Envisat Cyclic Altimetric Report

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

Quality Assessment Report

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reference/référence: ENVI-GSOP-EOPG-03-0011
issue/édition: 1
revision/révision: 0
date of issue/date d’édition: 30 April 2004
status/état: Technical Note

European Space Agency
Agence spatiale européenne
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10 PARTICULAR INVESTIGATIONS
1 INTRODUCTION

This document aims at reporting on the performances of the EnviSat Radar Altimeter, Microwave Radiometer and DORIS sensors, on the data quality of the corresponding Fast Delivery products (RA2_FGD_2P) as well as on the main events occurred during cycle 25.

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

2 DISTRIBUTION LIST

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

3 ACRONYMS

AGC Automatic Gain Control
DORIS Doppler Orbitography and Radiopositioning Integrated by Satellite
DSR Data Set Record
EPC Electronic Power Converter
ERS European Remote Sensing satellite
ESRIN European Space Research Institute
ESOC European Space Operations Centre
FD Fast Delivery products
GS Ground Segment
GTS Global Telecommunication System
HTL Height Tracking Loop
ICU Instrument Control Unit
IECF Instrument Engineering Calibration Facility
IF Intermediate Frequency
IE Individual Echoes
IPF Instrument Processing Facility
LUT Look Up Table
MCMD MacroCommand
MPH Main Product Header
MSS Mean Sea Surface
MWR MicroWave Radiometer
MPS Mission Planning System
OB0 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
4 REFERENCE DOCUMENTS

[R – 12] Defining a Rain flag for the Envisat altimeter, G. Quartly, study presented to the final CCVT plenary meeting, http://earth.esa.int/pcs/envisat/ra2/articles/
5 GENERAL QUALITY ASSESSMENT

5.1 Instruments status

The RA-2 instrument didn’t undergo to any instrument anomaly during this cycle, as given in par. 6.1.

The two known causes of random on-board anomalies are still present. In particular we refer to the so-called S-Band anomaly and the IF mask weird behavior described respectively in [R – 7] and [R – 3]. Only the S-Band anomaly partially affects a low number of Envisat data products as given in par. 7.1.7.

MWR sensor assessment report: refer to [R – 2].

DORIS sensor assessment report: refer to [R – 1].

5.2 Cycle quality

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

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

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

5.3 Orbit quality

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

<table>
<thead>
<tr>
<th>Burn Start Time</th>
<th>Nominal Delta-V</th>
<th>Calibrated Delta-V</th>
<th>Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>First burn</td>
<td>2004/04/07-21:05:00</td>
<td>0.0081 m/sec</td>
<td>0.0078 m/sec</td>
</tr>
</tbody>
</table>
5.4 Ground Segment Processing Chain Status

5.4.1 IPF PROCESSING CHAIN

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

5.4.2 F-PAC PROCESSING CHAIN

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

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

5.4.3 AUXILIARY DATA FILE

Hereafter all the Auxiliary files used actually used by the IPF ground processing are listed:

RA2_CHD_AXVIEC20030402_094243_20030407_000000_20200101_000000
RA2_CON_AXVIEC20020606_164228_20020101_000000_20200101_000000
RA2_CST_AXVIEC20020621_135858_20020101_000000_20200101_000000
RA2_DIP_AXVIEC20020122_134206_20020101_000000_20200101_000000
RA2_GEO_AXVIEC20020314_093428_20020101_000000_20200101_000000
RA2_ICT_AXVIEC20031208_143628_20020101_000000_20200101_000000
RA2_IFA_AXVIEC20020313_174755_20020101_000000_20200101_000000
RA2_IFB_AXVIEC20020313_174959_20020101_000000_20200101_000000
RA2_IFF AXVIEC20031208_151817_20030622_215929_20100101_000000
RA2_IOC AXVIEC20020122_141121_20020101_000000_20200101_000000
RA2_MSS AXVIEC20030131_100228_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_101737_20020101_000000_20200101_000000
RA2_SOI AXVIEC20031208_150608_20020101_000000_20200101_000000
RA2_SSB AXVIEC20031208_150749_20020101_000000_20200101_000000
RA2_TLD AXVIEC20031208_151137_20020101_000000_20200101_000000

The RA2_POL AX, the RA2_SOL AX and the RA2_PLA AX have been regularly updated every week without problems.

The RA-2 Auxiliary Data Files (ADF) are accessible from the Envisat Web pages under [http://envisat.esa.int/services/tools_table.html](http://envisat.esa.int/services/tools_table.html)
5.4.4 PLANNED UPGRADES

Evolution of the IPF Level 1B and Level 2 processing chain is currently planned. The next IPF version release shall nominally contain the following:

1. USO instrumental correction within the RA-2 L1b processor.
2. New MWR Side Lobes correction algorithm within MWR L1b processor
3. Correction of the mispointing evaluation algorithm within the RA-2 L2 processor
4. Inclusion of the loading tide for the GOT2000.2 model.
5. Addition of the peakiness fields in Ku and S band to the RA-2 and MWR FD/I/MAR meteorological products
6. Inclusion of the square of the significant wave height in Ku and S band
7. Inclusion of an S-band anomaly flag
8. Upgrade of the Level 1B and Level 2 processing for DORIS NRT orbital information computation.

Evolutions 3, 5 and 6 shall be reflected too in the F-PAC CMA processing chain.

6 ENVISAT PAYLOAD STATUS

6.1 Altimeter Events

The Radar Altimeter 2, during cycle 25, was never unavailable.

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

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

6.1.1 RA-2 INSTRUMENT PLANNING

The RA-2 instrument planning was performed as follows:

- IF Calibration Mode according the nominal operational acquisition scheme: 100 seconds of data per day over Himalayan region.
- Preset Loop Output mode for GAVDOS Range transponders, located in Creta.
- Preset Loop Output acquisition over ESA transponders, located near Rome; for both ascending and descending passes.
- Individual Echoes background planning: buffering of 20 Data block of individual Echoes and transmission of the in the following 160 Data Blocks. This repeated continuously.

Hereafter the map is reported showing the acquisition sites for both the Range and Sigma_0 transponders.
6.2 **MWR Events**

The MWR, during cycle 25 was never unavailable.

6.3 **DORIS Events**

The DORIS during cycle 25 was never unavailable.

7 **INSTRUMENT PERFORMANCES**

7.1 **RA-2 Performances**

7.1.1 **IF FILTER MASK**

In Figure 2 all valid IF masks retrieved by averaging the 100 seconds of data acquired daily during cycle 25 are plotted in the left panel. The on-ground measured IF mask (ref [R – 4]) is also plotted in that panel with a red solid line. In the right panel the difference of each of the calculated IF masks with respect to the on-ground measured one is reported. During cycle 25 the number of
valid IF masks has been of 14, representing the 40% of the total available IF masks. Only valid IF masks are used to generate the final IF mask used in the Level 1B ground processing; the method used for editing the data is based on the comparison between each of the single IF masks and the reference one (on-ground).

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

7.1.2 USO

In Figure 3 the USO clock period trend retrieved for cycle 25 is reported. In order to make the variability visible, the difference of the actual USO clock period with respect to the nominal one has been plotted, in the upper panel. In the lower panel the Range error due to the USO clock variability has been reported taking a satellite altitude of 800 Km as a nominal value.

Currently the nominal USO clock period (12500 ps) is used within the processing, this means that the data are not corrected for the bias and the drift correlated to the actual USO clock period.

A particular investigation has been performed regarding the USO clock trend and the associated auxiliary file; this is described in [R – 11]. The conclusion can be summarized as follows: the precision of 1ps available in the current USO auxiliary file is not enough to appreciate its trend and it is too rough for any altimetric application. A suitable resolution is considered to be of $10^{-6}$ ps. This problem will be corrected with the following upgrade of the IPF as described in par. 5.4.4.
Figure 3: USO clock period for cycle 25

7.1.3 TRACKING CAPABILITY

Figure 4: RA-2 Chirp ID for ascending passes during cycle 25
In Figure 4 and Figure 5, the Chirp ID is plotted respectively for ascending and descending passes of cycle 25. The MDSRs acquired with 320MHz bandwidth are plotted in light gray (Chirp ID equal to 0), the ones acquired with 80MHz bandwidth are plotted in violet (Chirp ID equal to 1) and the ones acquired with the 20MH bandwidth are plotted in dark green (Chirp ID equal to 2).

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

<table>
<thead>
<tr>
<th>Surface type</th>
<th>320 MHz</th>
<th>80 MHz</th>
<th>20MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Ocean</td>
<td>99.991%</td>
<td>0.008%</td>
<td>0.001%</td>
</tr>
<tr>
<td>Costal Water (ocean depth &lt; 200 m)</td>
<td>98.37%</td>
<td>1.41%</td>
<td>0.22%</td>
</tr>
<tr>
<td>Sea Ice</td>
<td>99.15%</td>
<td>0.73%</td>
<td>0.12%</td>
</tr>
<tr>
<td>Ice Sheet</td>
<td>96.25%</td>
<td>3.01%</td>
<td>0.74%</td>
</tr>
<tr>
<td>Land</td>
<td>81.10%</td>
<td>13.67%</td>
<td>5.23%</td>
</tr>
<tr>
<td>All world</td>
<td>94.97%</td>
<td>3.77%</td>
<td>1.26%</td>
</tr>
</tbody>
</table>

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

The figures given for the RA-2 tracking performances during this cycle are very much in line with the ones recorded at the end of the Commissioning Phase and presented in [R – 8]. The slight differences are in part due to the different algorithms used to discriminate the surface types.
Those figures completely satisfy the objectives of the Commissioning Phase “RSL and Tracking optimization” hereafter reported:

320MHz over Ocean > 99%
320 MHz within 15km of Land/Ocean boundary (Costal Water)
320 MHz over Sea Ice > 95%
320/80 MHz Fixed resolution at Ice Sheet Crossovers > 95%
320MHz over Ice Shelves > 95%

7.1.4 SIGMA0 TRANSPONDER

During cycle 25 four Sigma_0 Transponder measurement where performed on the following dates:

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

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

7.1.5 DATATION

A significant part of an eventual error in the RA-2 products datation could be given by the not perfect synchronism between the Satellite Binary Time and the UTC Time due to a drift of the ICU clock period. A correlation between those two times is performed at every Kiruna orbit dump and then extrapolated for the four non-Kiruna orbits. In Figure 6 (upper panel) the differences between the extrapolated UTC values and the corresponding real UTC values measured at the next Kiruna dump, are reported. For the whole cycle they are well under the 20 microseconds warning threshold. In the lower panel the ICU clock step for the same period is shown.
7.1.6 MISPOINTING

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

The average mispointing value, as extracted from the RA2_FGD_2P data products, is around 0.025 deg$^2$, is known to be higher than the one reported at platform level [R – 13].

This is due to a not perfect tuning of the algorithm currently used to retrieve the mispointing value from the RA-2 waveform data. An optimization of this algorithm shall be part of the next Level 2 processors upgrade, planned for mid-2004 (ref. 5.4.4).
Figure 7: Smoothed mispointing squared trend and histogram for cycle 25 (deg^2*10^4)

Figure 8: Smoothed mispointing squared histogram for cycle 25 (deg^2*10^4)
7.1.7 S-BAND ANOMALY

The so-called “S-Band anomaly” affects the RA-2 data products quality. Hereafter, the table lists the products files affected by the S-band anomaly problem during cycle 25. This corresponds to a total percentage of about 5 % of the acquired data.

Being the method used a statistical one working on ocean data; files containing less than 1000 seconds of data over ocean have not been considered. This choice is supported by the fact that the “S-Band anomaly” is associated to a particular instrumental behavior that cannot appear and disappear within a short time frame. (ref. [R – 7])

<table>
<thead>
<tr>
<th>File name</th>
<th>Start date</th>
<th>Start time</th>
<th>Stop date</th>
<th>Stop time</th>
</tr>
</thead>
<tbody>
<tr>
<td>RA2_FGD_2PNPDE20040401_011953_00062562025_00332_10907_0223.N1</td>
<td>01-Apr-04 01:19:53.768743</td>
<td>01-Apr-04 03:04:09.936808</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RA2_FGD_2PNPDE20040401_030322_00061392025_00333_10908_0226.N1</td>
<td>01-Apr-04 03:03:22.090510</td>
<td>01-Apr-04 04:45:41.288580</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RA2_FGD_2PNPDE20040401_044539_00060262025_00334_10909_0233.N1</td>
<td>01-Apr-04 04:45:39.116280</td>
<td>01-Apr-04 06:26:04.686353</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RA2_FGD_2PNPDE20040401_062558_00062162025_00335_10910_0330.N1</td>
<td>01-Apr-04 06:25:58.058054</td>
<td>01-Apr-04 08:09:34.122117</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RA2_FGD_2PNPDE20040401_080848_00060952025_00336_10911_0331.N1</td>
<td>01-Apr-04 08:08:48.503818</td>
<td>01-Apr-04 09:50:23.141888</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RA2_FGD_2PNPDE20040401_094936_00060142025_00337_10912_0332.N1</td>
<td>01-Apr-04 09:49:36.409590</td>
<td>01-Apr-04 11:29:50.839665</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RA2_FGD_2PNPDE20040401_130808_00059102025_00339_10914_0334.N1</td>
<td>01-Apr-04 13:08:06.613144</td>
<td>01-Apr-04 14:46:30.327222</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RA2_FGD_2PNPDE20040401_144524_000501312025_00340_10915_0335.N1</td>
<td>01-Apr-04 14:45:24.656924</td>
<td>01-Apr-04 16:10:55.685000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

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

7.2 MWR Performances

For MWR performances please refer to the Reference CLS Cyclic Report of the type of [R – 2].
7.3 **DORIS Performances**

For DORIS performances refer to the Reference F-PAC Monthly Report of the type of [R - 1].

8 **PRODUCT PERFORMANCES**

8.1 **Availability of data**

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

![Figure 9: RA-2 L0 unavailable products for first part of cycle 25](image)

<table>
<thead>
<tr>
<th>Start date</th>
<th>Start time</th>
<th>Stop date</th>
<th>Stop time</th>
<th>Duration (s)</th>
<th>Start orbit</th>
<th>Stop orbit</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-Mar-04</td>
<td>16:36:43</td>
<td>09-Mar-04</td>
<td>16:38:01</td>
<td>78</td>
<td>10587</td>
<td>10587</td>
<td>PDS UNKNOWN FAILURE</td>
</tr>
<tr>
<td>10-Mar-04</td>
<td>16:04:40</td>
<td>10-Mar-04</td>
<td>16:05:58</td>
<td>78</td>
<td>10601</td>
<td>10601</td>
<td>PDS UNKNOWN FAILURE</td>
</tr>
<tr>
<td>11-Mar-04</td>
<td>15:30:51</td>
<td>11-Mar-04</td>
<td>15:30:54</td>
<td>3</td>
<td>10615</td>
<td>10615</td>
<td>PDS UNKNOWN FAILURE</td>
</tr>
<tr>
<td>16-Mar-04</td>
<td>16:16:18</td>
<td>16-Mar-04</td>
<td>16:17:35</td>
<td>77</td>
<td>10687</td>
<td>10687</td>
<td>PDS UNKNOWN FAILURE</td>
</tr>
</tbody>
</table>
Table 4: List of gaps for RA-2 L0 products during cycle 25

| Date      | Time   | Date      | Time   | Days | Product ID | Gaps
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>17-Mar-04</td>
<td>15:45:07</td>
<td>17-Mar-04</td>
<td>15:46:24</td>
<td>77</td>
<td>10701</td>
<td>PDS UNKNOWN FAILURE</td>
</tr>
<tr>
<td>20-Mar-04</td>
<td>15:50:42</td>
<td>20-Mar-04</td>
<td>15:52:00</td>
<td>78</td>
<td>10744</td>
<td>PDS UNKNOWN FAILURE</td>
</tr>
<tr>
<td>25-Mar-04</td>
<td>16:34:01</td>
<td>25-Mar-04</td>
<td>16:35:19</td>
<td>78</td>
<td>10816</td>
<td>PDS UNKNOWN FAILURE</td>
</tr>
<tr>
<td>26-Mar-04</td>
<td>16:01:53</td>
<td>26-Mar-04</td>
<td>16:03:10</td>
<td>77</td>
<td>10830</td>
<td>PDS UNKNOWN FAILURE</td>
</tr>
<tr>
<td>30-Mar-04</td>
<td>15:36:42</td>
<td>30-Mar-04</td>
<td>15:38:00</td>
<td>78</td>
<td>10887</td>
<td>PDS UNKNOWN FAILURE</td>
</tr>
<tr>
<td>31-Mar-04</td>
<td>16:44:49</td>
<td>31-Mar-04</td>
<td>16:46:07</td>
<td>78</td>
<td>10902</td>
<td>PDS UNKNOWN FAILURE</td>
</tr>
<tr>
<td>01-Apr-04</td>
<td>16:13:19</td>
<td>01-Apr-04</td>
<td>16:14:37</td>
<td>78</td>
<td>10916</td>
<td>PDS UNKNOWN FAILURE</td>
</tr>
<tr>
<td>02-Apr-04</td>
<td>15:39:18</td>
<td>02-Apr-04</td>
<td>15:39:21</td>
<td>3</td>
<td>10930</td>
<td>PDS UNKNOWN FAILURE</td>
</tr>
<tr>
<td>02-Apr-04</td>
<td>15:42:17</td>
<td>02-Apr-04</td>
<td>15:43:35</td>
<td>78</td>
<td>10930</td>
<td>PDS UNKNOWN FAILURE</td>
</tr>
<tr>
<td>03-Apr-04</td>
<td>15:08:16</td>
<td>03-Apr-04</td>
<td>15:08:18</td>
<td>2</td>
<td>10944</td>
<td>PDS UNKNOWN FAILURE</td>
</tr>
<tr>
<td>03-Apr-04</td>
<td>15:10:18</td>
<td>03-Apr-04</td>
<td>15:11:36</td>
<td>78</td>
<td>10944</td>
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</tr>
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<td>04-Apr-04</td>
<td>16:20:31</td>
<td>78</td>
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</tr>
<tr>
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<td>06-Apr-04</td>
<td>15:17:30</td>
<td>78</td>
<td>10987</td>
<td>PDS UNKNOWN FAILURE</td>
</tr>
<tr>
<td>07-Apr-04</td>
<td>16:25:07</td>
<td>07-Apr-04</td>
<td>16:26:25</td>
<td>78</td>
<td>11002</td>
<td>PDS UNKNOWN FAILURE</td>
</tr>
<tr>
<td>08-Apr-04</td>
<td>15:50:43</td>
<td>08-Apr-04</td>
<td>15:50:46</td>
<td>3</td>
<td>11016</td>
<td>PDS UNKNOWN FAILURE</td>
</tr>
<tr>
<td>08-Apr-04</td>
<td>15:53:27</td>
<td>08-Apr-04</td>
<td>15:54:45</td>
<td>78</td>
<td>11016</td>
<td>PDS UNKNOWN FAILURE</td>
</tr>
<tr>
<td>09-Apr-04</td>
<td>15:19:31</td>
<td>09-Apr-04</td>
<td>15:19:34</td>
<td>3</td>
<td>11030</td>
<td>PDS UNKNOWN FAILURE</td>
</tr>
<tr>
<td>09-Apr-04</td>
<td>15:22:06</td>
<td>09-Apr-04</td>
<td>15:23:24</td>
<td>78</td>
<td>11030</td>
<td>PDS UNKNOWN FAILURE</td>
</tr>
<tr>
<td>10-Apr-04</td>
<td>16:31:02</td>
<td>10-Apr-04</td>
<td>16:32:19</td>
<td>77</td>
<td>11045</td>
<td>PDS UNKNOWN FAILURE</td>
</tr>
<tr>
<td>11-Apr-04</td>
<td>15:59:02</td>
<td>11-Apr-04</td>
<td>16:00:20</td>
<td>78</td>
<td>11059</td>
<td>PDS UNKNOWN FAILURE</td>
</tr>
</tbody>
</table>

In **Figure 10** and **Table 5** the summary of unavailable MWR L0 products is given.
Figure 10: MWR L.0 unavailable products for cycle 25

<table>
<thead>
<tr>
<th>Start date</th>
<th>Start time</th>
<th>Stop date</th>
<th>Stop time</th>
<th>Duration (s)</th>
<th>Start orbit</th>
<th>Stop orbit</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>13-Mar-04</td>
<td>03:00:04</td>
<td>13-Mar-04</td>
<td>04:42:04</td>
<td>6120</td>
<td>10636</td>
<td>10637</td>
<td>PDS_UNKNOWN_FAILURE</td>
</tr>
<tr>
<td>01-Apr-04</td>
<td>19:40:21</td>
<td>01-Apr-04</td>
<td>21:19:33</td>
<td>5952</td>
<td>10918</td>
<td>10919</td>
<td>PDS_UNKNOWN_FAILURE</td>
</tr>
</tbody>
</table>

Table 5: List of gaps for MWR L.0 products during cycle 25

In Figure 11 and Table 6 the summary of unavailable RA-2 L1b products is given.
Figure 11: RA-2 L1b unavailable products for cycle 25

<table>
<thead>
<tr>
<th>Start date</th>
<th>Start time</th>
<th>Stop date</th>
<th>Stop time</th>
<th>Duration (s)</th>
<th>Start orbit</th>
<th>Stop orbit</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>09-Mar-04</td>
<td>16:36:43</td>
<td>09-Mar-04</td>
<td>16:38:01</td>
<td>78</td>
<td>10587</td>
<td>10587</td>
<td>PDS_UNKNOWN_FAILURE</td>
</tr>
<tr>
<td>10-Mar-04</td>
<td>16:04:40</td>
<td>10-Mar-04</td>
<td>16:05:58</td>
<td>78</td>
<td>10601</td>
<td>10601</td>
<td>PDS_UNKNOWN_FAILURE</td>
</tr>
<tr>
<td>16-Mar-04</td>
<td>16:16:18</td>
<td>16-Mar-04</td>
<td>16:17:35</td>
<td>77</td>
<td>10687</td>
<td>10687</td>
<td>PDS_UNKNOWN_FAILURE</td>
</tr>
<tr>
<td>21-Mar-04</td>
<td>15:50:42</td>
<td>21-Mar-04</td>
<td>15:52:00</td>
<td>78</td>
<td>10744</td>
<td>10744</td>
<td>PDS_UNKNOWN_FAILURE</td>
</tr>
<tr>
<td>25-Mar-04</td>
<td>16:34:01</td>
<td>25-Mar-04</td>
<td>16:35:19</td>
<td>78</td>
<td>10816</td>
<td>10816</td>
<td>PDS_UNKNOWN_FAILURE</td>
</tr>
<tr>
<td>26-Mar-04</td>
<td>16:01:53</td>
<td>26-Mar-04</td>
<td>16:03:10</td>
<td>77</td>
<td>10830</td>
<td>10830</td>
<td>PDS_UNKNOWN_FAILURE</td>
</tr>
<tr>
<td>29-Mar-04</td>
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<td>29-Mar-04</td>
<td>16:08:46</td>
<td>78</td>
<td>10873</td>
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<td>PDS_UNKNOWN_FAILURE</td>
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<tr>
<td>30-Mar-04</td>
<td>15:36:42</td>
<td>30-Mar-04</td>
<td>15:38:00</td>
<td>78</td>
<td>10887</td>
<td>10887</td>
<td>PDS_UNKNOWN_FAILURE</td>
</tr>
<tr>
<td>31-Mar-04</td>
<td>16:44:49</td>
<td>31-Mar-04</td>
<td>16:46:07</td>
<td>78</td>
<td>10902</td>
<td>10902</td>
<td>PDS_UNKNOWN_FAILURE</td>
</tr>
<tr>
<td>01-Apr-04</td>
<td>16:13:19</td>
<td>01-Apr-04</td>
<td>16:14:37</td>
<td>78</td>
<td>10916</td>
<td>10916</td>
<td>PDS_UNKNOWN_FAILURE</td>
</tr>
</tbody>
</table>
8.2 RA-2 Altimeter Parameters

Hereafter a summary of the main Altimetric parameters performances is reported; these results have been obtained with the editing criteria mentioned in par. 8.3.

8.2.1 ALTIMETER RANGE

No current results for the time being. The monitoring of the RA-2 FD altimetric range shall be done once the NRT products shall be upgraded with the DORIS navigator NRT orbital information.
8.2.2 SIGNIFICANT WAVE HEIGHT

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

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

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

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

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

The trend and the histogram of the Ku-Band Sigma_0 show a nominal behavior for this cycle. The S-Band Sigma_0 histogram shows a double peak the cause of which is, at the moment, under investigation. The high daily means (sometimes plotted outside the figure range) reported for the S-Band Sigma_0 trend are due to the so-called S-Band anomaly (ref. par. 7.1.7).
Figure 16: Histogram of Ku Wind Speed for cycle 25 (mm/s)

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

In order to produce the statistics reported in 8.2, the following editing criteria have been used before using RA2_FGD products:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Surface type</th>
<th>Zone</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ku SWH</td>
<td>Open Ocean</td>
<td>All world</td>
<td>[0, 10] (m)</td>
</tr>
<tr>
<td>Ku Backscattering Coeff.</td>
<td>Open ocean</td>
<td>All world</td>
<td>[7, 17] (dBs)</td>
</tr>
<tr>
<td>Ku Wind Speed</td>
<td>Open ocean</td>
<td>All world</td>
<td>[0, 20] (m/s)</td>
</tr>
</tbody>
</table>

Table 7: Editing criteria for RA-2 parameters statistics

8.4 Product disclaimer

For the product disclaimers please refer to the following web link:
http://envisat.esa.int/dataproducts/availability/

8.5 Data handling recommendations

8.5.1 SEA-ICE FLAG

The following algorithm is proposed for the determination of a sea-ice flag, presently missing in the Level 2 Ra-2 and MWR data products. (See [R – 14]):

\[ |\text{Latitude (lat: field#4 of L2 data)}| > 50 \text{ deg} \]
\AND
\[ |\text{The number of 20Hz valid data (num\_18hz\_ku\_ocean: field#23 of L2 data)}| < 17 \]
\OR
\[ |\text{MWR Wet Tropospheric Correction (mwr\_wet\_tropo\_corr: field#42 of L2 data)–ECMWF Wet Tropospheric Correction (mod\_wet\_tropo\_corr: field#41 of L2 data)}| > 10 \text{ cm} \]
\OR
\[ |\text{Peakiness (Ku\_peak: field#139 of L2 data)}| > 2 \]

8.5.2 OCEAN S-BAND ANOMALIES DETECTION

A valuable algorithm to detect the Level 2 DSR affected by the RA-2 S-Band anomaly is proposed in [R- 12]. Note that its validity is limited to the data acquired over open-ocean.
8.5.3 WARNING ON IPF 4.56 VERSION IDENTIFICATION FIELD

All RA-2 and MWR level 1B and NRT Level 2 products generated after November 26, 2003 report a software version as being 4.54 (available in MPH field 8).

Nevertheless those products have been generated with the IPF V4.56 operational since November 26, 2003. The first nominal generated product, using the new SW version, will be the one relevant to the absolute orbit number 9094.

The software version ID is correct since December 4, 2003.

8.5.4 S-BAND BACKSCATTERING COEFFICIENT

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

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

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

8.5.5 USO RANGE CORRECTION

The actual data of cycle 25 have to be corrected to compensate for the Ultra Stable Oscillator drift shown in Figure 3. The measured Range shall be corrected considering a drift of –4.42 mm per year. Eventually it could also be corrected for the given bias (30.18 mm) that has to be subtracted from the measured value.

8.6 Wind & Wave quality assessment

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

9 LONG TERM MONITORING

9.1 RA-2 Instrument monitoring

9.1.1 IF FILTER MASK

In Figure 18 the evolution of the IF mask quality parameters evaluated as in [R – 4] is reported only for valid data. It can be observed that the difference with respect to the on-ground reference stays quite constant around 0.07 dBs. Two peaks are visible on the plot that correspond to the data
acquired on September the 27th at 15:48 and on October the 29th at 15:42. The reason of this could be found in the instrument warming up considering that the IF Cal acquisition has been made, in the two cases, only a couple of hours after an anomaly recovery. The residual noise and the accuracy show a very constant behavior over the whole period.

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

During cycle 25 the IF Calibration Mode still shows the weird behavior described in [R – 3]. This problem, present since the beginning of the mission, is under investigation. The anomaly directly affects the number of valid RA-2 IF masks obtained per cycle, but does not refrain from the generation of the IF mask correction file, used in input to the Level 1 B ground processing.

![IF mask Trend](image)

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

9.1.2 USO

In Figure 19 the USO clock period trend retrieved until the end of cycle 25 is reported. In order to make the variability visible, the difference of the actual USO clock period with respect to the nominal one has been plotted, in the upper panel. In the lower panel the Range error due to the USO clock variability has been reported taking a satellite altitude of 800 Km as a nominal value.

Currently the nominal USO clock period (12500 ps) is used within the processing, this means that the data are not corrected for the bias and the drift correlated to the actual USO clock period. Those values, translated into altimetric range figures, are respectively of 32.58 mm and –3.07 mm/year as
calculated with data covering the period 13 June 2003 to 13 April 2004. The given bias and drift have to subtracted from the original altimetric range.

![Graph](image.png)

**Figure 19: USO clock period until end of cycle 25**

### 9.1.3 TRACKING CAPABILITY

In [Figure 20] [Figure 21] and [Figure 22] the cyclic tracking percentages for the three RA-2 bandwidths are reported. The worsening in performances noticeable for cycle 20 was due to the up-load of wrong on-board software parameters for the lasted for about three days.

In general, even if a tiny evolution can be observed, the tracking performances are well in line with the output figures and objectives of the Commissioning Phase as given in par. 7.1.3.
Tracking Capability at 320 MHz

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

Tracking Capability at 80 MHz

Figure 21: RA-2 Tracking percentage at 80MHz for different surfaces
Tracking Capability at 20MHz

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

9.1.4 DATATION

In Figure 23 (upper panel) the differences between the extrapolated UTC values and the corresponding real UTC values measured at the next Kiruna dump, are reported. Only few anomalous events can be observed at the beginning of the period (cycles 16/17) for which the difference rises above the 20 microseconds warning threshold. However, during the last cycle, the number of small differences (10 microseconds plus or minus) has increased a lot; this problem is currently under investigation.

In the lower panel the ICU clock step for the same period is shown where big variations are reported. This is however not a problem because the ICU clock period variations are included in the algorithm for the SBT/UTC correlation evaluation.
9.1.5 MISPOINTING

In Figure 24 the overall mispointing squared trend is plotted for cycles 15 to 25. The two big jumps occurred on April the 7th and on November the 26th 2003 are correlated to the upload of IPF 4.54 and 4.56 respectively. In the second case the abrupt decreasing of the mispointing squared value is due to the usage of a new RA2.IFF_AX IF mask auxiliary file.

On the other hand, it can be noticed that the mispointing squared assumes lower values just after an instrument anomaly; showing an increasing trend until it reaches back a standard mispointing value. This particular behavior can be explained by the different shape that the over-ocean average waveform has before and after an anomalous event as visible in Figure 25. Observe, in particular, the disappearance of the small dip in the waveforms acquired after the anomaly. This problem will be solved with the introduction of an updated mispointing retrieval algorithm with the next version of the processing software as described in par. 5.4.4.
9.1.6 S-BAND ANOMALY

In the percentage of data per cycle that are affected by the so-called “S-Band” anomaly is reported. The figures are quite stable between 2.5% and 6.5%.
Figure 26: Percentage of data affected by the “S-Band Anomaly” for cycles 16-25

### 9.2 Products Monitoring

#### 9.2.1 AVAILABILITY OF DATA

Hereafter the percentage of the different levels of products unavailability is reported for different cycles up to number 25. Considering as reference the instrument unavailability, it is possible to notice that in the last four months the situation is greatly improved for all levels of products.
9.2.2 RA-2 ALTIMETER PARAMETERS

Hereafter a summary of the main Altimetric parameters performances is reported; these results have been obtained with the editing criteria mentioned in par. 8.3.

9.2.2.1 Altimeter range

No current results for the time being. The monitoring of the RA-2 FD altimetric range shall be done once the NRT products shall be upgraded with the DORIS navigator NRT orbital information.
9.2.2.2 Significant Wave Height

The Ku-Band SWH shows a stable behavior during the whole period. On the other hand, the S-Band SWH shows a drop on April the 9th 2003 corresponding to the operational up-load of IPF version 4.54; furthermore the high daily means reported (sometimes plotted outside the figure range) are due to the so-called S-Band anomaly (ref. par. 7.1.7).

9.2.2.3 Backscatter coefficient – Wind Speed

The Ku-Band Sigma_0 trend, reported hereafter, is characterized by a jump of in average 3.24 dBs concomitant with the operational upload of IPF version 4.54 occurred on the 9th of April 2004. To be said that this change is due to the upload of a new RA2_CHD_AX ADF file that artificially shifted the RA-2 real Sigma_0 in order to align it with ERS-2 Sigma_0 and make it coherent with the Witter and Chelton empirical wind model. A similar change in trend, but in the opposite direction, is also visible in the Wind Speed trend reported afterwards.

Beyond the huge jump occurred in April 2003, the S-Band Sigma_0 reports a smaller jump occurring on November the 26th 2003. Following the installation of the IPF processing chain V4.56, the average values of the RA-2 S-Band backscattering parameter, shows an increase of ~0.65 dBs, the new S-band sigma0 being higher with respect to the previous versions. See chapter 8.5.4.

Figure 28: Ku and S SWH daily average up to cycle 25 (mm)
Figure 29: Ku and S Sigma_0 daily average up to cycle 25 (dB/100)

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

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