PREPARATION AND OPERATIONS OF THE MISSION PERFORMANCE CENTRE (MPC) FOR THE COPERNICUS SENTINEL-3 MISSION

S3 SRAL Cyclic Performance Report

S3-A

Cycle No. 039

Start date: 06/12/2018

End date: 02/01/2019

S3-B

Cycle No. 020

Start date: 16/12/2018

End date: 12/01/2019



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SENTINEL 3



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Changes Log

Version	Date	Changes
1.0	19/01/2019	First Version

List of Changes

Version	Section	Answers to RID	Changes



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1 Introduction

1.1 Scope of the document

This document is dedicated to the cyclic monitoring report of the SRAL calibration parameters within the Sentinel-3 MPC project. This includes also a whole mission analysis.

1.2 Acronyms

ADF	Auxiliary Data File
Cal/Val	Calibration / Validation
CNES	Centre National d'Études Spatiales
DEM	Digital Elevation Model
ESA	European Space Agency
ESL	Expert Support Laboratory
ESTEC	European Space Technology Centre
НКТМ	House Keeping Temperatures Monitoring
IOCR	In-Orbit Commissioning Review
LRM	Low Resolution Mode
MPC	Mission Performance Centre
PTR	Point Target Response
SAR	Synthetic Aperture Radar
SCCDB	Satellite Calibration and Characterisation Database
SCT	Satellite Commissioning Team
SRAL	Synthetic Aperture Radar Altimeter
TBD	To Be Done



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1.3 Processing Baseline Version

<u>S3A</u>

IPF	IPF / Processing Baseline version	Date of deployment	
SR1	06.14 / 2.33	CGS: 04/04/2018 10:09 UTC	
		PAC: 04/04/2018 10:09 UTC	

<u>S3B</u>

IPF	IPF / Processing Baseline version	Date of deployment	
SR1	06.14 / 1.14	PAC: 06/12/2018 10:05 UTC	



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2 SRAL Internal Calibration Monitoring.

2.1 Introduction

The SRAL instrumental calibration is assessed during the mission. Several parameters are monitored and analysed in detail in order to characterise the altimeter performance along the mission lifetime.

Two main groups of calibration parameters are monitored.

The first is derived from the Point Target Response (PTR) calibration in CAL1 mode. The PTR signal follows the same circuitry path as the science waveforms within the calibration loop. The delay caused by the travel through the calibration path can be measured and afterwards compensated in the total range computation. The attenuation suffered by the signal when traveling through the instrument also needs to be monitored and the science waveforms need to be compensated for this power variations. Moreover, there are a collection of other parameters to be checked, such as the PTR width and the secondary lobes features. These CAL1 parameters are produced separately for LRM and SAR modes, as they follow different instrumental paths, and also they are duplicated for Ku-band and C-band. Moreover there are different options for characterising the delay and power of the closed loop signal, such as the PTR maximum power or PTR maximum position.

The second is related to the Instrument Transfer Function, measured by the CAL2 mode. The science waveforms spectra is distorted by the on-board instrumental hardware sections. Therefore, in order to retrieve the original echo shape, we need to compensate for this effect. Several parameters are derived from the analysis of the CAL2 waveforms for characterizing it and dissect any feature along the mission lifetime. The CAL2 waveform is the same for both modes LRM and SAR, but there is a distinction between bands Ku and C.

Additionally, for SAR mode, the two intra-burst corrections are monitored: they are the power and phase progressions within a burst. Science pulses within a burst are to be corrected for these expected variations in the burst. Some characteristics are computed for describing and following up their behaviour along the S3 mission.

It is also of major importance the monitoring of the on-board clocks. The altimeter clock counter, responsible for computing the echo travel time, has a multiplicative impact in the range determination. The platform clock is responsible for the overall platform instruments datation. Their stability and performance are to be supervised along the mission.

Finally, the data coming from the thermistors located in the different sections of the on-board HW (HKTM products), are to be analysed in order to check the relation of any calibration parameters anomaly with the thermal behaviour, and find solutions for modelling the instrument characterisation (for instance orbital oscillations) if needed.

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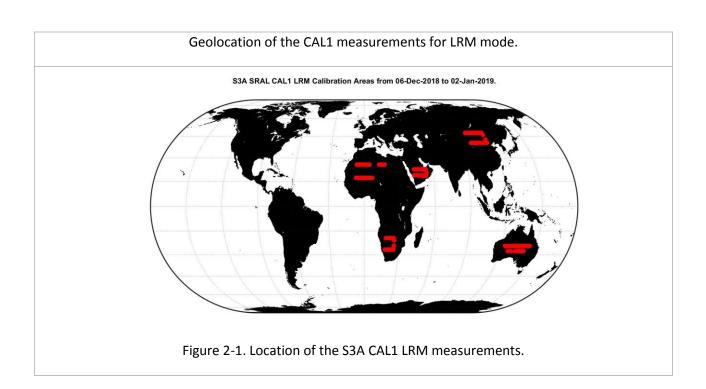
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An important remark is to be made: although we can see a certain drift of a specific calibration parameter along the mission, this is not to be considered as a warning for the quality of the science data, as long as the instrumental calibration is correctly applied during the science data processing. A warning shall be raised in the scenario of a calibration parameter value approaching the mission requirement bounds. The Autocal parameters monitor the actual attenuation values for each on-board ATT step, and are to be used for updating the on-board ATT table in case of need.

2.2 Cyclic In-Flight Internal Calibration.

In this chapter, the monitoring of all calibration modes main parameters for the S3A and S3B missions is depicted in figures (only Ku band). An analysis of the cycle results is developed in chapter 2.3.

2.2.1 CAL1 LRM



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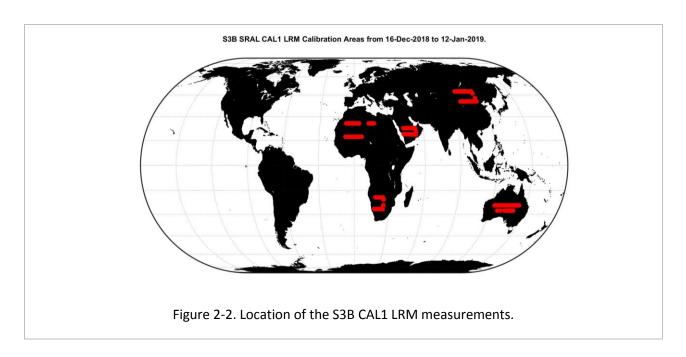
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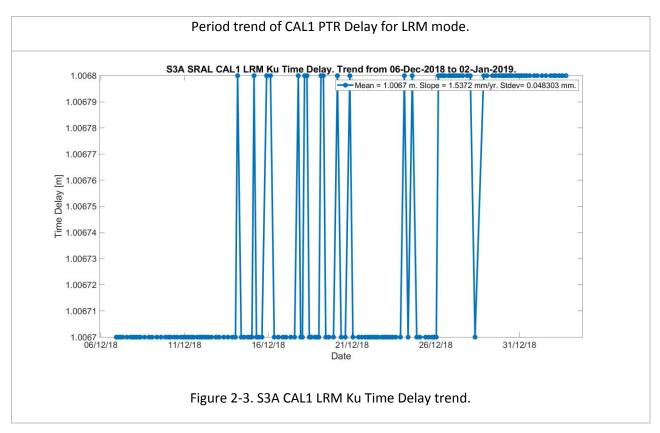
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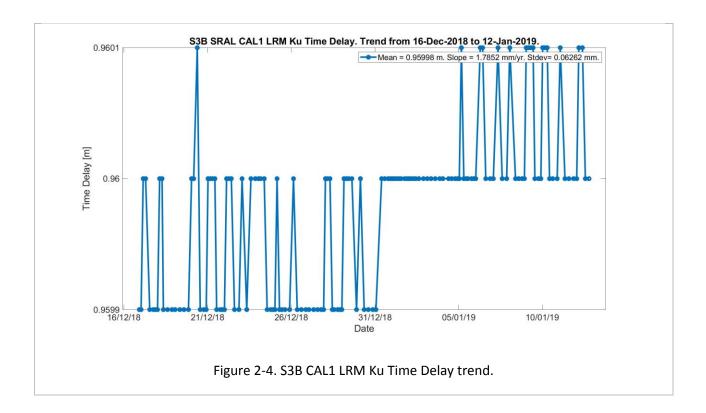
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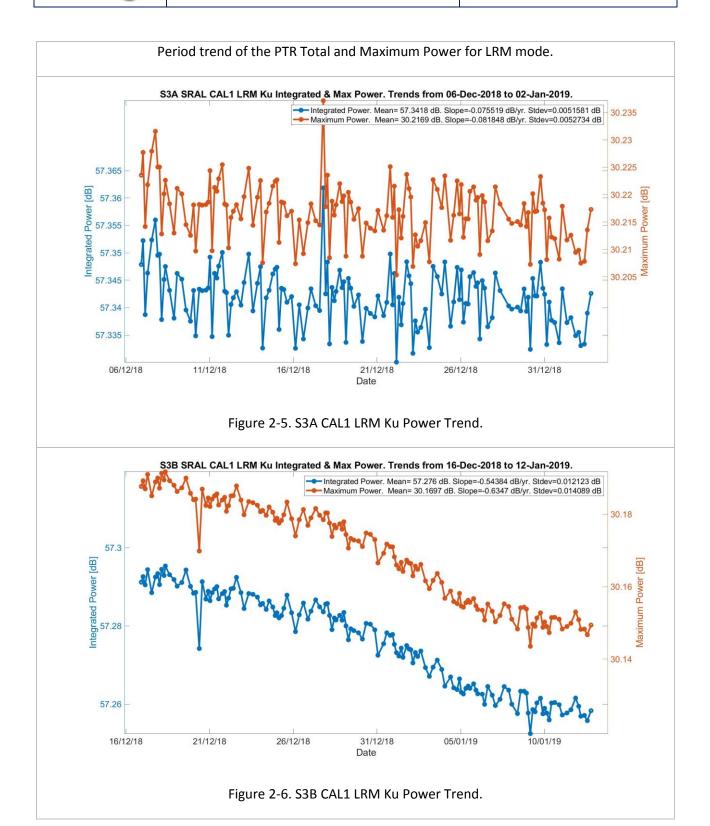
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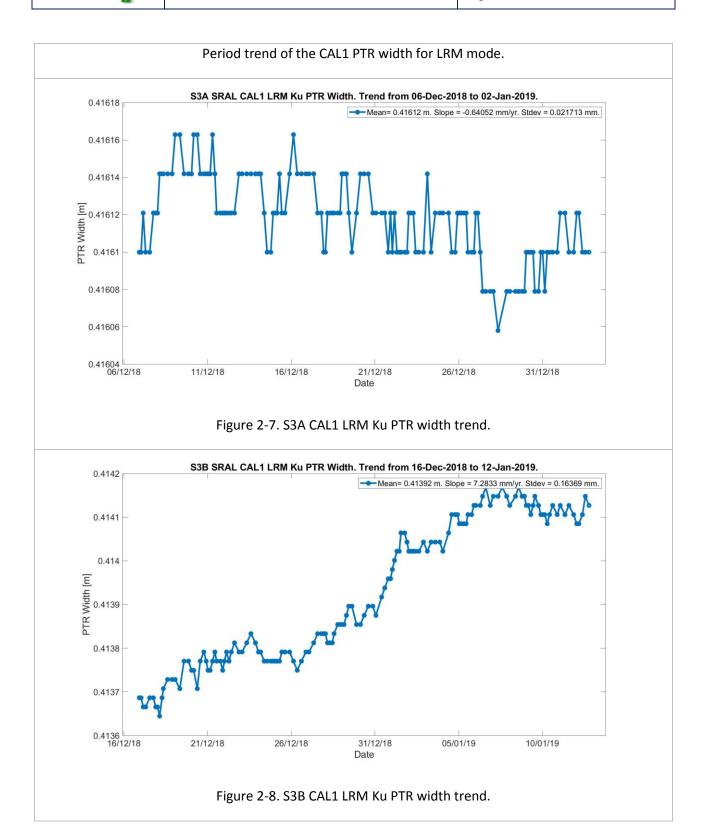
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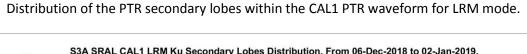
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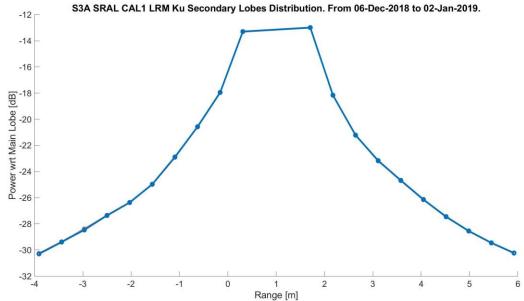


Figure 2-9. S3A CAL1 LRM Ku PTR secondary lobes Power and Position within the PTR waveform.

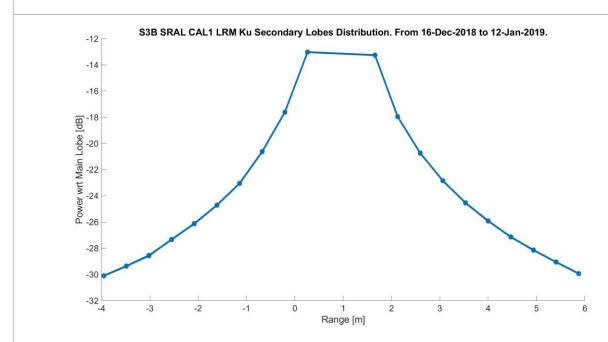


Figure 2-10. S3B CAL1 LRM Ku PTR secondary lobes Power and Position within the PTR waveform.



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Slope and Standard Deviation of CAL1 LRM PTR secondary lobes power.

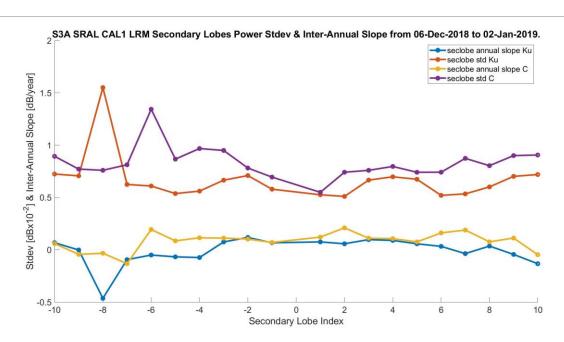


Figure 2-11. S3A CAL1 LRM Ku PTR secondary lobes characterisation. The inter-annual slope (in dB/year) and standard deviation (in dBx10⁻²) of each of the secondary lobes are shown.

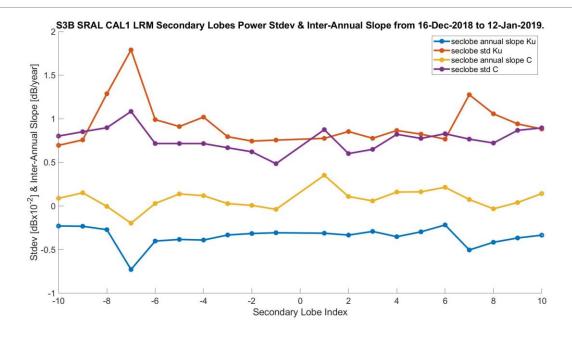


Figure 2-12. S3B CAL1 LRM Ku PTR secondary lobes characterisation. The inter-annual slope (in dB/year) and standard deviation (in dBx10⁻²) of each of the secondary lobes are shown.



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2.2.2 CAL1 SAR

Geolocation of the CAL1 measurements for SAR mode.

S3A SRAL CAL1 SAR Calibration Areas from 06-Dec-2018 to 02-Jan-2019.

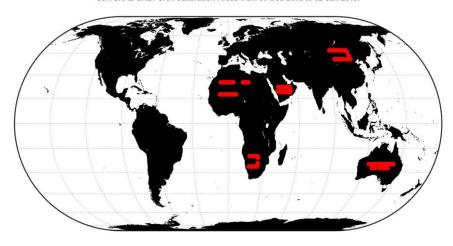


Figure 2-13. S3A Location of the CAL1 SAR measurements.

S3B SRAL CAL1 SAR Calibration Areas from 16-Dec-2018 to 12-Jan-2019.

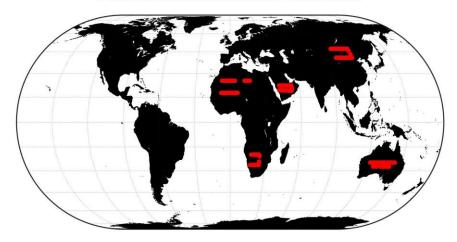


Figure 2-14. S3B Location of the CAL1 SAR measurements.

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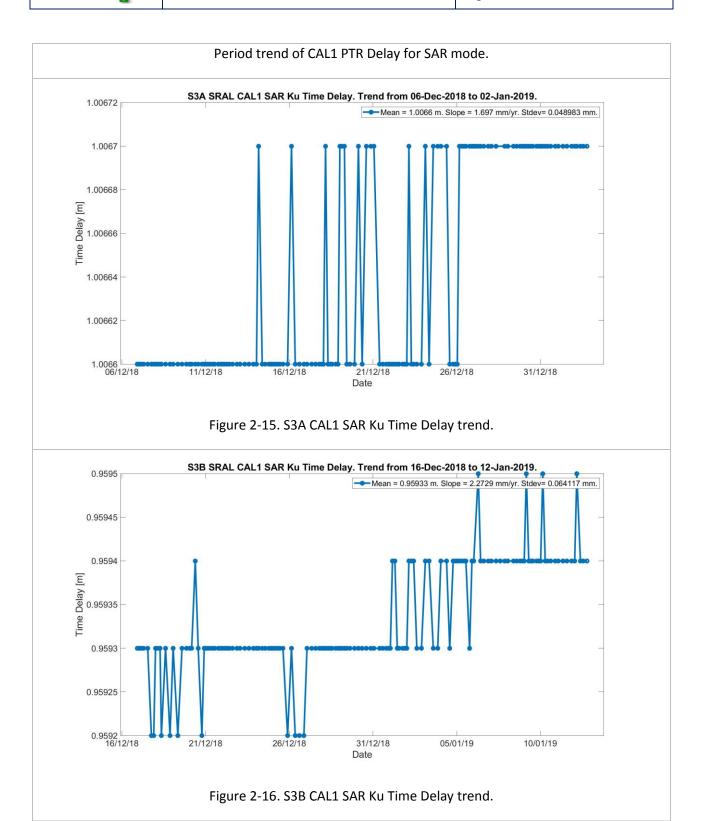
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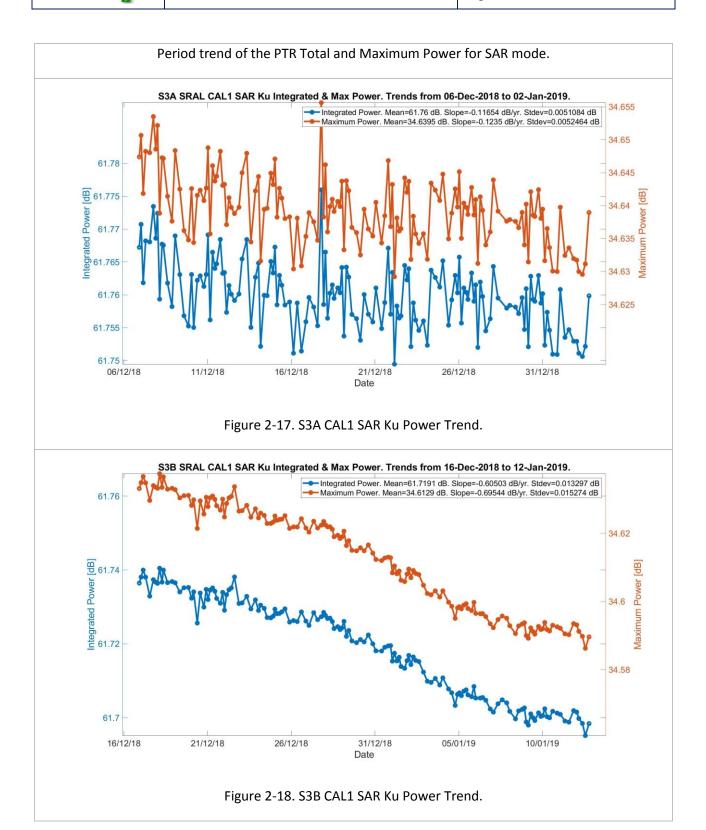
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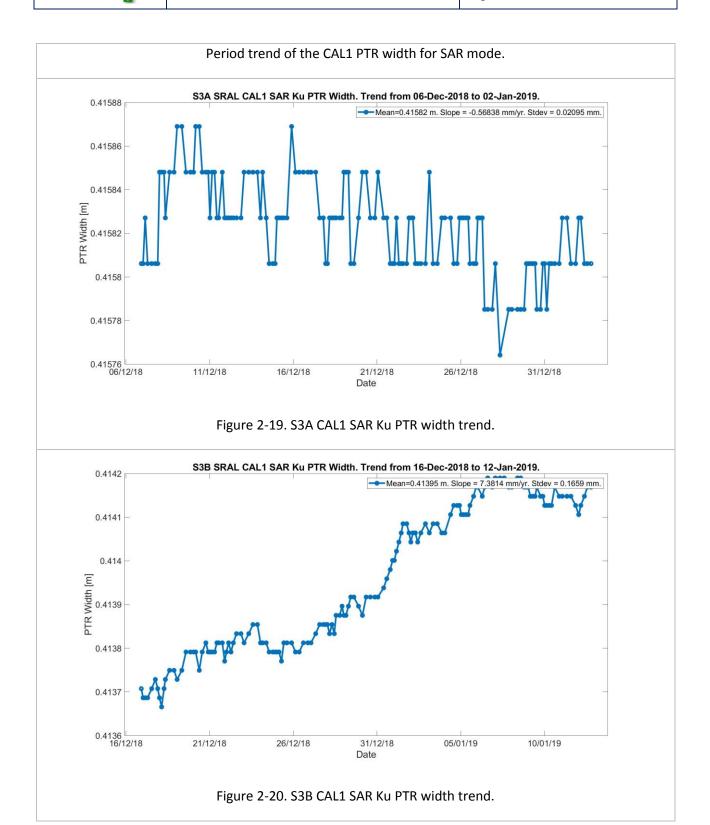
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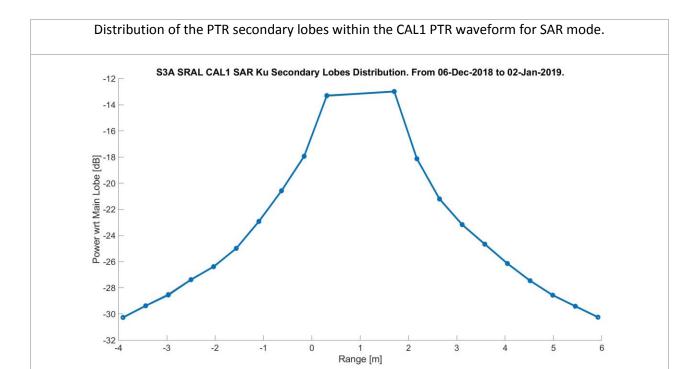


Figure 2-21. S3A CAL1 SAR Ku PTR secondary lobes Power and Position within the PTR waveform.

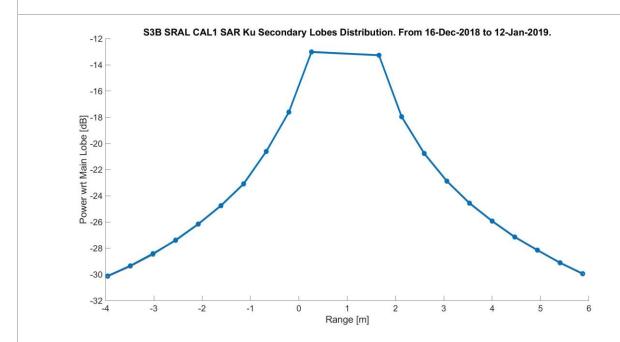


Figure 2-22. S3B CAL1 SAR Ku PTR secondary lobes Power and Position within the PTR waveform.



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Slope and Standard Deviation of CAL1 SAR PTR secondary lobes power.

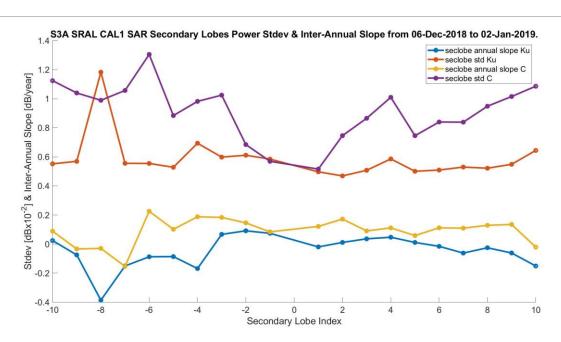


Figure 2-23. S3A CAL1 SAR Ku PTR secondary lobes characterisation. The inter-annual slope (in dB/year) and standard deviation (in dBx10⁻²) of each of the secondary lobes are shown.

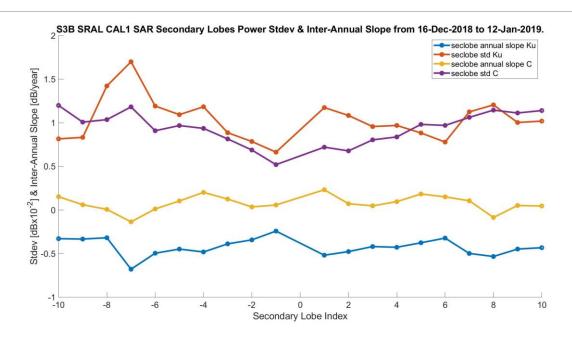


Figure 2-24. S3B CAL1 SAR Ku PTR secondary lobes characterisation. The inter-annual slope (in dB/year) and standard deviation (in dBx10⁻²) of each of the secondary lobes are shown.

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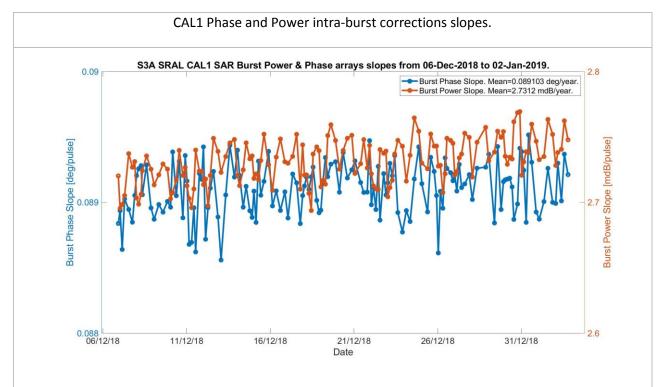


Figure 2-25. S3A CAL1 SAR Ku Phase & Power intra-burst corrections slopes over the cycle.

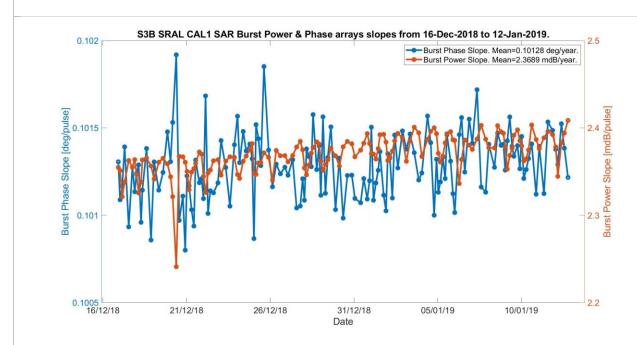


Figure 2-26. S3B CAL1 SAR Ku Phase & Power intra-burst corrections slopes over the cycle.



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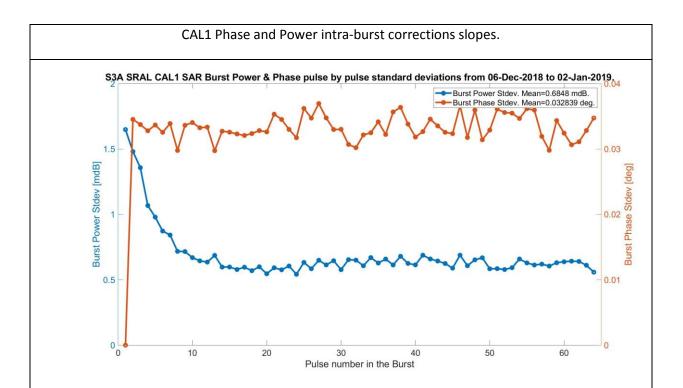


Figure 2-27. S3A Pulse by pulse standard deviations of the CAL1 SAR Ku Power and Phase intra-burst corrections.

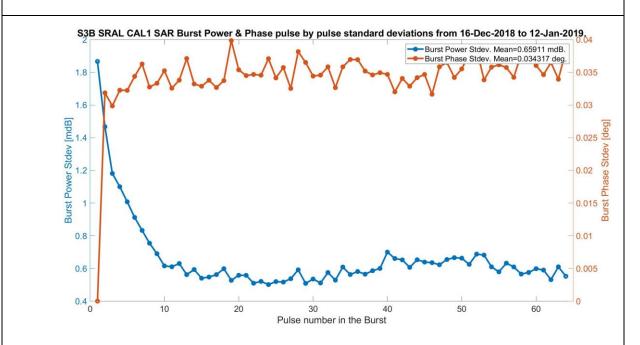


Figure 2-28. S3B Pulse by pulse standard deviations of the CAL1 SAR Ku Power and Phase intra-burst corrections.



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2.2.3 System Transfer Function (CAL2)

Geolocation of the CAL2 measurements for SAR mode.

S3A SRAL CAL2 SAR Calibration Areas from 06-Dec-2018 to 02-Jan-2019.

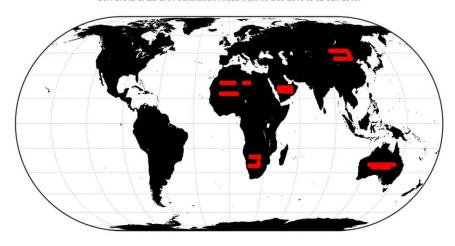


Figure 2-29. S3A Location of the CAL2 SAR measurements.

S3B SRAL CAL2 SAR Calibration Areas from 16-Dec-2018 to 12-Jan-2019.

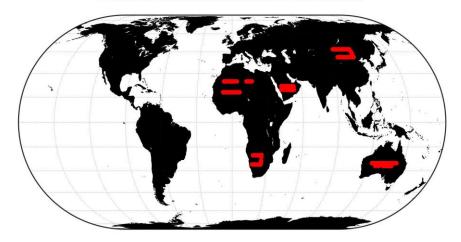


Figure 2-30. S3B Location of the CAL2 SAR measurements.



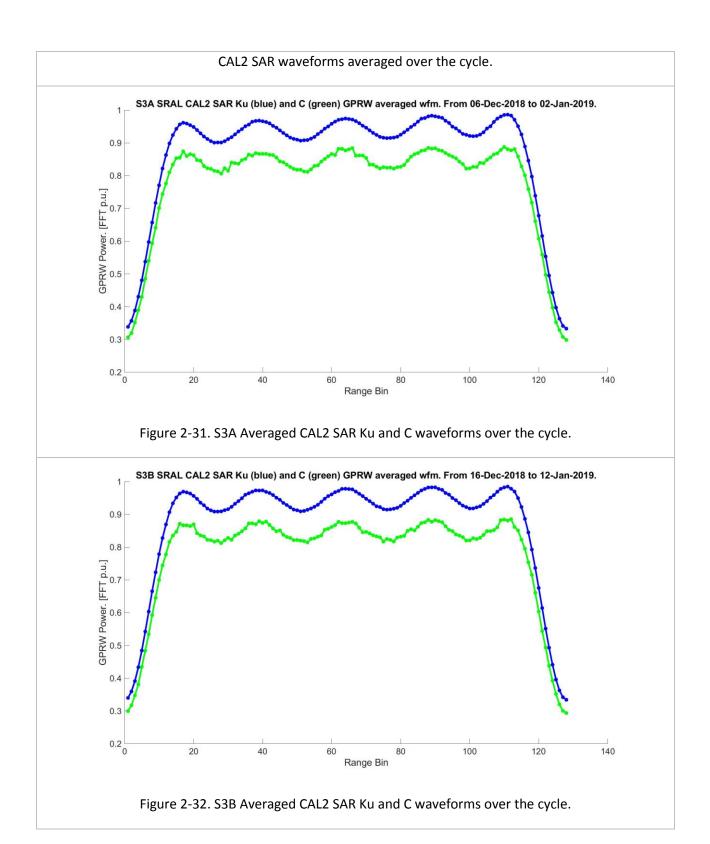
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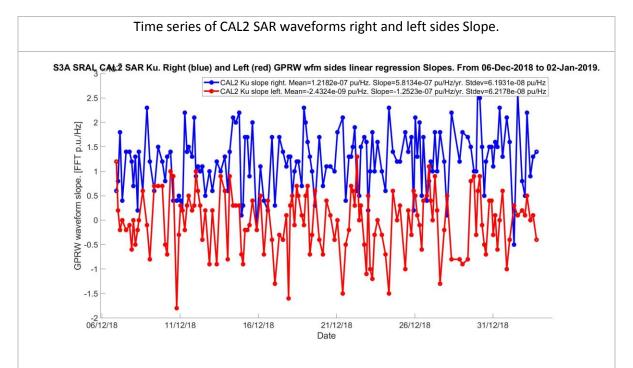


Figure 2-33. S3A CAL2 SAR Ku waveforms right (blue) and left (red) sides Slope over the period.

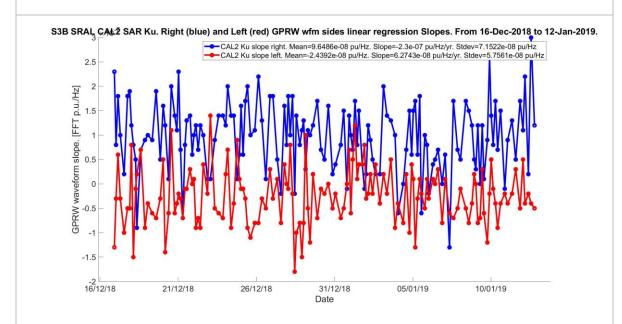


Figure 2-34. S3B CAL2 SAR Ku waveforms right (blue) and left (red) sides Slope over the period.



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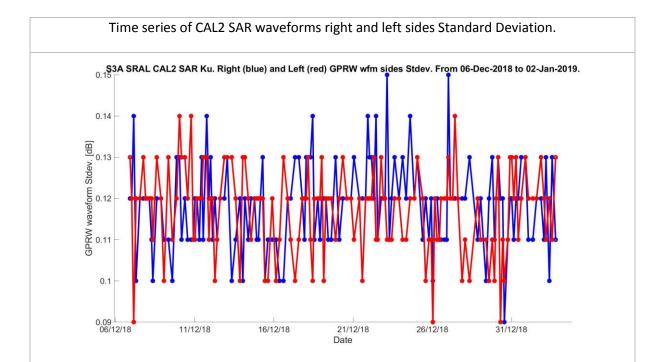


Figure 2-35. S3A CAL2 SAR Ku waveforms right (blue) and left (red) sides Standard Deviation over the period.

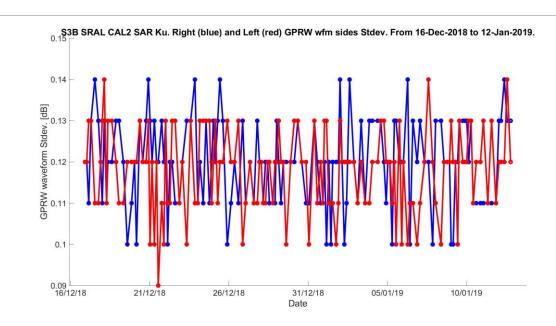


Figure 2-36. S3B CAL2 SAR Ku waveforms right (blue) and left (red) sides Standard Deviation over the period.



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2.2.4 AutoCAL (CAL1 SAR Auto)

Geolocation of the AutoCal measurements for SAR mode.

S3A SRAL CAL1 Auto-Calibration Areas from 08-Dec-2018 to 26-Dec-2018.

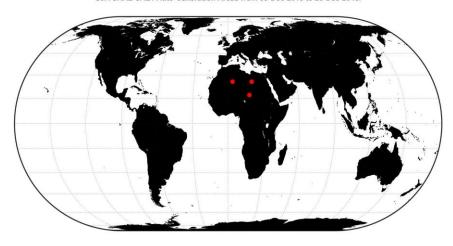


Figure 2-37. S3A Location of the AutoCal measurements.

S3B SRAL CAL1 Auto-Calibration Areas from 18-Dec-2018 to 05-Jan-2019.

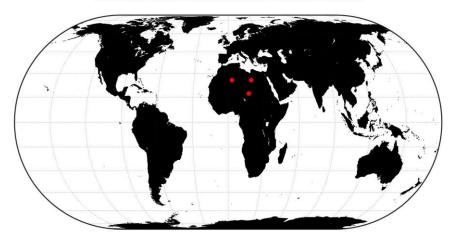


Figure 2-38. S3B Location of the AutoCal measurements.

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Figure 2-39. S3A AutoCal measurements: Corrected - Reference. Averaged over the cycle.

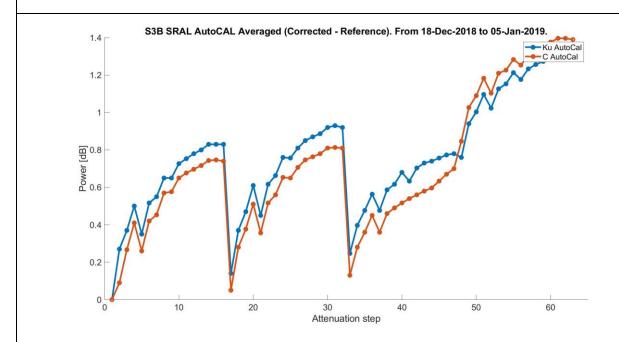


Figure 2-40. S3B AutoCal measurements: Corrected - Reference. Averaged over the cycle.

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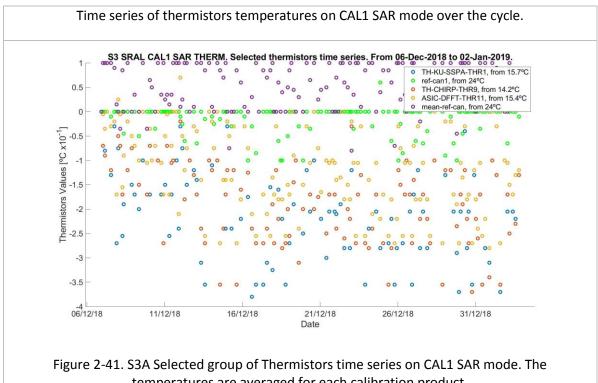
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2.2.5 **Housekeeping Temperatures**

The CAL1 SAR mode is assumed representative of the general SRAL thermal behaviour.



temperatures are averaged for each calibration product.



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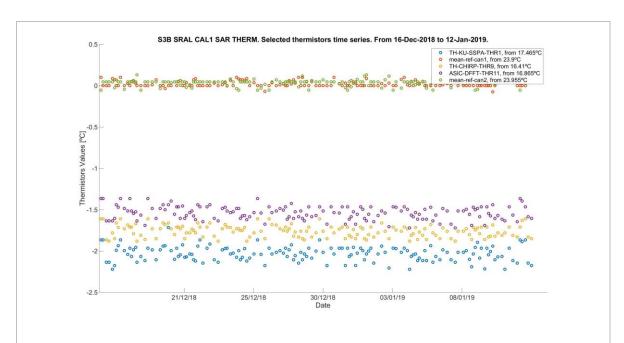


Figure 2-42. S3B Selected group of Thermistors time series on CAL1 SAR mode. The temperatures are averaged for each calibration product.

2.3 Cyclic SRAL Status Summary

This section is dedicated to a summary of the cyclic performances and status of the altimeter parameters exposed in section 2.2. It covers both S3A and S3B missions.

For the analysed cycle, none of the calibration parameters is showing a significant anomalous behaviour. Nonetheless some specific observations are explained here below.

The absolute values of the S3A parameters are very similar to the S3B ones.

In general, the LRM and SAR performances are similar for a given band (Ku or C).

The main CAL1 parameters statistics are detailed in Table 2-1 and Table 2-3, respectively for S3A and S3B missions.

The S3A CAL1 power trend for Ku band is no longer close to -1 dB/yr as at the first cycles of the mission. It presents a decreasing trend but less negative than at BOM. The CAL1 power trend for S3B at this cycle is higher in absolute values than the S3A trend.

All CAL1 time delay slopes have absolute values below 3 mm/year.

The Ku band CAL1 width inter-annual drifts are several orders of magnitude below the nominal PTR width value (Ku-band). The ones of S3B are notably higher than the ones of S3A.

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CAL2 parameters are stable and nominal. They are similar between the two missions.

AutoCal tables are nominal for both missions, but presents a very different attenuation steps array. This is not due to a fundamental difference between the S3A and S3B instruments design, but due to a different strategy for trying to achieve the same theoretical attenuation.

The thermistors values are showing a stable series over the analysed period.

All these observations are related to the different SRAL calibration parameters during this cycle. A whole mission monitoring is developed in section 2.4.



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	Ku band			C band		
S3A Calibration Parameter	mean	annual slope	standard deviation	mean	annual slope	standard deviation
LRM CAL1 time delay	1.0067 m	1.54 mm	0.05 mm	0.8928 m	-0.20 mm	0.07 mm
SAR CAL1 time delay	1.0066 m	1.70 mm	0.05 mm	0.8935 m	-0.01 mm	0.07 mm
LRM CAL1 power	57.34 dB	-0.08 dB	0.01 dB	50.88 dB	0.07 dB	0.00 dB
SAR CAL1 power	61.76 dB	-0.12 dB	0.01 dB	48.39 dB	0.08 dB	0.00 dB
LRM CAL1 PTR width	0.4161 m	-0.64 mm	0.02 mm	0.4543 m	0.35 mm	0.02 mm
SAR CAL1 PTR width	0.4158 m	-0.57 mm	0.02 mm	0.4541 m	0.30 mm	0.02 mm

Table 2-1. Collection of S3A calibration parameters statistics for all modes and bands covering the cycle period.

S3B Calibration Parameter	Ku band			C band		
	mean	annual slope	standard deviation	mean	annual slope	standard deviation
LRM CAL1 time delay	0.9600 m	1.79 mm	0.06 mm	0.9583 m	-0.47 mm	0.05 mm
SAR CAL1 time delay	0.9593 m	2.27 mm	0.06 mm	0.9581 m	-0.59 mm	0.06 mm
LRM CAL1 power	57.28 dB	-0.54 dB	0.01 dB	50.47 dB	-0.09 dB	0.00 dB
SAR CAL1 power	61.72 dB	-0.61 dB	0.01 dB	47.82 dB	-0.09 dB	0.00 dB
LRM CAL1 PTR width	0.4139 m	7.28 mm	0.16 mm	0.4659 m	6.81 mm	0.15 mm
SAR CAL1 PTR width	0.4140 m	7.38 mm	0.17 mm	0.4661 m	6.82 mm	0.15 mm

Table 2-2. Collection of S3B calibration parameters statistics for all modes and bands covering the cycle period.

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2.4 Mission SRAL Status Summary

The main SAR Ku L1b calibration parameters series of S3A and S3B missions are gathered and plotted in this section, in order to observe their whole missions behaviour.

The plotted calibration parameters are:

- CAL1 time delay
- CAL1 power
- PTR width
- Burst corrections (power and phase) and their slopes
- CAL2 waveform ripples shape, plus the waveforms slopes and de-trended standard deviations
- Autocal averaged differences and attenuation progression

The SAR mode thermistors series are also plotted.

Additionally it is represented a simulation of the S3A CAL1 SAR Ku Integrated Power for 20 years of mission, in order to foresee how long the SRAL Power would meet the mission requirements. This need comes from the warning raised at BOM due to high CAL1 Power trends.

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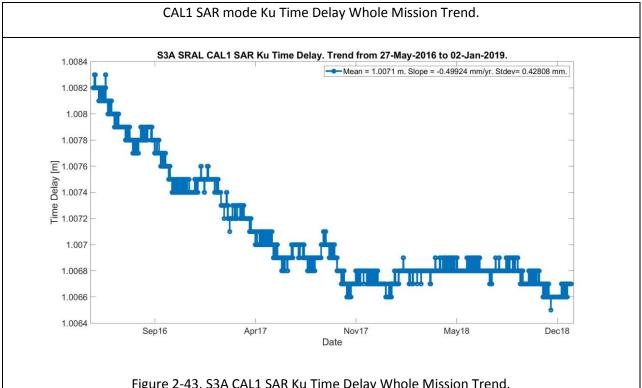


Figure 2-43. S3A CAL1 SAR Ku Time Delay Whole Mission Trend.

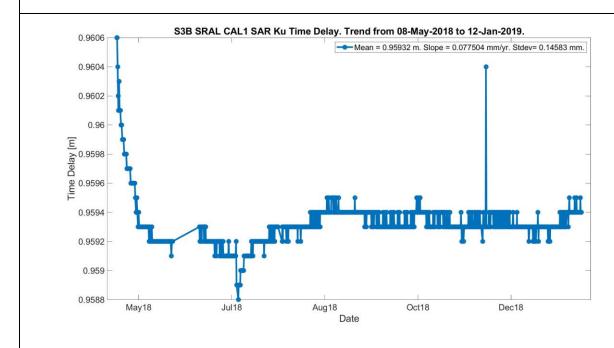


Figure 2-44. S3B CAL1 SAR Ku Time Delay Whole Mission Trend.

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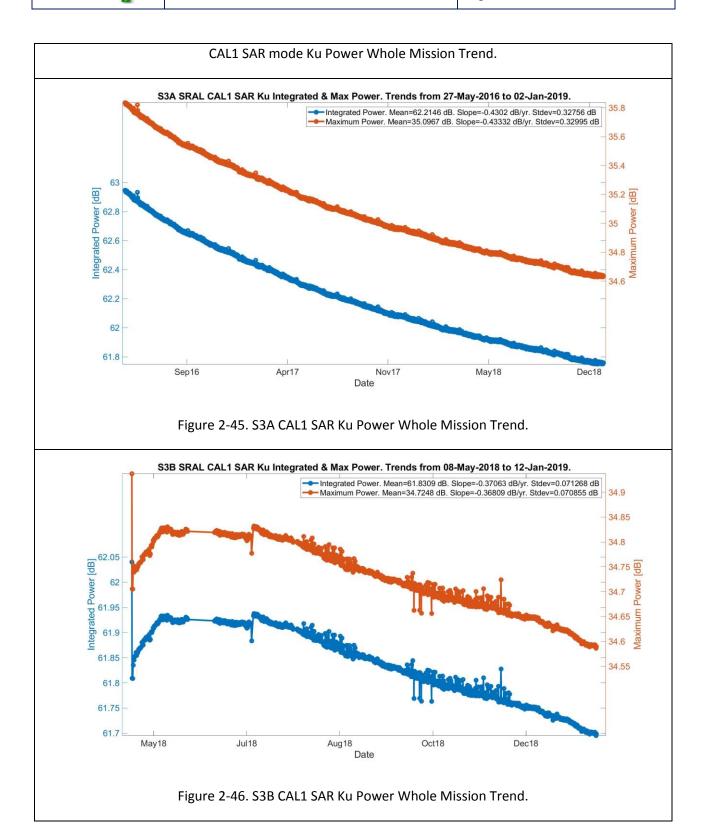
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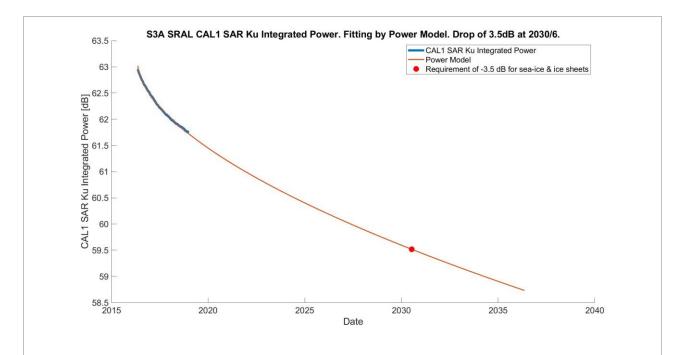


Figure 2-47. S3A CAL1 SAR Ku Power series and long term trend extrapolation with power model.

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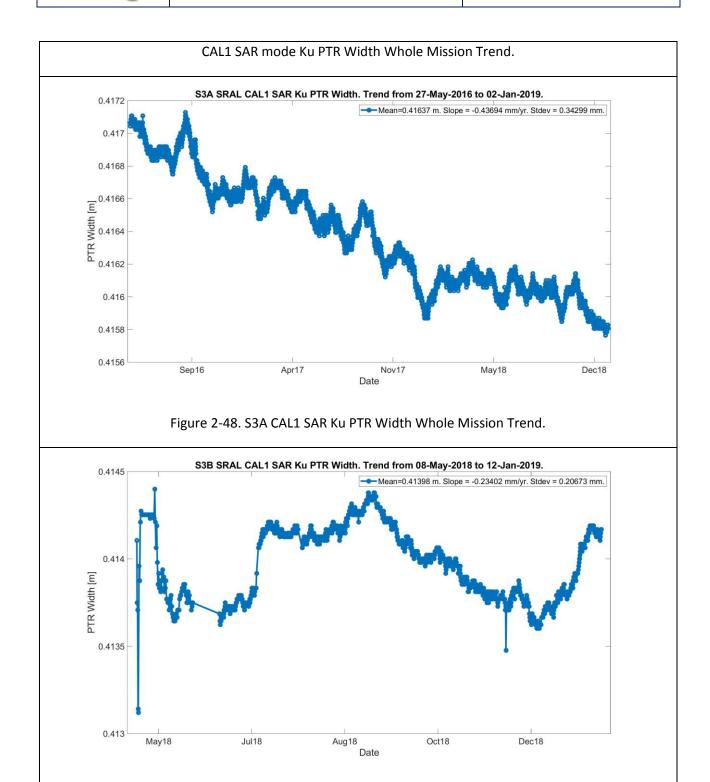


Figure 2-49. S3B CAL1 SAR Ku PTR Width Whole Mission Trend.



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Whole Mission Trend of CAL1 SAR mode Ku Phase & Power intra-burst corrections slopes.

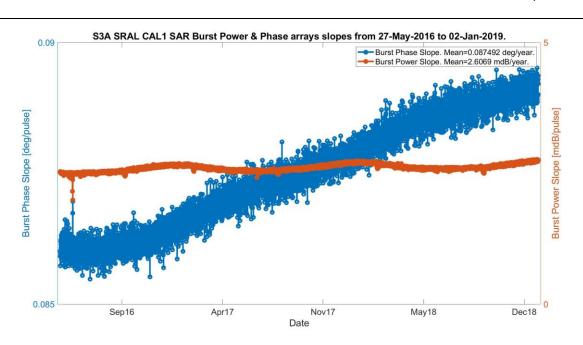


Figure 2-50. S3A CAL1 SAR Ku Phase & Power intra-burst corrections slopes along the whole mission.

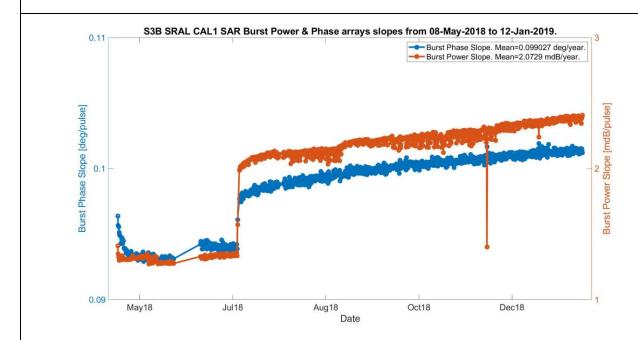


Figure 2-51. S3B CAL1 SAR Ku Phase & Power intra-burst corrections slopes along the whole mission.

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May18

Dec18

Figure 2-52. S3A Slope at each side of the CAL2 Ku waveform, averaged over the whole mission.

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Nov17

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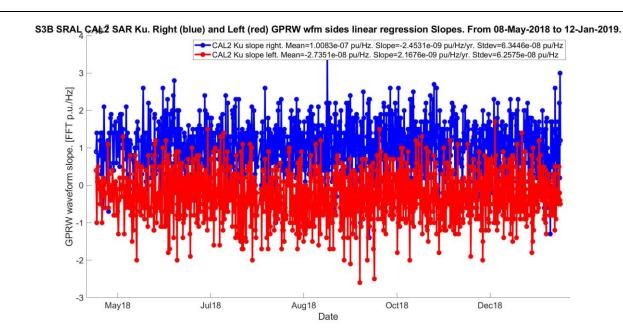


Figure 2-53. S3B Slope at each side of the CAL2 Ku waveform, averaged over the whole mission.



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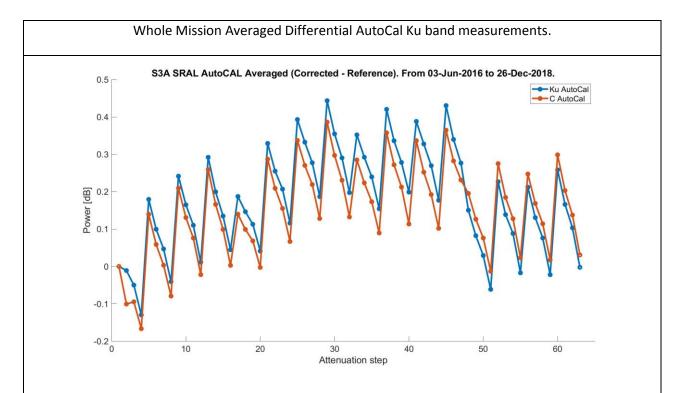


Figure 2-54. S3A Autocal measurements: Corrected - Reference. Averaged over the whole mission.

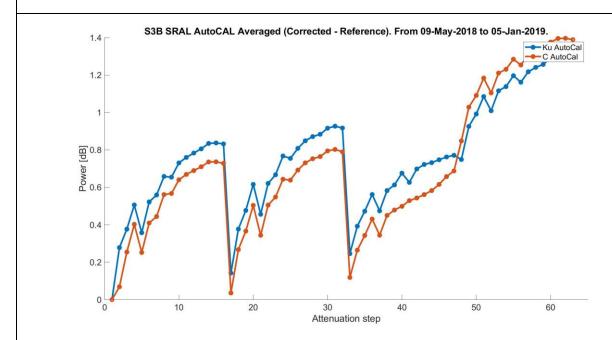


Figure 2-55. S3B Autocal measurements: Corrected - Reference. Averaged over the whole mission.



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AutoCAL Ku band attenuation progression series.

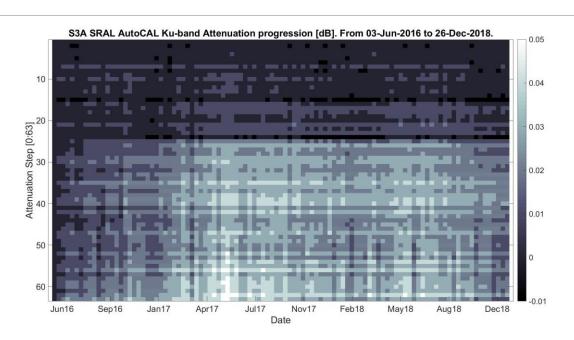


Figure 2-56. S3A AutoCAL attenuation whole mission progression. Difference in dB with respect to the first attenuation value, for each attenuation step.

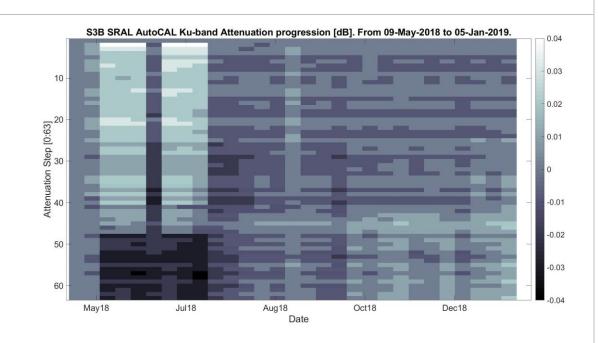


Figure 2-57. S3B AutoCAL attenuation whole mission progression. Difference in dB with respect to the first attenuation value, for each attenuation step.



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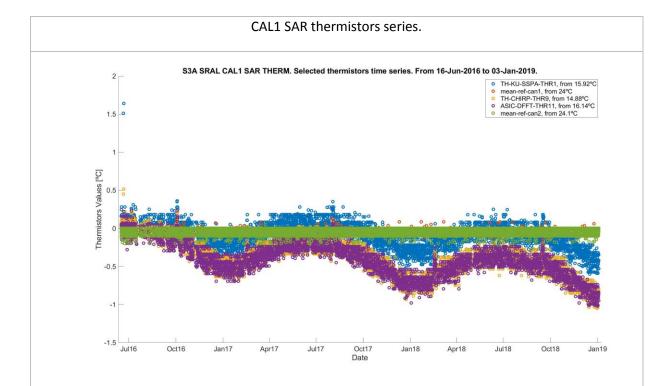


Figure 2-58. S3A Selected CAL1 SAR thermistors series along the whole mission.

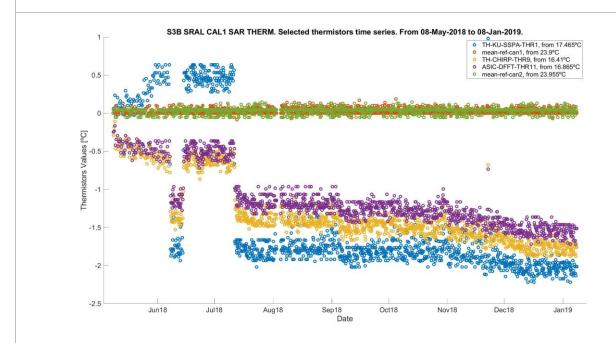


Figure 2-59. S3B Selected CAL1 SAR thermistors series along the whole mission.



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Looking at the above figures and its legends, we can see a general agreement between the S3A and S3B calibration parameters absolute values.

The most important and notable drift observed in the whole missions series is the S3A CAL1 Ku Power series, presenting a significant power decay, especially at BOM (about -1 dB/year). Anyhow, we can see a slow stabilisation of this parameter, decreasing in absolute values the observed trend along the mission.

A mission requirement of the CAL1 SAR Ku power is a maximum power drop of 3.5dB from beginning of mission. Below that power bound, the sea-ice and ice sheets geophysical measurements could be impacted, due to a poor SNR. A power model fitting has been computed for the S3A mission, and the assumption is to reach the limit by 2030.

The S3A PTR time delay has also decreased its negative trend. The S3B values are close to the S3A ones.

The Ku band PTR widths of both missions have trends that are several orders of magnitude below their absolute values, and similar to their standard deviation.

From the attenuation steps progression in dB we can check, for each attenuation step, the delta in attenuation with respect to the previous value in time. The tendencies are visible for specific attenuations in each band case, with small drifts (see colour code at right hand side) of less than 0.1 dB for both missions.

The intra-burst corrections along the missions are quite stable. The S3A burst power slope shows a clear annual behaviour (oscillations of less than 0.2 mdB/pulse) and a sensibility to instrumental thermal changes. This cannot be observed in the S3B figure yet, due to a shorter period of observation. The burst phase slope is increasing along the missions, around 1 deg/pulse per year for S3A and around 2 deg/pulse per year for S3B if we takes the most consolidated period after July 2018.

The CAL2 parameters behaviour is stable and nominal along the mission. The flagging of certain CAL2 parameters is dismissed in order to plot the series: it is needed yet to make some parametrisation changes in the characterisation auxiliary file for a correct flagging, for instance in the CAL2 slope.

The thermistors data series are showing an annual oscillation (clear for S3A, yet to be better detected for S3B with a larger series), and a long term negative drift. At some dates there are increases of the S3A thermistors values of around 0.2°C, returning in a short term to its precedent values. We can distinguish in the S3B thermal series two different status, which coincides with the science tracking modes LRM and SAR. These sudden changes impacts S3B calibrations parameters such as the burst corrections and the AutoCal attenuations.

The collection of statistics for the main calibration parameters for both modes and bands of S3A and S3B missions is depicted below in Table 2-3 and Table 2-4 respectively.

The long term drift for the S3A time delay and power variables is higher in absolute terms for the Ku band than for the C band, the Ku band ageing is faster than the one from C band, probably caused by

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the more stressed Ku band instrumental operations (e.g. bursts transmission & reception only in Ku band). All standard deviations are computed without detrending.

As a general observation, we can say that the behaviour of all calibration parameters is nominal.



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	Ku band			C band			
S3A Calibration Parameter	mean	annual slope	standard deviation	mean	annual slope	standard deviation	
LRM CAL1 time delay	1.0074 m	-0.70 mm	0.59 mm	0.8931 m	-0.38 mm	0.31 mm	
SAR CAL1 time delay	1.0071 m	-0.50 mm	0.43 mm	0.8937 m	-0.28 mm	0.24 mm	
LRM CAL1 power	57.78 dB	-0.42 dB	0.32 dB	50.92 dB	-0.02 dB	0.03 dB	
SAR CAL1 power	62.21 dB	-0.43 dB	0.33 dB	48.43 dB	-0.02 dB	0.03 dB	
LRM CAL1 PTR width	0.4167 m	-0.42 mm	0.33 mm	0.4543 m	-0.08 mm	0.08 mm	
SAR CAL1 PTR width	0.4164 m	-0.44 mm	0.34 mm	0.4542 m	-0.09 mm	0.09 mm	

Table 2-3. Collection of S3A calibration parameters statistics for all modes and bands covering the whole mission.

	Ku band			C band			
S3B Calibration Parameter	mean	annual slope	standard deviation	mean	annual slope	standard deviation	
LRM CAL1 time delay	0.9603 m	-1.54 mm	0.32 mm	0.9583 m	0.19 mm	0.11 mm	
SAR CAL1 time delay	0.9593 m	0.08 mm	0.15 mm	0.9581 m	0.18 mm	0.10 mm	
LRM CAL1 power	57.36 dB	-0.27 dB	0.06 dB	50.407 dB	0.41 dB	0.10 dB	
SAR CAL1 power	61.83 dB	-0.37 dB	0.07 dB	47.75 dB	0.40 dB	0.10 dB	
LRM CAL1 PTR width	0.4140 m	-0.29 mm	0.22 mm	0.4658 m	0.44 mm	0.19 mm	
SAR CAL1 PTR width	0.4140 m	-0.23 mm	0.21 mm	0.4660 m	0.48 mm	0.20 mm	

Table 2-4. Collection of S3B calibration parameters statistics for all modes and bands covering the whole mission.

So far the whole mission monitoring dataset presented in this document is different for the 2 missions. For S3A the data gathered starts after the usual BOM period, a period that shows a very different behaviour with respect to the rest of the mission. It improves the dataset for the mission analysis and predictions. For the S3B mission there is not enough data yet for discarding at this point the BOM period.

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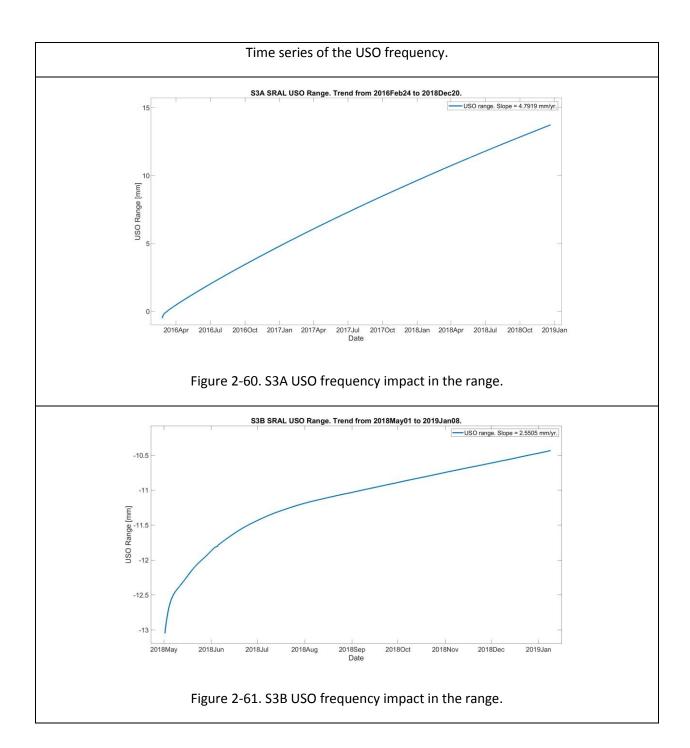
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2.5 On-board Clock Performance

The altimeter USO clock frequency has a major multiplicative impact in the determination of the altimeter range. The USO clock is the one that drives the chirp generation and controls the acquisition time (window delay or tracker range) of the returned echo signal. Here below are depicted the USO frequency impact on the altimeter range for S3A (Figure 2-60) and S3B (Figure 2-61).



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The USO clock frequency impact in the range has a constant trend of around 5 mm per year for the S3A mission and 2.5 mm for the S3B mission.

The USO impact in the range can change around an orbit considering an elliptical orbit and the variations on the surface elevations, but these differences are far below the nominal absolute values.

In addition, the temperatures on-board can make the clock suffer frequency fluctuations, but as we can see in the previous figures, no visible effects of this kind has been observed so far.

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2.6 SRAL Dedicated Investigations

This chapter is devoted to the investigations derived from observations along the mission. The on-going investigations results will be updated in each new version of the report; solved issues will be dismissed from the report.

The flagging of some L1b CAL2 parameters (mean, slope and standard deviation over the slope) seemed to be reversed. This issue did not impact the quality of the science data. An investigation was done by the S3-MPC team. The cause was related to the use of wrong units in the variables written in the characterisation file. In addition, the impact of a low absolute error in the final relative error computation was addressed. Updated nominal and redundant characterization ADFs have been delivered. There is a remaining issue about the auxiliary characterisation file update, which have an impact in some series such as the CAL2 slope, to be solved. Therefore, at this time those parameters impacted by this issue will be monitored without considering the correspondent flagging.



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3 Calibration with Transponder

isardSAT has processed the TRP data from a list of L1A products. S3A Passes with IPF-SR-1 Version 06.13 (cycle 3 to 23) use reprocessed L1A and L2 data provided on the ftp.s3rep.acri-cwa.fr FTP server. S3A Passes from cycle 24 to 39 increase in IPF-SR-1 Version as newer ones become available, up to Version 06.14 for the most recent passes.

The range bias results are of the order of millimetres. The datation bias is of the order of hundreds of microseconds.

For S3A, the passes on cycles 13 and 21 have not been analysed because the transponder was not switched on due to extreme climate conditions. For S3B, cycles 1 to 7 and 15 to 18 have not been included as the satellite was not overflying the TRP.

Table 3-1 and Figure 3-1 to Figure 3-4 present the results from the TRP passes processing. The range bias is computed as measured minus theoretical. The results for S3A show a positive measured range, 6.50 mm larger than expected (elevation 6.50 mm shorter than expected), and a datation bias of -184.1 microseconds, both extracted from the minimisation of the RMS between theoretical and measured series. They also show a 0.85 mm stack noise. For S3B, the results show a negative measured range, -15.29 mm smaller than expected (elevation 15.29 mm higher than expected), a datation bias of -199.50 microseconds and a ~0.88 mm stack noise, following the same method. The regression line in Figure 3-1 shows a S3A range drift of -1.28 mm/year, but it has a very low significance.



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Cycle – Mission	Date	Range bias [mm]	Datation bias [microseconds]	Alignment [mm/beam]	Noise [mm]	IPF-SR-1 Version
3 - S3A	2016/04/09	2.78	-140.07	-0.08	0.81	06.13
4 - S3A	2016/05/06	19.01	-114.60	-0.07	0.78	06.13
5 - S3A	2016/06/02	-3.91	-165.54	-0.09	0.86	06.13
6 - S3A	2016/06/29	0.72	-152.81	-0.06	0.92	06.13
7 - S3A	2016/07/26	-2.86	-152.81	-0.07	1.01	06.13
8 - S3A	2016/08/22	-1.04	-140.07	-0.09	0.81	06.13
9 - S3A	2016/09/18	1.26	-216.48	-0.13	0.71	06.13
10 - S3A	2016/10/15	8.83	-178.27	-0.12	0.66	06.13
11 - S3A	2016/11/11	19.89	-140.07	-0.09	0.79	06.13
12 - S3A	2016/12/08	22.34	-127.34	-0.07	0.82	06.13
13 - S3A	Transponder not switched on due to heavy snow.					
14 - S3A	2017/01/31	26.11	-140.07	-0.09	0.72	06.13
15 - S3A	2017/02/27	1.95	-165.54	-0.10	0.86	06.13
16 - S3A	2017/03/26	-0.24	-216.48	-0.13	0.79	06.13
17 - S3A	2017/04/22	14.70	-165.54	-0.13	1.05	06.13
18 - S3A	2017/05/19	28.66	-127.34	-0.06	1.11	06.13
19 - S3A	2017/06/15	-4.15	-203.74 -0.09		1.28	06.13
20 - S3A	2017/07/12	-15.89	-127.34	-0.09	0.70	06.13
21 - S3A	Tr	ansponder no	ot switched on due	to high tempera	tures.	
22 - S3A	2017/09/04	26.32	-165.54	-0.12	0.69	06.13
23 - S3A	2017/10/01	19.51	-152.81	-0.10	0.70	06.13
24 - S3A	2017/10/28	0.31	-229.21	-0.15	0.92	06.11
25 - S3A	2017/11/24	15.63	-203.74	-0.15	0.83	06.12
26 - S3A	2017/12/21	-1.81	-216.48	-0.14	0.80	06.12
27 - S3A	2018/01/17	10.20	-203.74	-0.14	0.94	06.12
28 - S3A	2018/02/13	2018/02/13 13.89 -229.21		-0.15	0.75	06.13
29 - S3A	2018/03/12	-1.69	-203.74	-0.17	0.95	06.14
30 - S3A	2018/04/08	4.78	-229.21	-0.16	0.82	06.14
31 - S3A	2018/05/05	5 2.01 -241.		-0.14	0.89	06.14



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Cycle – Mission	Date	Range bias [mm]	Datation bias [microseconds]	Alignment [mm/beam]	Noise [mm]	IPF-SR-1 Version		
32 - S3A	2018/06/01	-8.69	-229.21	-0.16	0.93	06.14		
8 - S3B	8 - S3B 2018/06/01		S3B in LRM mode, results to be computed					
33 - S3A	2018/06/28	0.39	-216.48	-0.12	0.70	06.14		
10- S3B	2018/06/28		S3B in LRM mode	e, results to be c	omputed			
34 - S3A	2018/07/25	4.82	-241.94	-0.15	0.82	06.14		
11- S3B	2018/07/25		S3B in LRM mode	e, results to be c	omputed			
35 - S3A	2018/08/21	-10.35	-216.48	-0.16	0.95	06.14		
12 - S3B	2018/08/21	-23.33	-216.48	-0.12	0.84	06.14		
36 - S3A	2018/09/17	-1.62	-203.74	-0.15	0.77	06.14		
13 - S3B	2018/09/17	-19.00	-191.01	-0.11	1.05	06.14		
37 - S3A	2018/10/14	4.84	-216.48	-0.13	0.94	06.14		
14 - S3B	2018/10/14	-3.54	-191.01	-0.13	0.76	06.14		
38 - S3A	2018/11/10	15.24	-216.48	-0.15	0.69	06.14		
39 - S3A	2018/12/07	2018/12/07 15.70 -152.81		-0.16	1.13	06.14		
19 - S3B 2018/12/13		Not	good data (issue un	ider investigatio	n)	06.14		
N	Mean S3A 6.50 -184.10 -0.12 0.85							
Standar	d Deviation S3A	11.17	38.99	0.03	0.14	-		
N	/lean S3B	-15.29	-199.50	-0.12	0.88	-		
Standar	d Deviation S3B	10.40	14.70	0.01	0.15	-		

Table 3-1. Results of TRP passes processing

Regarding the geophysical corrections, the ionospheric and wet/dry tropospheric corrections were extracted from the transponder auxiliary files provided by the MPC team.

Then, the solid earth, geocentric tide and ocean loading corrections are selected from the L2 products. A table with the Geophysical corrections used is shown in Table 3-2. The TRP internal delay is 4.954 meters.



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3	2016/04/09	-2.02600	-0.08710	-0.02418	-0.12970	0.00290	0.00310
4	2016/05/06	-2.04220	-0.07140	-0.03489	-0.04410	0.00230	0.01020
5	2016/06/02	-2.05024	-0.12316	-0.03851	0.03480	0.00100	0.00900
6	2016/06/29	-2.05184	-0.11006	-0.02995	-0.00030	-0.00060	0.00250
7	2016/07/26	-2.04933	-0.07117	-0.02432	-0.08820	-0.00260	-0.00200
8	2016/08/22	-2.05343	-0.07527	-0.02265	-0.12310	-0.00380	-0.00140
9	2016/09/18	-2.05799	-0.12541	-0.02411	-0.03270	-0.00470	0.00360
10	2016/10/15	-2.06529	-0.06351	-0.01800	0.13620	-0.00470	0.00680
11	2016/11/11	-2.06734	-0.07036	-0.01639	0.19500	-0.00400	0.00310
12	2016/12/08	-2.07943	-0.01087	-0.01453	0.09160	-0.00270	-0.00300
14	2017/01/31	-2.06552	-0.01138	-0.01913	-0.08110	0.00060	-0.00220
15	2017/02/27	-2.05001	-0.09089	-0.01818	-0.00790	0.00200	0.00310
16	2017/03/26	-2.05115	-0.06735	-0.01618	0.11520	0.00270	0.00520
17	2017/04/22	-2.04841	-0.04449	-0.02672	0.13670	0.00270	0.00160
18	2017/05/19	-2.05320	-0.03910	-0.03295	0.03340	0.00210	-0.00260
19	2017/06/15	-2.05731	-0.07789	-0.02817	-0.08180	0.00080	-0.00230
20	2017/07/12	-2.05252	-0.08288	-0.02232	-0.11870	-0.00080	0.00190
22	2017/09/04	-2.05777	-0.00013	-0.02142	0.02520	-0.00370	0.00900
23	2017/10/01	-2.06119	-0.06361	-0.02128	0.05060	-0.00440	0.00510
24	2017/10/28	-2.03975	-0.12175	-0.01537	0.00120	-0.00440	-0.00040
25	2017/11/24	-2.06119	-0.06461	-0.01486	-0.03940	-0.00340	-0.00270
26	21/12/2017	-2.05275	-0.12315	-0.01603	-0.00760	-0.00160	-0.00150
27	2018/01/17	-2.03678	-0.06282	-0.01587	0.08640	-0.00020	0.00100
28	2018/02/13	-2.04978	-0.04902	-0.01518	0.17020	0.00130	0.00130
29	2018/03/12	-2.04591	-0.11249	-0.01673	0.16230	0.00170	-0.00130
30	2018/04/08	-2.05024	-0.06556	-0.02125	0.05600	0.00160	-0.00350
31	2018/05/05	-2.04203	-0.02587	-0.03728	-0.06510	0.00100	-0.00200
32	2018/06/01	-2.05320	-0.05610	-0.02567	-0.11360	-0.00010	0.00300

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Cycle	Date	Dry Tropo [m]	Wet Tropo [m]	Iono [m]	Solid Earth [m]	Geocentric Tide [m]	Ocean Loading [m]
33	2018/06/28	-2.04385	-0.06845	-0.02478	-0.07970	-0.00150	0.00810
34	2018/07/25	-2.04135	-0.09865	-0.02589	-0.02590	-0.00280	0.00920
35/12	2018/08/21	-2.05320	-0.08720	-0.02164	-0.01370	-0.00350	0.00590
36/13	2018/09/17	-2.05982	-0.08578	-0.01871	-0.04380	-0.00410	0.00100
37/14	2018/10/14	-2.06005	-0.12355	-0.01497	-0.05520	-0.00420	-0.00200
38	2018/11/10	-2.05571	-0.08129	-0.01236	0.01380	-0.00390	-0.00090
39	2018/12/07	-2.05366	-0.01764	-0.01546	0.13660	-0.00290	0.00120

Table 3-2. Geophysical Corrections of TRP passes processing

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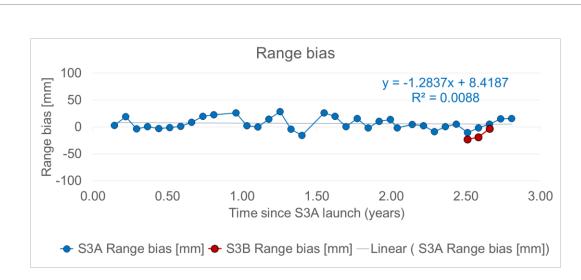


Figure 3-1. Range Bias Results.

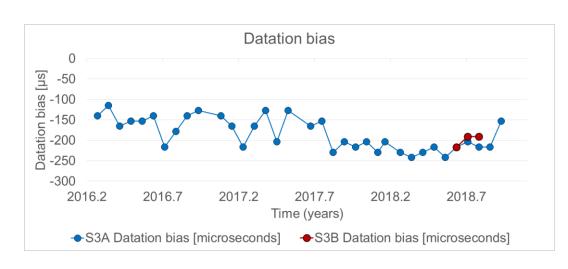


Figure 3-2. Datation Bias Results.

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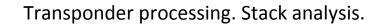
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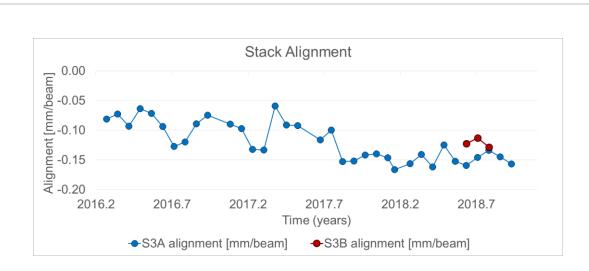


Figure 3-3. Alignment Results.

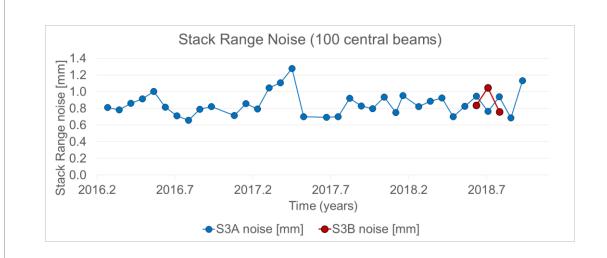


Figure 3-4. Stack Noise Results.

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4 Events

Add here the list of all OLCI events happened during the cycle.

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5 Appendix A

Other reports related to the Optical mission are:

- S3 MWR Cyclic Performance Report, S3A Cycle No. 039, S3B Cycle No. 020 (ref. S3MPC.CLS.PR.05-039-020)
- S3 Ocean Validation Cyclic Performance Report, S3A Cycle No. 039, S3B Cycle No. 020 (ref. S3MPC.CLS.PR.06-039-020)
- S3 Winds and Waves Cyclic Performance Report, S3A Cycle No. 039, S3B Cycle No. 020 (ref. S3MPC.ECM.PR.07-039-020)
- S3 Land and Sea Ice Cyclic Performance Report, S3A Cycle No. 039, S3B Cycle No. 020 (ref. S3MPC.UCL.PR.08-039-020)

All Cyclic Performance Reports are available on MPC pages in Sentinel Online website, at: https://sentinel.esa.int

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