td></td>
<td>RECORD polygon pt: LONG=+005.473000&lt;deg&gt; LAT=+043.070000&lt;deg&gt;</td>
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<td>ENDRECORD</td>
</tr>
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<td>RECORD polygon pt: LONG=+005.473000&lt;deg&gt; LAT=+043.160000&lt;deg&gt;</td>
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<tr>
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<td></td>
<td>RECORD polygon pt: LONG=+005.500000&lt;deg&gt; LAT=+043.160000&lt;deg&gt;</td>
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<tr>
<td></td>
<td>ENDRECORD</td>
</tr>
<tr>
<td>&quot;Vostok x&quot;</td>
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<tr>
<td></td>
<td>ENDRECORD</td>
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<tr>
<td></td>
<td>RECORD polygon pt: LONG=+105.500000&lt;deg&gt; LAT=-078.000000&lt;deg&gt;</td>
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</tr>
<tr>
<td></td>
<td>ENDRECORD</td>
</tr>
<tr>
<td></td>
<td>RECORD polygon pt: LONG=+106.500000&lt;deg&gt; LAT=-077.500000&lt;deg&gt;</td>
</tr>
<tr>
<td></td>
<td>ENDRECORD</td>
</tr>
<tr>
<td>&quot;Dome x&quot;</td>
<td>RECORD polygon pt: LONG=+124.000000&lt;deg&gt; LAT=-075.250000&lt;deg&gt;</td>
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<tr>
<td></td>
<td>ENDRECORD</td>
</tr>
<tr>
<td></td>
<td>RECORD polygon pt: LONG=+122.000000&lt;deg&gt; LAT=-075.250000&lt;deg&gt;</td>
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<td>ENDRECORD</td>
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<tr>
<td></td>
<td>RECORD polygon pt: LONG=+122.000000&lt;deg&gt; LAT=-074.750000&lt;deg&gt;</td>
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