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Title : **IDEAS+ – SMOS Public Monthly Report - January 2018**

Abstract : This document provides a summary of the status and performance of SMOS over the course of the reporting month.

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AMENDMENT POLICY

This document shall be amended by releasing a new edition of the document in its entirety. The Amendment Record Sheet below records the history and issue status of this document.

AMENDMENT RECORD SHEET

ISSUE	DATE	DCI No	REASON
1	20nd February 2018	N/A	First release

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1. EXECUTIVE SUMMARY

This is the routine Soil Moisture and Ocean Salinity (**SMOS**) Monthly Public Report containing a summary of the instrument health, product quality status and updates to SMOS processing and auxiliary files during January 2018.

The instrument health during January 2018 was found to be nominal. There was one un-availability reported during the reporting period that translate into time intervals with data loss or degraded data. The list of unavailabilities is included in the section 3.2.

The data quality during January 2018 was found to be nominal, with the exceptions listed in section 4.5. These degraded periods have been induced either by instrument anomalies or unavailability of dynamic auxiliary files.

2. INTRODUCTION

2.1 Structure of the Document

After this introduction, the document is divided into a number of major sections that are briefly described below:

1 Executive summary

The executive summary covers the main findings from the report.

2 Introduction

A list of referenced documents and definitions of terms are available.

3 Instrument status

This section covers the instrument health and unavailabilities from this reporting period.

4 Data Summary

This section covers reprocessing, updates to processors and aux files as well as a data coverage summary.

5 Long Term Analysis

Long-term analysis of the instrument calibration and data quality are provided in this section.

2.2 Definitions of Terms

The following terms have been used in this report with the meanings shown.

Term	Definition
CMN	Control and Monitoring Node, responsible for commanding the receivers, reading their physical temperatures and telemetry and the generation of the synchronization signal (local oscillator tone) among receivers.
CCU	Correlator and Control unit, instrument computer on-board
DPGS	Data Processing Ground Segment
ESL	Expert Science Laboratory
IC4EC	Internal Calibration for External calibration. Calibration sequences for the instrument monitoring and calibration of science data acquired in external target pointing.
IDEAS+	Instrument Data quality Evaluation and Analysis Service, reporting to the ESA Data Quality and Algorithms Management Office (EOP-GQ), responsible for quality of

	data provided to users including the data calibration and validation, the data processing algorithms, and the routine instrument and processing chain performances.
IPF	Instrument Processor Facility
L2SM	Level 2 Soil Moisture
MM	Mass Memory
OCM	Orbit Correction Manoeuvre
PMS	Power Measurement System
RFI	Radio Frequency Interference
SPQC	Systematic Product Quality Control facility
N/A	Not applicable

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3. INSTRUMENT STATUS

3.1 Instrument health

The current instrument status is that all the **instrument** subsystems are working correctly. The current configuration of the instrument is that the arm A and the arm B are working in nominal side and arm C is in the redundant side.

Table 3-1 History of instrument problems and mode changes

Start	Stop	Description
11 January 2010 12:07z Orbit 1013	N/A	Arm A changes from redundant to nominal side. That operation is to avoid the malfunction of one of the redundant CMNs of the arm.
12 January 2011 09:15z Orbit 6278	N/A	Arm B changes from redundant to nominal side. That operation is to avoid the malfunction of one of the redundant CMNs of the arm.

3.2 Instrument unavailabilities and anomalies

The unavailabilities and anomalies listed in Table 3-2 occurred during the reporting period. A full list of unavailabilities can be found in the Mission Status section on the SMOS Earthnet website accessible here

During these unavailabilities and anomalies the instrument may have either not collected data or may have collected corrupt data which may not have been processed to higher levels. Table 4-5, Table 4-6 and Table 4-7 provide details of the data which has been affected by gaps and quality degradation respectively.

Table 3-2 SMOS unavailability list

Start Time (UTC)	Stop Time (UTC)	Unavailability Report Reference	Planned	Description
19/01/2018 05:24:09	19/01/2018 07:07:11	FOS-3083	No	CCU Reset

4. DATA SUMMARY

4.1 Reprocessing activities

The information regarding to data reprocessing activities (REPR data type) during the reporting period are:

1) None

The information regarding to the data regeneration activities (OPER data type) during the reporting period are:

1) On the 17th of January, a TLM_MIRA0 failed in processing due a timeout, introducing a TLM gap which was propagated into science and local oscillator calibration. In order to recover the dataset, all CSTD1A and science products (up to L2) were regenerated on the 19th of January.

The information regarding to past version data reprocessing activities (REPR data type) are:

1) Level 2 soil moisture reprocessing for product baseline v650, finished the 9th of September 2017, catch-up reprocessing finished the 15th of November 2017. The reprocessed dataset has been delivered to the user on the 20th November 2017. Sensing time of the reprocessed data goes from 1st June 2010 to 16th November 2017. For more details see the SMOS news here. The SMOS users are strongly encouraged to consult the level 2 read-me-first notes before using the SMOS data. The level 2 read-me-first note for soil moisture product is available here.

2) Level 2 sea surface salinity reprocessing for products baseline v662, finished in April 2017, catch-up reprocessing finished in July 2017. The reprocessed dataset has been delivered to the user on 15 May 2017 and a gap filling reprocessed dataset has been delivered on 20 July 2017. Sensing time of the reprocessed data goes from 1st June 2010 to 9th May 2017. For more details see the SMOS news here. The SMOS users are strongly encouraged to consult the level 2 sea surface salinity v662 read-me-first notes before using the SMOS data. The level 2 read-me-first note for sea surface salinity product is available here.

3) The second SMOS mission reprocessing for L1 v62x finished the 25th June 2015. Sensing time of the reprocessed data goes from 12th January 2010 to 05th May 2015. Data set is available for the SMOS user community since 25th June 2015 (see the SMOS news here). The SMOS data users are strongly encouraged to consult the level 1 read-me-first note before using the SMOS data. The level 1 read-me-first note is available here:

The information regarding to the past version V62x data regeneration activities (OPER data type) are:

1) On the 9th of October 2017, an anomaly in SPQC report distribution introduced processing timeouts for some products. In order to regenerate a properly consolidated calibration dataset, the following files were invalidated and regenerated: All affected telemetry (TLM) files were regenerated. Calibration CSTD1A data files were invalidated and regenerated: from validity times: 20171008T134744_20171009T082745 to 20171009T053745_20171010T001746. Science data files were regenerated: from validity times 20171009T064720_20171009T074122 to 20171009T082725_20171009T092125.

2) On the 4th of October 2017, a misconfiguration in a recently-installed processing node (PFW) introduced several TLM processing failures leading to data gaps in all

subsequent levels (between 1312z-1416z, 1542z-1646z and 2132z-2236z, for the 4th, and 0002z-0106z and 0052z-0156z for the 5th). All TLM, Calibration (including CSTD1A) and Science (up to L2) affected was regenerated successfully.

3) Period from 20170804T011718 to 20170804T053039 has been regenerated from level L1C to level2 due to late arrival of ionosphere information (VTEC_P auxiliary file).

4) On the 22nd of July 2017, 3 Svalbard passes were received late at ESAC and L0 production was affected. L0 data affected by this anomaly were invalidated and re-generated. The next files and periods were reprocessed: **a)** TLM_MIRA0 files were reprocessed from 20170722T084240 up to 20170722T112655; **b)** MIR_CORD0 files were reprocessed from 20170722T090455 up to 20170722T221455; **c)** MIR_SC_F0 files were reprocessed up to L2 from 20170722T085250 up to 20170722T121657.

5) The 7th of January 2017 Flat Target Transformation correction (FTTF) was produced and incorrectly used for level 1 data processing. Level 1A data from 20170110T104625 up to 20170112T025130 was regenerated up to level 2 with the correct FTTF (i.e. initial one from 2010).

6) Leap second ingestion on the 31th of December 2016 lead to some issues when processing the SMOS data along the 1st of January 2017: one gap appeared and some calibration files were degraded due to some duplicated L0 packets stored inside the L0 database, since they were processed with different ORBPRE files. The next activities were carried on in order to have a proper and consolidated dataset: **a)** Reprocessing of L0 telemetry and science from 20170101T081550 to 20170101T095954; **b)** Invalidation of duplicated MIR_CORD0 and MIR_CSTD1A files; **c)** Regeneration of CSTD1A files from 20161231T154620 to 20170102T041620; **d)** Regeneration of science data and up to level 2 from 20170101T072633 to 20170102T104955

7) A hardware anomaly in DPGS systems introduced a large delay in the production on 05th May 2016. As a consequence, some calibration CSTD1A files where incorrectly consolidated when the production was recovered. This introduced some LO gaps, which impacted the quality of the data severely (no local oscillator calibration) from 20160505T170715z until 20160506T113201z. All the affected data were successfully regenerated from L0 up to L2.

8) Dataset sensed from 20160414T172533 to 20160419T100347 was degraded due to the usage of an out of date long calibration. Period has been regenerated with the proper calibration up to level 2.

9) The data gap from 20160314T095107 to 20160316T211747 originated by the Proteus platform on-board software upgrade operations has been recovered, level 1 and level 2 science data are now available.

10) On December 2015, the next periods were regenerated from level 1C to level2 due to late arrival of ionosphere information (VTEC_P auxiliary file): the period from 20151206T005504 to 20151206T041830 and the period from 20150719T005448 to 20150720T024908.

11) CCU reset on the 25th of November 2015 caused a delay in the data production. As consequence, the calibration CSTD1A files where not processed in the correct order from 20151125T033228 to 20151127T082215. All these affected CSTD1A files have been regenerated and used to regenerate level 1 and level 2 science dataset.

12) On 15th of August 2015 a hardware anomaly caused a TLM_MIRA1A order to fail due to timeout. Therefore, a gap in science and in calibration (CSTD1A) was introduced. The next data types and periods has been regenerated: TLM_MIRA1A at

20150815T031323, CSTD1A files with times between 20150815T003625 and 20150815T214626, affected science level 1 and level 2 between 20150815T023400 and 20150815T050753.

13) A hardware anomaly in DPGS systems introduced a large delay in the data production. As a consequence some CSTD1A orders were dropped due time-out. This introduced bad-consolidated calibration information in the system, with some Local Oscillator (LO) calibration gaps, which has impacted the quality of the data severely. Data from 20150713T194909 until 20150714T032238 was affected. All data were regenerated successfully from level 0 up to level 1; level 2 data was reprocessed and is available as REPR data type.

14) Due to an anomaly in the NIR calibration on the 3rd of June 2015, the next data types has been regenerated from 2015-06-03 06:43z to 2015-06-12 08:14z: MIR_SC_F1A, MIR_SC_F1B, MIR_SCLF1C, MIR_SCSF1C, MIR_BWLF1C and MIR_BWSF1C. Level 2 data was reprocessed and is available as REPR data type.

15) Period from 29 May 2015 to 31 May 2015 have been regenerated since one of the DPGS processing nodes (PWF-5) induced several science and calibration gaps for the reported period. Level 2 data was reprocessed and is available as REPR data type

The information regarding the past version V5xx data regeneration and reprocessing activities (OPER and REPR data type) are available in the monthly report of April 2015.

4.2 Processing changes

4.2.1 Processor updates

During the reporting period no new processor versions were deployed into operations.

4.2.2 Processor Status

At the end of the reporting period, the Processing Facility is using the following processors:

Table 4-1 Instrument Processors status

Processor	Version	Deployment date
L1OP	620 (L1a/L1c/NIRCAL) 621 (L1b/CAL_1A)	05/05/2015
L2OS	662	10/05/2017
L2SM	650	16/11/2017

Table 4-2 Pre- and Post-processors status

Processor	Version	Deployment date
ECMWFP	318	07/11/2013
VTECGN	320	18/05/2016

LAI pre-processor (currently not used)	307	18/02/2010
OSCOTT	625	10/05/2017
L2 Post-processors	510	05/05/2015
SNOWP	102	28/10/2016

4.2.3 Schema updates

No updates for product schema in the reporting period.

4.2.4 Schema status

At the end of the reporting period, the schema version of the datablock of the products generated and distributed through SMOS dissemination service is:

Table 4-3 Schema version status

Product type	Version
MIR_SC_F1B	400
MIR_SCSF1C	400
MIR_SCLF1C	400
MIR_BWSF1C	400
MIR_BWLF1C	400
MIR_SMUDP2	400
MIR_OSUDP2	401
AUX_ECMWF_	300

The schema package v07.02.01 is available from the SMOS Global Mapping Tool (GMT) webpage:

https://earth.esa.int/web/guest/software-tools/-/asset_publisher/P2xs/content/gmt-smos-global-mapping-tool

Further information about the product format is available in the level 1 and level 2 Product specification documents available here

4.2.5 Aux file updates

The following quasi-static AUX files were disseminated to the processing stations this reporting period. The status of the quasi-static AUX files at the end of the reporting period is in the section 7.

SM_OPER_AUX_BULL_B_20171102T000000_20171201T235959_120_001_3

Start sensing time at L1 processor: N/A

Justification: Bulletin Update including values from November 2017 and the prediction for December 2017. Its usage is intended for reprocessing.

SM_OPER_AUX_BULL_B_201711002T000000_20500101T000000_120_001_3

Start sensing time at L1 processor: 2018-01-09 07:57:07z

Justification: Bulletin Update including values from November 2017 and the prediction for December 2017. Its usage is intended for the nominal production.

4.3 Calibration Events Summary

The following table summarizes the major calibration activities conducted during the reporting period. The Local Oscillator calibration is not included in the table since occurs periodically every 10 minutes. The short calibrations are acquired weekly since 2011-03-24 and they are currently used in the nominal processing chain.

Table 4-4 Calibration summary

Date	Start Time	Stop Time	Calibration	Comments
04/01/2018	09:33:00	09:34:44	Short	Nominal
10/01/2018	01:19:23	02:41:37	NIR-Warm	Nominal Brightness temperature: 3.6469 K RMS: 0.0702 K Moon Elevation: -62.899 Sun Elevation: 9.260687 Right Ascension: 17.24 Declination: -15.47
11/01/2018	08:20:00	08:21:44	Short	Nominal
18/01/2018	08:48:00	08:49:44	Short	Nominal
24/01/2018	02:14:02	03:36:15	NIR-Warm	Nominal Brightness temperature: 3.6642 K RMS: 0.0781 K Moon Elevation: -69.5366 Sun Elevation: 9.009028 Right Ascension: 31.32 Declination: -13.92
25/01/2018	07:35:30	07:37:14	Short	Nominal

4.4 Data Coverage Summary

Where instrument unavailabilities or anomalies have occurred during this reporting period, gaps in data coverage may have occurred. A list of the gaps due to a permanent data loss is given in Table 4-5 by product level. On the other hand, a list of gaps due to operational problems is given in Table 4-6. The latter gaps may be recovered when the problem is fixed.

The science data gaps due to the execution of calibration activities are not listed in this section.

Table 4-5 Data loss summary

Start	Finish	Data Level	Comments
19/01/2018 05:24:09	2018-01-19 07:06:40	All Products	CCU Reset (FOS-3047)

1: Data acquired during the manoeuvre is flagged as external pointing and not available as nominal data.

Table 4-6 Operational gaps summary

Start	Finish	Data Level	Comments
N/A	N/A	N/A	N/A

4.5 Summary of degraded data

In January 2018, SMOS data was affected by the following instrument and processing anomalies which have had a detrimental effect on the data quality.

Table 4-7 Summary of degraded data

Start	Finish	Affected products	Problem Description
2018-01-14 21:10:05	2018-01-14 21:20:05	L1a and above products	CMN Unlock (FOS-3074)

4.6 Product Quality Disclaimers

The following product disclaimers affects the data generated in the reporting period:

Table 4-8 Summary of product quality disclaimers

Date	Product level	

From: beginning of the mission To: 1st September 2016	L1 L2	Due to a software anomaly in the Level 0 processor, the *Cycle, orbit relative and orbit absolute* fields in all the product headers are incorrectly set. Those values are annotated in the headers of all the higher level products. The anomaly was fixed on 1st September 2016 with the deployment in the processing facility of a new version (v308) of the L0 processor.
From: 18th of August 2016 (16:36z) To: 20thSeptember 2016 (08:26z)	L1	Brightness temperature generated with calibration occurred on 2nd July instead of calibration occurred on 18th August. The impact of wrongly consolidated calibrated visibilities (UAVD1A) is negligible. In relation to the impact in the brightness temperature of the degraded PMS gain and offset (CRSD1A) the analysis had shown a small bias of +/- 0.25K in the image
From: 21st June 2017 (06:05:53z) To: 21st June 2017 (07:28:07z)	L1	Due to CCU reset side effect science data was acquired with instrument pointing in external target looking at deep sky.

5. LONG-TERM ANALYSIS

5.1 Calibration Analysis

The calibration parameters are under monitoring. During the reporting period, there have been three Warm-NIR calibrations event on the 10^{th}, 24^{th} of January 2018.

The evolution of the noise temperature of the reference noise diodes Tna and Tnr computed with processor baseline V62x since the beginning of the mission is shown from figures from Figure 1 to Figure 4. The evolution of the temperature parameters, which are related to the internal diode stability, are stable in particular for the NIR CA which is the only one used for the level 1 data calibration. The small deviation in the NIR calibration on 3^{rd} June 2015 and on 2^{nd} August 2017 was due to a Radio Frequency Interference (RFI) that has corrupted the measurement. This calibration should not be used for the scientific processing of the data from 2015-06-03 06:43z to 2015-06-12 08:14z. Deviations in NIR calibration can be also seen on 2016-04-06, 2016-04-20, 2016-05-04, 2016-05-18, 2016-08-24, 2016-09-07, 2017-02-11, 2017-02-17, 2017-03-29 due to proximity of the equinox. These calibrations have failed the quality control checks and were not used for the scientific processing of the data.

The seasonal evolution of the calibration parameters: Tna and Tnr present in the previous processor baseline V5xx (see for an example the monthly report for April 2015) had been largely mitigated by the new calibration algorithm which decouple the variation of the antenna losses and the drift of the reference diode. This approach allows to compensate each drift separately improving the diode stability monitoring and increasing the accuracy of the consequent calibration correction. Further improvements in the calibration stability were achieved by implementing the “warm NIR calibration” since 15^{th} of October 2014. During “warm NIR calibration” the Noise Injection Radiometer (NIR) calibration is performed with a Sun elevation of 10 degrees above the antenna plane in order to maintain a stable thermal environment of the instrument through the calibration sequence. The impact on the final brightness temperature is a more stable long term measurement.

Figure 5 and Figure 6 present the evolution of the NIR Observed brightness temperature (BT) since the beginning of the mission for the V620x baseline. Small variation of few Kelvin, in the observed BT are due to slightly different region of the Sky sensed during the calibration manoeuvre. This parameter is used only for monitoring purpose.

The leakage and cross-coupling factors of the NIR channels shown in Figure 7 and Figure 8 remain small and no problems can be observed apart from a peak in the phase of the NIR-AB cross-coupling term on 11 April 2012. That peak corresponds to an anomaly in the NIR-AB that did not have impact on the data.

Figure 1 Tna evolution of NIR AB (blue), NIR BC (green) and NIR CA (red) in the H-channel since the beginning of the mission. Thresholds in dashed lines

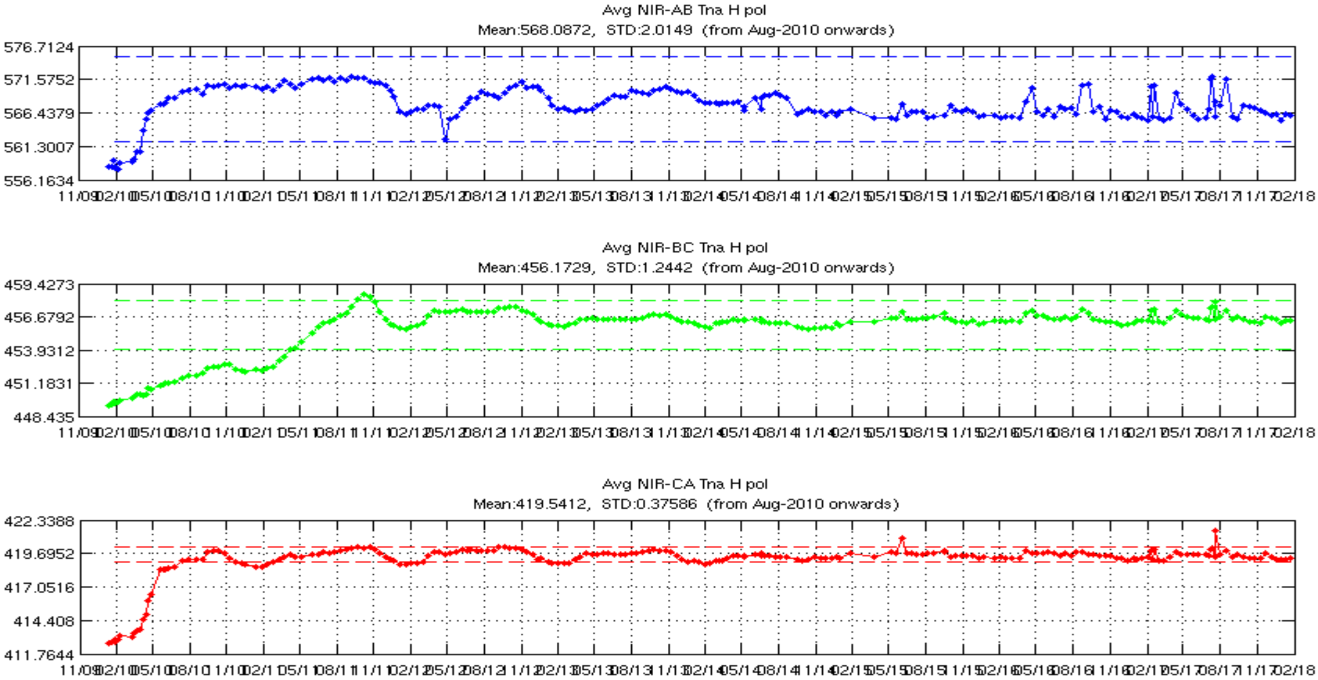


Figure 2 Tna evolution of NIR AB (blue), NIR BC (green) and NIR CA (red) in the V-channel since the beginning of the mission. Thresholds in dashed lines

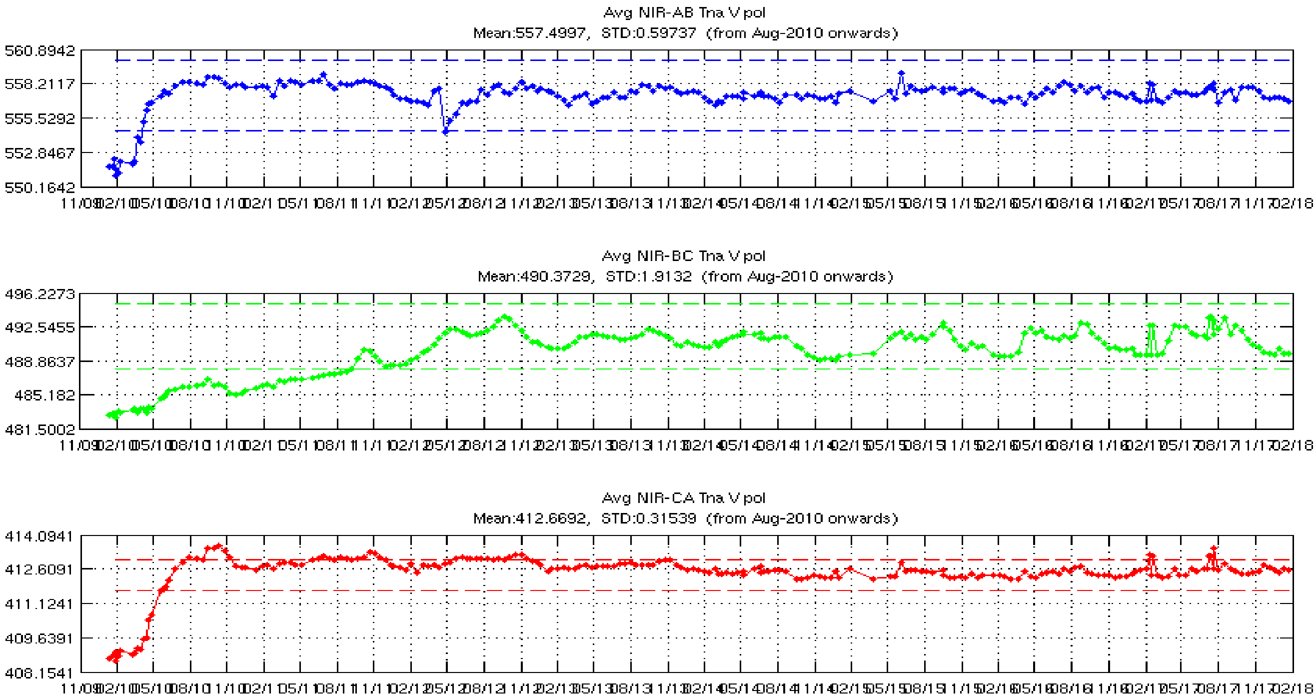


Figure 3 Tnr evolution of NIR AB (blue), NIR BC (green) and NIR CA (red) in the H-channel since the beginning of the mission.

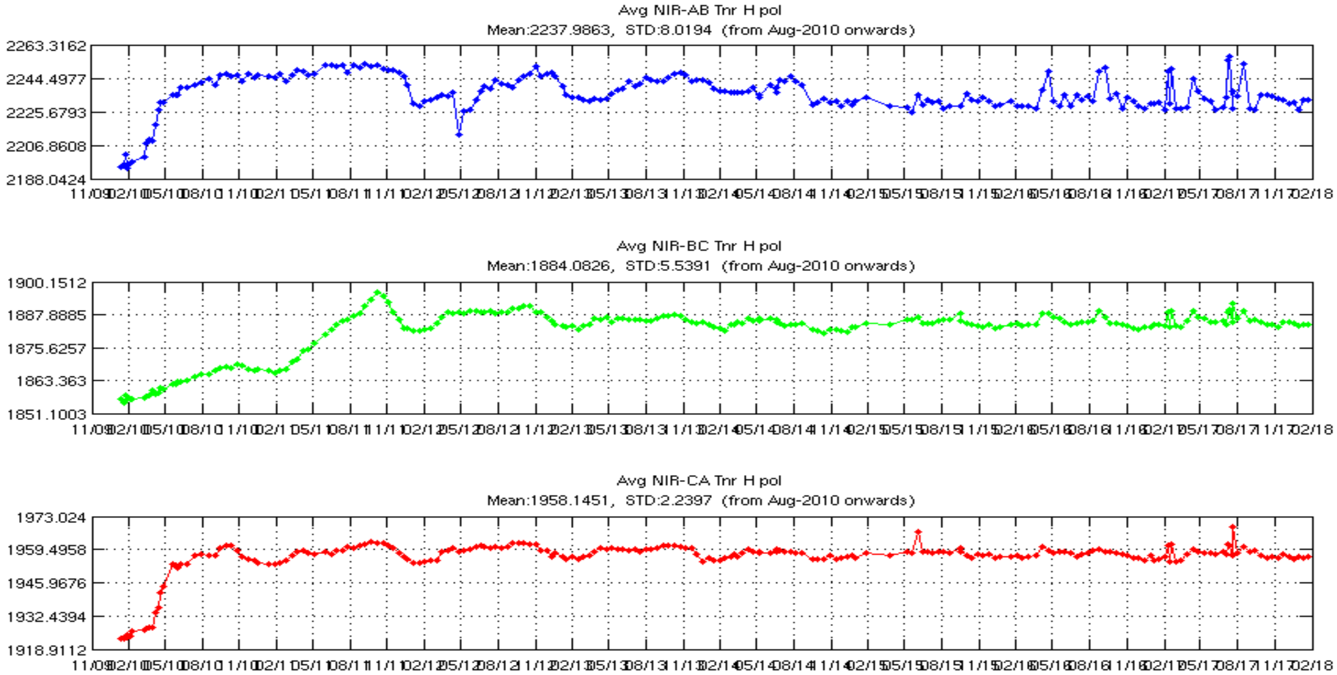


Figure 4 Tnr evolution of NIR AB (blue), NIR BC (green) and NIR CA (red) in the V-channel since the beginning of the mission.

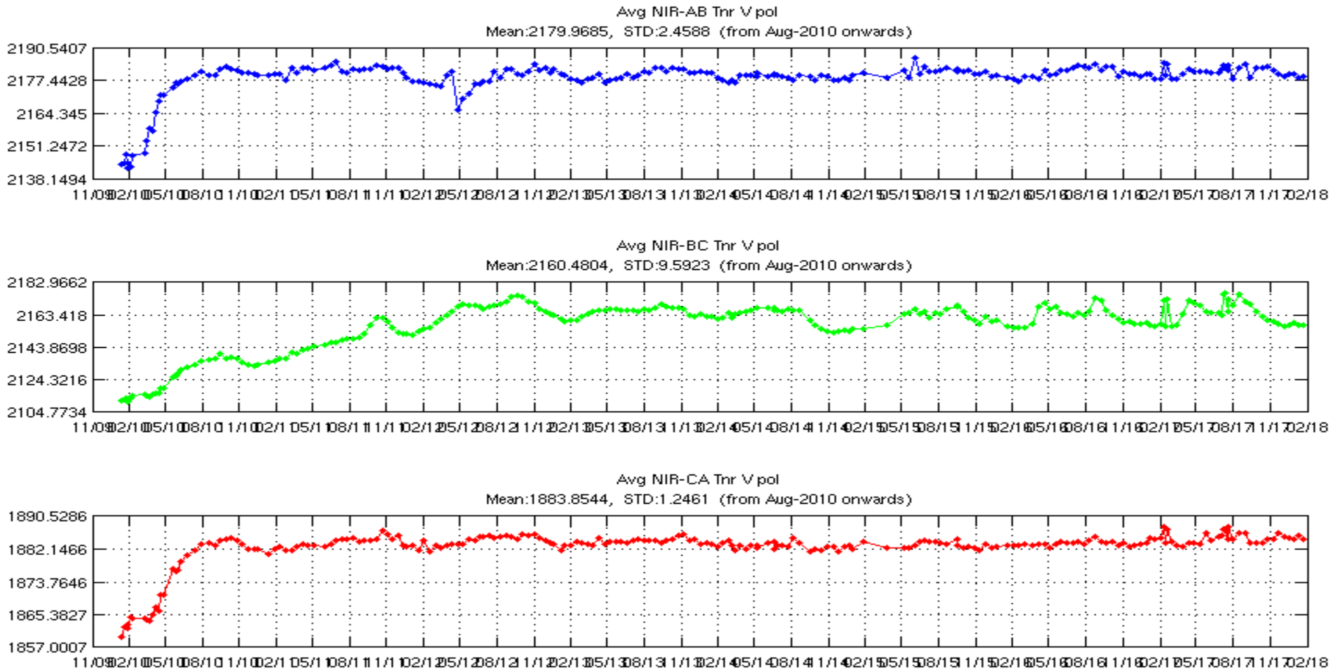


Figure 5 NIR Observed BT evolution of NIR AB (blue), NIR BC (green) and NIR CA (red) in the H-channel since the beginning of the mission. Thresholds in dashed lines

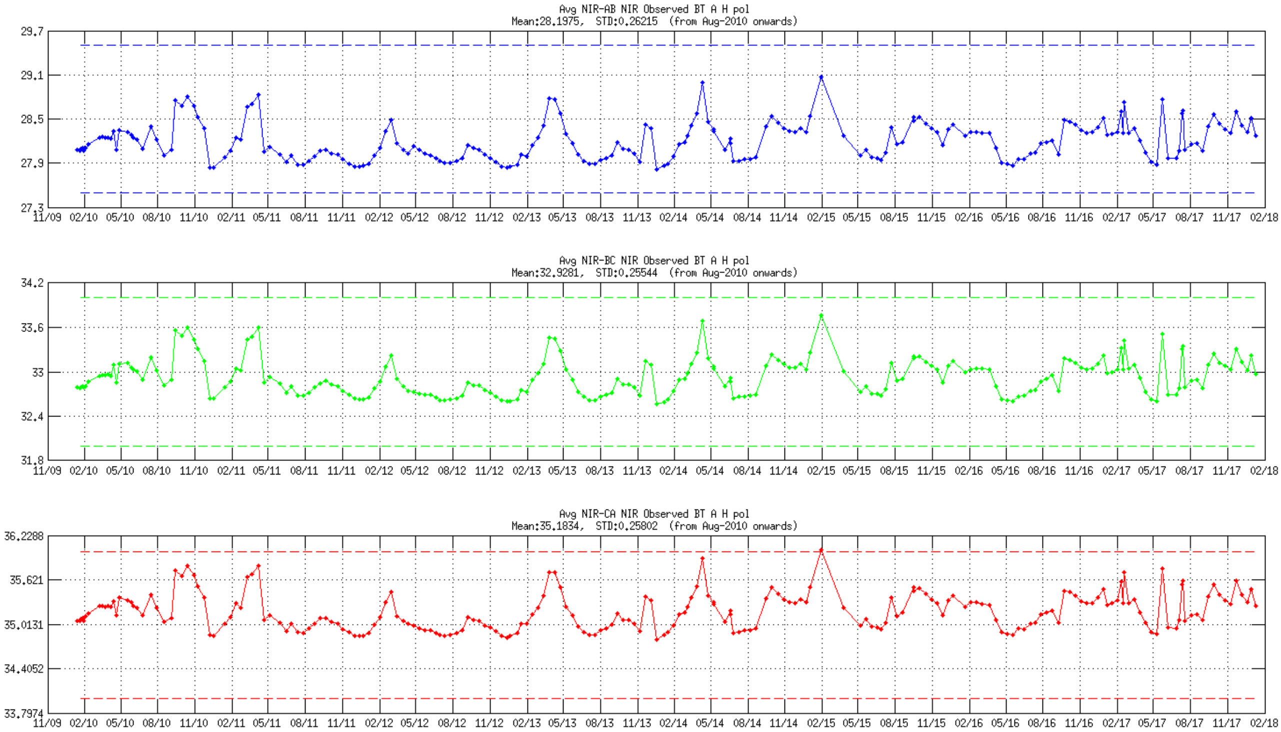


Figure 6 NIR Observed BT evolution of NIR AB (blue), NIR BC (green) and NIR CA (red) in the V-channel since the beginning of the mission. Thresholds in dashed lines

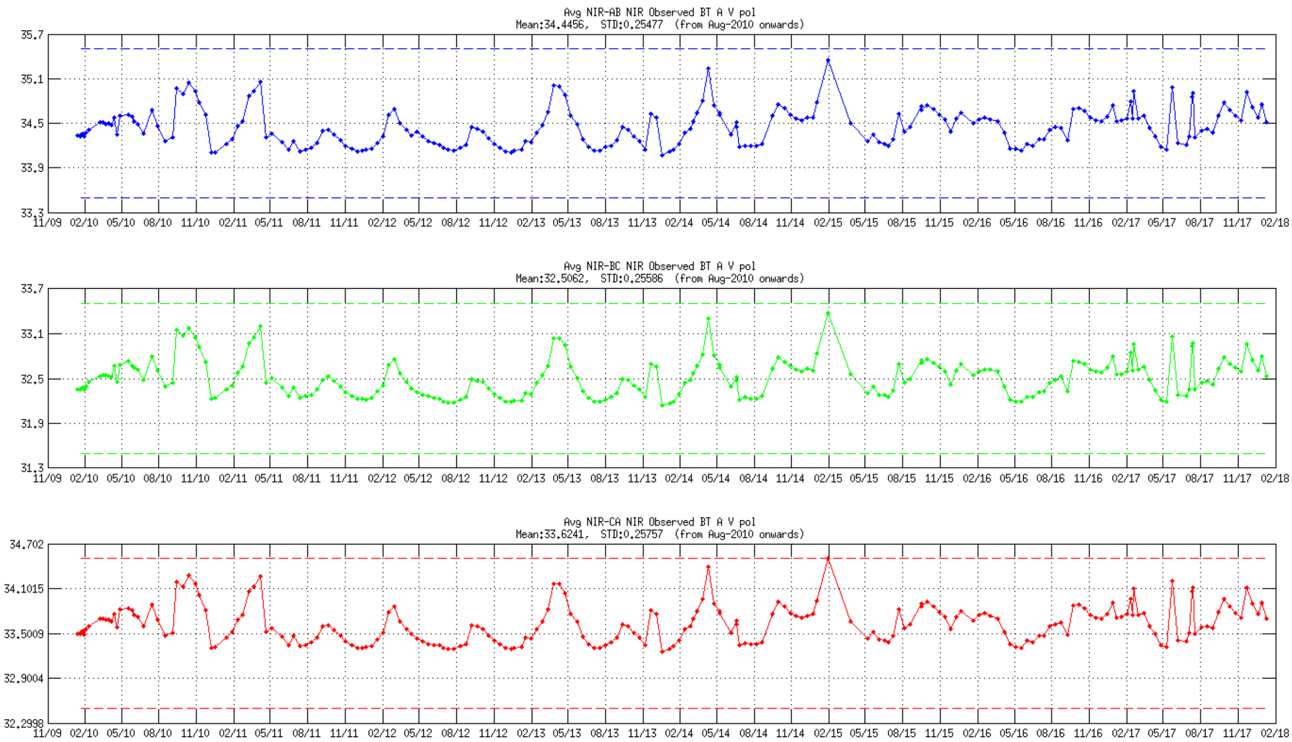


Figure 7 Cross-coupling evolution in amplitude and phase of NIR AB (blue), NIR BC (green) and NIR CA (red) since the beginning of the mission

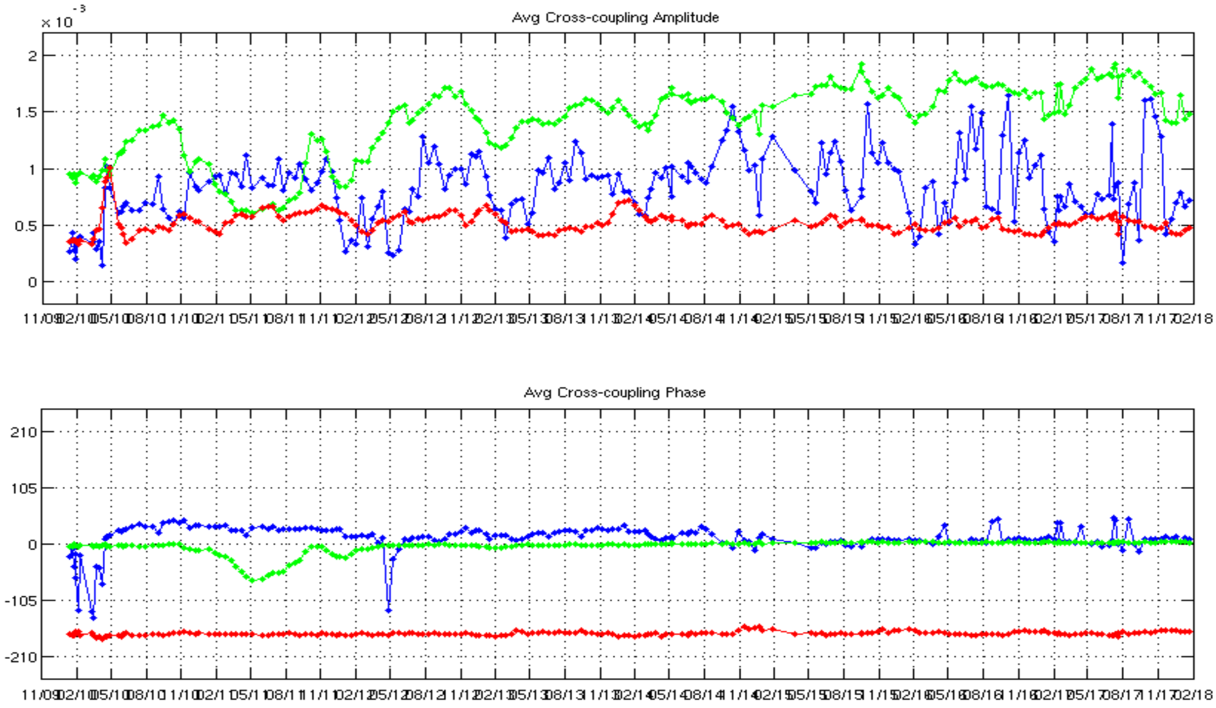
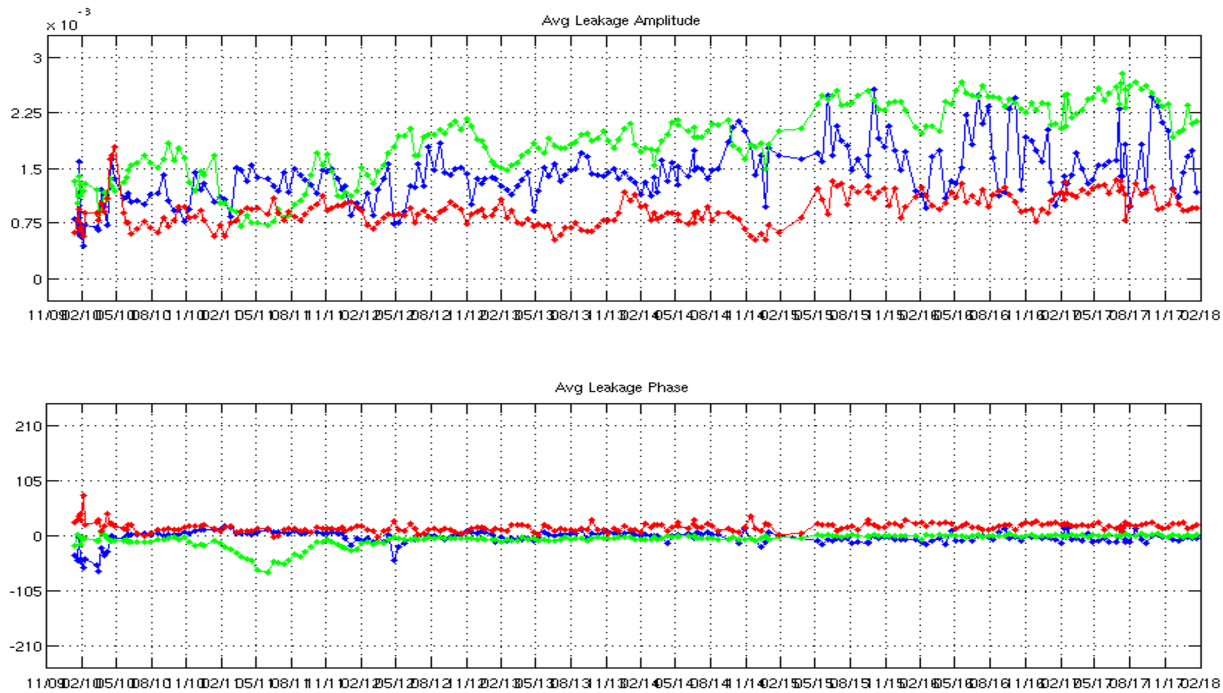


Figure 8 Leakage factor evolution in amplitude and phase of NIR AB (blue), NIR BC (green) and NIR CA (red) since the beginning of the mission



The LICEF calibration status is updated by long (every 8 weeks) and short (weekly) on-board calibration activities. No Long calibration have been executed in January.

LICEF PMS gain is derived during the long calibration activity and figures from Figure 9 to Figure 20 show the evolution (V62x algorithm baseline) of the deviations of the PMS gain with respect to its average over time. Note that PMS gain depends on the physical temperature of the receivers, PMS calibration is performed at slightly different physical temperature due to calibration time (season effect) and position of the receiver (LICEF) in the instrument (arms and central hub). In order to compare the calibration results the gains and offsets obtained during the calibration are normalised to 21 degrees Celsius temperature by using the receiver PMS gain and offset temperature sensitivity parameter (one value for each LICEF).

Apart from receiver (LICEF) LCF_A_18, LCF_C_11, LCF_C_19, which have shown a clear evolution from the main trend (see Figure 12, 19, 20) the others PMS gains are stable. The seasonal PMS gain variation present in some LICEFs is mainly due to the PMS gain temperature sensitivity parameters which needs refinement for some LICEFs.

The LCF_A_10 PMS gain evolution in the period January-March 2016 as been further analysed. The evolution in the PMS gain computed at 21C is mainly due to the usage of the temperature sensitivity parameter for that LICEF rather than a change in the receiver itself due to the slightly temperature increase occurred on 10^{th} January 2016. The computation of the PMS gain at 21C with a more refined temperature sensitivity parameter does not show such evolution.

The usage of refined temperature sensitivity parameters for all the LICEFs is under evaluation by the calibration team and it might be introduced in the next version of the level 1 processor to further improve the level 1 data calibration.

Figures from Figure 21 to Figure 32 show the evolution of the PMS offsets (V62x algorithm baseline) derived during the short calibration activity.

Figure 33 shows the evolution of the average over all the baselines of the Fringe Washing Function (FWF) amplitude in the origin derived during the long calibration. The amplitude of the FWF at the origin does not show any drift and their values are inside the ranges defined in the routine calibration plan.

The evolution of the visibility average offsets (Figure 34 and Figure 35) had an unexpected peak on the 2^{nd} of February 2017. Accordingly to preliminary analysis, this seems related to RFI. The quality impact on the data is small with a peak-to-peak bias of about 0.1K in brightness temperature.

Figure 9 Evolution of the Δ PMS Gain of the LICEFS in CMN H1

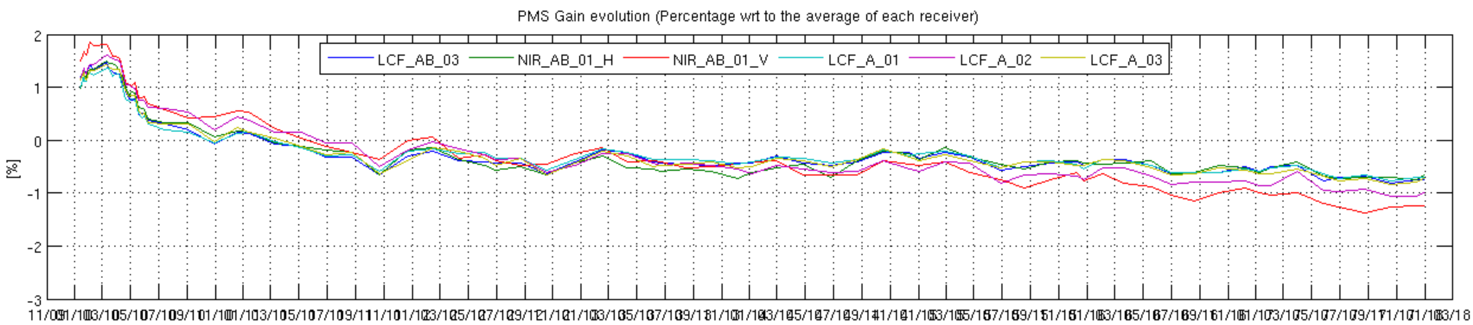


Figure 10 Evolution of the Δ PMS Gain of the LICEFS in CMN A1

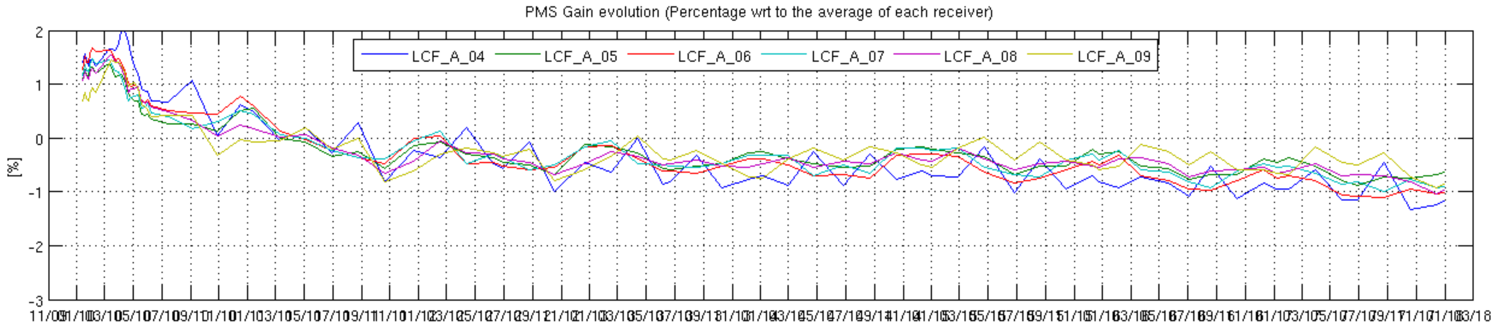


Figure 11 Evolution of the Δ PMS Gain of the LICEFS in CMN A2

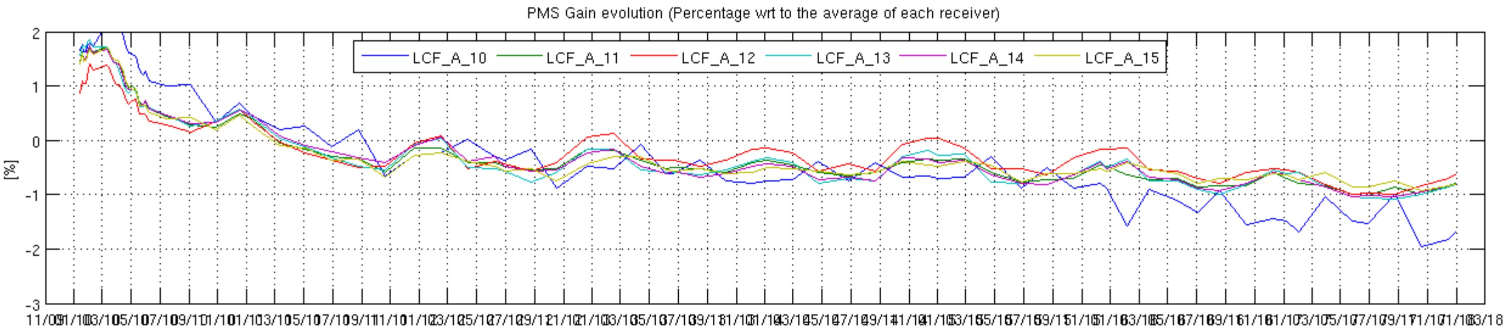


Figure 12 Evolution of the Δ PMS Gain of the LICEFS in CMN A3

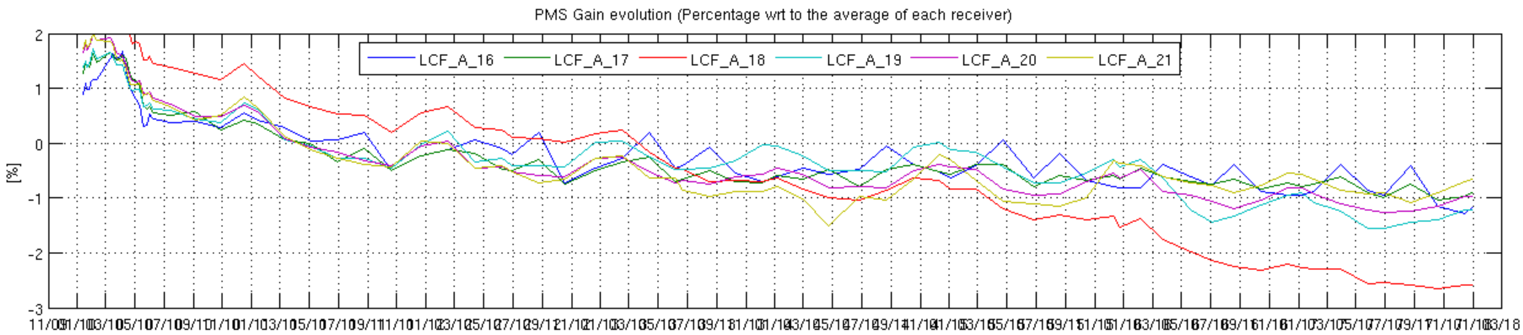


Figure 13 Evolution of the Δ PMS Gain of the LICEFS in CMN H2

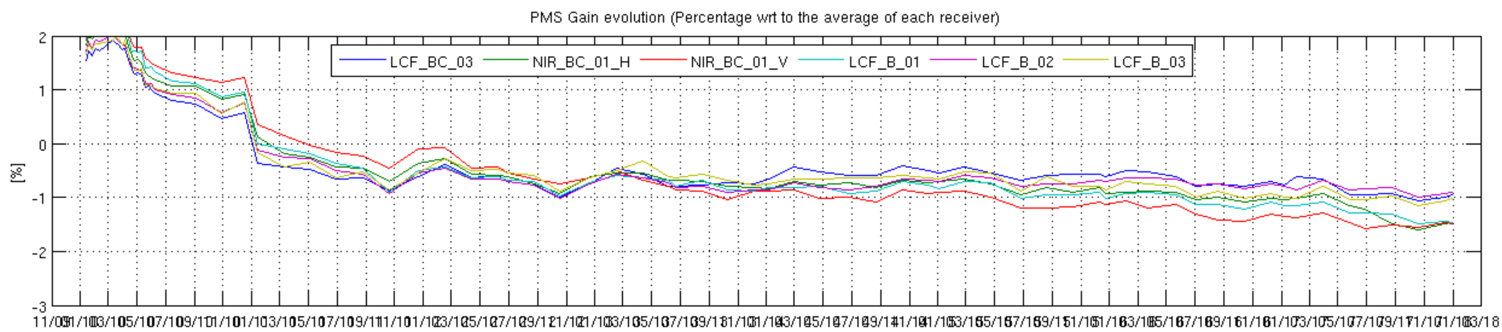


Figure 14 Evolution of the Δ PMS Gain of the LICEFS in CMN B1

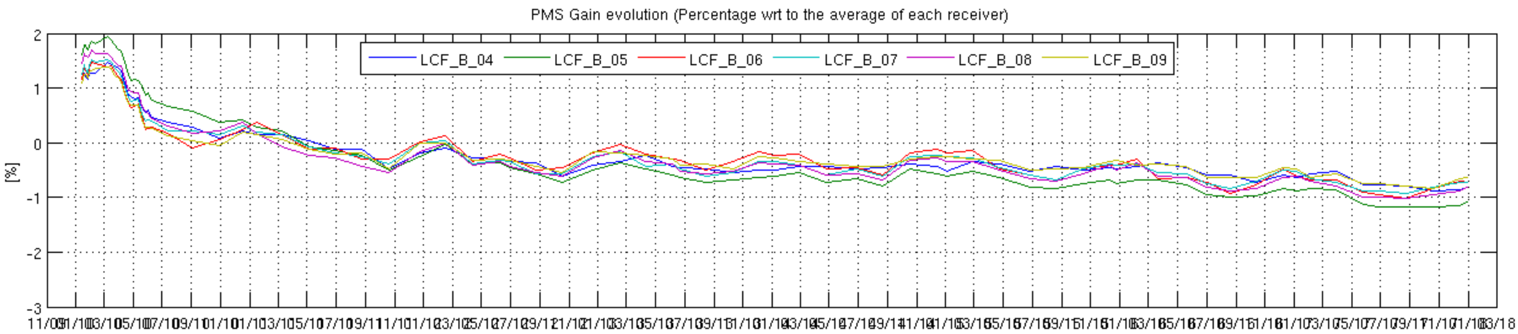


Figure 15 Evolution of the Δ PMS Gain of the LICEFS in CMN B2

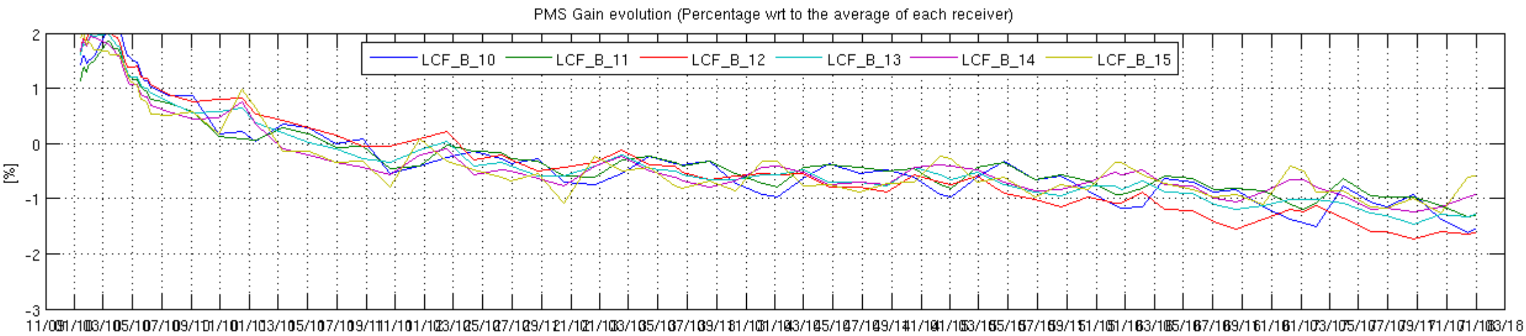


Figure 16 Evolution of the Δ PMS Gain of the LICEFS in CMN B3

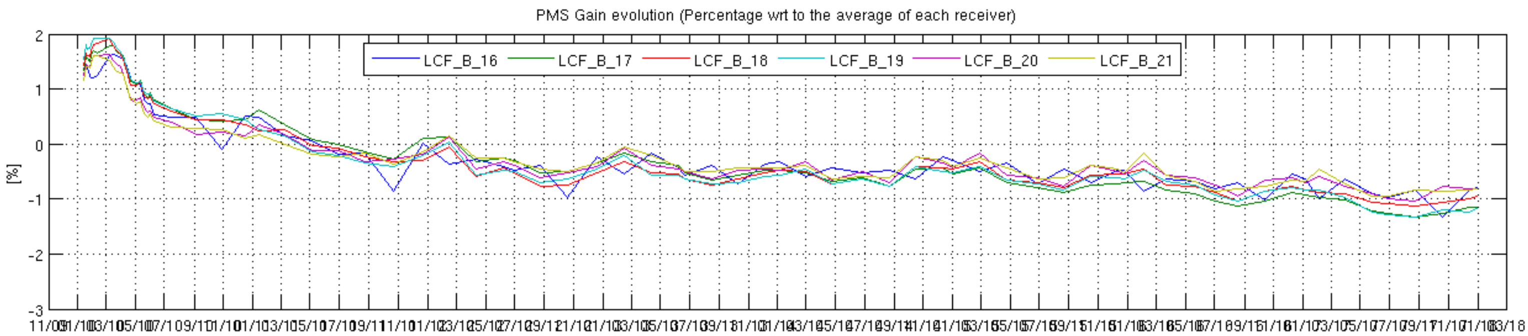


Figure 17 Evolution of the Δ PMS Gain of the LICEFS in CMN H3

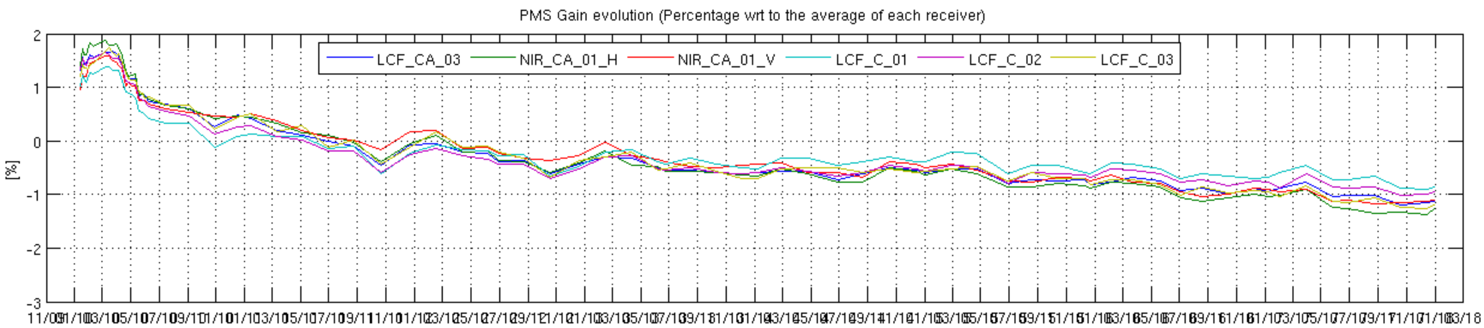


Figure 18 Evolution of the Δ PMS Gain of the LICEFS in CMN C1

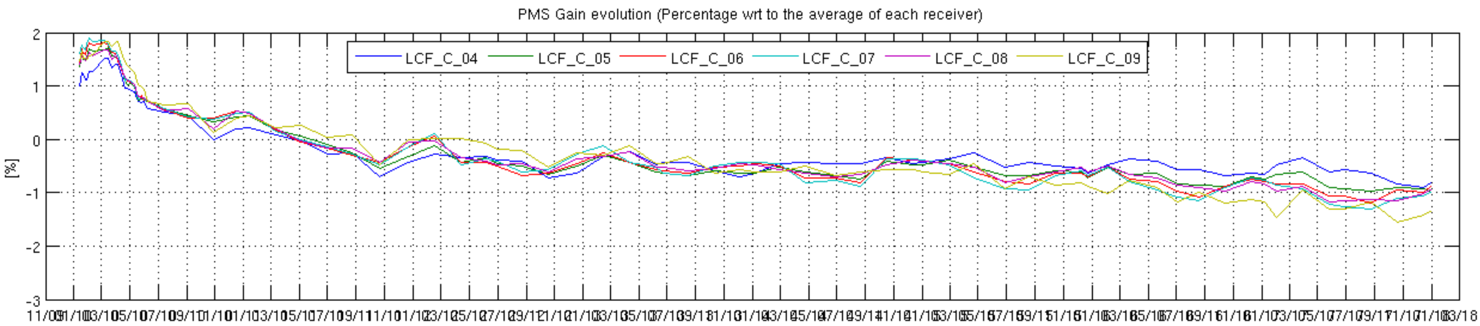


Figure 19 Evolution of the Δ PMS Gain of the LICEFS in CMN C2

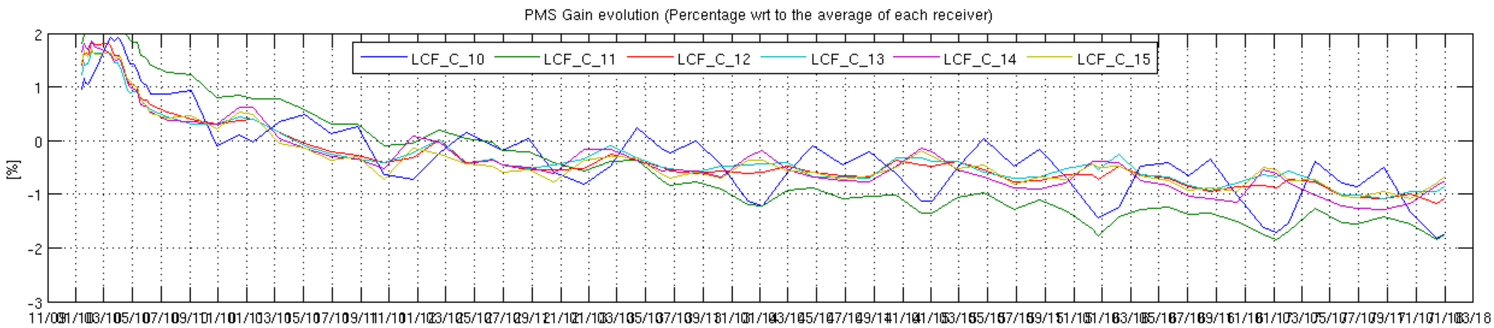


Figure 20 Evolution of the Δ PMS Gain of the LICEFS in CMN C3

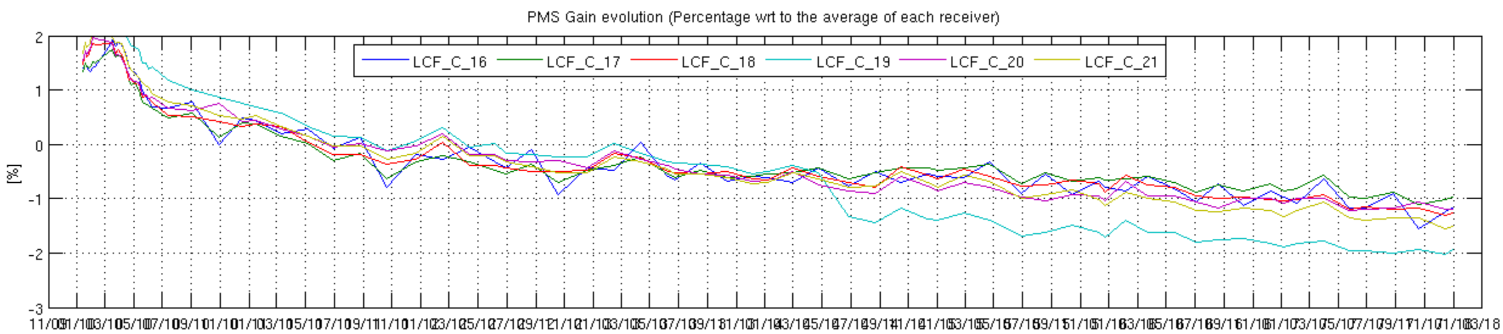


Figure 21 Evolution of the Δ PMS Offset of the LICEFS in CMN H1

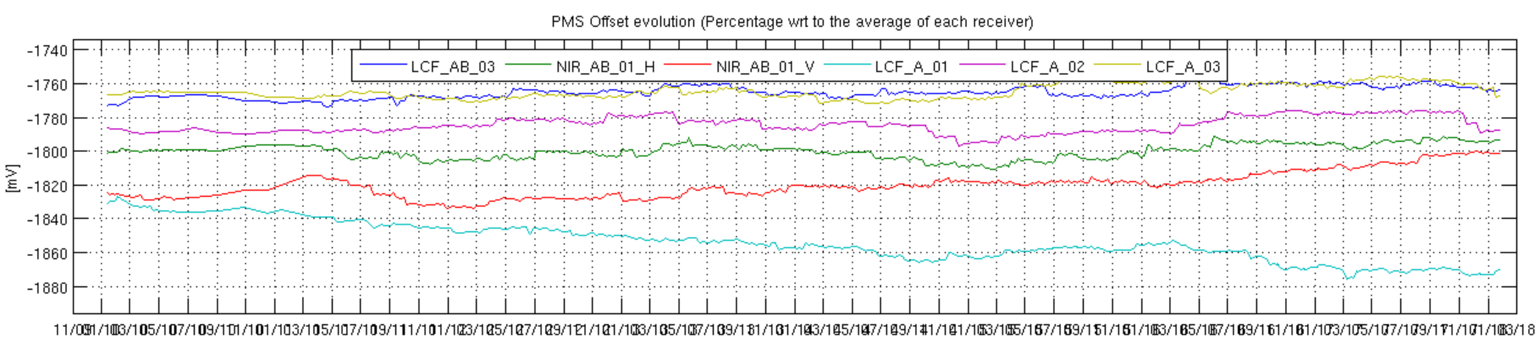


Figure 22 Evolution of the Δ PMS Offset of the LICEFS in CMN A1

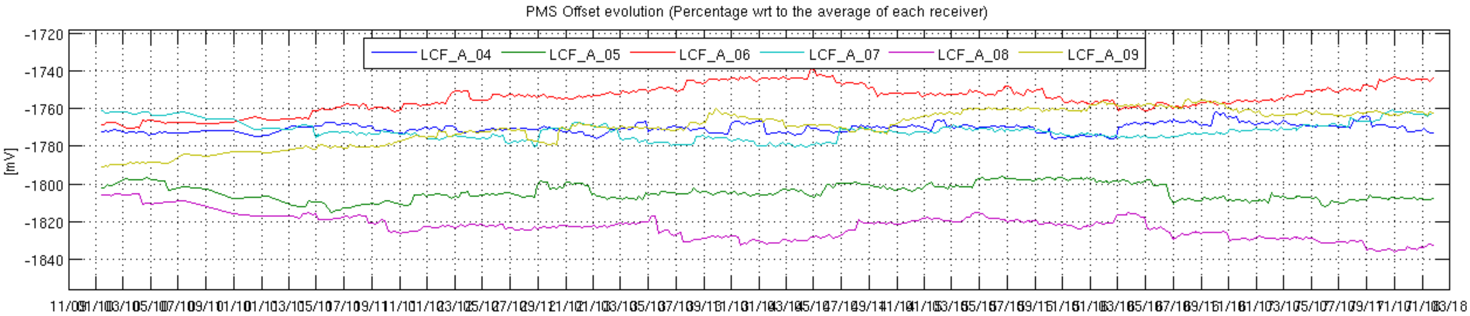


Figure 23 Evolution of the Δ PMS Offset of the LICEFS in CMN A2

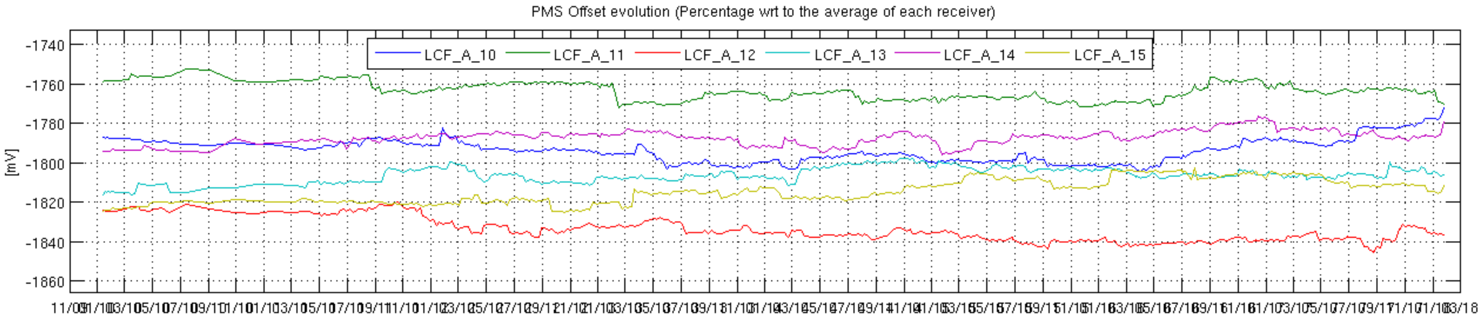


Figure 24 Evolution of the Δ PMS Offset of the LICEFS in CMN A3

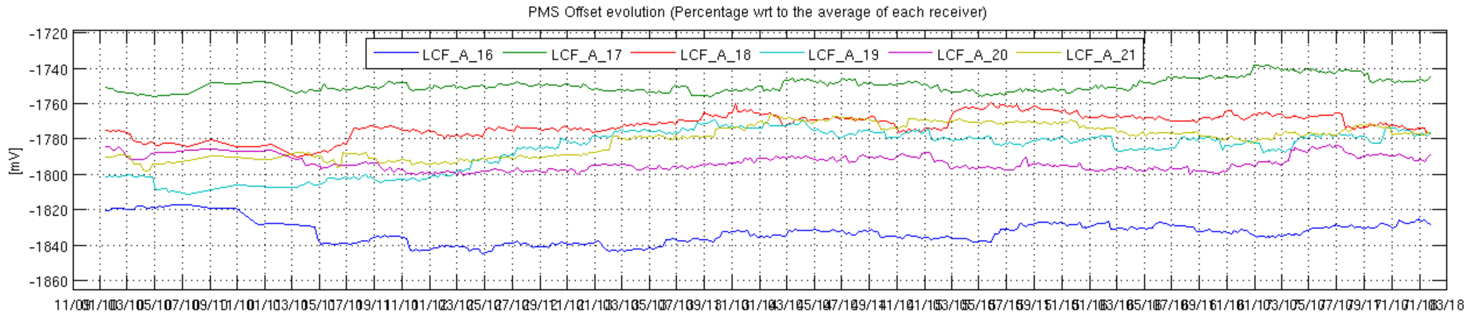


Figure 25 Evolution of the Δ PMS Offset of the LICEFS in CMN H2

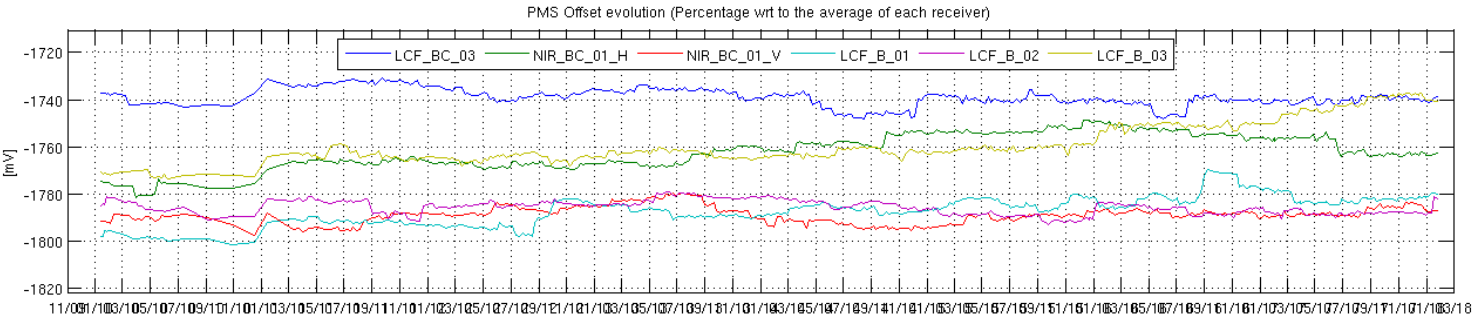


Figure 26 Evolution of the Δ PMS Offset of the LICEFS in CMN B1

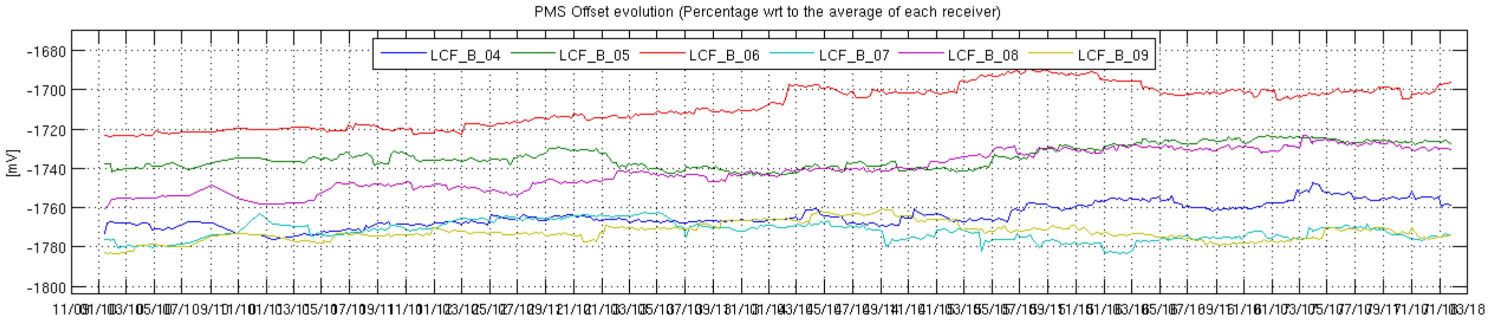


Figure 27 Evolution of the Δ PMS Offset of the LICEFS in CMN B2

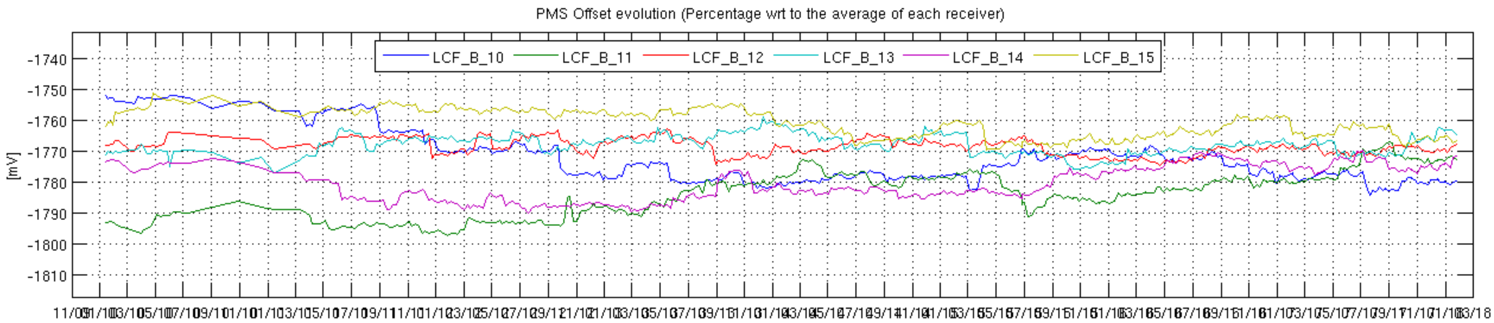


Figure 28 Evolution of the Δ PMS Offset of the LICEFS in CMN B3

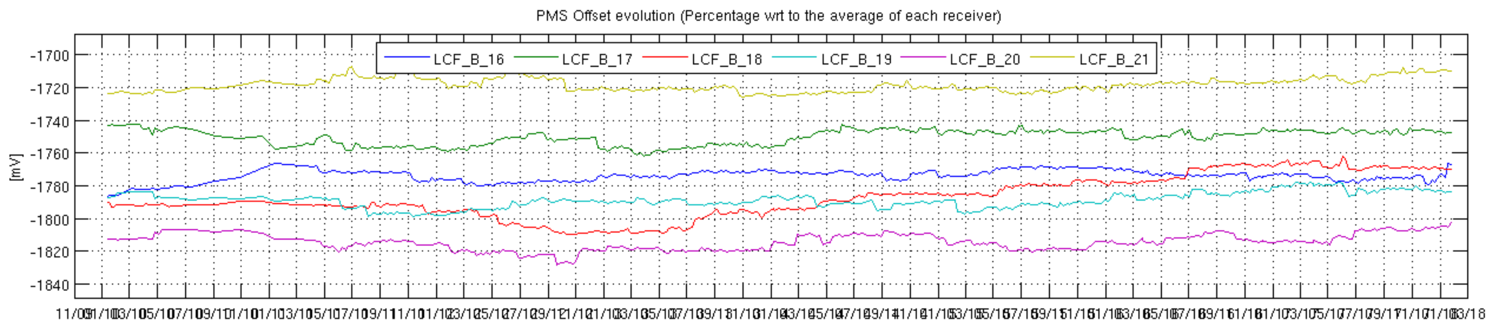


Figure 29 Evolution of the Δ PMS Offset of the LICEFS in CMN H3

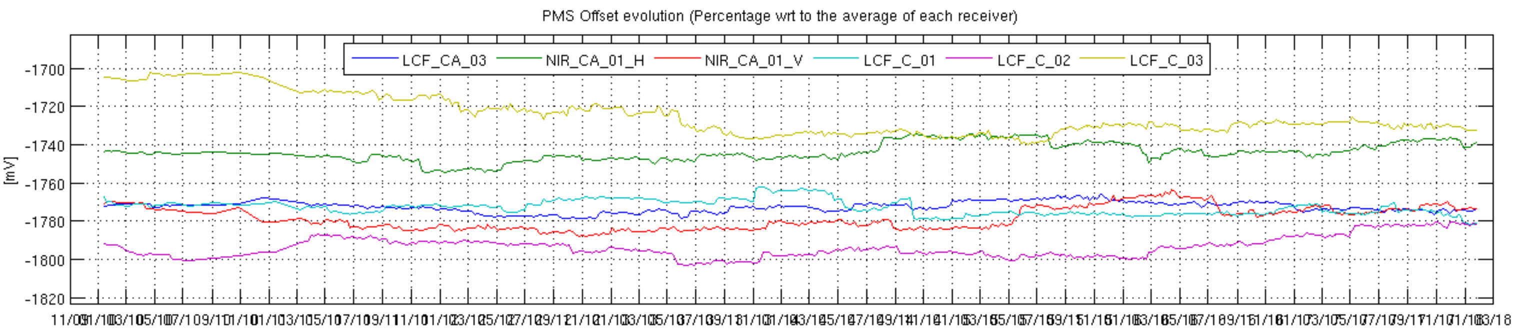


Figure 30 Evolution of the Δ PMS Offset of the LICEFS in CMN C1

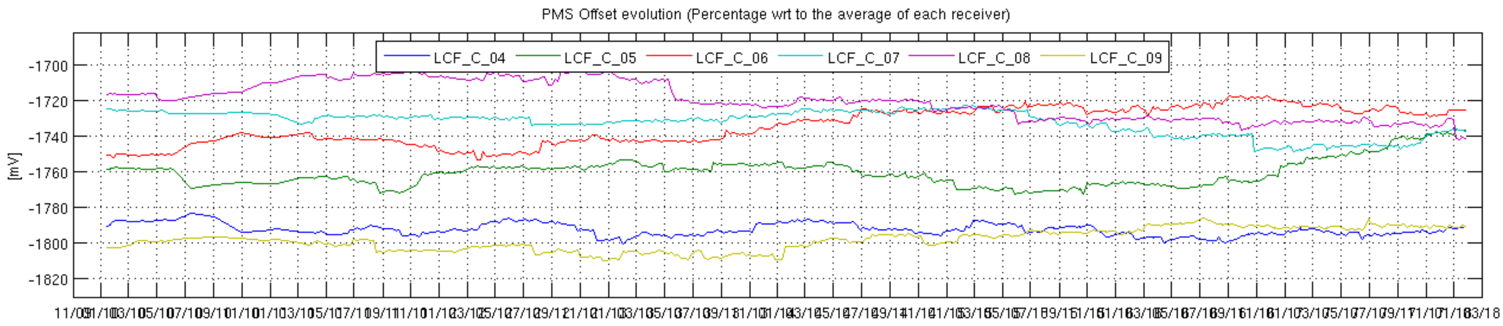


Figure 31 Evolution of the Δ PMS Offset of the LICEFS in CMN C2

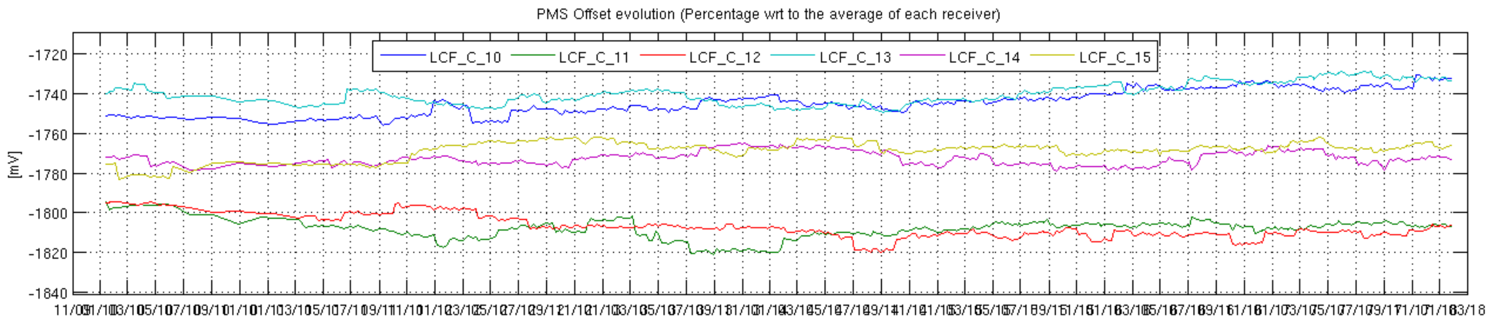


Figure 32 Evolution of the Δ PMS Offset of the LICEFS in CMN C3

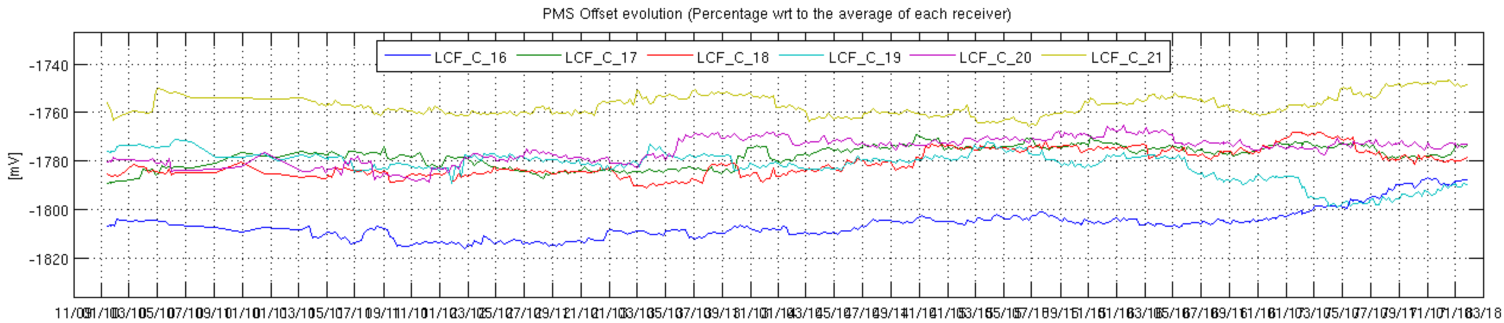
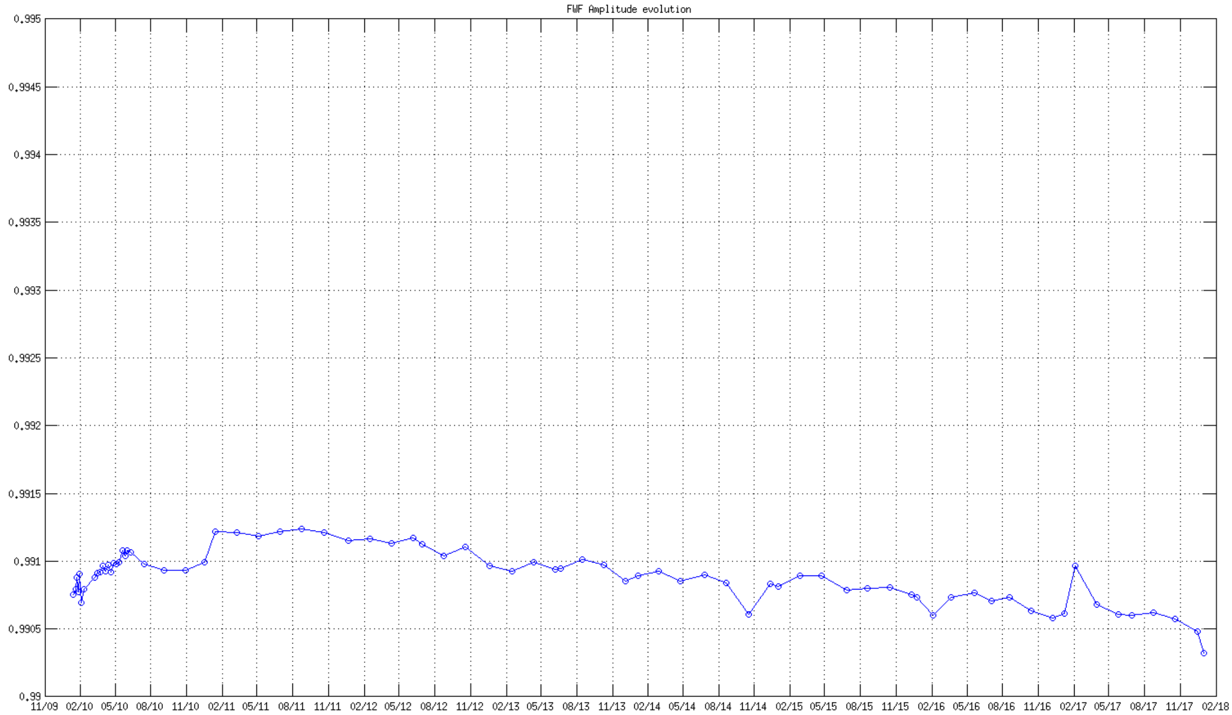


Figure 33 Evolution of the average of the FWF Amplitude at the origin



The evolution of the average of the correlator offsets does not show any significant drift. Also, the correlation offsets between receivers that do not share local oscillator remains much smaller than the correlation offsets between receivers sharing local oscillator. This result is expected since any residual correlated signal arriving to a pair of receivers, arrives through the local oscillator signal.

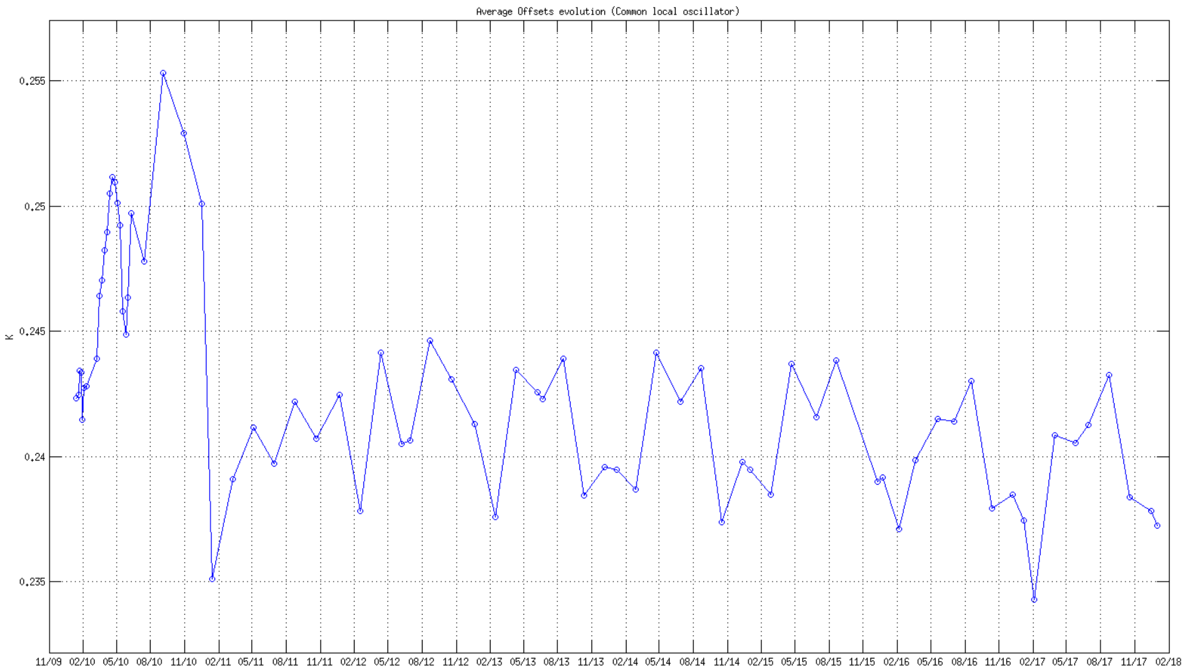


Figure 34 Evolution of the average of the Correlator offsets for the baselines which share local oscillator

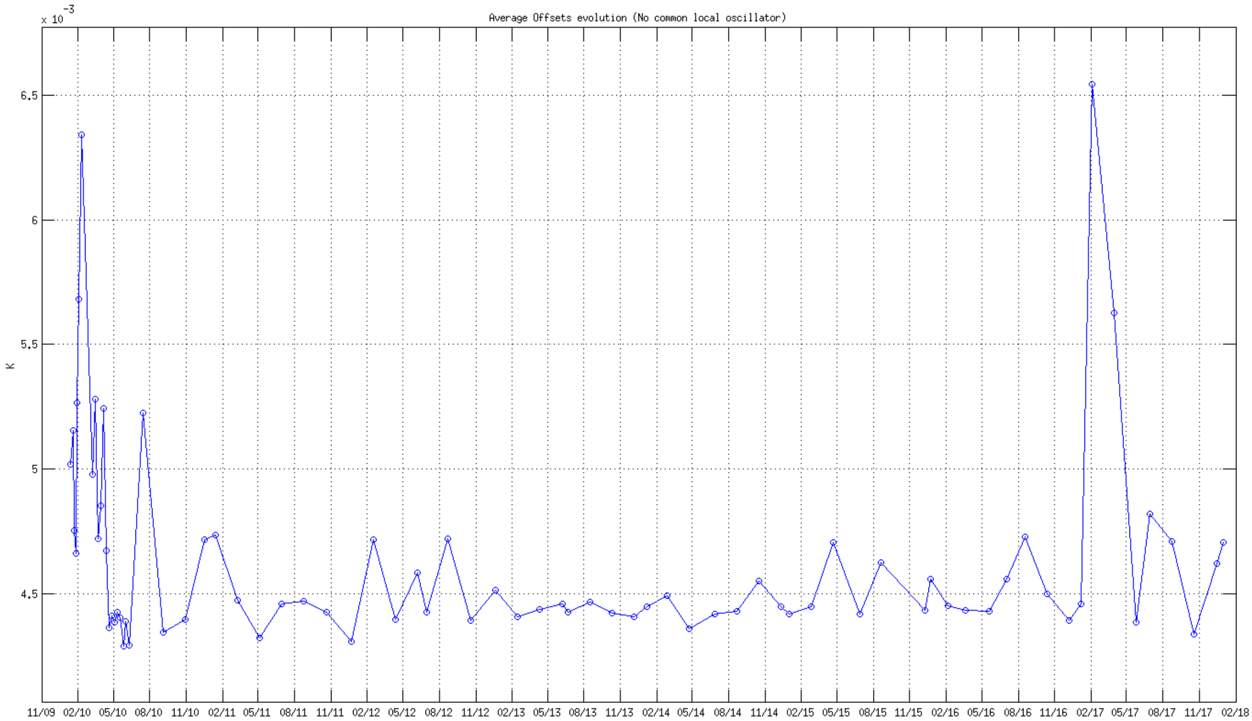


Figure 35 Evolution of the average of the Correlator offsets for the baselines which do not share local oscillator

5.2 Brightness Temperatures Trends over Dome-C Point (Antarctic)

The result of the monitoring of the evolution of the SMOS brightness temperature over Dome-C is shown in the Figure 36 (X and Y polarization at antenna frame for all the incidence angles) and in Figure 37, Figure 38 (H and V polarization at surface level for 42.0 degrees incidence angle for different areas of the Field Of View). The values are averaged every 18 days to reduce the noise and the value for July 2010 is subtracted and used as relative reference. In figure 37 are also shown in situ measurements (dome-C) from the DOMEX experiment averaged on the same period of the SMOS data.

The evolution of the brightness temperature trend over Dome-C does not show any significant drift except for the beginning of 2015 in H polarization. This drift was due to a change on surface geophysical condition: accumulation of snow since November 2014 and rapidly evolution of snow density on 22 March 2015 when a strong wind has changed the surface condition. This event has impacted the emissivity of the ice that was confirmed by on-site L-band measurement (Dome-x experiment) and from the Aquarius data set.

The brightness temperature V polarization measurements are quite stable since the beginning of the mission. The brightness temperature H polarization measurements are less stable and impacted by geophysical condition at surface level.

Figure 36: Dome-C X and Y polarization trends (all incidence angles)

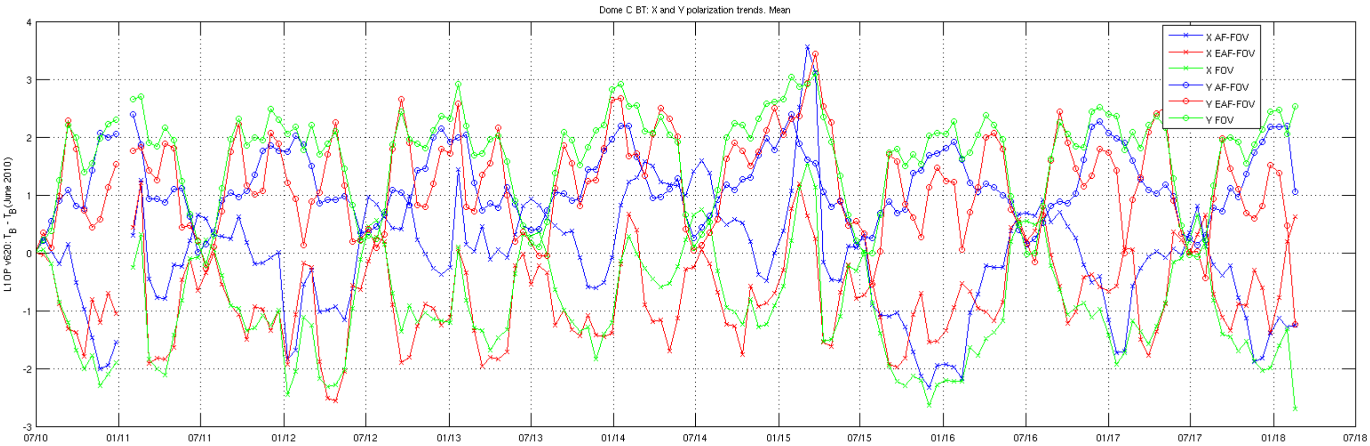


Figure 37: Dome-C H and V polarization trends in Alias Free zone (incidence angle 42°)

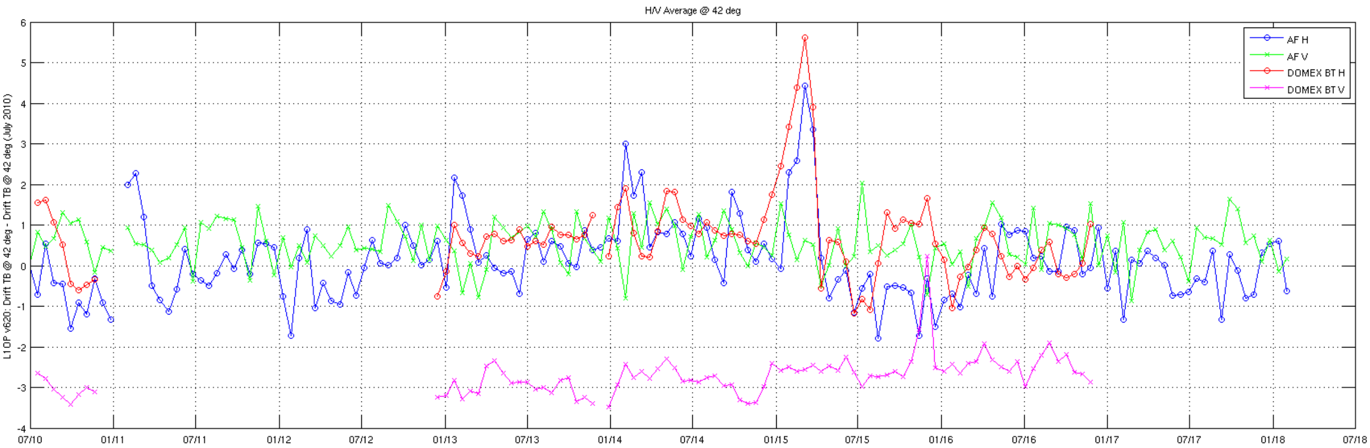
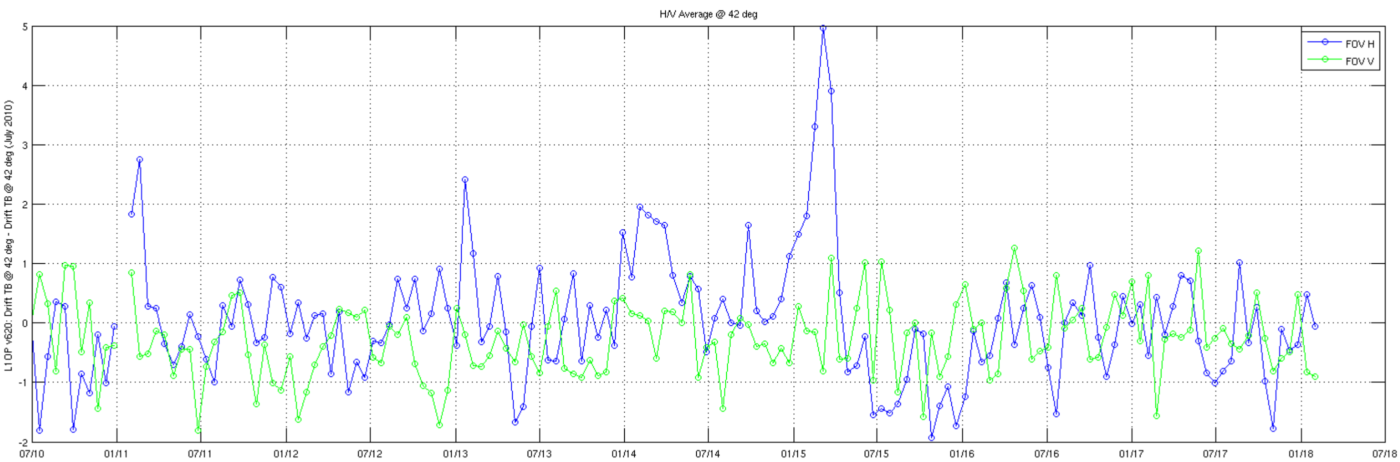


Figure 38: Dome-C H and V polarization trends in Extended Alias Free zone (incidence angle 42°)



5.3 Brightness Temperature Stability over the ocean:

The result of the monitoring of the evolution of the SMOS brightness temperature over the ocean is shown in the Figures 40-43 as a Hovmoller plot (time-latitude plot with averaged longitudes for the Brightness Temperature anomaly with respect to the ocean model).

The latitude-longitude area is defined as described in figure 39. This aims to obtain a sufficiently large water body without much interfering land masses, land sea contamination, RFI presence, etc, to be used as a well-known reference. For that area, the ocean model is deemed sufficiently known.

In addition to the Hovmoller plots, several additional metrics are provided. Figures 44-47 contain trends computed over the Hovmoller for several areas of interest. They contain latitude-longitude Brightness Temperature averages evolution.

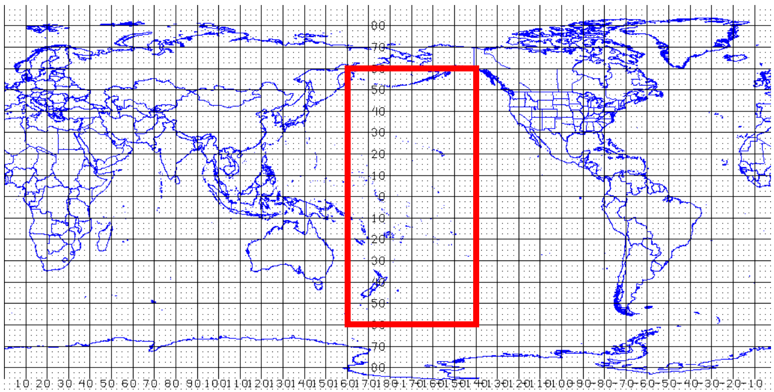


Figure 39: Open ocean region used for the Hovmoller computation.

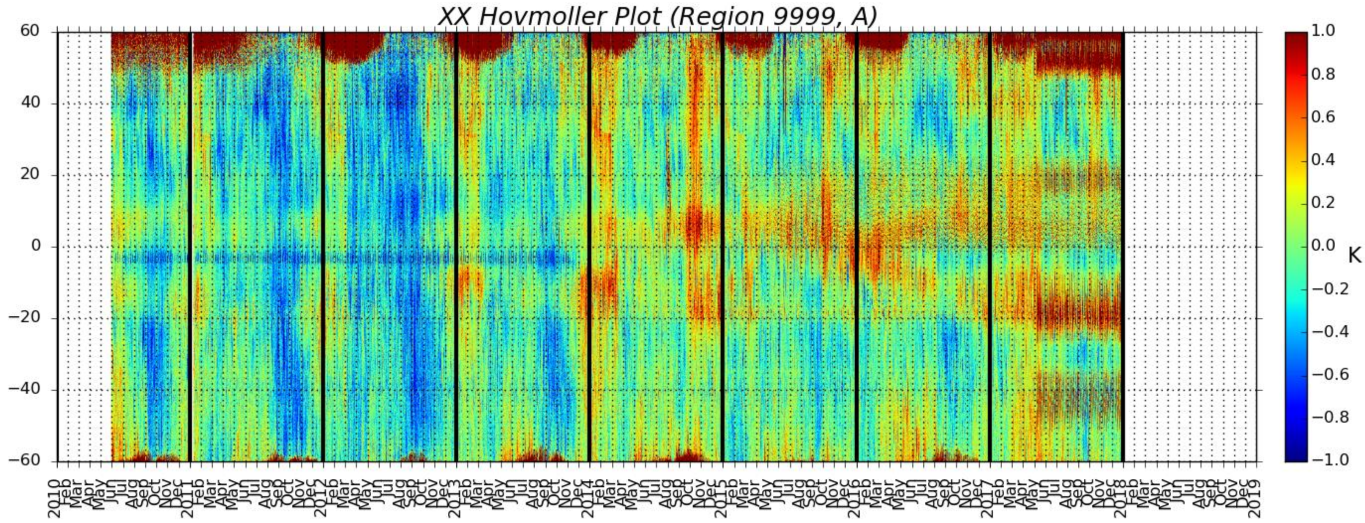


Figure 40: BT stability over the ocean, for XX polarization and Ascending passes.

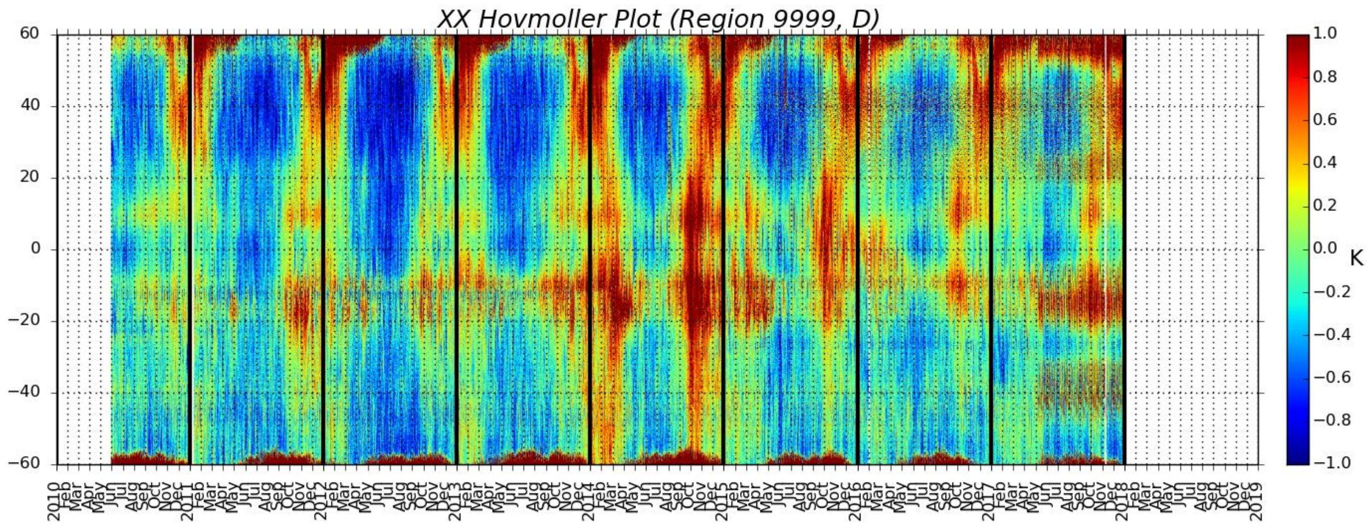


Figure 41: BT stability over the ocean, for XX polarization and Descending passes.

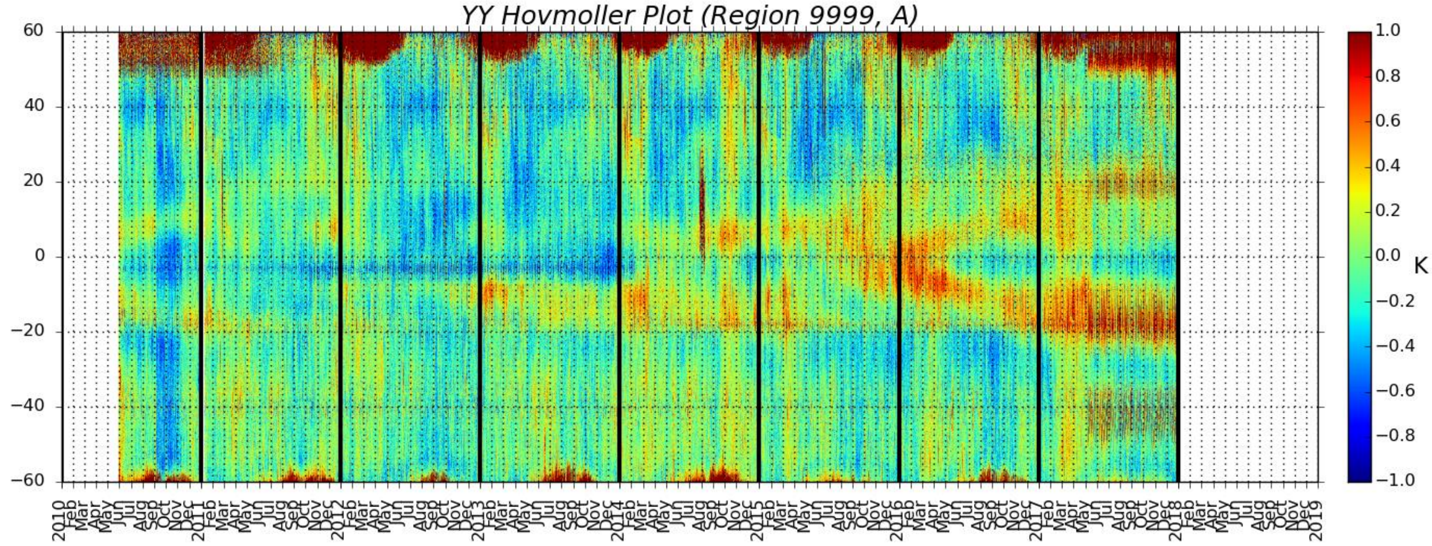


Figure 42: BT stability over the ocean, for YY polarization and Ascending passes.

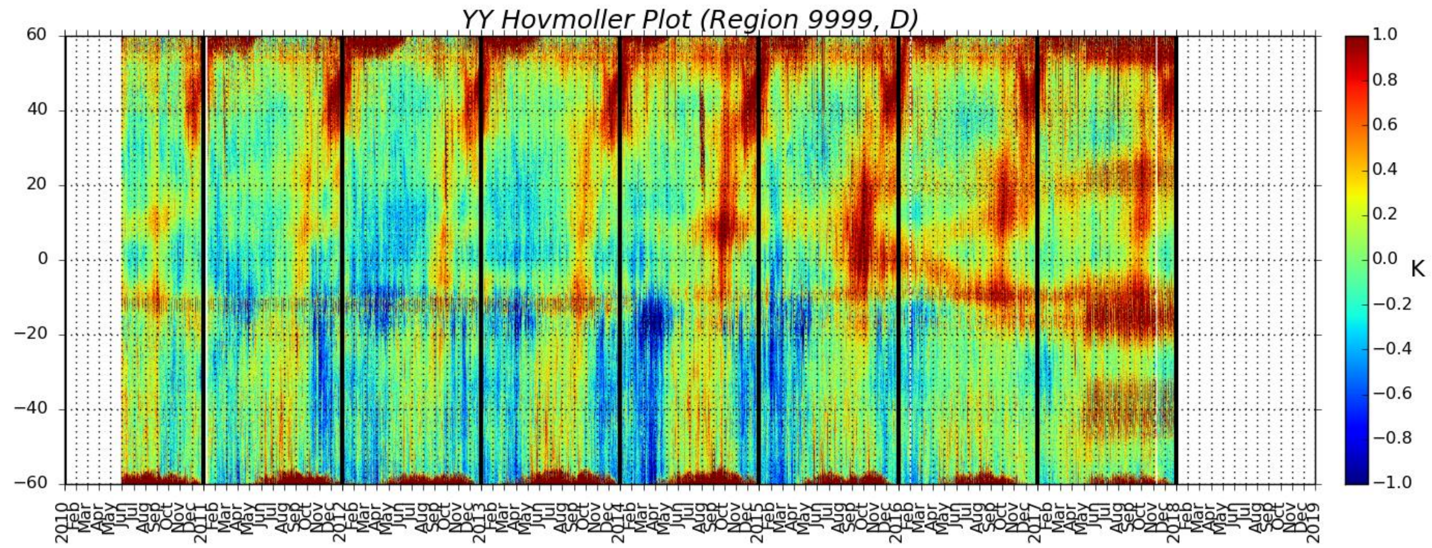


Figure 43: BT stability over the ocean, for YY polarization and Descending passes.

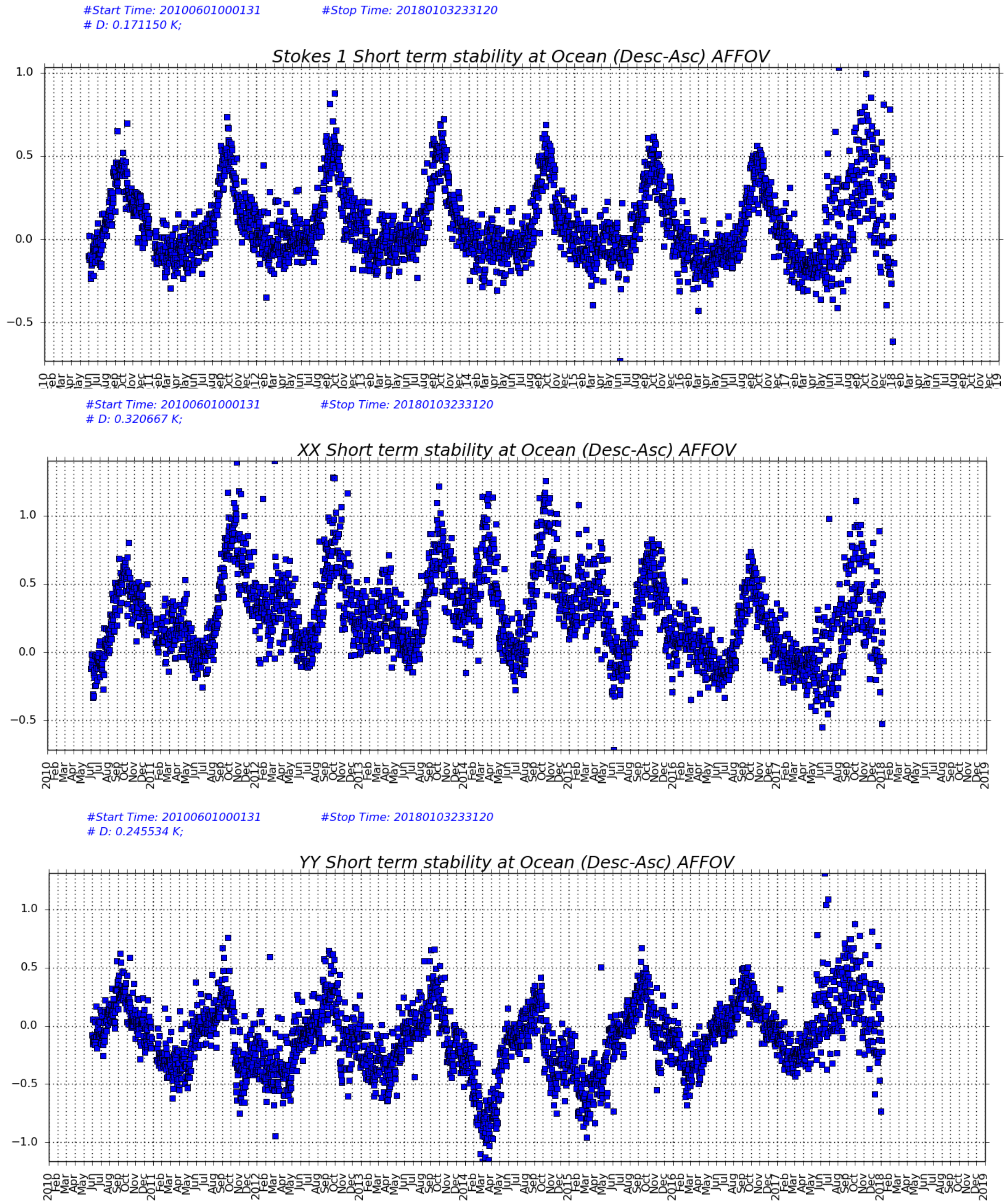


Figure 44: BT short-term stability trends (ASC-DES) for Stokes 1, XX and YY polarizations

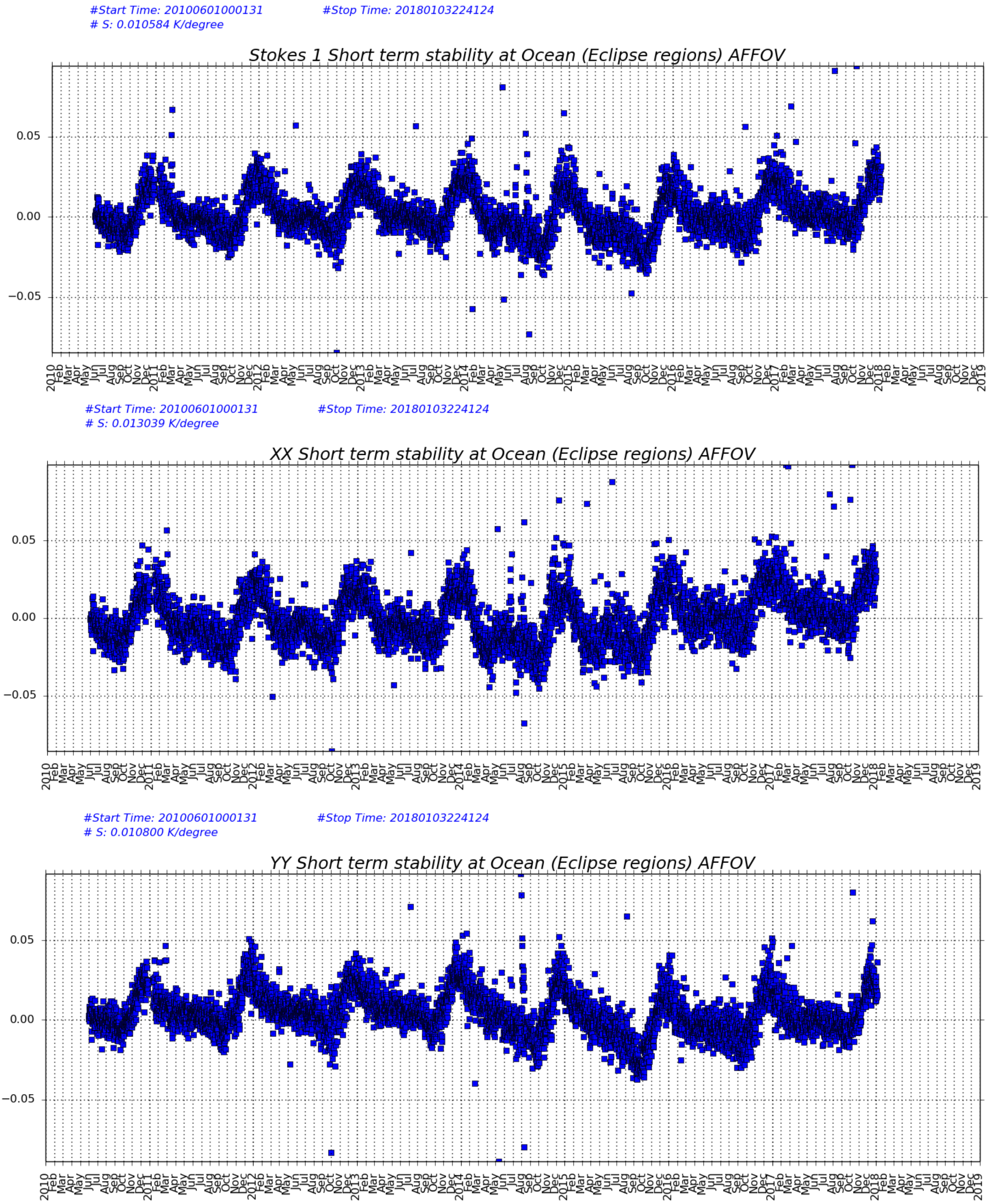


Figure 45: BT short term stability at Eclipse regions, for Stokes 1, XX and YY polarizations

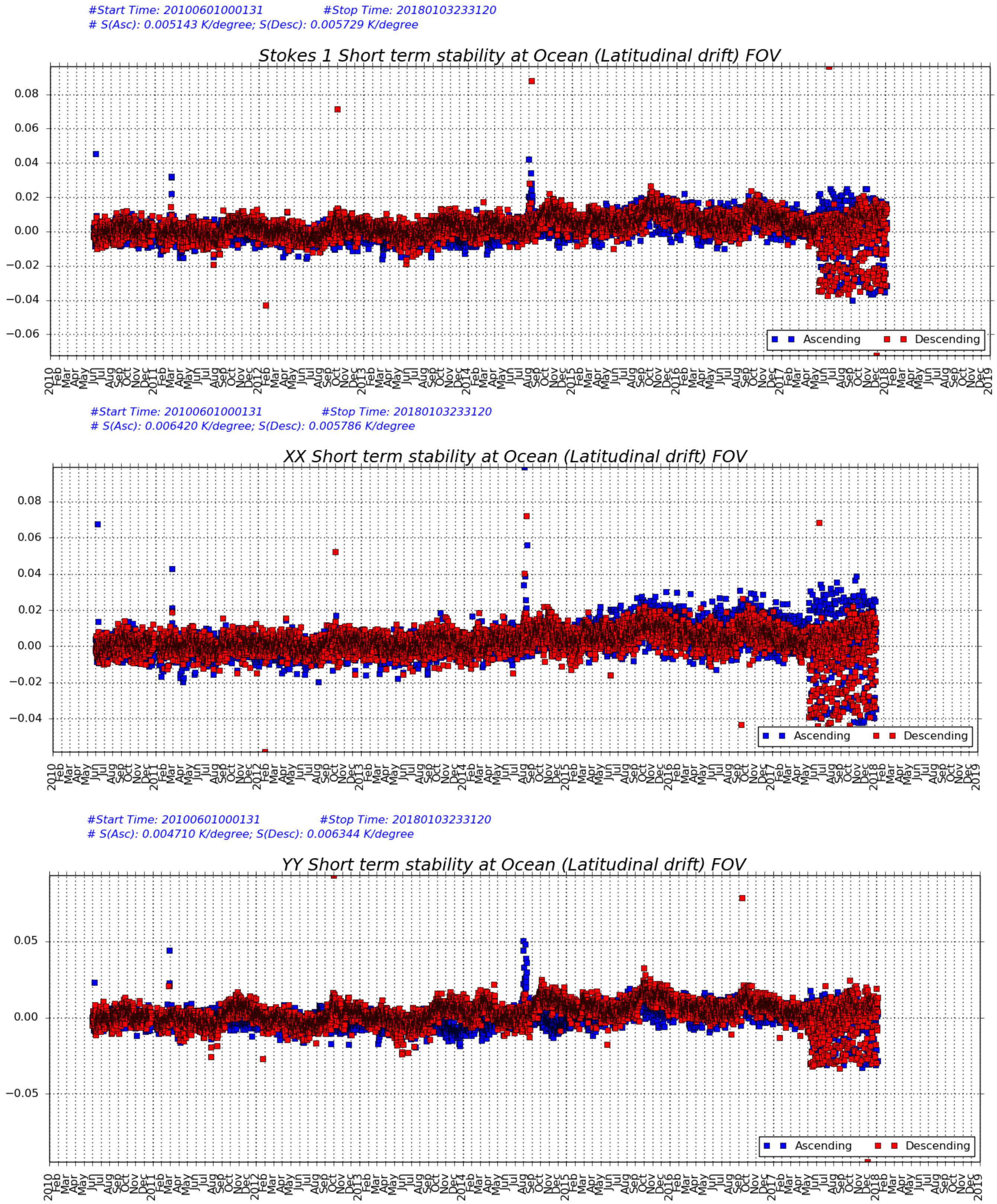


Figure 46: BT short term stability (Latitudinal drift) for Stokes 1, XX and YY polarizations.

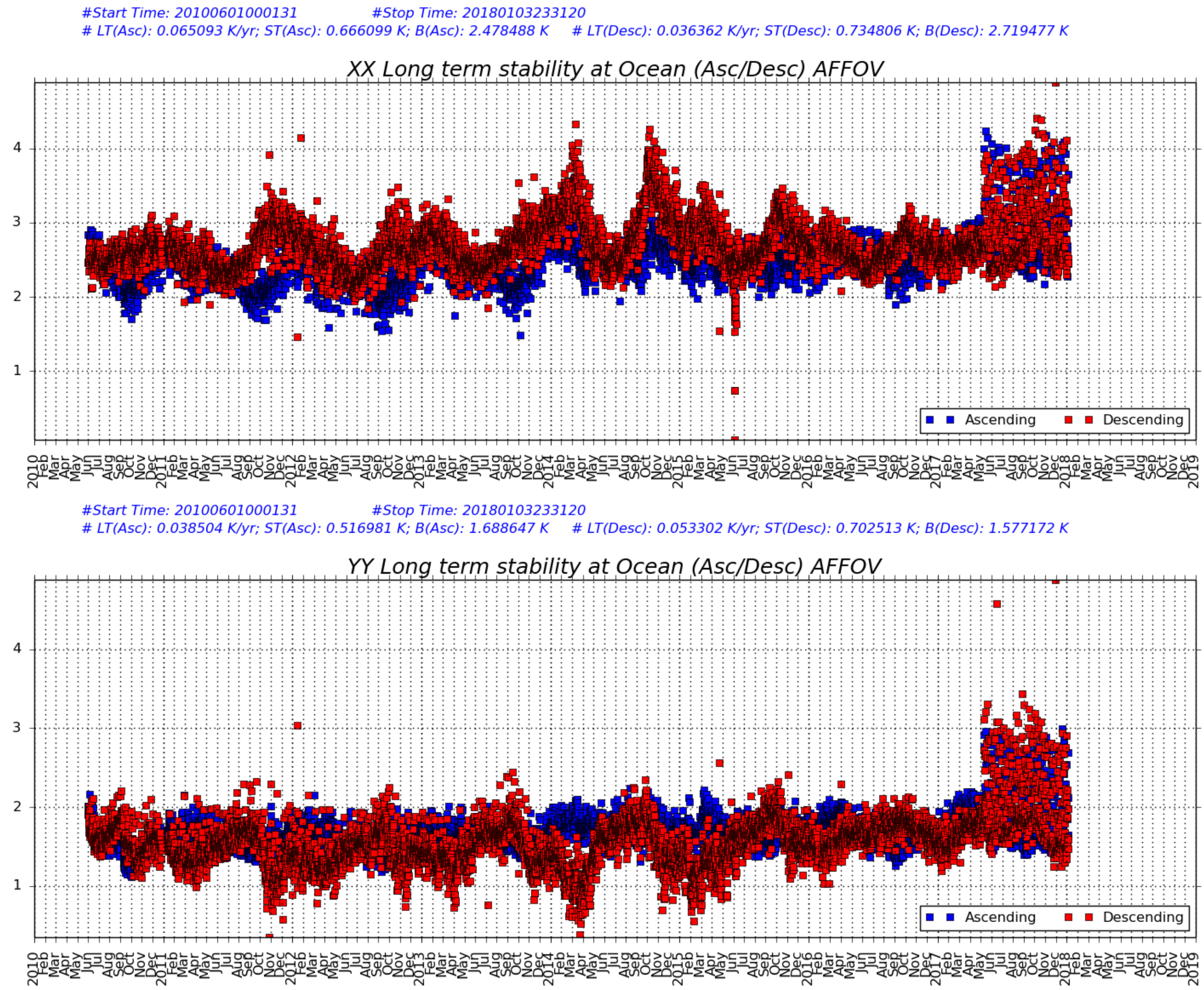


Figure 47: BT long term stability (ASC/DES), for XX and YY polarizations.

5.4 L2OS Ocean Target Transformation (OTT) Orchestration Analysis

The OTT correction is used by the L2OS processor for sea surface salinity retrieval. The correction is computed roughly on a daily basis by accumulating previous SMOS L1C measurements. The proper usage of the OTT correction is monitored and results are present in Figure-44 since June 2010. Figure-44 shows the OTT delay defined as the delta time between the L2OS science product sensing time and the OTT correction validity time and averaged over 1 day period. As the validity time of the OTT correction depends on the dataset used to compute the correction, this OTT delay represents a quality indicator for the selection of the best OTT correction (i.e. the better correction is achieved by using an OTT with validity time closer to the L2OS sensing time).

Nominal OTT delay interval goes from 4 to 8 days of delay. The most of the OTT delays fall in the middle of such values, 5-6 days. OTT delays outside the nominal interval reveals anomalies either in the data selection policy or problems in accumulating L1C dataset (i.e. data rejection due to bad quality or presence of RFI).

For the current SMOS L2OS v662 dataset, the next anomaly periods affecting the OTT delay (i.e. delay above 8 days) have been found:

1) From 21/12/2010 to 08/01/2011: Electrical Stability Test and Temperature Reading anomalies with consequent unavailability of L1C data and increased OTT delay

2) From 01/04/2014 to 08/04/2014 OTT delays above 8 days due to L1C rejected data for OTT correction. Data rejection was due to corrupted L1C measurement affected by RFI.

A detailed list of OTT delays is available in the L2OS Quality Control reprocessing report accessible here.

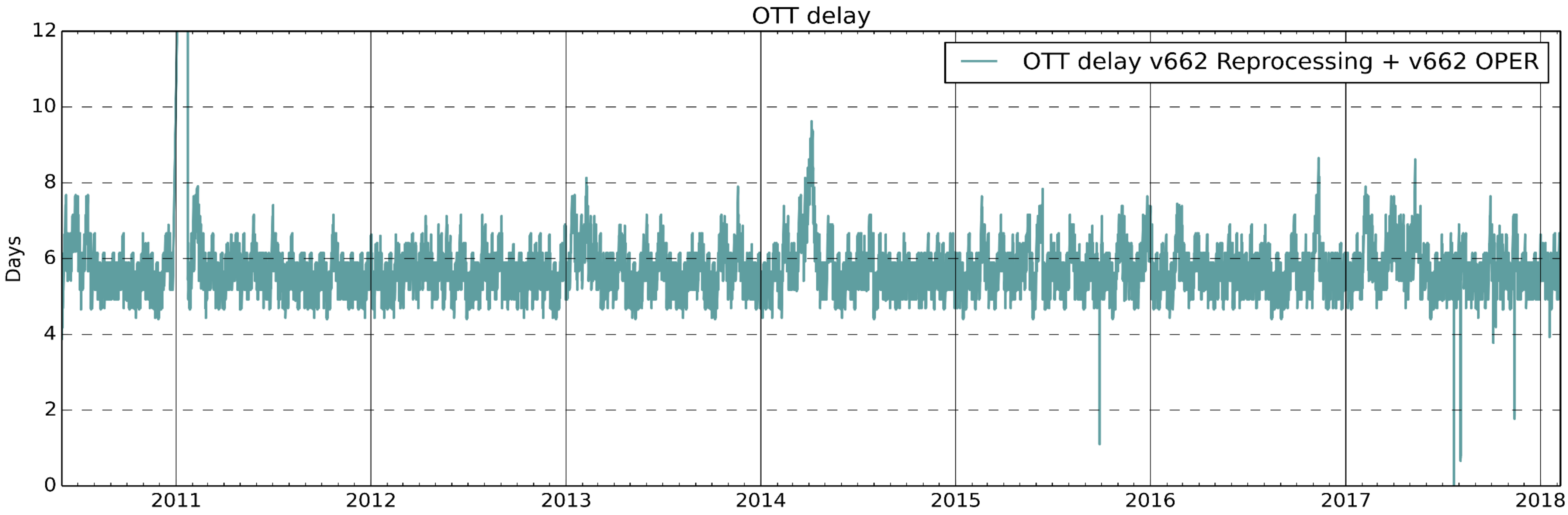


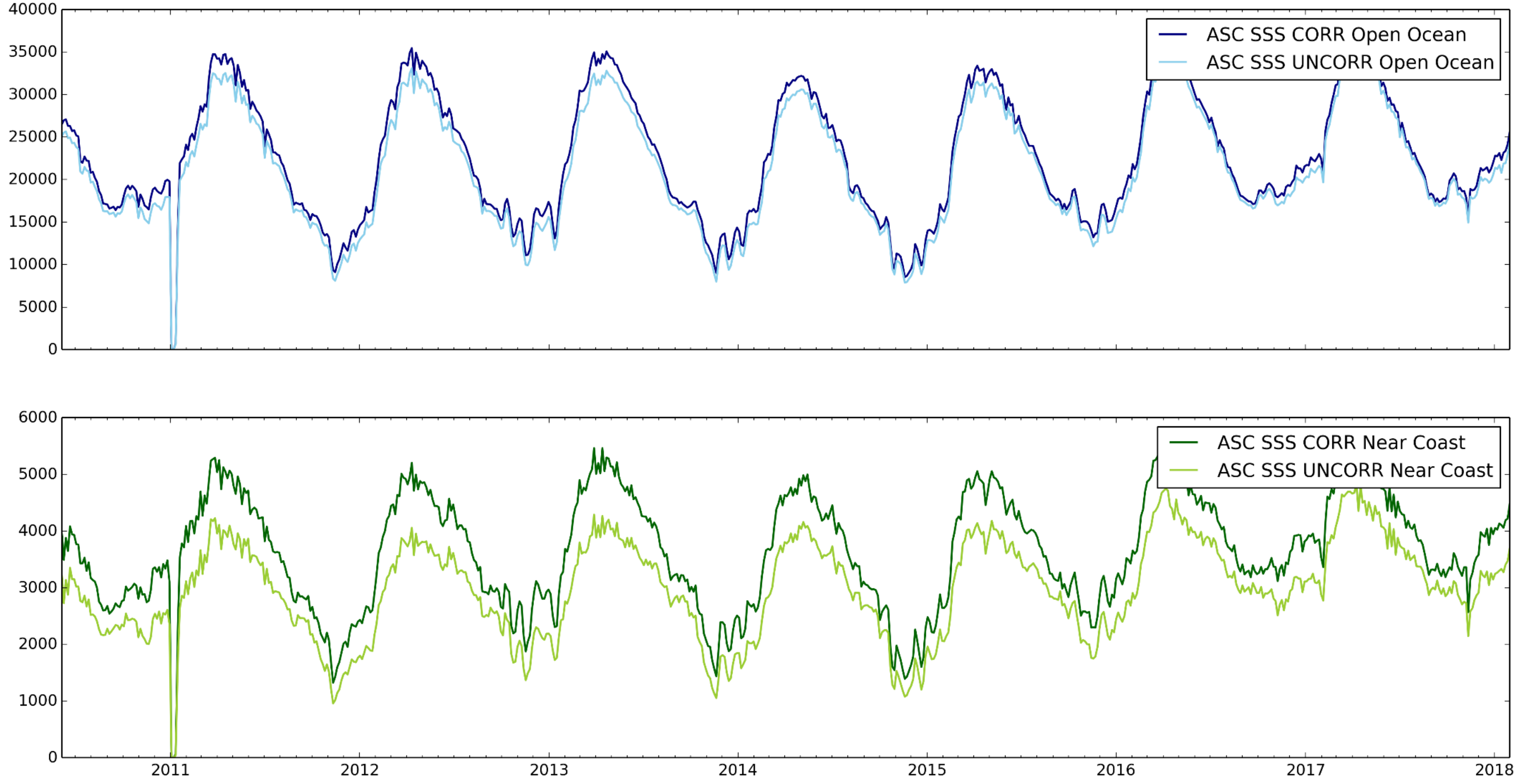
Figure 48: OTT delay per semi-orbit (Delta time between each L2OS product start time and the OTT correction validity start time file).

5.5 L2OS Retrievals assessment

Analysis on the overall quality of the L2OS dataset is based on the evolution of the number of 'good quality' retrievals as shown in Figure-45 (ascending orbits) and in Figure-46 (descending orbits).

These 'Good Quality' retrievals are taken into account for two different areas: Open Ocean (more than 800km away from coastline) and Near Coast (within 800 km from the coastline).

Also, retrievals have been computed for the land-sea contamination corrected and uncorrected Sea Surface Salinity (SSS_corr, SSS_uncorr) and averaged on a daily basis, providing an estimation of the average number of retrievals per product. The average number of good quality retrievals is around 25k in open ocean and 4k near coast, as expected by the ESL. The seasonal variation is more evident in near coast than in open ocean.



Number of successful salinity retrievals per retrieval case (Open Ocean and Near Coast). Computed as 4-day per product average.

Figure 49: ASC Open Ocean and Near Coast L2OS Good Quality Retrievals

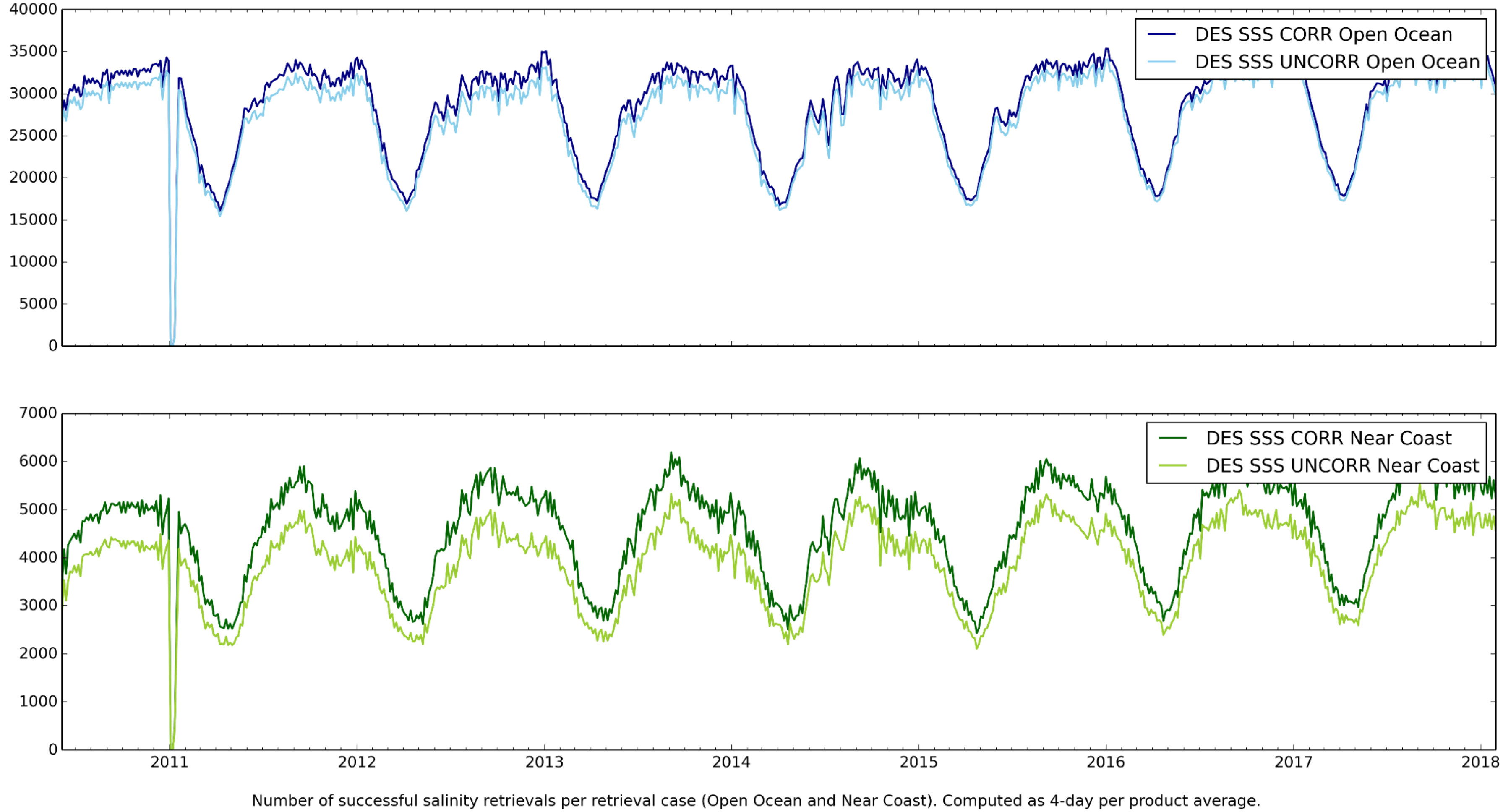


Figure 50: DES Open Ocean and Near Coast L2OS Good Quality Retrievals

5.6 L2SM Retrievals assessment

Analysis on the overall quality of the L2SM v650 dataset is based in the number of successful retrievals annotated in the SMUDP2 header file.

Such parameter is extracted for each retrieval branch. For some of the retrieval branches (i.e. Soil and Forest cover) this means a successful Soil Moisture retrieval. For the rest of branches, however, the parameter retrieved could be surface dielectric constant, optical depth, surface roughness or surface temperature. Please, refer to L2SM processor product specification for more details at this respect.

The metric is aggregated every 4 days in order to remove rapid variations originated due to geophysical changes in the surface. Also, it is provided as an average value per product, both in absolute value and in percentage with respect the total retrievals per branch. The metric is computed separately between ASC and DES semi-orbits, as the time of the overpass is different (ascending pass equator crossing at 06.00UTC a.m , descending pass equator crossing at 06.00UTC p.m.) .

An increase on the number of retrievals for the 3 first years of operations is apparent. The origin of this is the reduction of RFI sources as a consequence of reporting the RFI case to the Spectrum Management Authorities since launch. In addition, V650 shows a higher number of retrievals with respect to v620. This is expected due to the change in the land cover auxiliary information especially relevant for Forest cover, but it is also apparent for other retrieval branches (e.g. Soil).

The relative total number of successfully retrievals presents some seasonal behaviour specially for descending semi-orbits. For some of the parameters (i.e. Forest, Snow) this bearing is especially clear for both ascending and descending, and may be related with surface changes across the seasons.

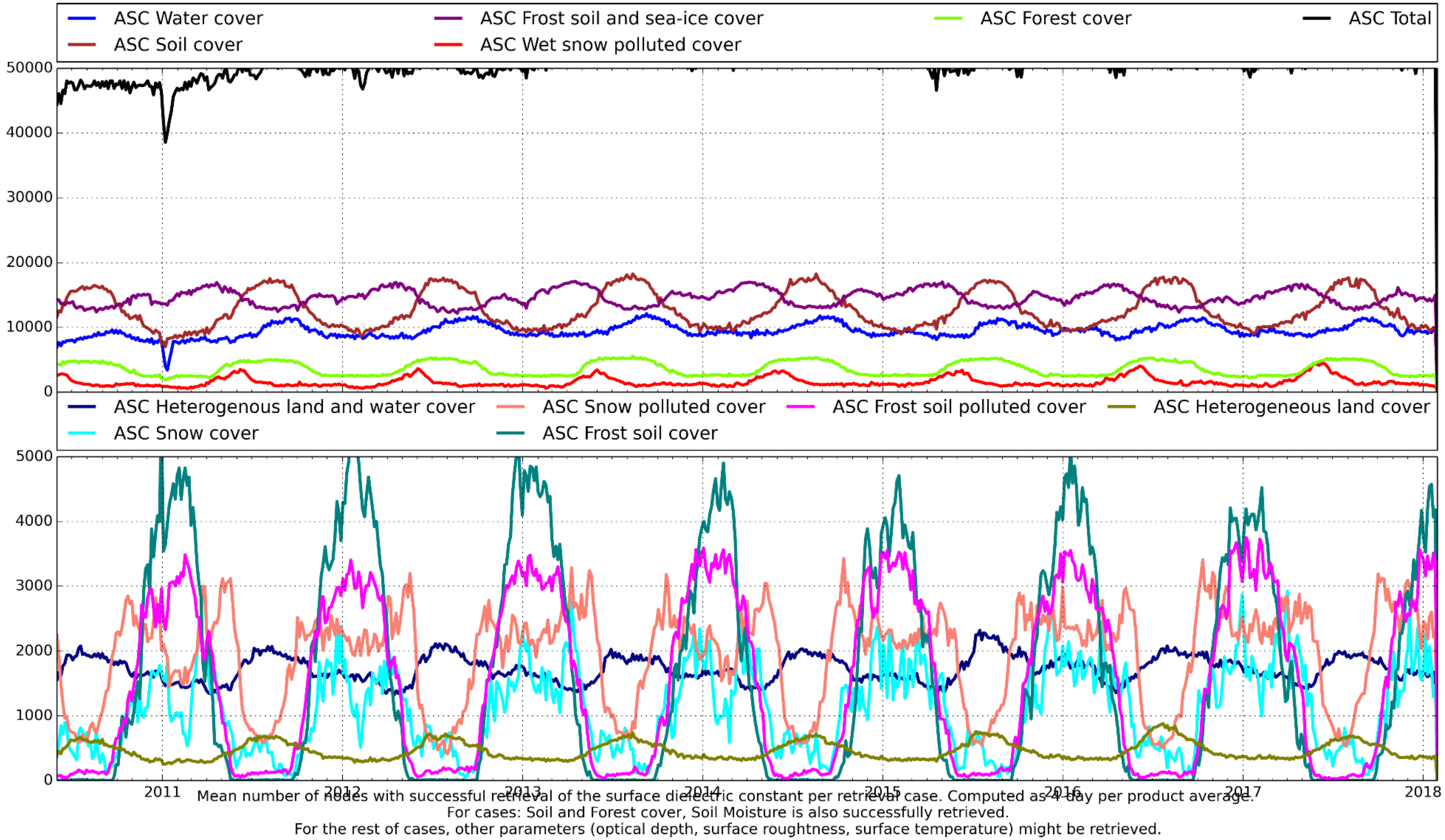


Figure 51: L2SM v650 Mean Retrievals Absolute - ASC

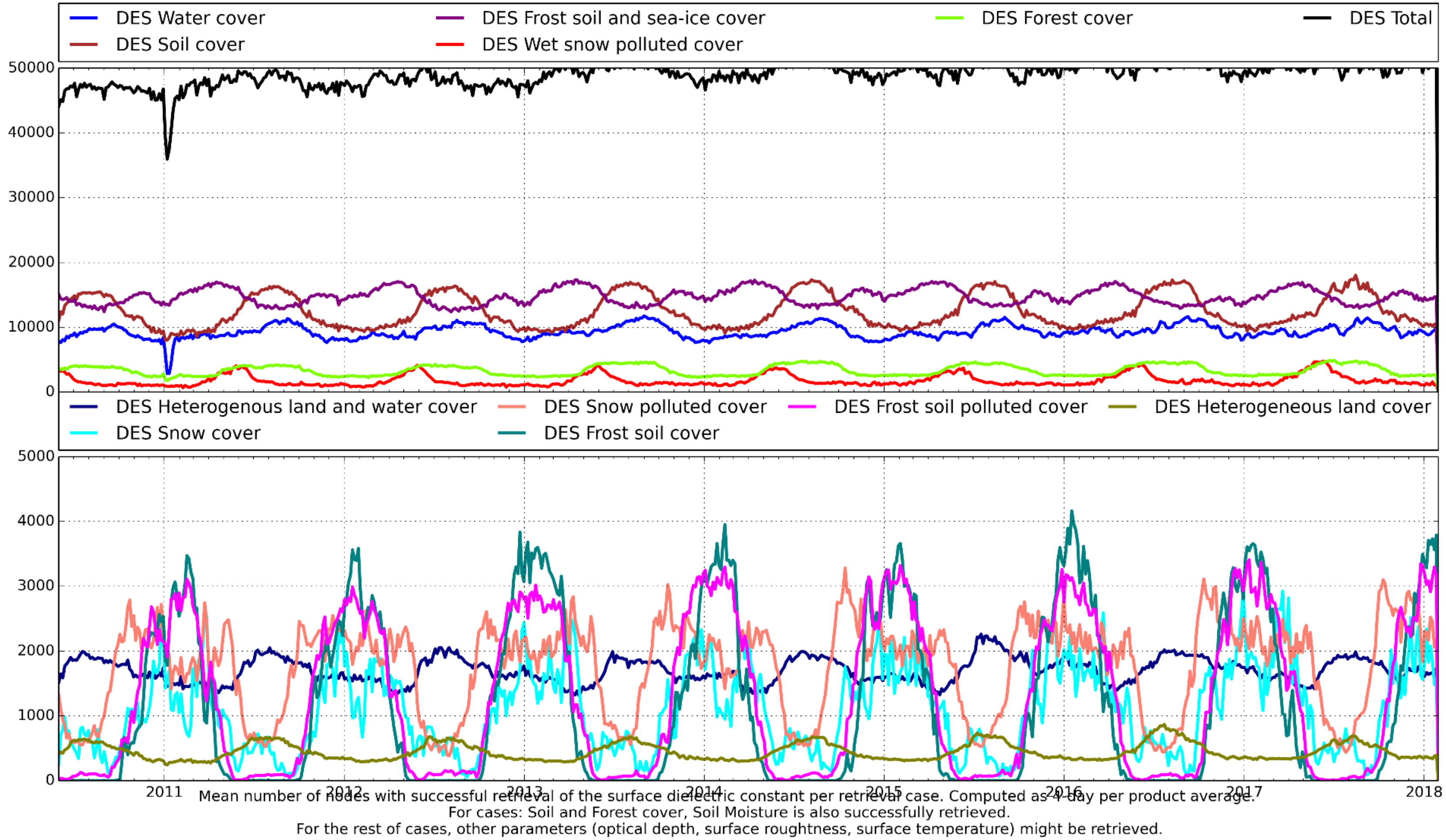
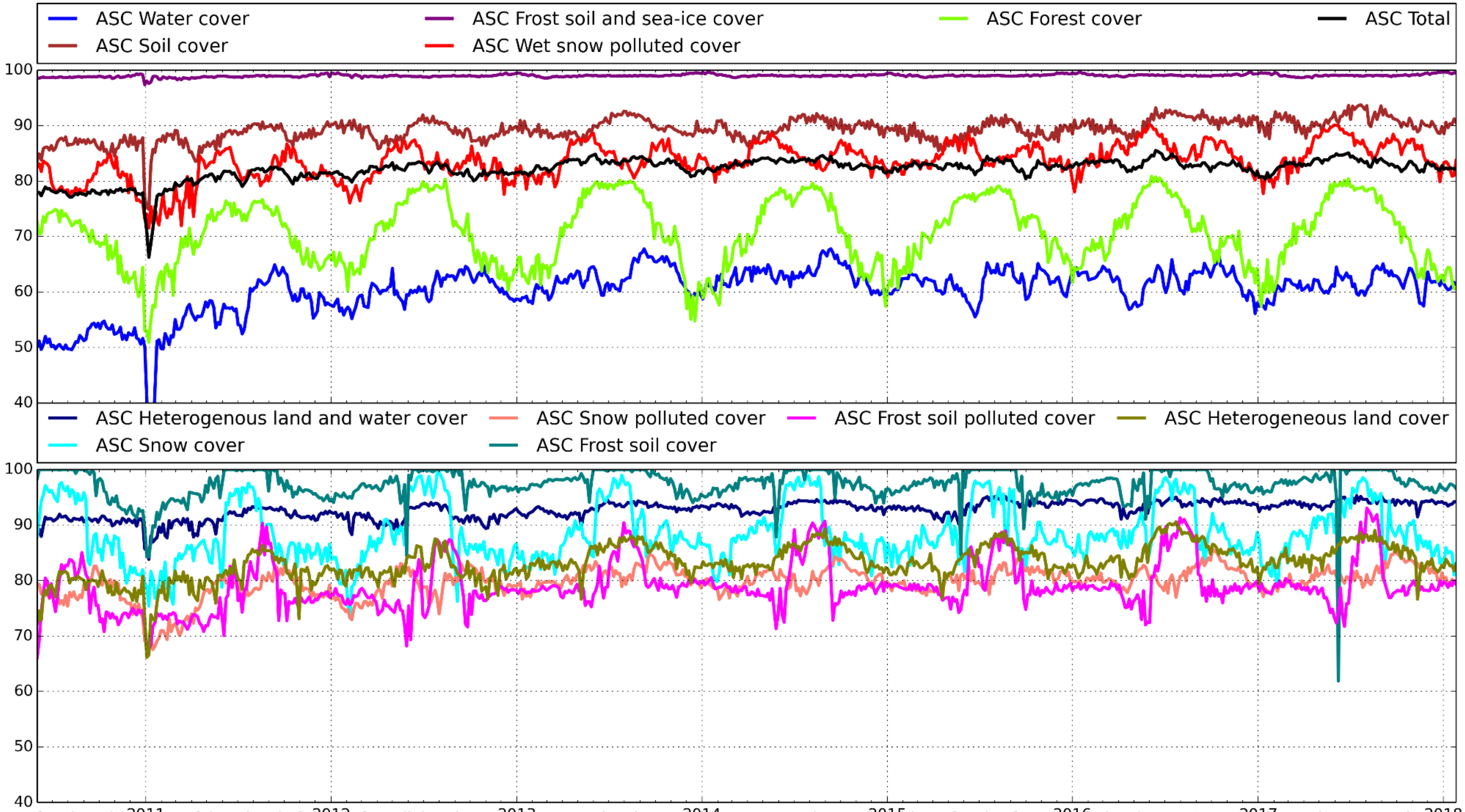


Figure 52: L2SM v650 Mean Retrievals Absolute - DES



% number of nodes with successful retrieval of the surface dielectric constant per retrieval case, with respect to the total number of nodes for such retrieval case. Computed as 4-day per product average.
For cases: Soil and Forest cover, Soil Moisture is also successfully retrieved.
For the rest of cases, other parameters (optical depth, surface roughtness, surface temperature) might be retrieved.

Figure 53: L2SM v650 Mean Retrievals Relative - ASC

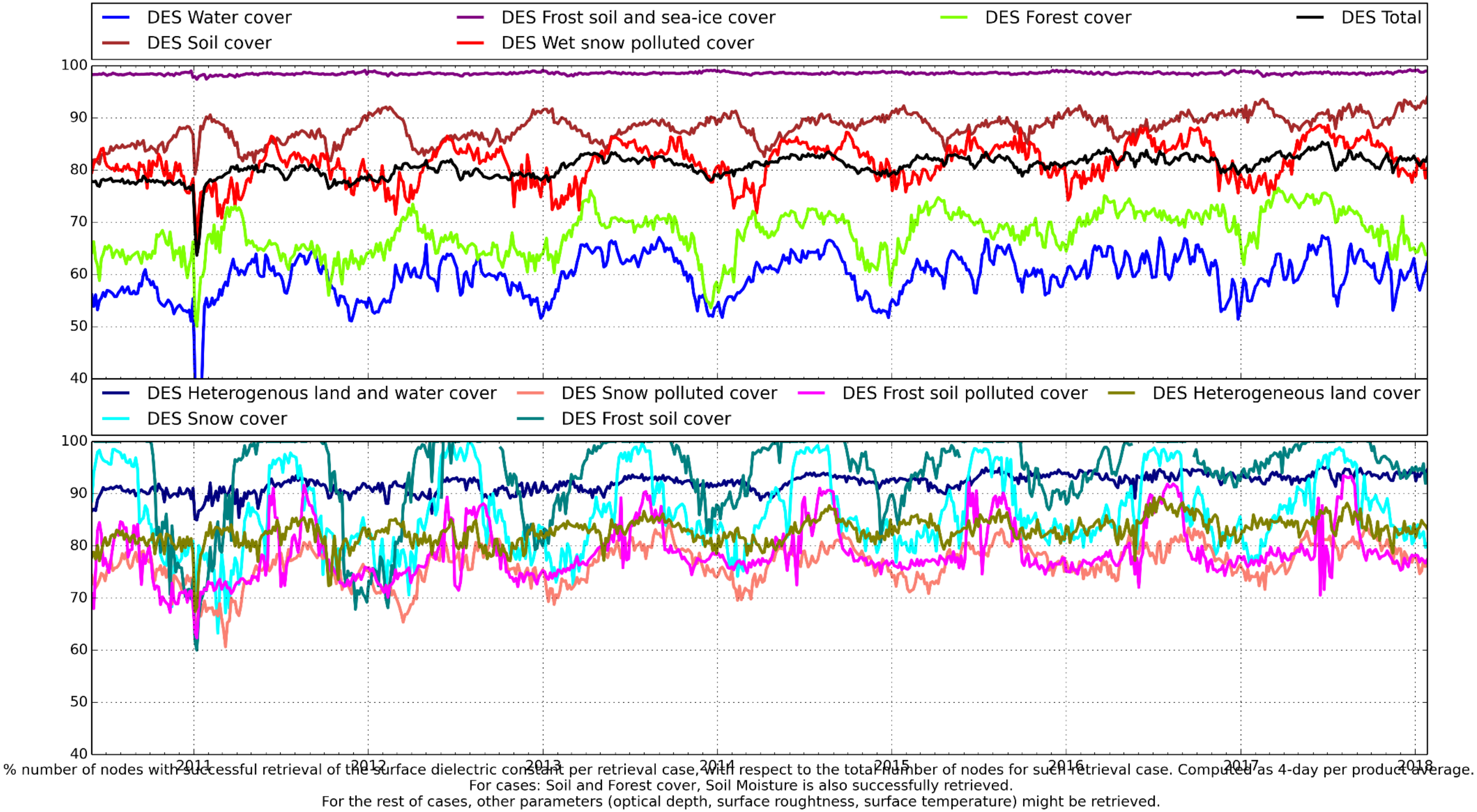


Figure 54: L2SM v650 Mean Retrievals Relative - DES

6. PRODUCT QUALITY ANALYSIS

Level 1 data quality for January has found to be nominal except in the time intervals listed in the section 4.5. Weekly maps for ascending and descending passes for the Stokes 1, Stokes 3 and Stokes 4 in videos format can be found at:

https://earth.esa.int/web/guest/missions/esa-operational-eo-missions/smos/content/-/asset_publisher/t5Py/content/data-quality-7059

All the artificial patterns in the maps can be explained by the presence of RFIs.

Level 2 Soil Moisture data quality for January has found to be nominal. Weekly maps for ascending and descending passes for the soil moisture in videos format can be found at:

https://earth.esa.int/web/guest/missions/esa-operational-eo-missions/smos/content/-/asset_publisher/t5Py/content/data-quality-7059

Level 2 Sea Surface Salinity data quality is nominal in the reporting period. Weekly maps for ascending and descending passes for good retrieved sea surface salinity in videos format can be found at:

https://earth.esa.int/web/guest/missions/esa-operational-eo-missions/smos/content/-/asset_publisher/t5Py/content/data-quality-7059

The lack of good retrieval at descending passes during the boreal winter season is less evident for winter season 2015/2016, 2016/2017 and 2017/2018, This fact points out that thermal effect on the instrument due to eclipse is only one contributor and others sources (e.g. L-band Sun signal direct or reflected) impacting the number of good retrieval are under investigation by the calibration team and level 2 expert support laboratory.

For more details on soil moisture and sea surface salinity retrieval algorithms and caveats in data usage see the level 2 Algorithm Theoretical Baseline Documents and the read-me-first note available here:

https://earth.esa.int/web/guest/missions/esa-operational-eo-missions/smos/content/-/asset_publisher/t5Py/content/data-processors-7632

7. ADF CONFIGURATION AT THE END OF THE REPORTING PERIOD

ADF File Type	Operational ADF Version (DPGS Baseline)	Updated
AUX_APDL__	SM_OPER_AUX_APDL___20050101T000000_20500101T000000_300_004_3.EEF	No
AUX_APDNRT	SM_OPER_AUX_APDNRT_20050101T000000_20500101T000000_208_001_6.EEF	No
AUX_APDS__	SM_OPER_AUX_APDS___20050101T000000_20500101T000000_300_004_3.EEF	No
AUX_ATMOS_	SM_OPER_AUX_ATMOS__20050101T000000_20500101T000000_001_010_3.EEF	No
AUX_BFP___	SM_OPER_AUX_BFP____20050101T000000_20500101T000000_340_004_3.EEF	No
AUX_BNDLST	SM_OPER_AUX_BNDLST_20050101T000000_20160308T000000_303_004_3 SM_OPER_AUX_BNDLST_20160308T000000_20500101T000000_303_004_3	No
AUX_BSCAT_	SM_OPER_AUX_BSCAT__20050101T000000_20500101T000000_300_003_3	No
AUX_BULL_B	**SM_OPER_AUX_BULL_B_20171102T000000_20500101T000000_120_001_3**	**Yes**
AUX_BWGHT_	SM_OPER_AUX_BWGHT__20050101T000000_20500101T000000_340_006_3.EEF	No
AUX_CNFFAR	SM_OPER_AUX_CNFFAR_20050101T000000_20500101T000000_100_002_3.EEF	No
AUX_CNFL0P	SM_OPER_AUX_CNFL0P_20050101T000000_20500101T000000_001_005_3.EEF	No
AUX_CNFL1P	SM_OPER_AUX_CNFL1P_20110206T010100_20500101T000000_620_054_3.EEF	No
AUX_CNFNRT	SM_OPER_AUX_CNFNRT_20050101T000000_20500101T000000_620_012_3.EEF	No
AUX_CNFOSD	SM_OPER_AUX_CNFOSD_20050101T000000_20500101T000000_001_027_3.EEF	No
AUX_CNFOSF	SM_OPER_AUX_CNFOSF_20050101T000000_20500101T000000_001_030_3.EEF	No
AUX_CNFSMD	SM_OPER_AUX_CNFSMD_20050101T000000_20500101T000000_001_016_3.EEF	No
AUX_CNFSMF	SM_OPER_AUX_CNFSMF_20050101T000000_20500101T000000_001_016_3.EEF	No
AUX_DFFFRA	SM_OPER_AUX_DFFFRA_20050101T000000_20500101T000000_001_006_3	No
AUX_DFFLMX	SM_OPER_AUX_DFFLMX_20050101T000000_20500101T000000_001_006_3	No
AUX_DFFSOI	SM_OPER_AUX_DFFSOI_20050101T000000_20500101T000000_001_002_3	No
AUX_DFFXYZ	SM_OPER_AUX_DFFXYZ_20050101T000000_20500101T000000_001_003_3	No
AUX_DGG___	SM_OPER_AUX_DGG____20050101T000000_20500101T000000_300_003_3	No
AUX_DGGXYZ	SM_OPER_AUX_DGGXYZ_20050101T000000_20500101T000000_001_004_3	No
AUX_DISTAN	SM_OPER_AUX_DISTAN_20050101T000000_20500101T000000_001_011_3	No
AUX_DTBCUR	SM_OPER_AUX_DTBCUR__20120504T203936_20500101T000000_624_001_1 Initialization file for the deployment of the L2OS V62x processor.	No
AUX_ECOLAI	SM_OPER_AUX_ECOLAI_20050101T000000_20500101T000000_305_006_3	No
AUX_ECMCDF	SM_OPER_AUX_ECMCDF_20101109T000000_20500101T000000_001_003_3.EEF SM_OPER_AUX_ECMCDF_20050101T000000_20101109T000000_001_003_3	No
AUX_FAIL__	SM_OPER_AUX_FAIL___20050101T000000_20500101T000000_300_004_3.EEF	No
AUX_FLTSEA	SM_OPER_AUX_FLTSEA_20050101T000000_20500101T000000_001_010_3.EEF	No
AUX_FOAM__	SM_OPER_AUX_FOAM___20050101T000000_20500101T000000_001_011_3	No
AUX_GAL_OS	SM_OPER_AUX_GAL_OS_20050101T000000_20500101T000000_001_011_3	No
AUX_GAL_SM	SM_OPER_AUX_GAL_SM_20050101T000000_20500101T000000_001_003_3	No
AUX_GAL2OS	SM_OPER_AUX_GAL2OS_20050101T000000_20500101T000000_001_016_3	No
AUX_GALAXY	SM_OPER_AUX_GALAXY_20050101T000000_20500101T000000_300_004_3	No
AUX_GALNIR	SM_OPER_AUX_GALNIR_20050101T000000_20500101T000000_300_003_3	No
AUX_LANDCL	SM_OPER_AUX_LANDCL_20050101T000000_20500101T000000_001_005_3.EEF	No
AUX_LCF___	SM_OPER_AUX_LCF____20050101T000000_20500101T000000_500_016_3.EEF	No
AUX_LSMASK	SM_OPER_AUX_LSMASK_20050101T000000_20500101T000000_300_003_3	No
AUX_MASK__	SM_OPER_AUX_MASK___20050101T000000_20500101T000000_300_002_3	No
AUX_MISP__	SM_OPER_AUX_MISP___20050101T000000_20500101T000000_300_004_3.EEF	No
AUX_MN_WEF	SM_OPER_AUX_MN_WEF_20050101T000000_20500101T000000_001_002_3	No
AUX_MOONT_	SM_OPER_AUX_MOONT__20050101T000000_20500101T000000_300_002_3	No
AUX_MSOTT_	SM_OPER_AUX_MSOTT__20050101T000000_20500101T000000_001_001_3	No
AUX_N256__	SM_OPER_AUX_N256___20050101T000000_20500101T000000_504_002_3	No

AUX_NIR___	SM_OPER_AUX_NIR____20050101T000000_20500101T000000_500_010_3.EEF	No
AUX_NRTMSK	SM_OPER_AUX_NRTMSK_20050101T000000_20500101T000000_207_001_6	No
AUX_OTT1D_	SM_OPER_AUX_OTT1D__20120504T203936_20500101T000000_624_001_1 Initialization file for the deployment of the L2OS V662 processor. Since level 2 OS processor V62x the new file is generated on routine basis by the level 2 post processor	No
AUX_OTT1F_	SM_OPER_AUX_OTT1F__20170502T085844_20500101T000000_625_001_1 Initialization file for the deployment of the L2OS V662 processor. Since level 2 OS processor V62x the new file is generated on routine basis by the level 2 post processor	No
AUX_OTT2D_	SM_OPER_AUX_OTT2D__20120504T203936_20500101T000000_624_001_1 Initialization file for the deployment of the L2OS V662 processor. Since level 2 OS processor V62x the new file is generated on routine basis by the level 2 post processor	No
AUX_OTT2F_	SM_OPER_AUX_OTT2F__20170502T085844_20500101T000000_625_001_1 Initialization file for the deployment of the L2OS V662 processor. Since level 2 OS processor V62x the new file is generated on routine basis by the level 2 post processor	No
AUX_OTT3D_	SM_OPER_AUX_OTT3D__20120504T203936_20500101T000000_624_001_1 Initialization file for the deployment of the L2OS V662 processor. Since level 2 OS processor V62x the new file is generated on routine basis by the level 2 post processor	No
AUX_OTT3F_	SM_OPER_AUX_OTT3F__20170502T085844_20500101T000000_625_001_1 Initialization file for the deployment of the L2OS V662 processor. Since level 2 OS processor V62x the new file is generated on routine basis by the level 2 post processor	No
AUX_PATT__	SM_OPER_AUX_PATT___20050101T000000_20500101T000000_320_003_3	No
AUX_PLM___	SM_OPER_AUX_PLM____20050101T000000_20500101T000000_600_008_3.EEF	No
AUX_PMS___	SM_OPER_AUX_PMS____20050101T000000_20500101T000000_600_011_3.EEF	No
AUX_RFI___	SM_OPER_AUX_RFI____20050101T000000_20500101T000000_300_003_3	No
AUX_RFILST	Since level 1 processor version V62x the file is generated by CATDS on monthly basis	No
AUX_RGHNS1	SM_OPER_AUX_RGHNS1_20050101T000000_20500101T000000_001_016_3	No
AUX_RGHNS2	SM_OPER_AUX_RGHNS2_20050101T000000_20500101T000000_001_013_3	No
AUX_RGHNS3	SM_OPER_AUX_RGHNS3_20050101T000000_20500101T000000_001_016_3.EEF	No
AUX_SGLINT	SM_OPER_AUX_SGLINT_20050101T000000_20500101T000000_001_012_3	No
AUX_SOIL_P	File discontinued since level 2 SM processor V62x SM_OPER_AUX_SOIL_P_20050101T000000_20500101T000000_001_002_3	No
AUX_SPAR__	SM_OPER_AUX_SPAR___20110112T091500_20500101T000000_340_012_3.EEF SM_OPER_AUX_SPAR___20100111T120700_20110112T091500_340_011_3.EEF SM_OPER_AUX_SPAR___20050101T000000_20100111T120700_340_010_3.EEF	No
AUX_SSS___	SM_OPER_AUX_SSS____20050101T000000_20500101T000000_001_014_3	No
AUX_SUNT__	SM_OPER_AUX_SUNT___20050101T000000_20500101T000000_300_002_3	No
AUX_WEF___	SM_OPER_AUX_WEF____20050101T000000_20500101T000000_001_003_3	No
MPL_ORBSCT	SM_OPER_MPL_ORBSCT_20091102T031142_20500101T000000_410_001_1	No

APPENDIX A. CONFIGURATION DOCUMENT LIST

The list of internal documents used for the generation of this report is:

- Unavailability.xls
- Details_Calibrations.xls
- SMOS-CEC-VEG-IPF-REP-0609_v2.00_SMOS_Auxiliary_Data_File_List.pdf

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