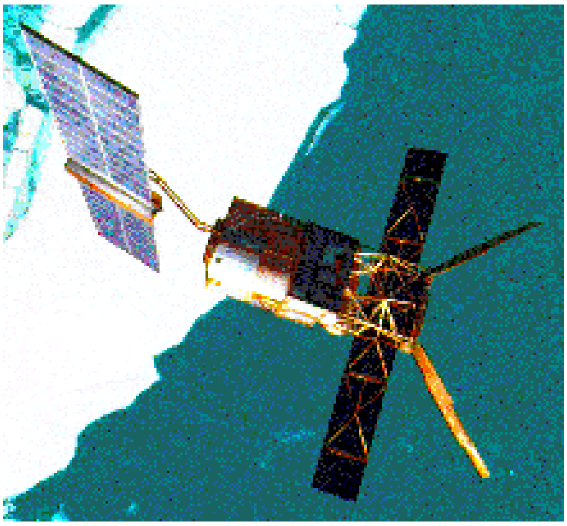
ERS-2 Radar Altimeter performance monitoring

Theoretical Background



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Acronyms

AGC	Automatic Gain Control
DSR	Data Set Record
EBM	Extra Backup Mode
HTL	Height Tracking Loop
IF	Intermediate Frequency
LUT	Look Up Table
MPH	Main Product Header
PCS	Products Control Service
PTR	Point Target Response
RA	Radar Altimeter
SPH	Specific Product header
SPSA	Signal Processing Sub-Assembly
SPTR	Scanning Point Target Response
USO	Ultra Stable Oscillator

1.0 Introduction

This document describes the approach used to perform the long loop performance monitoring of the ERS-2 Radar Altimeter. In particular the theoretical background of the several algorithm used for the data examination and the related instrument characteristics are described.

This document will represent the reference for the Cyclic Reports compiled on a regular basis and where the results of the analysis here presented will be reported.

2.0 Calibration performance

The calibration measurements performed operationally for the Radar Altimeter are executed with the internal calibration technique. It is not an end-to-end absolute calibration because some elements like some ferrite circulators, waveguides and the antenna are outside the calibration path, but makes a relative calibration of time dependent variations in the instrument measurements caused by thermal variation around the orbit as well as ageing effects. There are three types of calibration measurements: The Openloop Calibration, the Scanning Point Target Response (SPTR) Calibration and the Ultra Stable Oscillator (USO) Calibration. The Openloop Calibration, is related to two parameters: the altimetric range and the received power which is then related to the normalized backscattering coefficient (Sigma_0). The Openloop Calibration is dedicated in particular to correct for the thermal orbital variation. It does anyway take into account variabilities due to instrument ageing. The SPTR and USO Calibration are performed to keep under control time-related effects on some reference parameters used in the evaluation of the altimetric range.

2.1 Openloop Calibration

2.1.1 Automatic Gain Control (AGC)

The received power in the Radar Altimeter, during nominal tracking operations, is automatically attenuated of amplified by the instrument aiming to have the best detection of the signal. In order to calibrate the value of that attenuation, a measurement is performed every minute using a special transmitted impulse called Point Target Response. In this case the impulse is not sent to the ground but, after transmission, is redirected to the receive along the calibration path. The calibration mode measures the variations of the Point Target Response power due to the internal electronics of the instrument. The attenuation or amplification of the signal is performed respect to a Reference Power defined at the beginning of the mission as described by the following formula:

$$A^F = \frac{\sum_{1}^{64} MWA(i)}{K_4}$$

Where:

A^F: Calibration sigma_0 correction value

$MWA(i)$: Waveform Samples

K_4: Power reference value for Openloop Calibration

The values measured with this technique, after translation in dBs and smoothing, are added to the sigma_0 measurements during the on-ground processing. A continuous monitoring of the AGC Openloop Calibration is performed within ESRIN/PCS evaluating orbital averages; this hides the orbital variations in the AGC values, which otherwise would be clear.

2.1.2 Height Tracking Loop (HTL)

The Radar Altimeter, during nominal tracking operations, measures the time delay the transmitted impulse takes to travel to the ground and back, including the internal path. In order to calibrate the equivalent length of the internal path, a measurement is performed every minute using a special transmitted impulse called Point Target Response (PTR). In this case the impulse is not sent to the ground but, after transmission, is redirected to the receive along the calibration path. The calibration measures the variations in the delay time the Point Target Response signal takes to travel through the entire length of the calibration path; or, in other words, the variation of the calibration path equivalent length. The measurements are performed with reference to the centre of the tracking window. The overall calibration correction value is given by the following formula:

$$T^F = (N_f - 32)k_f + K_1$$

where:

T^F: Calibration height correction value

N_f: derived centre of the Point Target response

k_f: conversion factor from filter units to time

K_1: delay time to the range window position

First the position of the PTR in the tracking window is determined (where the centre of the tracking window is identified by filter number 32) and then the position of the tracking window is established and added. During the openloop calibration only the position of the PTR within the tracking window is observable and the window position is assumed as know. Anyway for the calibration to be accurate, also this last parameter has to kept under control and its stability to be assessed. This can be done via the SPTR Calibration described in par. 2.3. The values measured with this technique, after smoothing, are added to the altimeter measurements during the on-ground processing. As for all the time delay measurements in the Radar Altimeter, the measurement unit for the Openloop HTL calibration is a frequency derived from the USO one. In case of instrument anomaly, the HTL measurements can show very sudden variations in their values; they are probably due to an asymmetry of the reference clock and to a variation of the equivalent length of an internal subsystem. A continuous monitoring of the HTL Openloop Calibration is performed within ESRIN/PCS evaluating orbital averages; this hides the orbital variations in the HTL values, which otherwise would be clear.

2.2 Ultra Stable Oscillator (USO)

Every time delay measurement performed by the Radar Altimeter, both in tracking and calibration modes, uses, as measurement unit, a clock frequency derived from the Ultra Stable Oscillator one. Any variation in that reference clock could cause an error the time delay measurements and consequently on the altimetric range estimation. For this reason the USO is kept under control by mean of a weekly measurement of a derived frequency, which nominal value is 15 MHz. The output of this campaign is used by ESRIN/PCS to calculate, every week, a correction value to be added to the range measurements in order account for any variation of the internal clock and so to enhance the quality of the data.

2.3 Scanning Point Target Response (SPTR)

During the Radar Altimeter operations all the time delay measurements are performed calculating the position of the received echo within the tracking window with reference to its centre. The range value equivalent to the tracking window centre has been evaluated prior to launch and was considered to be stable. After launch it has been noticed that value was not stable, on the contrary, it was affected by abrupt changes in correspondence to instrument anomalies. The original value is anyway still used as reference for the time delay measurements both in tracking and calibration modes. The cause of those jumps has been identified in an internal clock asymmetry; in order to determine the position of the tracking window centre, correcting for the clock asymmetry effects, a dedicated Scanning Point Target Response campaign is performed every day. The basic concept for the measurement campaign is the study of the positions, within the tracking window, of different PTR related to different trigger positions. Every day, the output of this campaign is used by ESRIN/PCS to calculate a range correction value which takes into account the discrepancies between the operationally used tracking window position values and the measured one. That correction value has to be added to the range measurements in order to improve the quality of the data. The campaign was previously performed every three days and it could happen that two subsequent anomalies occur without that an SPTR campaign was performed. Knowing that the position of the tracking window is affected by abrupt changes related to instrument anomalies, in the period between the two anomalies it would not have been possible to determine the exact position.

2.3.1 SPTR and HTL Openloop Calibration Corrections Correlation

Observing the behaviour of the SPTR and the HTL Openloop Calibration corrections trends, both affected by jumps in their values in correspondence to instrument anomalies; it would be reasonable to think that the values of the two corrections could be in some way correlated. This idea could be furthermore supported by the fact that the techniques the two calibrations are implemented with are very similar, both basing on the measurement of the Point Target Response internal delay.

Considering that the SPTR calibration is aimed to correct for the abrupt changes in the tracking window centre position which is the reference for the HTL Openloop calibration and supposing that the HTL Openloop calibration would follow a logarithmic trend when not affected by jumps; it could be inferred that the difference between the real and the theoretical HTL trends would represent the SPTR correction.

For each interval between two instrument anomalies (inter-anomaly period), a differential value was calculated between the theoretical HTL logarithmic trend and the average over that period of the real HTL Openloop calibration series. The HTL Openloop calibration trend, its average over every inter-anomaly period and the theoretical logarithmic behaviour were evaluated. Only HTL Openloop calibration values lower than the median over every inter-anomaly period have been considered in order to eliminate the influence of the high HTL variability. Every inter-anomaly value obtained from he HTL was then correlated with the corresponding SPTR correction one. This was performed by mean of a scatter plot and the evaluation of the correlation coefficient and of the correlation slope.

The results obtained were not really satisfying with values respectively of 0.7 and 0.8 for slope and correlation coefficient.

The knowledge of the instrument and the calibration techniques can explain the evidence as follows. Even if both the SPTR and HTL Openloop calibrations are effected by the clock asymmetry which causes a certain similarity in the their behaviours, the HTL Openloop calibration is affected by a secondary effect, also happening in correspondence to instrument anomalies, which causes the numerical uncorrelation. The secondary effect just mentioned can be identified in the delay line equivalent length variation due to the internal temperature change often associated with instrument anomalies.

3.0 Instrument performance

The instrument performances are assessed monitoring the following parameters:

- Acquisition Percentage: the percentage of products in Acquisition Mode both for every cycle and since the beginning of the mission. It is useful to determine the capability of the instrument in performing meaningful measurements.
- Internal Instrument Parameters for the period covering every cycle. They are important to keep track of the status of every subsystem internal to the instrument, and try to establish correlation with eventual variations in the measured quantities (e.g. Range, Sigma_0 and Significant Wave Height) and with instrument malfunctions.
- IF Filter Shape for every cycle and trend of the difference respect to the shape the IF Filter had at the beginning of the mission (e.g. on the 5^{th} of May 1995). This is important in order to monitor if and how the waveforms are distorted by this component inside the instrument and if how distortions have been changing during the mission lifetime.
- Off-nadir pointing trend since the beginning of the mission. This is important in order to asses if the RA antenna really points at nadir being this one the of the main requirements for all the RA data processing.

3.1 Acquisition Percentage

During nominal operations the Radar Altimeter works alternatively in Acquisition and Tracking Modes. In Acquisition Mode the instruments adjust cyclically its internal parameters in order to reach the best reception of the backscattered echo. In this mode the instrument cannot perform any meaningful measurement. When the internal parameters are set to their optimum values for the best reception of the echo in those particular conditions, the instrument switches automatically to Tracking Mode. In Tracking Mode the instrument can perform meaningful measurements. A change in the environment the instrument is flying over (in particular the slope of the terrain) cause the instrument to adjust again its internal parameters to obtain the best reception. If it is able to perform the adjustment without switching again to Acquisition Mode, we can affirm that the instrument “maintains the lock” with the backscattered signal; the most the instrument stays in Tracking Mode, the better its performances can be considered. Considered the working concept just described, it easily to understand that zones characterised by high terrain slope variations (like mountainous and coastal zones) cause the instrument to loose the lock and consequently force him to work in Acquisition Mode for an high percentage of time.

3.2 Internal Instrument Parameters

During nominal operations several engineering parameters characterizing many of the instrument subsystems are constantly measured and transmitted to the ground. The parameters are measured with a frequency of one sample every 16 seconds and mainly consist of power, current, voltage and temperature at different points inside the instrument. They are useful in order to have a better insight of the behaviour of the instrument and can be used to identify eventual malfunctions or anomalous functioning.

3.2.1 Internal Instrument Parameters Trends

For detailed information on the internal instrument parameters long term trends: http://ersmon-rp.esoc.esa.de/

The internal instrument parameters can be subdivided into two categories:

- Parameters not influenced by the temperature outside the instrument thus not presenting variations synchronous with the orbit. They are in general plotted in such a way that all the values (one every 16 seconds) are displayed and the discrimination due to the quantization is easy to notice.
- Parameters influenced by the temperature outside the instrument thus presenting variations synchronous with the orbit. They are displayed, in general, after the daily mean has been calculated.

3.2.2 Internal Instrument Parameters and Instrument Anomalies

The internal instrument parameters are very useful in controlling the status of the instrument especially in case of instrument anomalies. They allow a better understanding of its behaviour during the different phases of the operational status recovery and help to identify the different types of anomalies occurred.

During nominal operations the instrument works alternatively in Ocean and Ice mode. Depending on the type of anomaly, when an anomaly occurs, sometimes the instrumental parameters are not recorded sometimes they are. Anyway during the anomaly, or just after it, the instrument switches to one of the not nominal modes like Stand By USO Off/On, Stand By SPSA Off/On recovering to the operational working modes via some of the following ones: Warm Up 0, Warm Up 1, Warm Up 2.

3.3 IF Filter Shape

Within the microwave section of the receiver, the Intermediate Frequency filter plays a very important role. After being deramped and downconverted to intermediate frequency, the return signal is filtered in order to remove spurious components. The IF filter is made using a SAW device and has a bandwidth of 3.2 MHz. The characteristics of this filter have a very critical role since they can introduce distortions in the signal, which affect the waveform shape as it is seen within the filter bank. It is easy to understand that, since the retrieval of the geophysical parameters is based on the waveform shape, especially in case of application of retracking algorithms; the waveform should not be distorted by instrumental effects. In any case, the distortions on the signal, due to instrumental effects such as the IF filtering, have to be known and corrected. An algorithm to retrieve the impulse response of the filter has been developed making use of the Scanning Point Target Response calibration data in ice mode. This operation mode allows to perform a sort of sampling of the IF filter shape in the frequency domain. Using a spline function a more smoothed shape can be reconstructed in order to evaluate the filter attenuation on the signal for any position within the filter bank. Using that algorithm, the IF Filter behaviour is daily monitored within ESRIN/PCS.

3.4 Off-Nadir Pointing

The Radar Altimeter is a nadir looking instrument. This means that the bore-sight of its antenna pattern has to be perpendicular to the scene the Radar Altimeter looks at. Any variation of the pointing angle (mispointing) degrades the measurements introducing errors on the three most important geophysical parameters derived from the raw data. For this reason the mispointing angle has to be monitored in order to characterize its behaviour and eventually to evaluate a correction to be applied to the Radar Altimeter measurements.

Furthermore during cycle 50 a special event occurred referring to the scheme with which the ERS-2 satellite attitude is maintained. On the 7th of February 2000 a new software has been uploaded in order to pilote the satellite with only one gyroscope while before the piloting has always been performed with three of them. After a commissioning period of two weeks, the attitude of the ERS-2 platform was operationally maintained with one gyro for almost one year time.

During cycle 60 another important event regarding the attitude control of the ERS satellite has happened. After an anomaly occurred on the 17th of January 2001, the subsequent recovering and the switch on of the payload (occurred on the 5th of February for what regards the RA); the spacecraft is piloted in Extra Backup Mode. This mode controls the platform attitude without gyros and it is geocentric. This means that the boresight of the RA antenna is not pointing perpendicularly to the local tangent plane to the ellipsoid, but it is pointing towards the centre of the earth.

Since the change in attitude control could have affected the pointing performances of the Radar Altimeter, a tool was developed which allows to keep under control the mispointing behaviour.

3.4.1 Method Description

The off-nadir pointing of the radar Altimeter has an impact on the shape of the averaged returned waveform in the filter bank. Hereafter the method will be described which has been used to retrieve the mispointing information from those echo waveforms and then to evaluate the mispointing trend from the Radar Altimeter raw data.

The theoretical shape of the return waveform can be described, for small pointing error ξ respect to the nadir direction, by the following formula. This when the echo has already been corrected for the antenna effects and when some approximations, valid for small ξ, have been performed. for $t < 0$

$$P(t) = L\left(1 + erf\left(\frac{t}{\sigma_c\sqrt{2}}\right)\right)$$

for $t > 0$

$$P(t) = L\left(1 + erf\left(\frac{t}{\sigma_c\sqrt{2}}\right)\right)\left[1 + \left(\frac{2}{\gamma}\sqrt{\frac{c\varepsilon t}{H}}2\xi\right)^2\right]$$

In order to put this in relation with the waveform representation in the filter bank (frequency domain) the time variable t has to be related to the FFT filter numbers. A FFT sample n represents a time instant t_n as: $t_n = (n-32)t_c$; where t_c is the time delay corresponding to one FFT unit:

3.012 ns for ERS-2 depending on the chirp slope. The factor L is regulated by the Automatic Gain Control in order to have a predetermined average power value P_{ref}. The factor ε takes into account the non spherical earth; γ depends on the 3dBs antenna aperture and σ_c is a composite parameter taking into account the point target response -3dBs width and the rms height of the backscattering points.

Considering the two equations previously reported it is possible to notice that: the mispointing value ξ has influence on the echo waveforms only for positive values of the time variable *t* and it has effect on the slope of the trailing edge of the echo shape which is proportional to ξ^2. This allows the mispointing squared to be calculated using the following formula:

$$\xi^2 = \frac{\frac{slope}{y32}\gamma^2 H}{16c\varepsilon t}$$

where *slope* is the slope of the line fitted to the trailing edge and *y32* is the value assumed by that line at filter number 32.

3.4.2 Overall Trend Data Processing Description

The Radar Altimeter raw data contain information over the echo waveforms in the frequency domain with a frequency of 1/20 Hz. They have been processed and corrected in such a way that the waveforms obtained from them could be assimilated to the theoretical ones described in the previous paragraph. Only data over ocean have been selected. For every data file containing several minutes of data the processing algorithm used to assess the average mispointing value can be summarised as hereafter reported:

- The waveform information have been extracted from the raw data; 20 waveforms per seconds are available which have been then normalised in order to prevent errors related to the Automatic Gain Control loop behaviour.
- The waveforms have been corrected for the IF Filter Shape (ref. par. 3.3). This compensate for an instrumental effect affecting the echo waveform in reality but which is not considered in the theoretical model used.
- The waveforms have been averaged over one second and corrected for antenna pattern effects.
- One mispointing squared value per second has been evaluated using the formula reported in the previous paragraph. From the corrected echo shapes, the slope has been identified as the one of the line which best fitted the samples related to FFT numbers 37 to 60.
- A sliding average with one minute window duration has been performed over the mispointing squared ξ^2 time series. The mispointing ξ time series has been obtained from it by mean of a square root operation (eventual ξ^2 negative values have been considered equal to zero).
- Assuming the mispointing squared ξ^2 distribution being gaussian (central limit theorem) and considering that the mispointing can be defined as: $\xi = \sqrt{\xi^2}$ for $\xi^2 \geq 0$ and $\xi = 0$ for $\xi^2 < 0$; the probability density function describing the mispointing statistics behaviour can be represented with the following formula:

for $\xi \geq 0$

$$P(\xi) = \frac{1}{\sqrt{2\pi}\sigma_{\xi^2}} 2\xi \exp\left[-\left(\frac{\xi^2 - m_{\xi^2}}{\sqrt{2}\sigma_{\xi^2}}\right)^2\right]$$

for $\xi < 0$

$$P(\xi) = 0$$

from which its mean value m_ξ can be derived as:

$$m_\xi = \sqrt{m_{\xi^2}}\left[0.5 + \frac{1}{2\sqrt{2\pi}} \frac{\sigma_{\xi^2}}{m_{\xi^2}}\right]$$

where m_{ξ^2} and σ_{ξ^2} are respectively the mispointing squared mean and standard deviation.

- The histogram of the mispointing time series has been evaluated and fitted to the theoretical probability density function just described. From this procedure the two values m_{ξ^2} and σ_{ξ^2} have been retrieved with which the mispointing average value m_ξ has been determined.

3.4.3 Along the Orbit behaviour Data Processing Description

For evaluation of the mispointing along orbit behaviour, an slightly different algorithm has been used respect to the one described in par 3.4.2 which is used to evaluate series of punctual results.

- The first five steps are in common between the two algorithms until the point when the mispointing value ξ is calculated from the mispointing squared ξ^2. In this case the squared off-nadir pointing figures are kept, as they were calculated and smoothed, for all the data recorded over ocean, excluding the areas covered by sea ice.
- The orbital values are then averaged over all the orbits of one day in such a way that each mean value at a certain time distance from the ascending node, taken as a reference, is calculated using the figures from all the orbits recorded at the same time distance from the reference. This can obviously be done only if assuming that the RA off-nadir pointing behaviour is periodical with one orbit period. The assumption of orbital periodicity has been determined after a visual inspection but it has been confirmed by the evaluation of the standard deviation which is in general decreasing when averaging over an higher and higher number of orbits.

3.4.4 Results

The off-nadir pointing analysis work has been performed on the Radar Altimeter raw data products disseminated in fast delivery since the beginning of the ERS-2 mission. Every day, some minutes of raw data are available three hour after sensing. They are measured over the Pacific Ocean within $0°$ and $35°$ latitude north. Those data have been analysed with the method described in par. 3.4.1 and 3.4.2 giving, as output, mispointing values since the beginning of the mission.

Two important considerations have to be made at this point:

- The Radar Altimeter waveforms undergo several corrections during the processing. They are the antenna and the IF Filter correction which do influence a lot the outcome of the exercise. In particular, during this study, the processing to retrieve the mispointing squared figures from the echo shape has been found to be very sensitive to the IF Filter Shape used for the correction. The analysis has been anyway performed using the proper IF Filter Shape, the most updated for each measurement, in order to minimize the IF Filter Shape impact on the off-nadir pointing results (ref. par. 3.3).
- The algorithm itself is affected by an error, which is exponentially growing as the absolute mispointing squared value decreases.

4.0 Products performance

The four ESA ground stations (Gatinueau, Kiruna, Mas Palomas and Prince Albert) process ERS-RA raw data to produce URA products and distribute them within three hours after sensing. Before the beginning of cycle 44, the raw data received by the fourth ground station (Prince Albert) were processed a week later at Gatineau; since the 28th June 1999 a network connection has been established between Prince Albert and Gatineau which allows also the data received in Prince Albert to be processed and distributed in near real time. The quality of these URA products is checked by PCS at ESA/ESRIN. (For more information on the ground stations; http://earth1.esrin.esa.it/f/eeo3.324/0xc1cce41c_0x00006d3b).

The performance of the fast delivery products is determined by mean of the following criteria:

- Availability of Data and Quality Assessment: a summary of the percentages of available/not available products and of all the features affecting their quality during every cycle.
- Fast Delivery Data Summary
- Instrument Mode: an overall picture of the modes the instrument worked in during every cycle.
- Look Up Tables (LUT) Status
- Data Comparison with Forecasts: the comparison of the fast delivery data with the forecasts performed by ECMWF is useful to validate the URA products

4.1 URA Fast Delivery Products Short Description

Each product of the RA fast delivery data consists of:

- **1 MPH (Main Product Header)**: general information of the product such as sensing and generation time, the satellite position at sensing time, the ground station which acquired the product, the software used to process the data and some quality flags.
- **1 SPH (Specific Product Header)**: information on the auxiliary parameters used in the processing of the product and some quality flags.
- **77 DSRs (Data Set Record)** include information as wind speed and significant wave height, instrument mode, geophysical corrections and some quality flags are part of it.

Note that only the data in ocean tracking mode are processed within the on-ground processing chain and reported in the fast delivery products.
For more information on the URA products: http://earth1.esrin.esa.it/f/eeo2.267/pgersaltura

4.2 Availability of Data and Quality Assessment

The fast delivery data (URA) are checked every day by ESRIN/PCS for quality assurance. The summary of all the most important features affecting the quality of the data during each cycle is analysed for long loop performance monitoring.

4.3 Fast Delivery Data Summary

From the fast delivery data arriving every day at ESRIN/PCS, the relevant parameters are extracted on a daily basis. For every parameter all the information relative to every cycle have been averaged on a geographical basis over pixels of 1 deg latitude per 1 deg longitude. They are reported in the analysed cycle by cycle in order to give a global overview of the Radar Altimeter data for each cycle.

4.4 Instrument Mode

During nominal operations the Radar Altimeter works alternatively in Ocean and Ice Modes. The two modes differ basically on the resolution of the altimetric range measurements and on the capability to maintain the “lock” with the backscattered echo. In Ocean Mode the resolution is higher but the instrument can easily loose the tracking when flying over surfaces characterised by high slope variations. On the other hand in Ice Mode the resolution is lower but the instrument succeeds in keeping the tracking also when flying over very steep terrains. The switch from Ocean to Ice Mode and vice-versa is not performed automatically by the instrument, but it is commanded following the water/ground borders indicated by the Ice/Ocean mask. Within both the Ice and Ocean Modes, two sub-modes can be distinguished: Tracking and Acquisition Modes, which have been already mentioned in the paragraph dedicated to the Instrument Performance.

When the satellite is flying over central Asia, the instrument is commanded to operate in a special calibration mode called SPTR. The Instrument works permanently first in Ocean Tracking and then in Ice Tracking Mode, due to the presetting mode used during the calibration. The data recorder during the SPTR campaign, both Ocean and Ice Modes, are used to evaluate the calibration correction as described in par. 2.3. Furthermore, the data in SPTR Ice Mode measured during this campaign are used to evaluate the IF Filter Shape presented in par. 3.3.

Starting from cycle 43 on, the campaign has been and will be performed in the future every day instead of every three days as it was previously planned. The decision of performing the calibration campaign more often has been taken in order to minimize the probability to have periods between two anomalies without any SPTR measurement. Being the SPTR measurements affected by quasi-random abrupt changes in case of instrument anomalies, the situation of having two subsequent anomalies without any SPTR calibration campaign will cause the impossibility to produce a completely trustable SPTR calibration correction for the altimetric range values recorded during that period. A solution to this problem had been proposed by Richard Francis and Monica Roca in early 1996, but it has been not yet operationally implemented due to difficulties in the operational retrieval of several parameters useful for the algorithm execution.

4.5 Look Up Tables Status

The Look Up Tables (LUT) contain auxiliary parameters used in the on-ground processing. Those parameters need, from time to time, to be updated. In those cases, new versions of the tables containing the parameters have to be produced and loaded in memory at the ground stations. The LUT status, as extracted from the data, is continuously monitored within ESRIN/PCS in order to keep track of all the changes and to verify that the proper parameters have been used for the processing.

4.6 Special Events

Special events are monitored on a cyclic basis which have an impact on the Radar Altimeter Instrument and products performance.

4.7 Data Comparison with forecasts

With the aim of validating the fast delivery Radar Altimeter products; a comparison is performed, on a cyclic basis, by the European Centre for Medium Range Weather Forecast (ECMWF) between the RA Sigma_0, Wind Speed and Significant Wave Height with the collocated analogous parameters from buoys and models.