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Title : **QA4EO – SMOS Public Monthly Report - October 2020**

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
1.0	09/11/2020	N/A	Formal 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 October 2020.

The instrument health during October 2020 was found to be nominal. There were 4 unavailabilities reported during the reporting period which translated into time intervals with data loss or degraded data. The list of unavailabilities is included in section 3.2.

The data quality during October 2020 was found to be nominal, with the exceptions listed in section 4.5. These degraded periods have been induced either by instrument anomalies or by unavailability of dynamic auxiliary files.

A new section has been added with the monitoring results of the Sea Surface Salinity (SSS) differences between SMOS Level 2 measurements and in-situ (Argo buoys) measurements. This monitoring is now regularly provided by the SMOS Pilot-Mission Exploitation Platform project (SMOS Pi-MEP).

SMOS Pi-MEP is a project funded by ESA, for more detail on the project please visit the SMOS Pilot-Mission Exploitation Platform (Pi-MEP).

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
CCU	Correlator and Control unit, instrument computer on-board
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.
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.
IFREMER	French Research Institute for Sea Exploitation (Institut Français de Recherche pour l'Exploitation de la MER)
IPF	Instrument Processor Facility

L2OS	Level 2 Ocean Salinity
L2SM	Level 2 Soil Moisture
LICEF	Lightweight Cost Effective Receivers
MIRAS	Microwave Imaging Radiometer using Aperture Synthesis
MM	Mass Memory
N/A	Not applicable
OCM	Orbit Correction Manoeuvre
Pi-MEP	SMOS Pilot-Mission Exploitation Platform project
PMS	Power Measurement System
RFI	Radio Frequency Interference
SPQC	Systematic Product Quality Control facility
SSS	Sea Surface Salinity

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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 Earth-net 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 4-7, Table 4-8 and Table 4-9 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
12/10/2020 06:18:39	12/10/2020 06:28:39	FOS-4481	No	CMN Unlock
13/10/2020 16:27:45	13/10/2020 16:37:45	FOS-4492	No	CMN Unlock
13/10/2020 16:44:27	13/10/2020 16:44:32	FOS-4490	No	Failure Detection and Isolation Recovery (FDIR) – PROTEUS GPS

Start Time (UTC)	Stop Time (UTC)	Unavailability Report Reference	Planned	Description
21/10/2020 02:01:18	21/10/2020 03:41:22	FOS-4494	Yes	Gyro Calibration Manoeuvre - PROTEUS

4. DATA SUMMARY

4.1 Reprocessing activities

The information regarding to data reprocessing activities (REPR data type) is shown in the table below.

Table 4-1 Data Summary - REPR

Data type	Sensing start	Sensing stop	Version	Comments
L1	01/10/2019	31/03/2020	V724	L1 V724 Reprocessing Catch-Up Campaign began on May 22nd, 2020 and finished on May 29th, 2020.
L1	01/01/2010	31/09/2019	V724	L1 V724 Reprocessing Campaign began on January 2nd, 2020 finished on February 12th, 2020. Reprocessing of pending products finished on February 19th, 2020 concluding this reprocessing activity.
L2SM	01/06/2010	16/11/2017	V650	Reprocessing finished the 9th of September 2017 and catch-up reprocessing finished the 15th of November 2017. The reprocessed dataset has been delivered to the user on the 20th 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.
L2 OS	01/06/2010	09/05/2017	V662	Reprocessing 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. 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.

Data type	Sensing start	Sensing stop	Version	Comments
L1	12/01/2010	05/05/2015	V62x	The second SMOS mission reprocessing for L1 v62x finished the 25th June 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:

4.2 Operational activities

The information regarding to the data regeneration activities (OPER data type) is shown in the table below:

Table 4-2 Data Summary - OPER

Reporting period			
Data type	**Sensing start**	**Sensing stop**	**Comments**
Previous reporting periods			
Data type	**Sensing start**	**Sensing stop**	**Comments**
MIR_CSTD1A, MIR_CORD0, TLM_MIRA0, TLM_MIRA1A	03/09/2020 04:16:17	03/09/2020 04:36:16	Local Oscillator gap from 04:16:17 to 04:36:16 due to DPGS acquisition issues. These data were successfully regenerated.
MIR_SC_F1A onwards; MIR_CSTD1A, MIR_CORD0, MIR_CSTD1A	20/08/2020 09:05:00	20/08/2020 10:31:00	Due to a database maintenance activity, a gap in science was introduced from 09:05 to 10:31. In addition, wrongful consolidation of MIR_CORD0 caused warning flags in SPQC. These data were successfully regenerated.
MIR_CSTD1A	07/07/2020 07:23:00	07/07/2020 08:43:00	MIR_CSTD1A gap between 07:23z and 08:43z due to problems in orchestration. Data was regenerated successfully on 11-AUG-2020.
L0 onwards	27/07/2020 09:13:00	27/07/2020 09:50:00	Gap in science between 09:13z and 09:50z in addition to several warnings/failures due to anomaly in receiving the Svalbard pass in the DPGS. Data was recovered and regenerated successfully.
MIR_CSTD1A, MIR_CORD0, TLM_MIRA0, TLM_MIRA1A	19/07/2020 22:10:00	19/07/2020 23:30:00	Local Oscillator gap on between 2210 and 2330 of 20200719. This originated several CSTD1A flagged as Warning due to the consolidation. Data was recovered and regenerated successfully.

MIR_CSTD1A	02/07/2020 14:03:20	02/07/2020 15:03:19	MIR_CSTD1A gap between 14:03:20z and 15:03:19z and one MIR_SCXF1C warning due to problem in orchestration. Data was regenerated successfully.
MIR_CSTD1A, MIR_CORD0, MIR_CSTD1A	04/06/2020 13:12:56	04/06/2020 14:02:55	On the 4th of July 2020 it was found that some issues in DPGS lead to some orchestration problems and gaps in calibration data between 13:12:56z and 14:02:55z were found. Data was regenerated successfully.
L1B onwards	02/04/2020 02:15:56	02/04/2020 12:21:12	Two passes had issues when being transmitted from Svalbard to ESAC, some of the packets were delivered with a delay and mixed. This has led to an initial 5 seconds gap in L1B onwards at 07:30:58z. No further degradation has been found in relation to this. Regardless, both passes were successfully reprocessed without gaps.
All	19/05/2019 12:38:11	19/05/2019 19:22:29	ESAC acquisition problem led to degraded L0 data for Telemetry, Calibration and Science. Affected dataset was regenerated with the L0 data recovered at the next pass acquired at Svalbard.
Calibration, L1A and L1C	18/04/2019 01:44:08	18/04/2019 02:48:19	One TLM_MIRA0 order failed due to 'Time Out', the order was retried the next day and TLM_MIRA1A files was successfully generated. This issue has led to degraded Calibration, L1A and L1C data in between 1:44 and 02:48z. A request for regeneration for affected period has been made.
L0 onwards	03/04/2019 06:42	03/04/2019 15:02	Data gap from 06:42z to 13:08z and data degradation (L1, Cal and L2) from 13:08z to 15:02z. This was originated by the introduction of the February AUX_BULL_B auxiliary file, which unexpectedly introduced processing errors. Ingestion was reverted, and investigations are going on to understand the root cause. It could be related to EO Libraries reading routines. As a result, the February BULL_B dissemination is on-hold. All affected data are being reprocessed with the old BULL_B to properly cover the gap.
L2	05/03/2019 06:24:46	-	Since 062846z, ECWMF products used in L2 processing were computed with an updated interpolation algorithm (PGEN). More information can be found at https://confluence.ecmwf.int/display/UDOC/New+Product+Generation+software
L0 onwards	23/02/2019 11:49	23/02/2019 11:58	There was a Svalbard acquisition problem in this period due to RFI, which led to a data gap from L0 onwards in between 11:49z and 11:58z. Data was recovered with the ESAC acquisition.
L1	01/01/2019	15/01/2019	VTEC files used for Faraday rotation have been computed with an older Solar Flux than expected due to a delay in RSGA primitives. This is due to on-going US government shutdown and a workaround was implemented on 16/01/2019
TLM_MIRA1A	26/09/2018 20:10	26/09/2018 20:46	Gap in telemetry and science between 20:10z and 20:46z. Dataset has been regenerated.

All	27/09/2018 15:07:11z	27/09/2018 17:01:24z	Degraded Data from 15:07:11z to 17:01:24z in Telemetry, Calibration and Science as side-effect of the INDRA XBAS test activities on the temporary spare converter unit. Dataset has be regenerated.
MIR_CSTD1A	22/07/2018 19:45	23/07/2018 12:19	A processing anomaly in DPGS introduced some delays in the processing of the CSTD1A files. As a consequence, some CSTD1A were wrongly consolidated. This originated a Local Oscillator gap between 1127z and 1310z. Two science semi-orbits were processed without local oscillator calibration. One OSUDP2 product failed due to lack of retrievals due to this. CSTD1A and science products have been regenerated.
L2OS and L2SM	08/06/2018	11/06/2018	L2 Production stopped (L2SM and L2OS) since 20180608T171843 (sensing time) due to a distribution anomaly of the S2D and S2P ECMWF natives. Nominal L2 production service was recovered on 12/06/2018
TLM_MIRA1A	13/04/2018 00:07	13/04/2018 02:01	On 13th April 2018, between 0007z and 0201z, three TLM_MIRA1A flagged as Warning (SPQC-L1-009,011,012,013,014,015,018) and one NRT TLM_MIRA0 flagged as Fail in SPQC (Non-consecutive OBET). DPGS commented that KSAT had reported an acquisition problem, possibly related to RFI (of a satellite). The pass has been marked invalid for the next reprocessing.
MIR_CSTD1A	18/03/2018 11:30:38	19/03/2018 04:50:38	The 17th of March 2018 one MIR_CSTD1A (SM_OPER_MIR_CSTD1A_20180317T164037_20180318T112038_621_001_1) failed in the SPQC checks, as consequence, a gap was introduced for MIR_CSTD1A files. Although the order was retried and the file was correctly generated some calibration and science data were affected by the issue. Hence, next periods were also reprocessed once the gap was successfully recovered: a) MIR_CORD0 files were reprocessed from 20180318T113038_20180318T121038 up to 20180319T041038_20180319T045038; b) SC_F0 files were reprocessed from 20180318T093947_20180318T103349 up to 20180318T111952_20180318T121353
TLM_MIRA1A, MIR_CSTD1A L1 and L2	17/01/2018 20:16:29_	17/01/2018 21:09:42	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.
TLM_MIRA1A, MIR_CSTD1A L1 and L2	08/10/2017 13:47:77 09/10/2017 06:47:20	09/10/2017 00:17:46 09/10/2017 09:21:25	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.

TLM_MIRA1A, MIR_CSTD1A L1 and L2	04/10/2017 13:12	05/10/2017 01:56	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.
L1C and L2	04/08/2017 01:17:18	04/08/2017 05:30:39	Period from 20170804T011718 to 20170804T053039 has been regenerated from level L1C to level2 due to late arrival of ionosphere information (VTEC_P auxiliary file).
TLM_MIRA0, MIR_CORD0, MIR_SC_F0, TLM_MIRA1A, MIR_CSTD1A L1 and L2	22/07/2017 08:42:40	22/07/2017 22:14:55	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.
L1 and L2	10/01/2017 10:46:25	21/01/2017 02:51:30	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).
TLM_MIRA0, MIR_CORD0, MIR_SC_F0, TLM_MIRA1A, MIR_CSTD1A L1 and L2	31/12/2016 15:46:20	02/01/2017 10:49:55	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
MIR_CSTD1A, L1 and L2	05/05/2016 17:07:15	06/05/2016 11:32:01	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.
L1 and L2	14/04/2016 17:25:33	19/04/2016 10:03:47	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.

L1 and L2	14/03/2016 09:51:07	16/03/2016 21:17:47	The data gap from 20160314T095107 to 20160316T211747 originated by the Proteus platform on-board software up-grade operations has been recovered, level 1 and level 2 sci-ence data are now available.
L1C and L2	06/12/2015 00:05:04 19/07/2015 00:54:48	06/12/2015 04:18:30 20/07/2015 02:49:08	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.
MIR_CSTD1A, L1 and L2	25/11/2015 03:32:28	27/11/2015 08:22:15	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 regener-ate level 1 and level 2 science dataset.
TLM_MIRA1A, MIR_CSTD1A, L1 and L2	15/08/2015 02:34:00	15/08/2015 21:46:26	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.
MIR_CSTD1A, L1 and L2	13/07/2015 19:49:09	14/07/2015 03:22:38	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 im-pacted 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.
L1	03/06/2015 06:43	12/06/2015 08:14	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.
L1	29/05/2015	31/05/2015	Period from 29 May 2015 to 31 May 2015 have been regen-erated since one of the DPGS processing nodes (PWF-5) in-duced 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.

4.3 Processing changes

4.3.1 Processor updates

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

4.3.2 Processor Status

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

Table 4-3 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 4-4 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

4.3.3 Schema updates

No updates for product schema in the reporting period.

4.3.4 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 4-5 Schema version status

Product type	Version
MIR_SC_F1B	400
MIR_SCSF1C	400
MIR_SCLF1C	400

Product type	Version
MIR_BWSF1C	400
MIR_BWLF1C	400
MIR_SMUDP2	400
MIR_OSUDP2	401
AUX_ECMWF_	300

The schema package v07.04.03, the XML Read/Write API libraries to read SMOS products, visualization and mapping tools for SMOS L1 and L2 products are available here

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

4.3.5 Aux file updates

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

- **AUX_BULL_B**

Note that, as reported in SPCM37, the format of the BULL_B primitive has been manually modified in order to obtain a properly formatted SMOS file. This is due to a small format change since February 2019 Bulletin B.

SM_OPER_AUX_BULL_B_20200802T000000_20200901T235959_120_001_3
Start sensing time at L1 processor: N/A

Justification: Bulletin Update including values from August 2020 and the prediction for September 2020. Its usage is intended for reprocessing.

SM_OPER_AUX_BULL_B_20200802T000000_20500101T000000_120_001_3
Start sensing time at L1 processor: 2020-10-13 08:59:47z

Justification: Bulletin Update including values from August 2020 and the prediction for September 2020. Its usage is intended for the nominal production.

- **AUX_CNFOSF**

These files below are tailored as a contingency for the increased Arm-A temperatures (LCF-A-10) events, i.e. to avoid data discarding at L2. Note that, outside of the validity time of these files, the usual AUX_CNFOSF is still applicable and used.

Dissemination date: 2020-10-28

SM_OPER_AUX_CNFOSF_20201028T000000_20201128T000000_001_030_3
SM_OPER_AUX_CNFOSF_20210118T000000_20210222T000000_001_030_3

- **AUX_DFFLAI**

DFFLAI files delivery for 2021.

Dissemination time: 2020-10-28 12:12z

SM_OPER_AUX_DFFLAI_20210101T000000_20210111T014000_600_001_3
SM_OPER_AUX_DFFLAI_20210111T000000_20210121T014000_600_001_3
SM_OPER_AUX_DFFLAI_20210121T000000_20210203T014000_600_001_3
SM_OPER_AUX_DFFLAI_20210203T000000_20210213T014000_600_001_3
SM_OPER_AUX_DFFLAI_20210213T000000_20210223T014000_600_001_3
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SM_OPER_AUX_DFFLAI_20210829T000000_20210909T014000_600_001_3
SM_OPER_AUX_DFFLAI_20210909T000000_20210919T014000_600_001_3
SM_OPER_AUX_DFFLAI_20210919T000000_20210929T014000_600_001_3
SM_OPER_AUX_DFFLAI_20210929T000000_20211008T014000_600_001_3
SM_OPER_AUX_DFFLAI_20211008T000000_20211018T014000_600_001_3
SM_OPER_AUX_DFFLAI_20211018T000000_20211028T014000_600_001_3
SM_OPER_AUX_DFFLAI_20211028T000000_20211108T014000_600_001_3
SM_OPER_AUX_DFFLAI_20211108T000000_20211118T014000_600_001_3
SM_OPER_AUX_DFFLAI_20211118T000000_20211128T014000_600_001_3
SM_OPER_AUX_DFFLAI_20211128T000000_20211207T014000_600_001_3
SM_OPER_AUX_DFFLAI_20211207T000000_20211217T014000_600_001_3
SM_OPER_AUX_DFFLAI_20211217T000000_20220101T014000_600_001_3

4.4 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 4-6 Calibration summary

Date	Start Time	Stop Time	Calibration	Comments
01/10/2020	06:48:00	06:49:44	Short	Nominal
08/10/2020	07:15:30	07:17:14	Short	Nominal
14/10/2020	16:22:06	17:44:19	Warm-NIR	Nominal
15/10/2020	14:10:00	15:03:19	Long	Nominal
15/10/2020	15:52:00	16:45:19	Long	Nominal
22/10/2020	06:30:30	06:32:14	Short	Nominal

Date	Start Time	Stop Time	Calibration	Comments
28/10/2020	15:38:59	17:01:12	Warm-NIR	Nominal
29/10/2020	05:18:00	05:19:44	Short	Nominal

4.5 Data Coverage Summary

Where instrument unavailabilities or anomalies have occurred during this reporting period, gaps in data coverage may have also occurred. A list of the gaps due to a permanent data loss is given in Table 4-7 by product level. On the other hand, a list of gaps due to operational problems is given in Table 4-8. 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 4-7 Data loss summary

Start	Finish	Data Level	Comments
13/10/2020 16:44:27	13/10/2020 16:44:32	All	PROTEUS GPS anomaly which triggered the use of the internal Proteus Clock. After recovery efforts, all returned to nominal.

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

Table 4-8 Operational gaps summary

Start	Finish	Data Level	Comments

4.6 Summary of degraded data

In October 2020, SMOS data was affected by the following instrument and processing anomalies which have had a detrimental effect on the data quality.

Table 4-9 Summary of degraded data

Start	Finish	Affected products	Problem Description
12/10/2020 06:18:39	12/10/2020 06:28:39	All	CMN Unlock
13/10/2020 16:27:45	13/10/2020 16:37:45	All	CMN Unlock
21/10/2020 02:01:18	21/10/2020 03:41:22	All	Gyro Calibration Manoeuvre - PROTEUS

4.7 Product Quality Disclaimers

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

Table 4-10 Summary of product quality disclaimers

Date	Product level	
From: 9th September 2020 To: 10th September 2020	L1 L2	Due to a delay of the primitives, VTEC file for 20200909 and 20200910 were processed later than usual. Therefore, Faraday rotation was computed with the previous available TEC file for some periods. The impact of this in quality is regarded as minor.
From: 1rst January 2020 To: 14th January 2020	L2OS	OTT files were not generated due to an out of data IGRF-12 model. The impact of this event is still under assessment regarding Sea Surface Salinity.
From: 2nd November 2018 To: 19th November 2018	CSTD1A, L1C	All CSTD1A products and some L1C products are flagged as Warning due to Instrument Error. This is related with an expected temperature increase of LCF_A_10, which sometimes falls above 27 degrees. The temperature evolution of this LICEF is being monitored
From: 14th November 2018 To: 15th November 2018	L2OS	L2OS data between 14th and 15th of November lack retrievals for some areas due to antenna temperature slightly higher than nominal.
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

Date	Product level	
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 two Warm-NIR calibration events on the 14th and 28th of October 2020.

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 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 3rd June 2015 and on 2nd August 2017 was due to a Radio Frequency Interference (RFI) that corrupted the calibration measurement.

Currently, the calibration team is monitoring an ongoing evolution for the NIR CA Tna H-Pol which began end 2019. The origin of this evolution could be either internal reference diode power evolution or inaccuracy in the antenna losses thermal compensation during calibration. With reduced magnitude the effect is also present for the NIR CA Tna V-Pol. For the time being, the derived calibration parameter are used in the data processing, nevertheless this strategy could change in the future.

5.2 Seasonal Evolution of the Calibration Parameters

The Tna and Tnr present in the previous processor baseline V5xx (see for example the monthly report for April 2015) had been largely mitigated by the new calibration algorithm, which decouples the variation of the antenna losses and the drift of the reference diode. This approach allows compensating 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 15th 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 V62x baseline. The small variation of a few Kelvins, in the observed BT are due to slightly different regions 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.

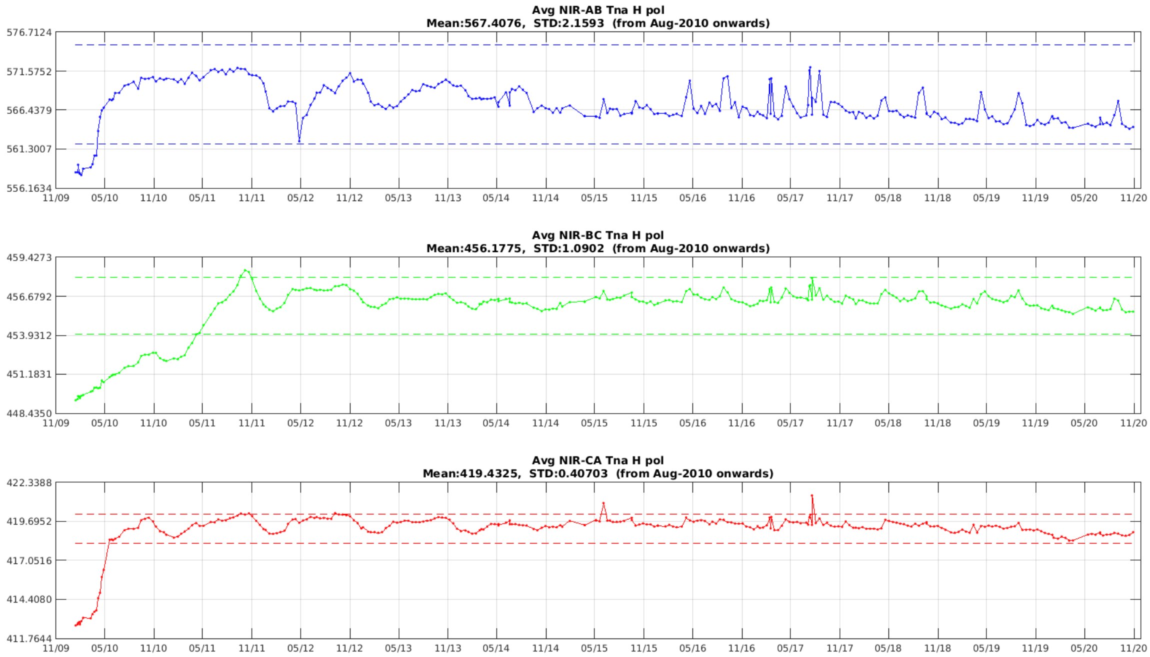


Figure 1 Tna evolution of NIR AB (blue), NIR BC (green) and NIR CA (red) in the H-channel since the beginning of the mission. Thresholds in dashed lines

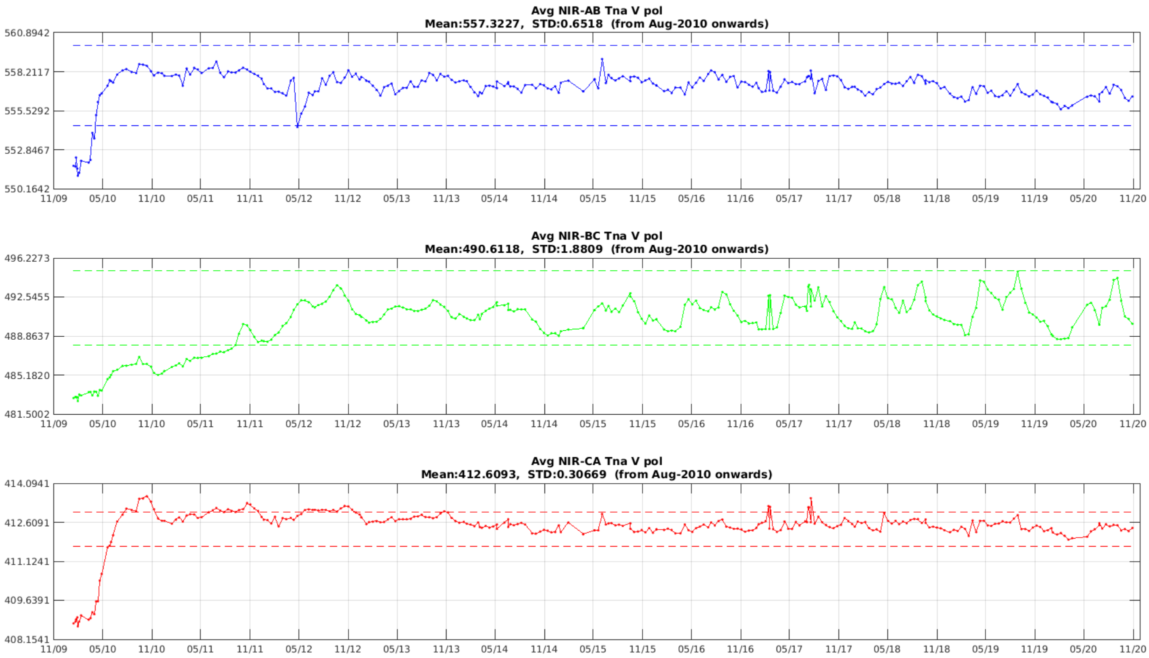


Figure 2 Tna evolution of NIR AB (blue), NIR BC (green) and NIR CA (red) in the V-channel since the beginning of the mission. Thresholds in dashed lines

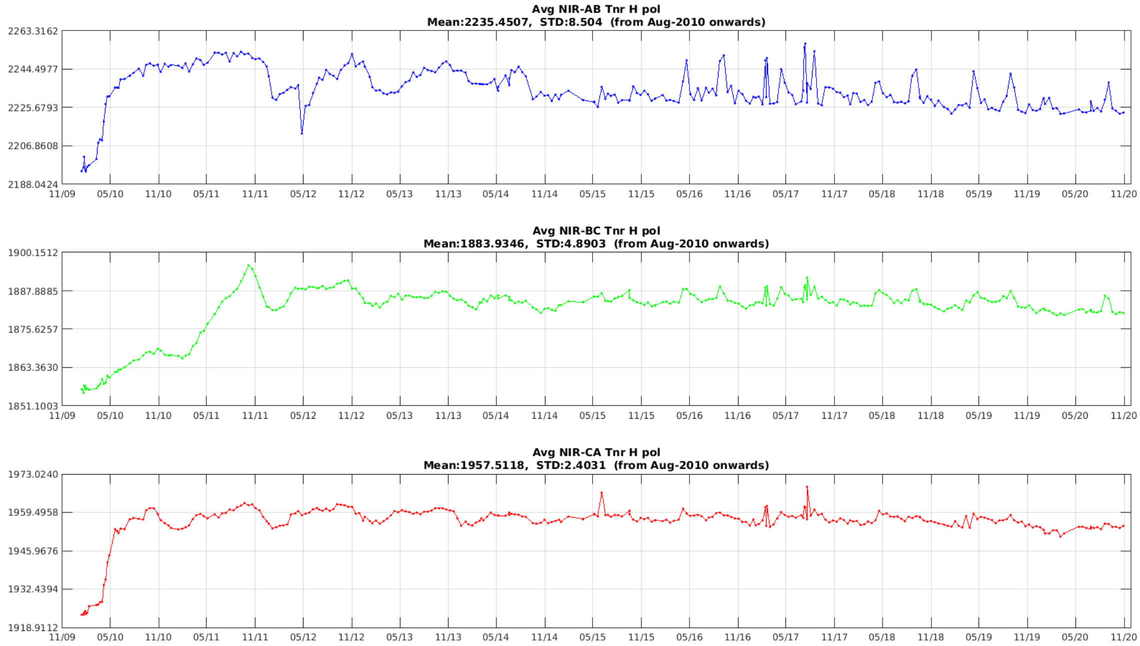


Figure 3 Tnr evolution of NIR AB (blue), NIR BC (green) and NIR CA (red) in the H-channel since the beginning of the mission.

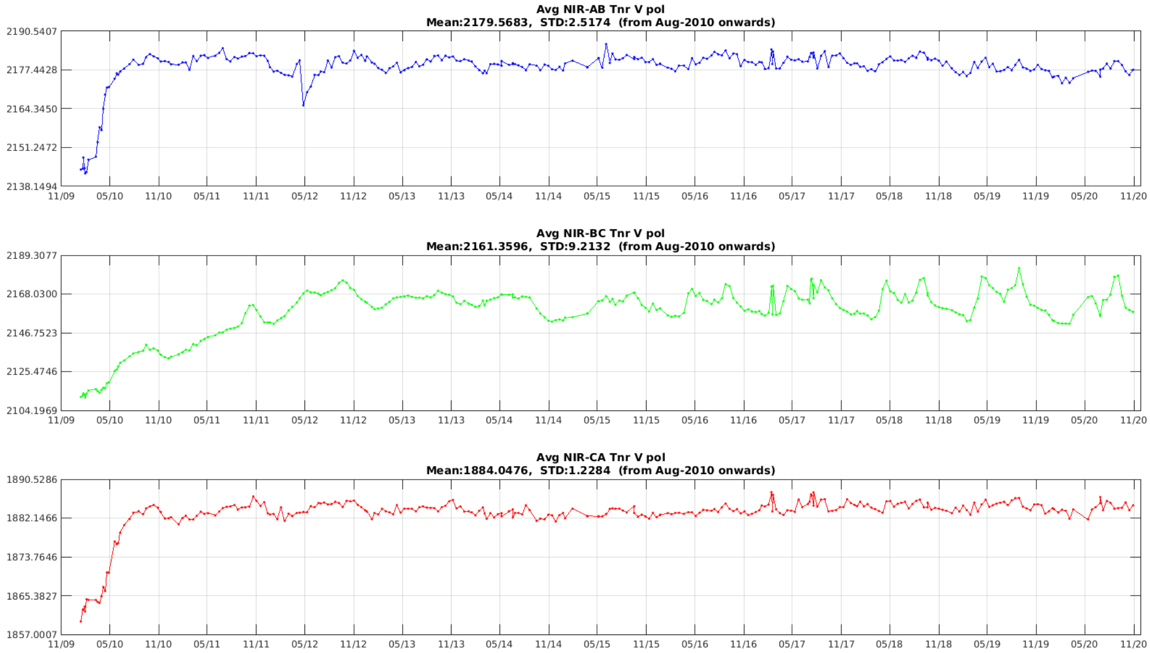


Figure 4 Tnr evolution of NIR AB (blue), NIR BC (green) and NIR CA (red) in the V-channel since the beginning of the mission.

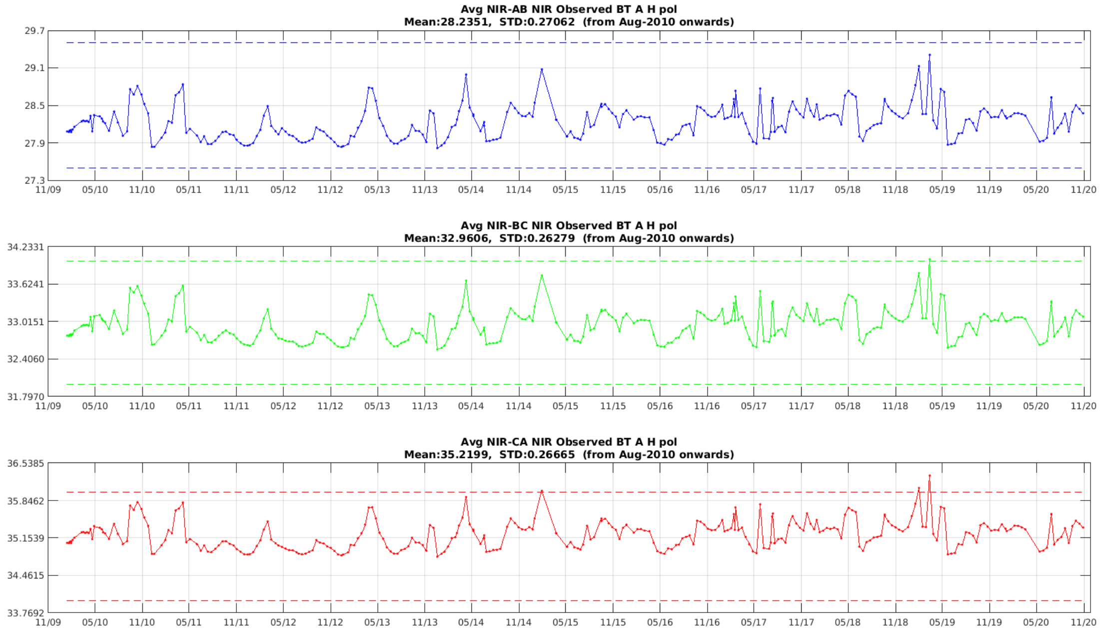


Figure 5 NIR Observed BT evolution of NIR AB (blue), NIR BC (green) and NIR CA (red) in the H-channel since the beginning of the mission. Thresholds in dashed lines

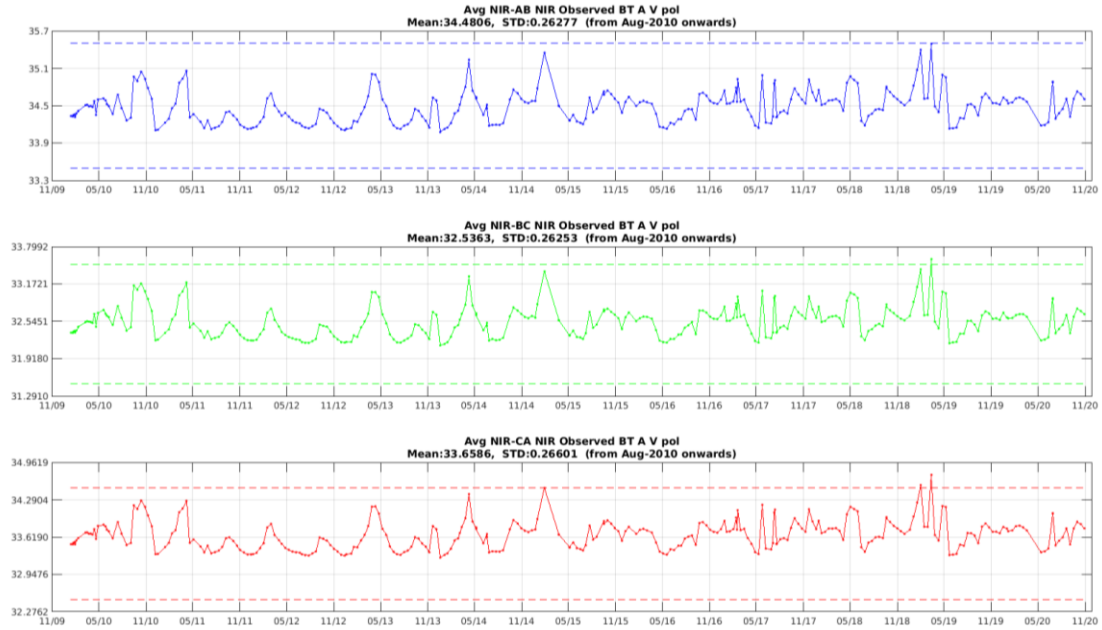


Figure 6 NIR Observed BT evolution of NIR AB (blue), NIR BC (green) and NIR CA (red) in the V-channel since the beginning of the mission. Thresholds in dashed lines

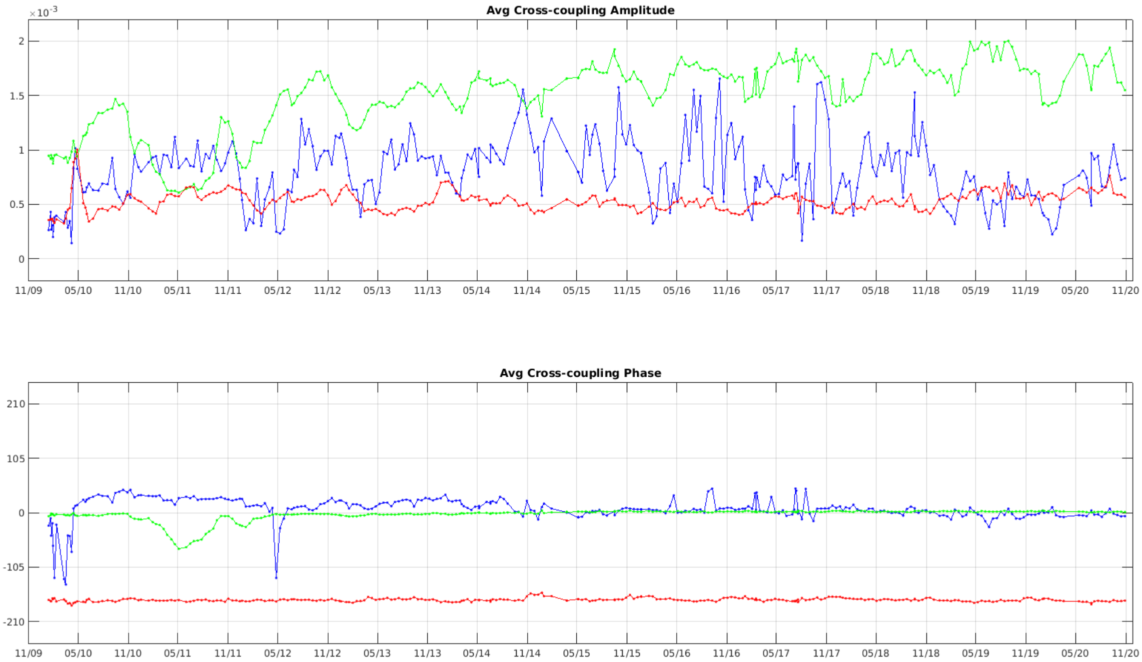


Figure 7 Cross-coupling evolution in amplitude and phase of NIR AB (blue), NIR BC (green) and NIR CA (red) since the beginning of the mission

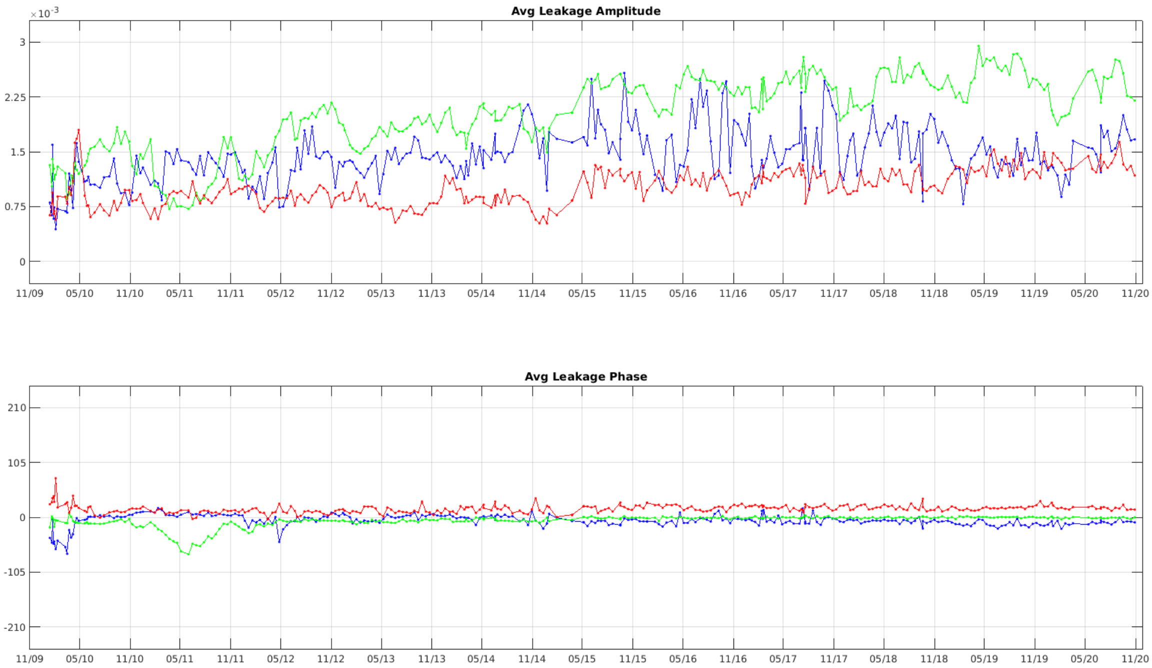


Figure 8 Leakage factor evolution in amplitude and phase of NIR AB (blue), NIR BC (green) and NIR CA (red) since the beginning of the mission

5.2.1 LICEFs

The Lightweight Cost Effective Receivers (LICEF) calibration status is updated by long (every 8 weeks) and short (weekly) on-board calibration activities. No Long calibration were executed during the reporting period.

LICEF PMS gain is derived during the long calibration activity and 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 10th 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 overall 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 shows a small drift since the beginning of the mission, nevertheless the 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 2nd 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.

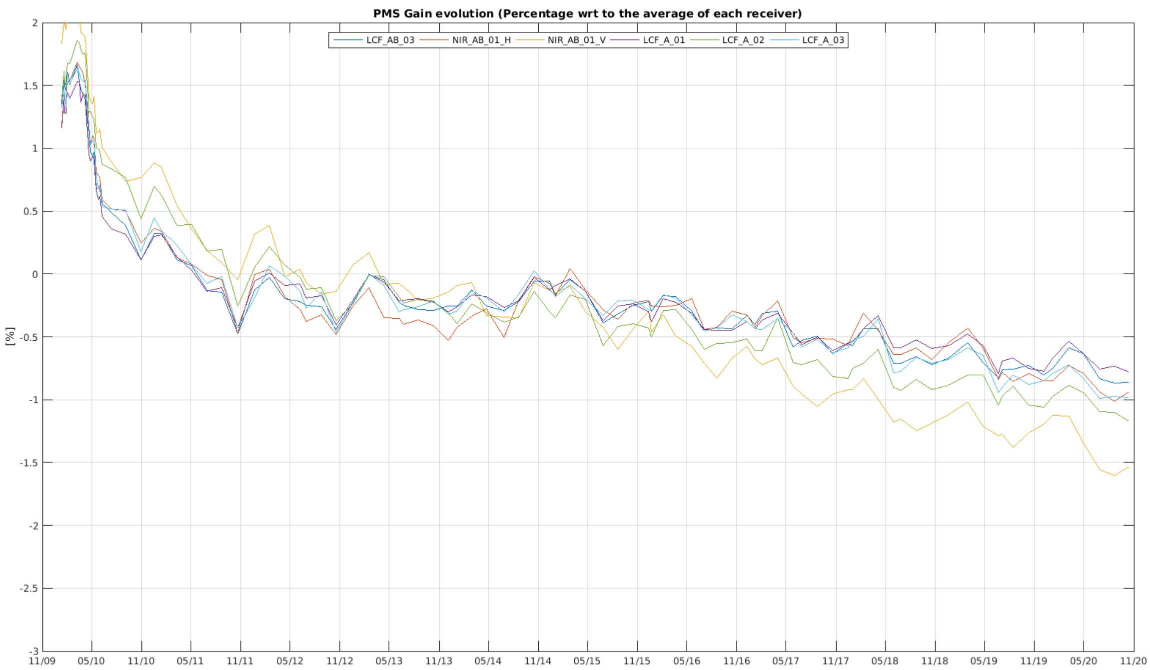


Figure 9 Evolution of the Δ PMS Gain of the LICEFS in CMN H1

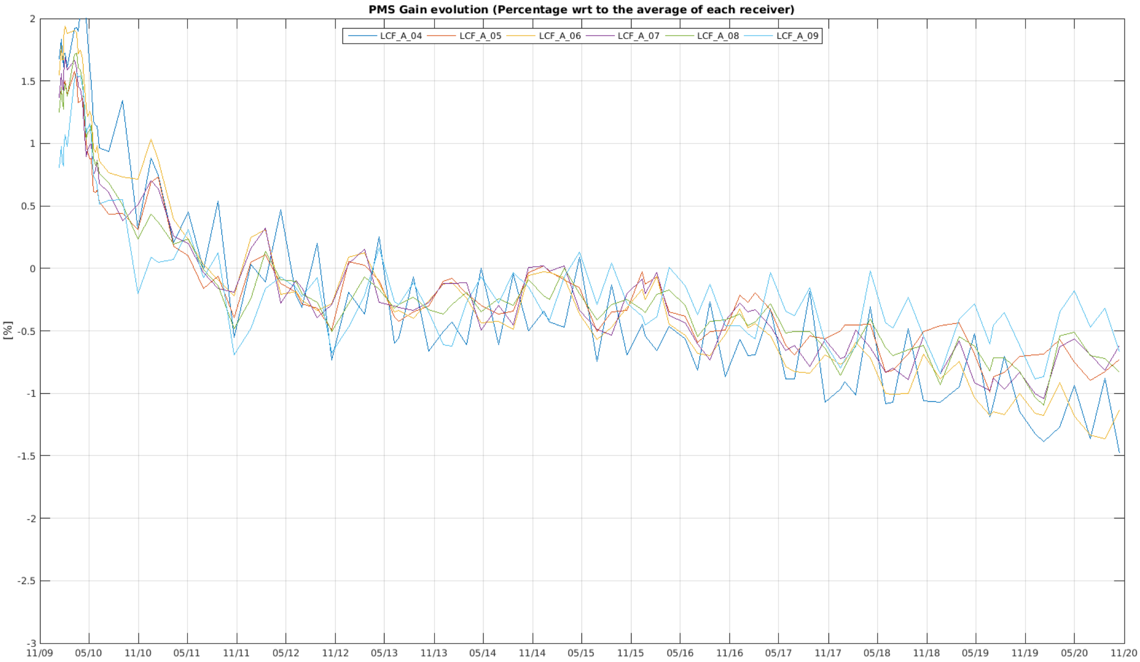


Figure 10 Evolution of the Δ PMS Gain of the LICEFS in CMN A1

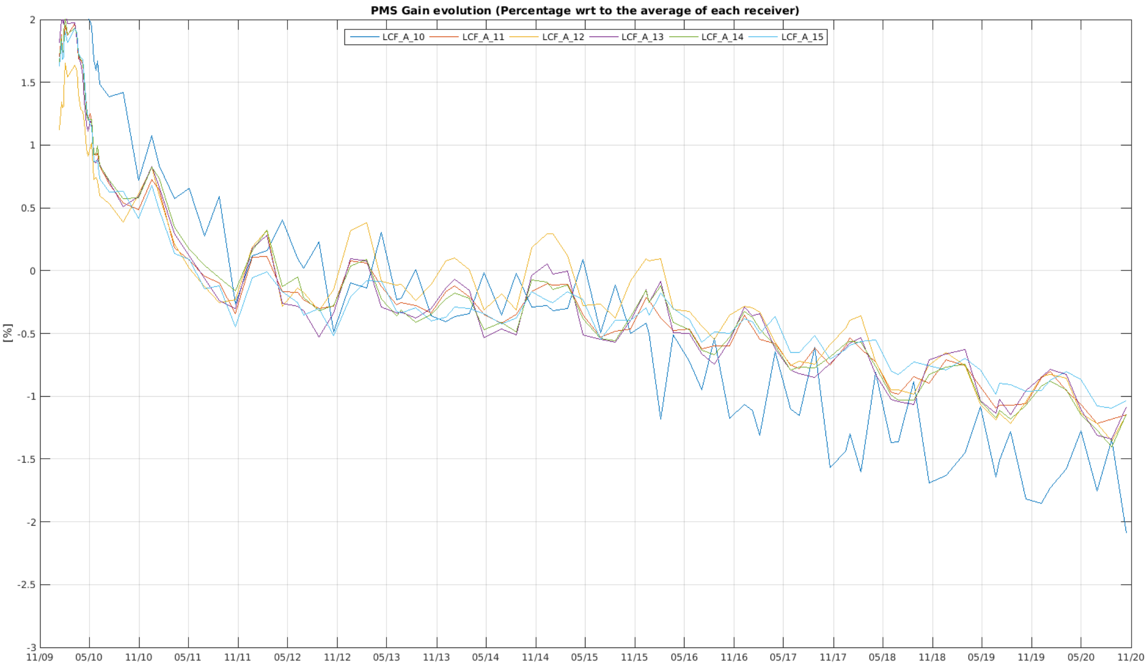


Figure 11 Evolution of the Δ PMS Gain of the LICEFS in CMN A2

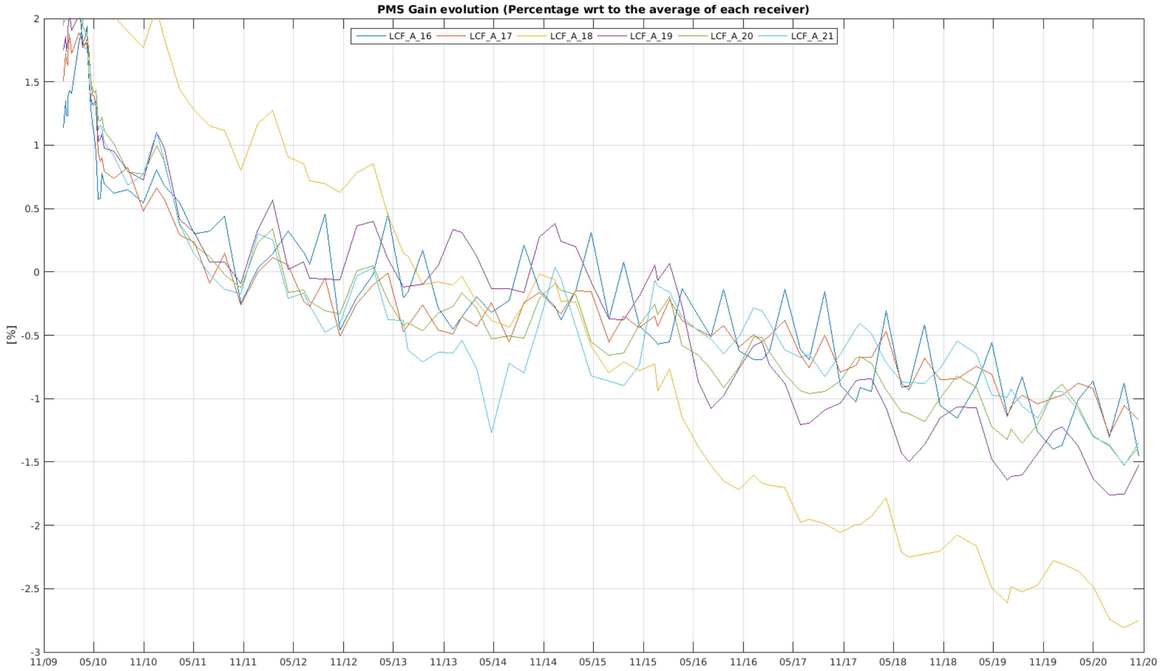


Figure 12 Evolution of the Δ PMS Gain of the LICEFS in CMN A3

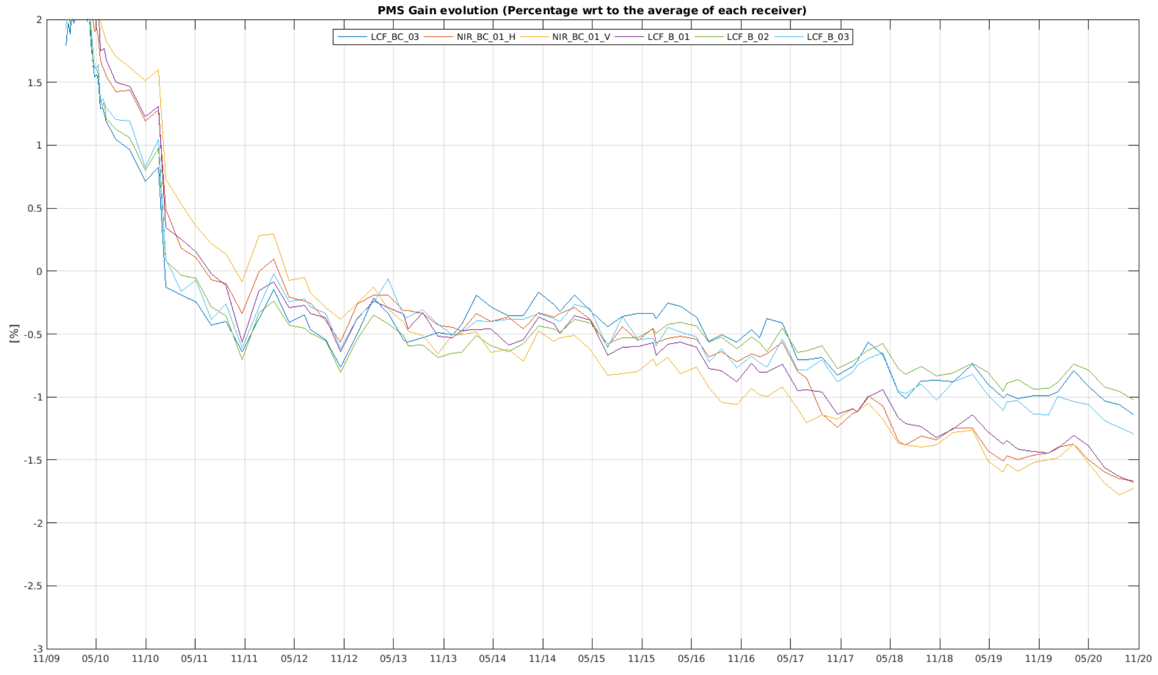


Figure 13 Evolution of the Δ PMS Gain of the LICEFS in CMN H2

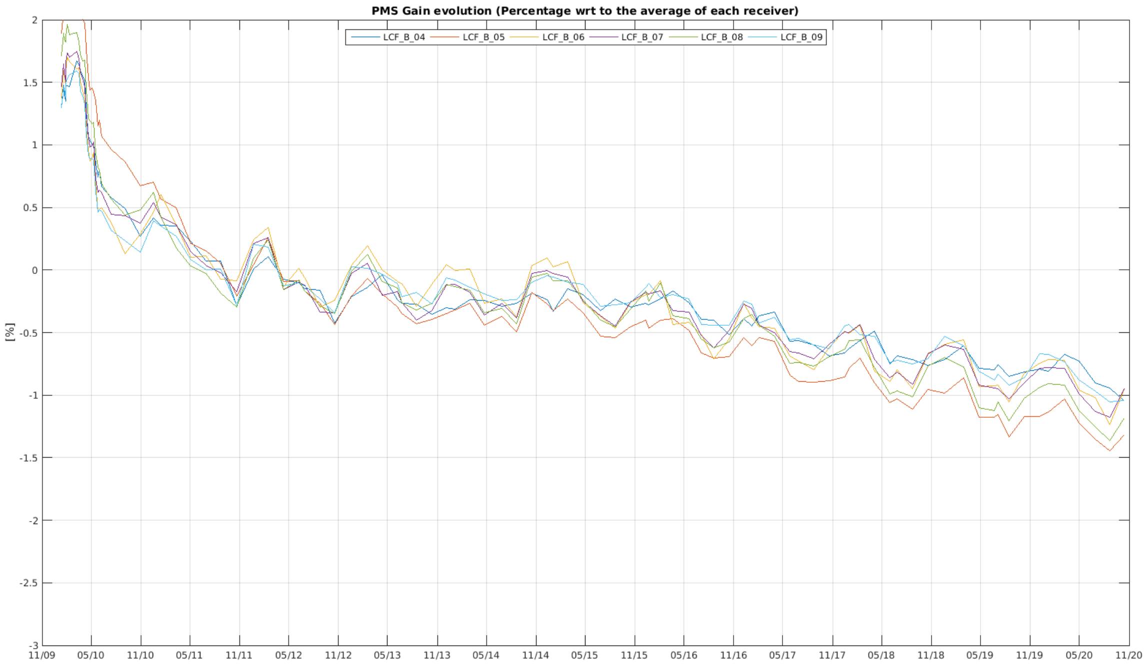


Figure 14 Evolution of the Δ PMS Gain of the LICEFS in CMN B1

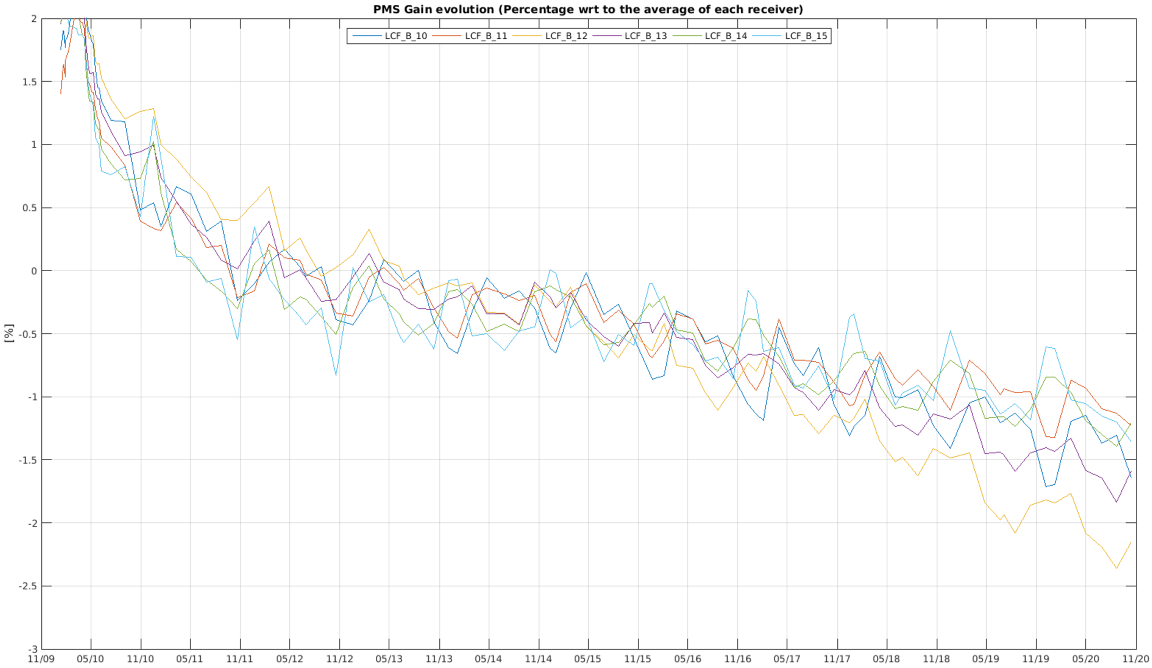


Figure 15 Evolution of the Δ PMS Gain of the LICEFS in CMN B2

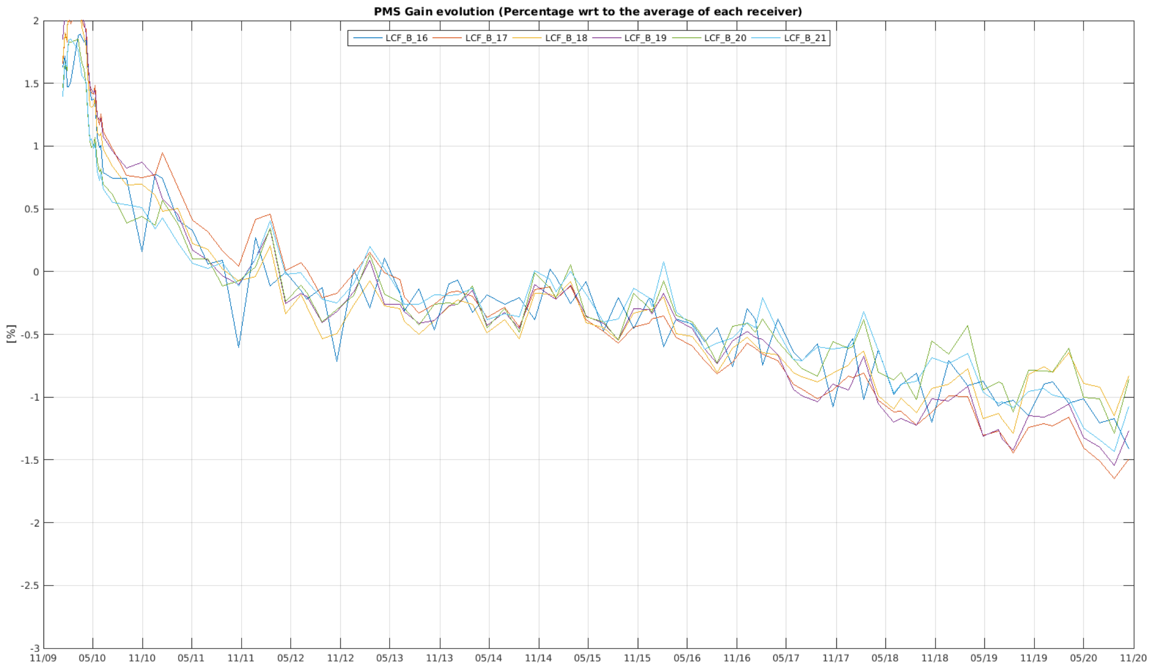


Figure 16 Evolution of the Δ PMS Gain of the LICEFS in CMN B3

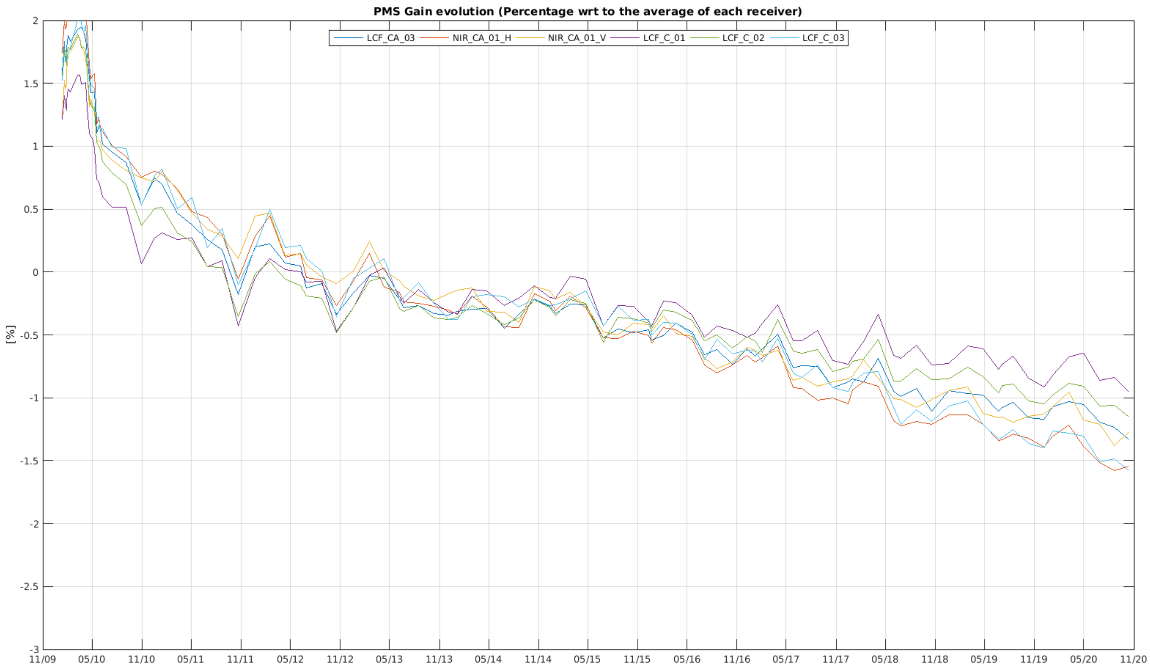


Figure 17 Evolution of the Δ PMS Gain of the LICEFS in CMN H3

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

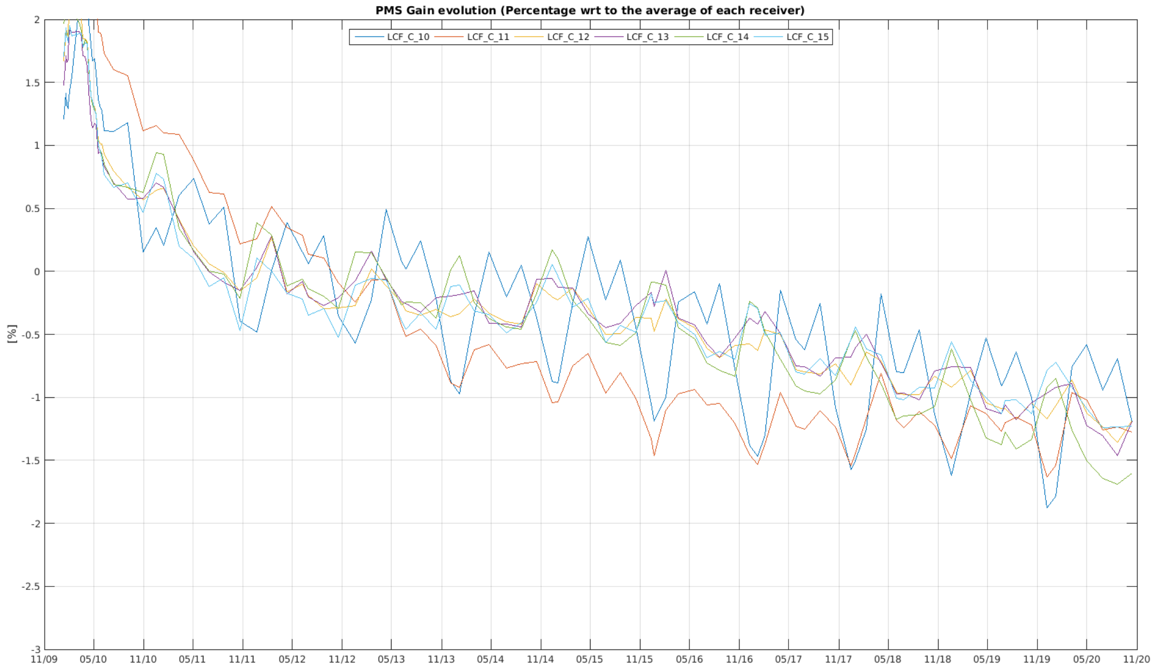


Figure 19 Evolution of the Δ PMS Gain of the LICEFS in CMN C2

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

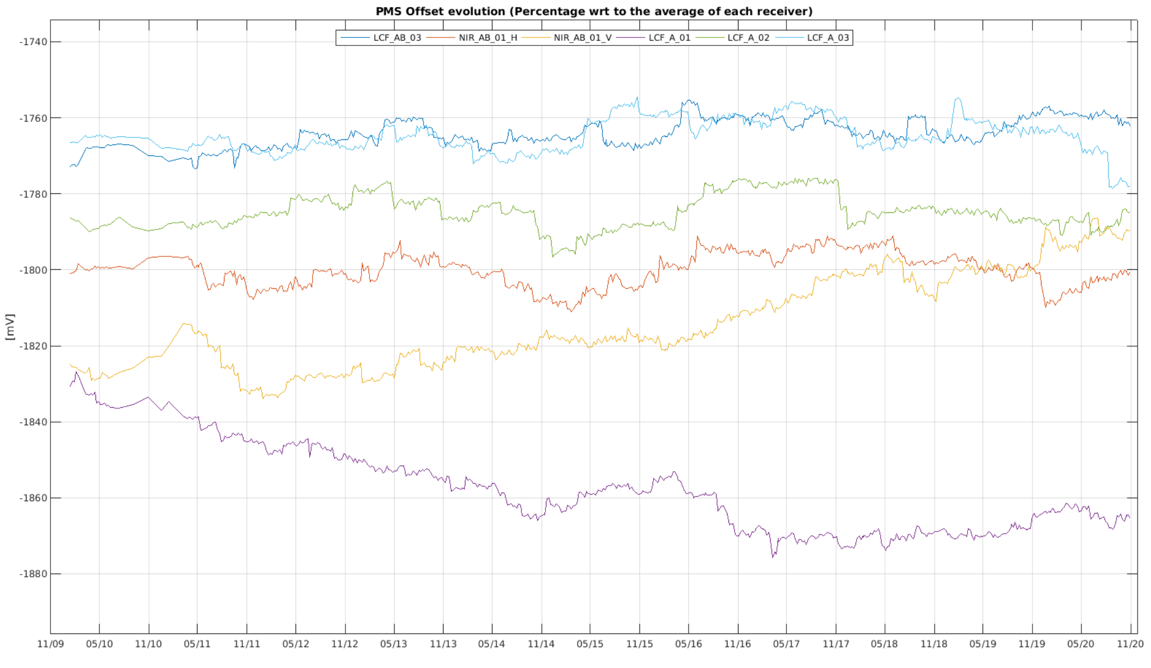


Figure 21 Evolution of the Δ PMS Offset of the LICEFS in CMN H1

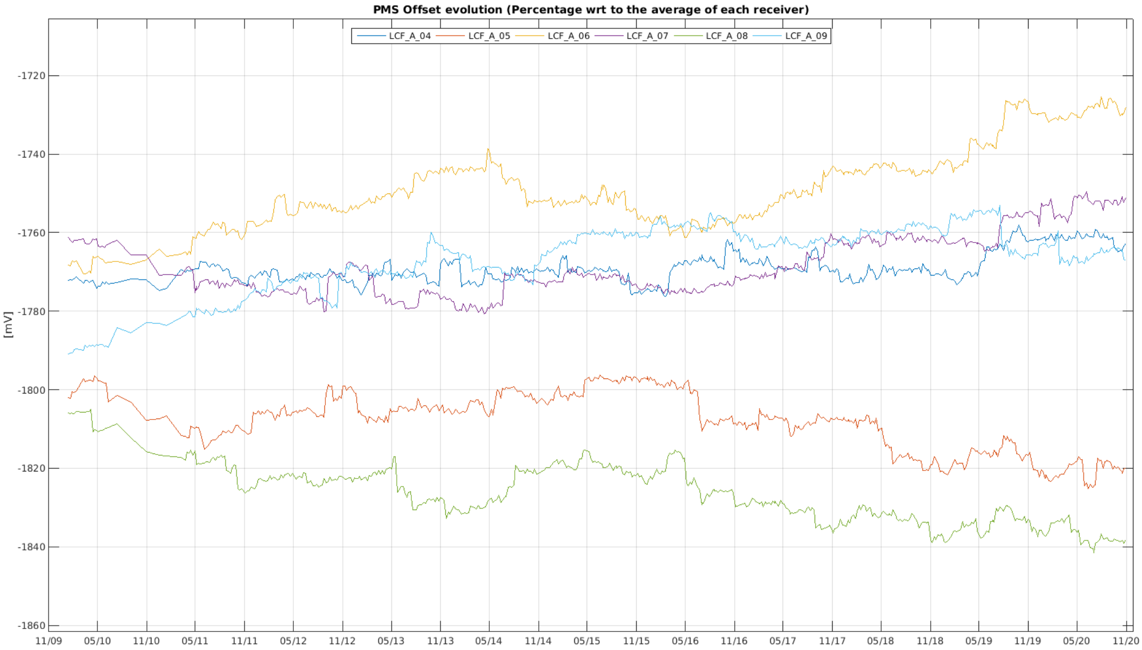


Figure 22 Evolution of the Δ PMS Offset of the LICEFS in CMN A1

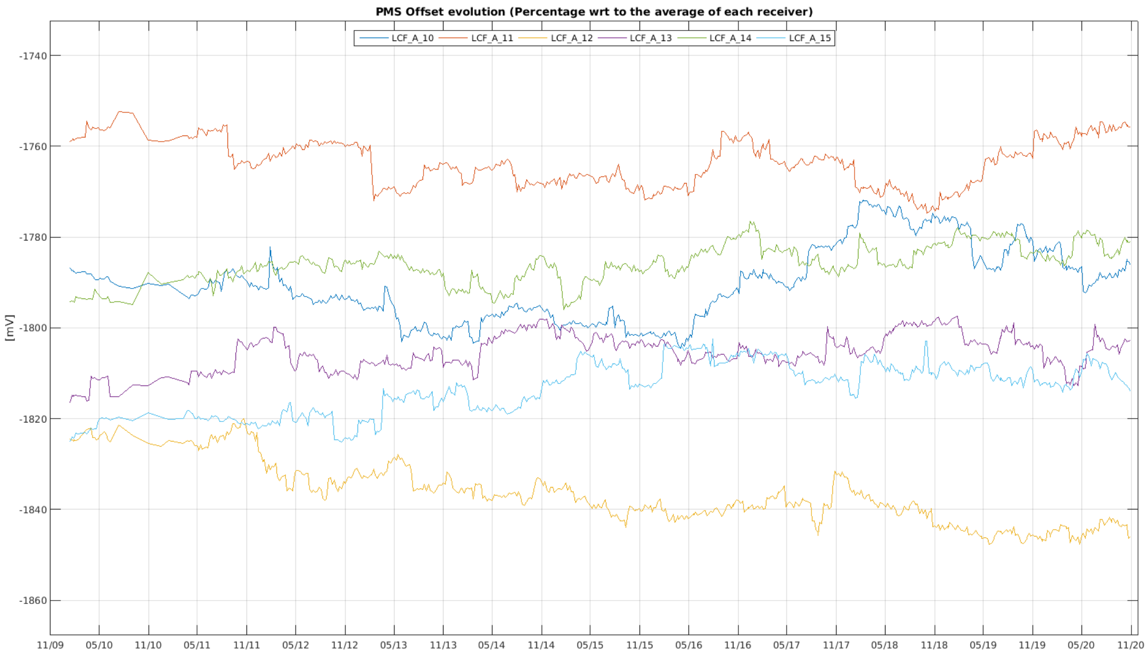


Figure 23 Evolution of the Δ PMS Offset of the LICEFS in CMN A2

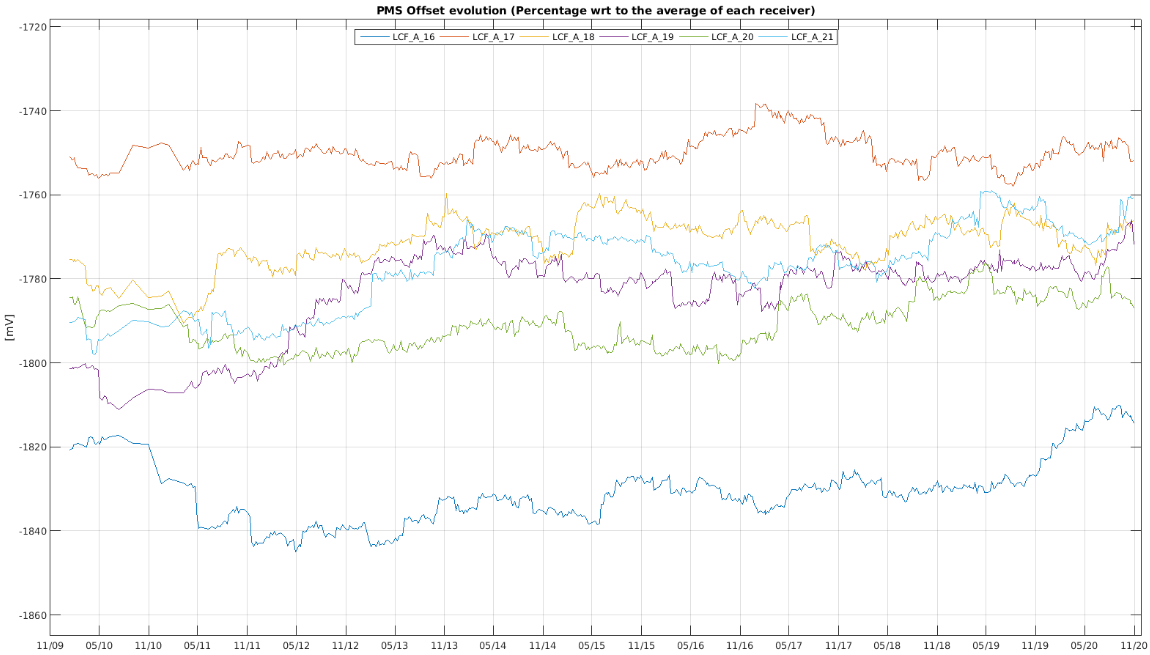


Figure 24 Evolution of the Δ PMS Offset of the LICEFS in CMN A3

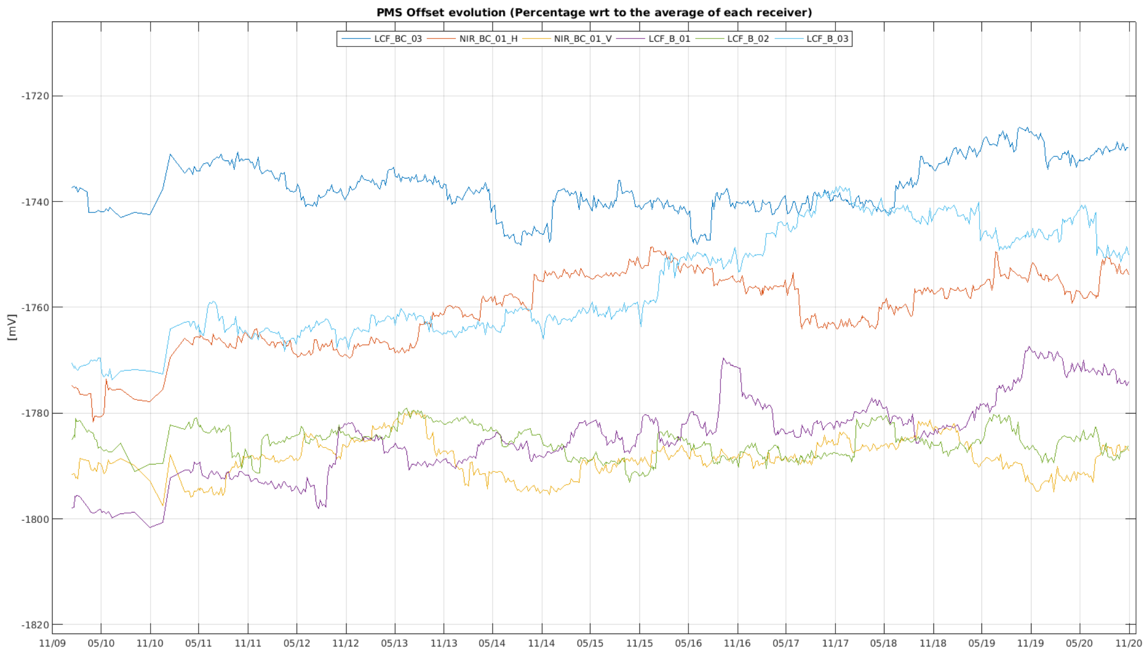


Figure 25 Evolution of the Δ PMS Offset of the LICEFS in CMN H2

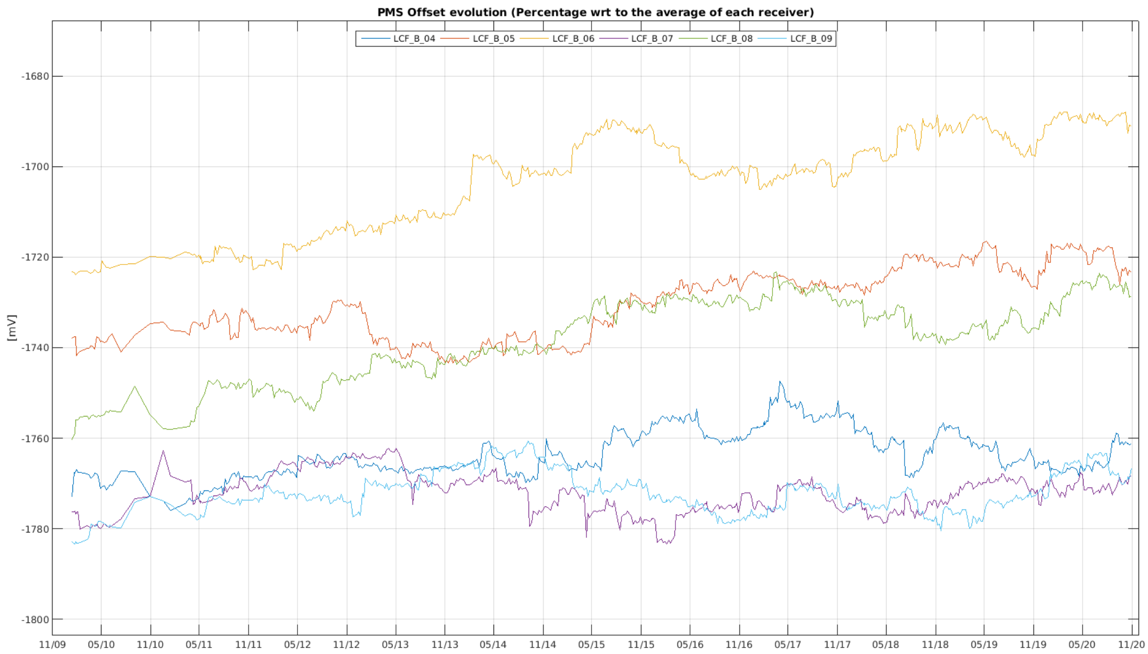


Figure 26 Evolution of the Δ PMS Offset of the LICEFS in CMN B1

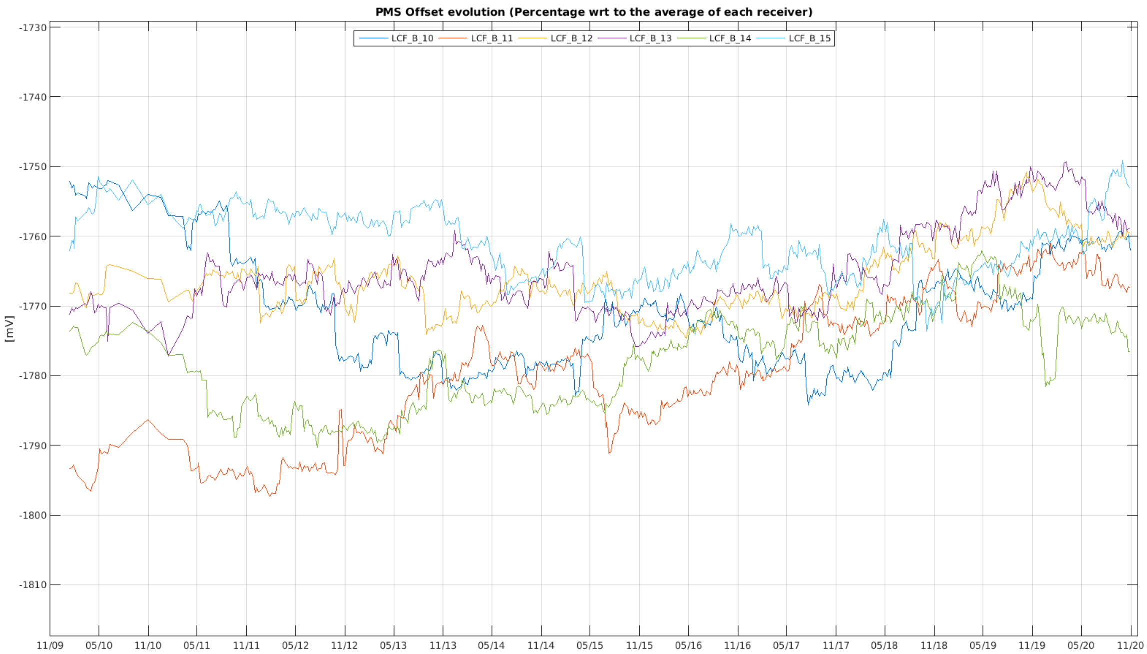


Figure 27 Evolution of the Δ PMS Offset of the LICEFS in CMN B2

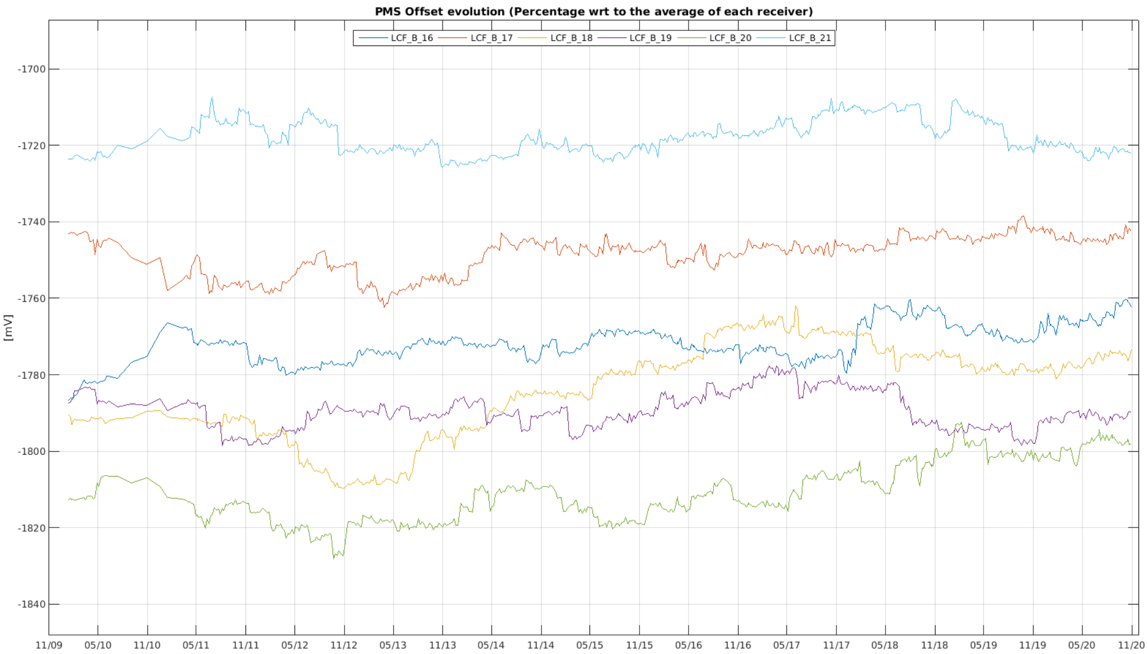


Figure 28 Evolution of the Δ PMS Offset of the LICEFS in CMN B3

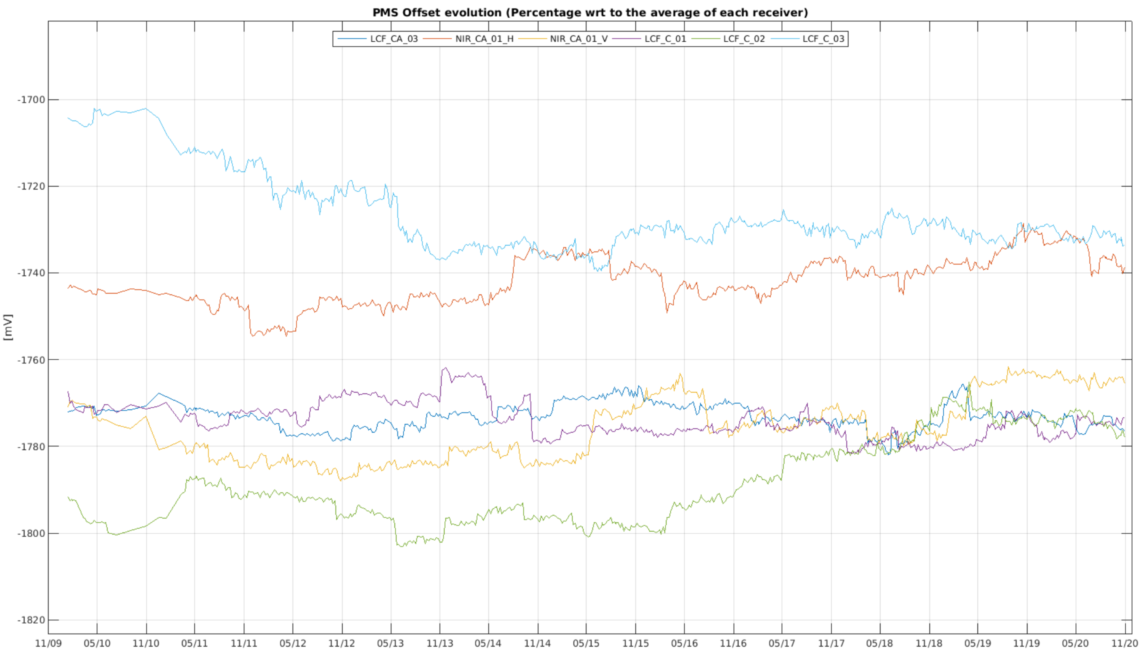


Figure 29 Evolution of the Δ PMS Offset of the LICEFS in CMN H3

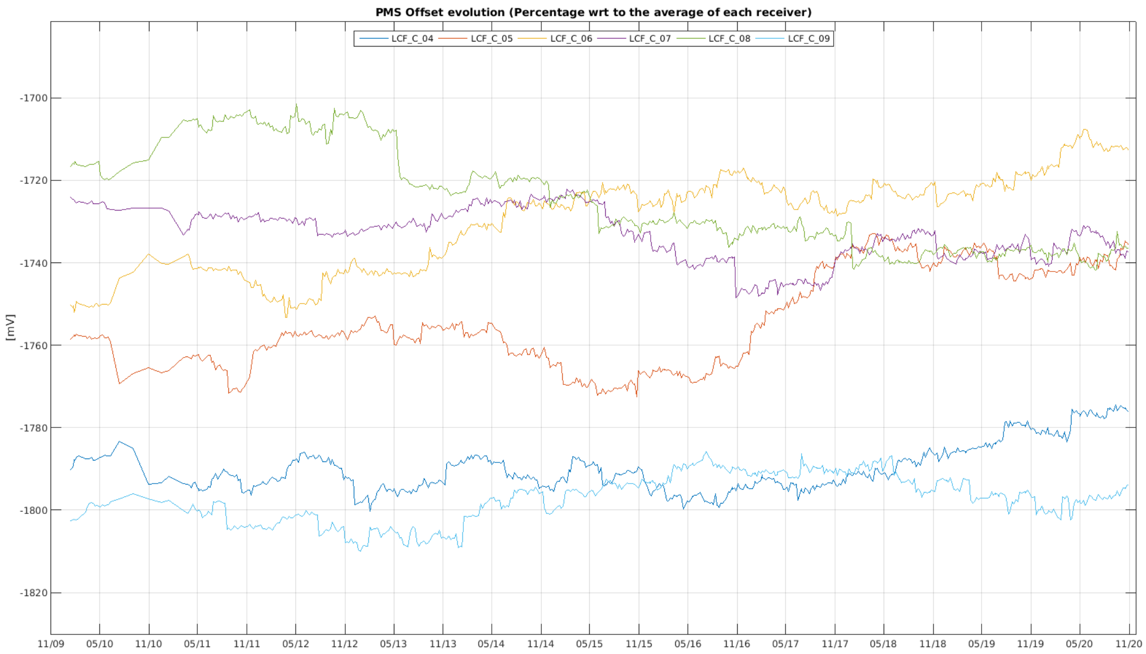


Figure 30 Evolution of the Δ PMS Offset of the LICEFS in CMN C1

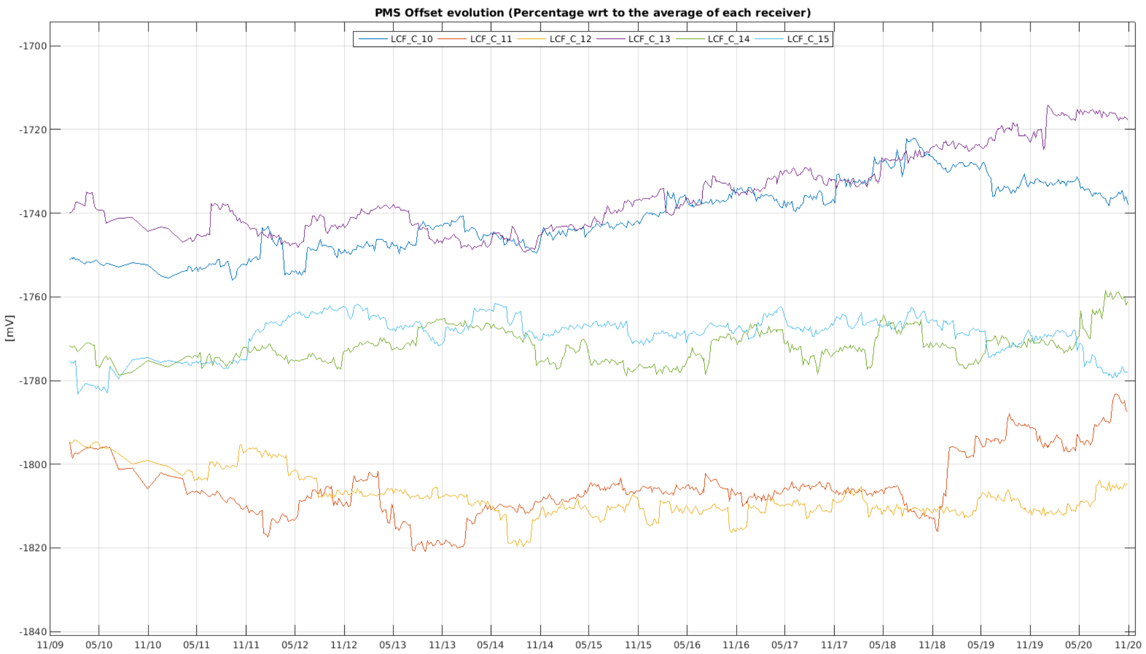


Figure 31 Evolution of the Δ PMS Offset of the LICEFS in CMN C2

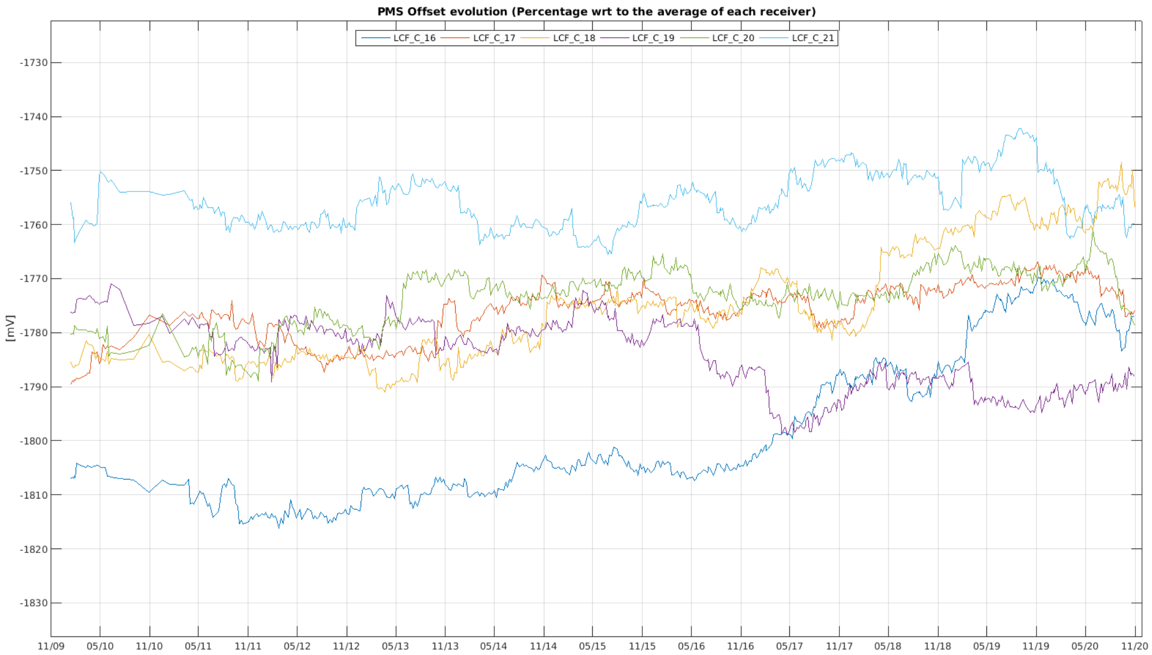


Figure 32 Evolution of the Δ PMS Offset of the LICEFS in CMN C3

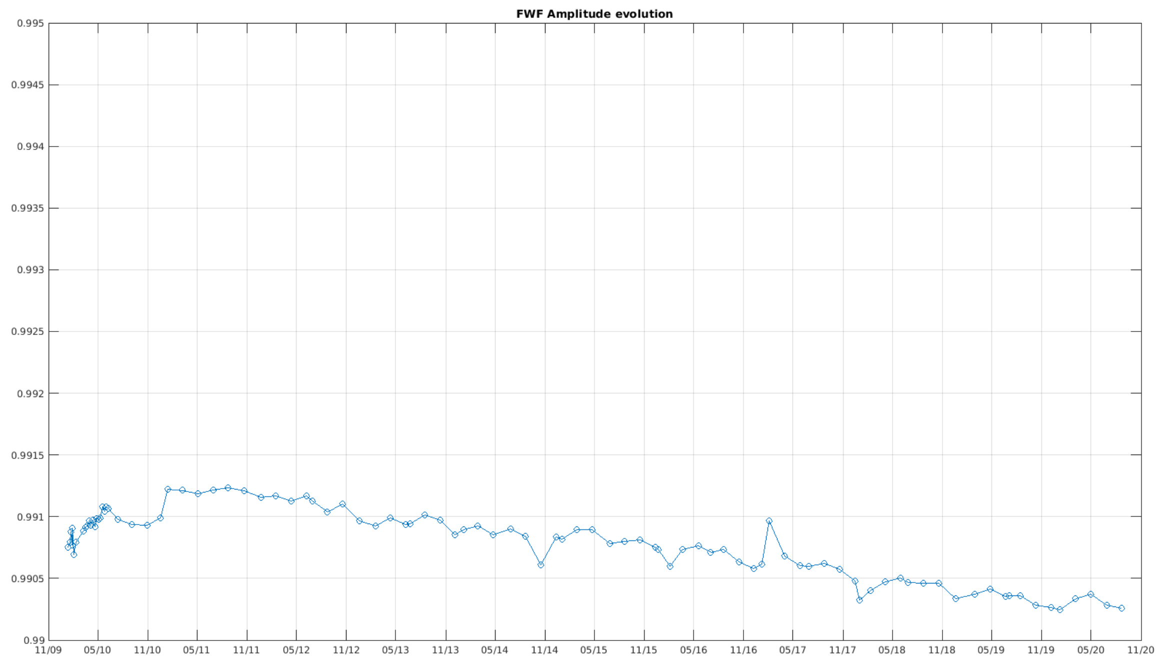


Figure 33 Evolution of the average of the FWF Amplitude at the origin

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.

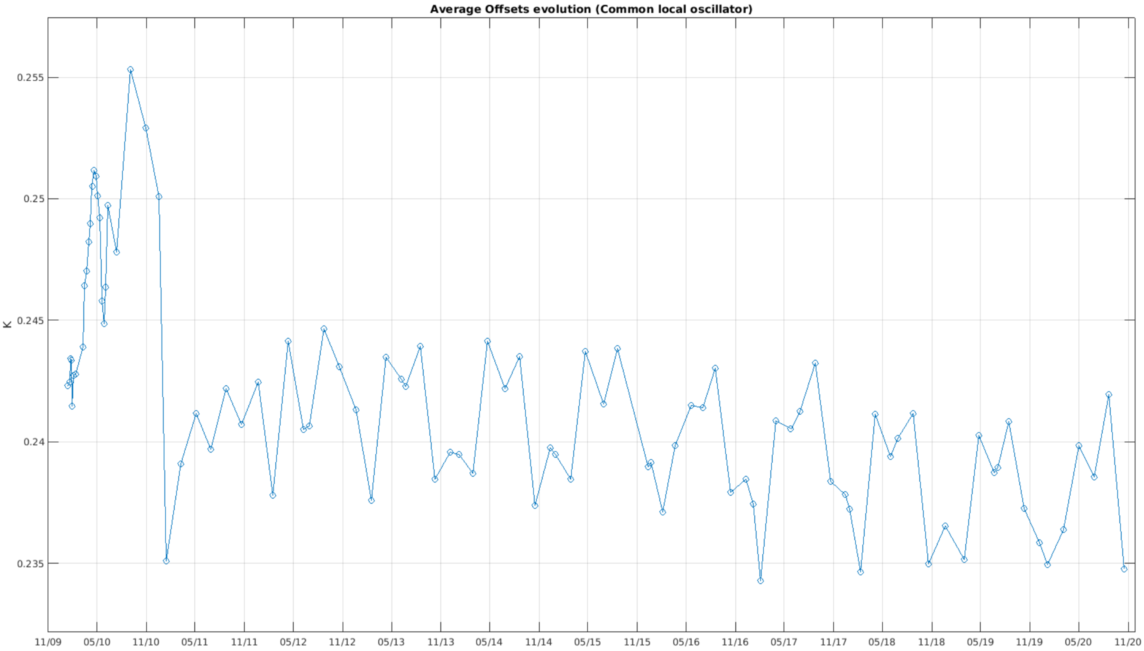


Figure 34 Evolution of the average of the Correlator offsets for the baselines which share local oscillator

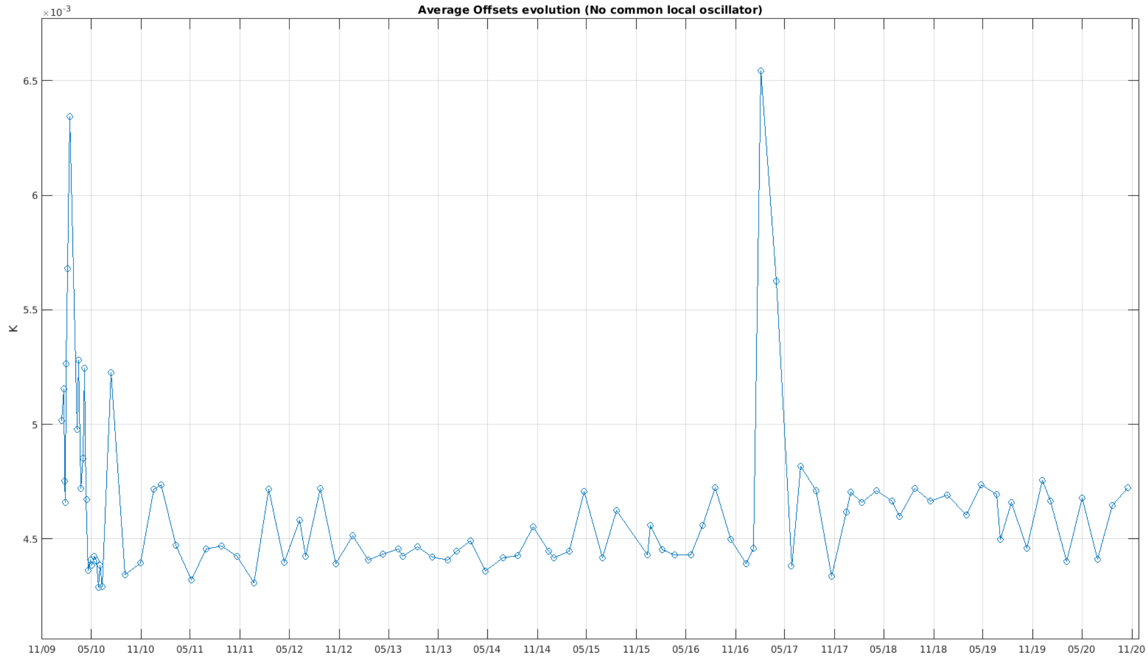


Figure 35 Evolution of the average of the Correlator offsets for the baselines which do not share local oscillator

5.3 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. DOMEX data for year 2017 has been calibrated with a more accurate and refined procedure, this explain the bias with reference to previous year acquisition. The residual long term drift in 2017 is due to drift in calibration parameters. Therefore is not a geophysical effect and it will be corrected in the next delivery of DOMEX data.

The evolution of the SMOS brightness temperature trend over Dome-C does not show any significant drift except for two events, in H polarization, at the beginning of 2015 and in March 2020. The increase in Brightness temperature in 2015 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 had changed the surface condition. This event has impacted the emissivity of the ice that was confirmed by on-site L-band measurement (DOMEX experiment) and from the Aquarius data set. The decrease in Brightness Temperature in March 2020 is under monitoring. It could be due to change in surface geophysical condition, Preliminary analysis of SMAP data over the same area shows similar trend in H polarisation. A comparison with on-site L-band measurement (DOMEX experiment) is on-going to better understand the case.

The SMOS brightness temperature V polarization measurements are quite stable since the beginning of the mission. The SMOS brightness temperature H polarization measurements are less stable and impacted by geophysical condition at surface level. Thus, the drop of the latter for the reporting month is under investigation.

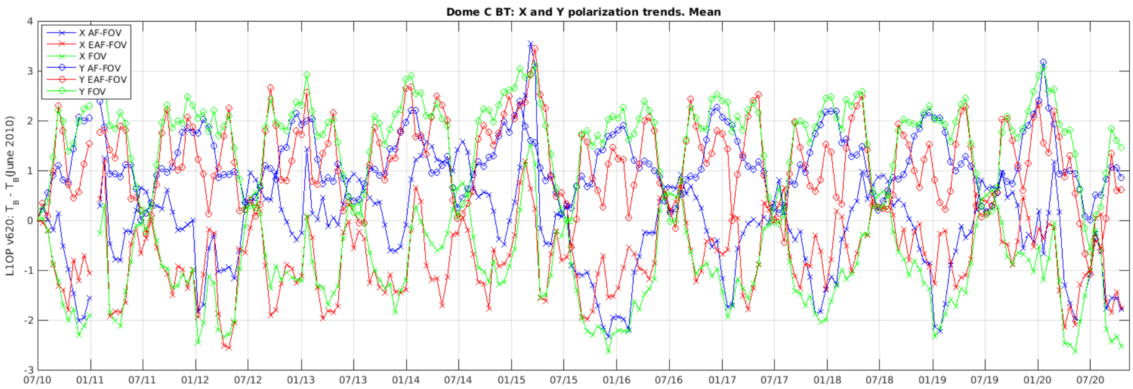


Figure 36: Dome-C X and Y polarization trends (all incidence angles)

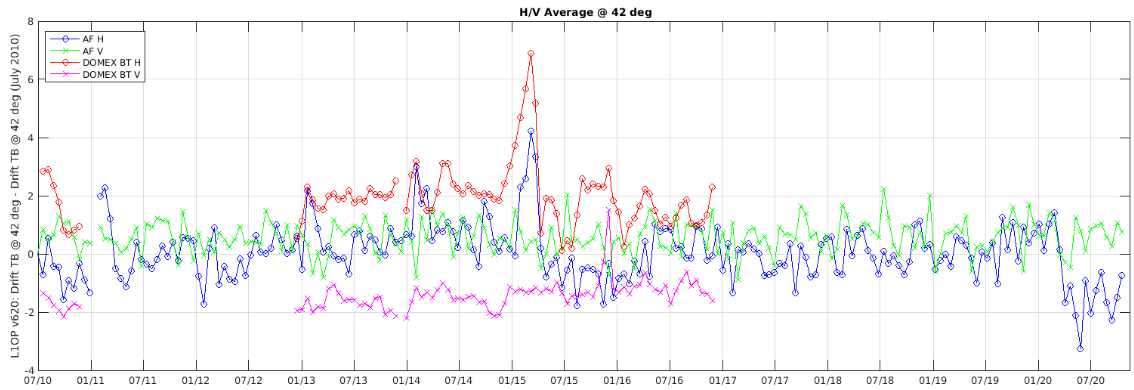


Figure 37: Dome-C H and V polarization trends in Alias Free zone (incidence angle 42°)

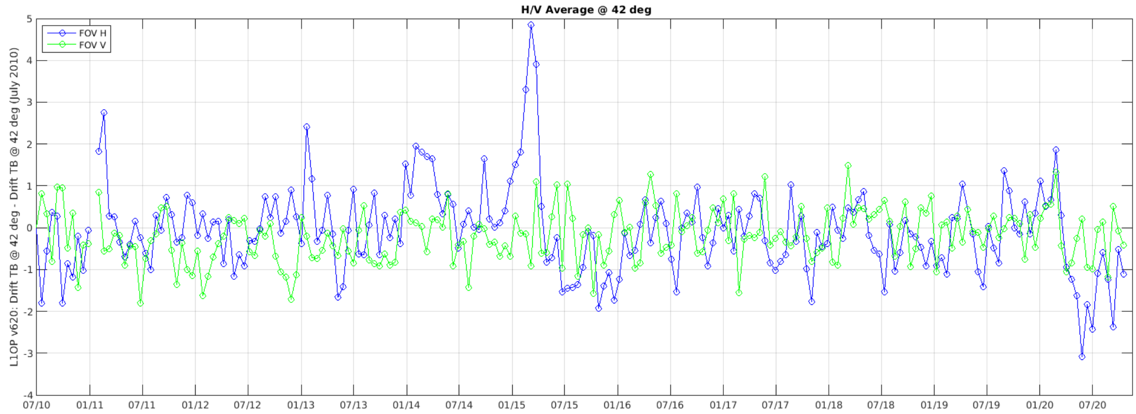


Figure 38: Dome-C H and V polarization trends in Extended Alias Free zone (incidence angle 42°)

5.4 Brightness Temperature Stability over the ocean:

SMOS Brightness Temperature Stability over the ocean is monitored by comparison of SMOS measurements with the forward ocean model. The initial monitoring based on Sea Surface Salinity derived by monthly fixed map from World Ocean Atlas model (WOA2009) has been upgraded with the usage of In-Situ Analysis System (ISAS) measurements interpolated by Objective Analysis (OA). With the new approach, geophysical effects in the difference between SMOS measurements and ocean model has been greatly mitigated allowing a better instrument calibration monitoring. Due to the complexity of the monitoring and the off-line availability of ISAS-OA dataset, the results are available till March 2020. Results will be updated on a yearly basis.

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

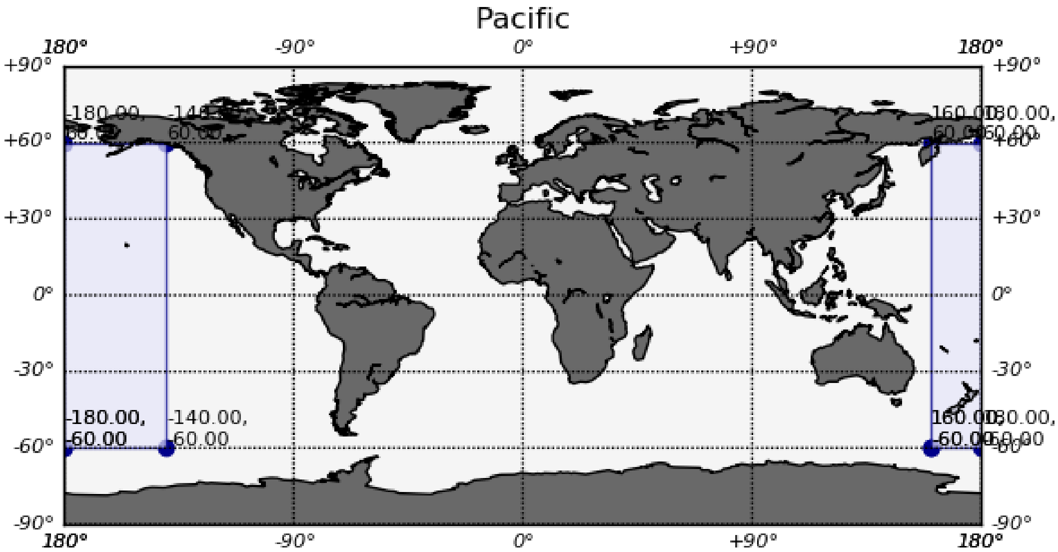


Figure 39: Open ocean region used for the Hövmoller computation.

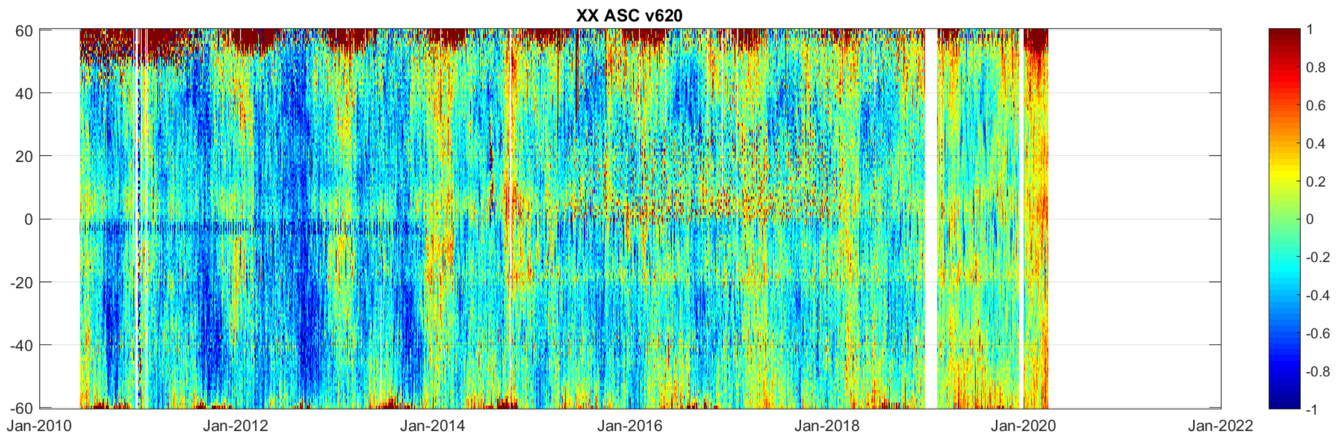


Figure 40: BT stability over the ocean, for XX polarization and Ascending passes in Kelvin.

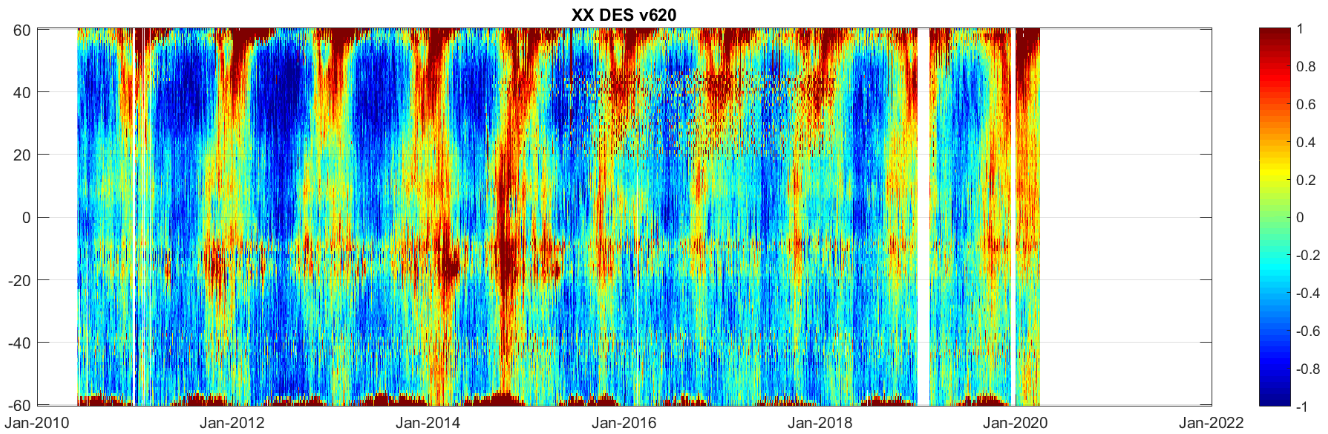


Figure 41: BT stability over the ocean, for XX polarization and Descending passes in Kelvin.

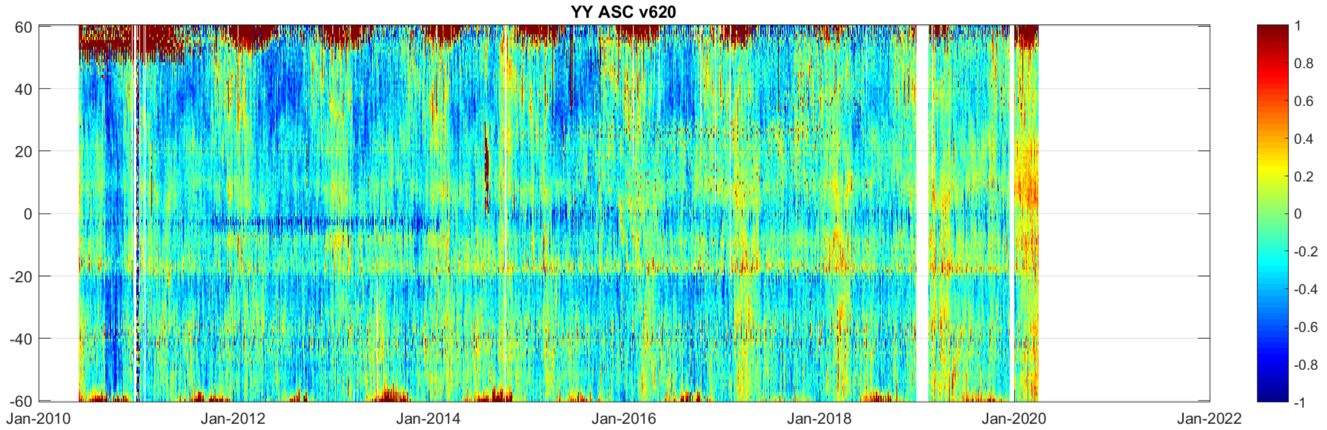


Figure 42: BT stability over the ocean, for YY polarization and Ascending passes in Kelvin.

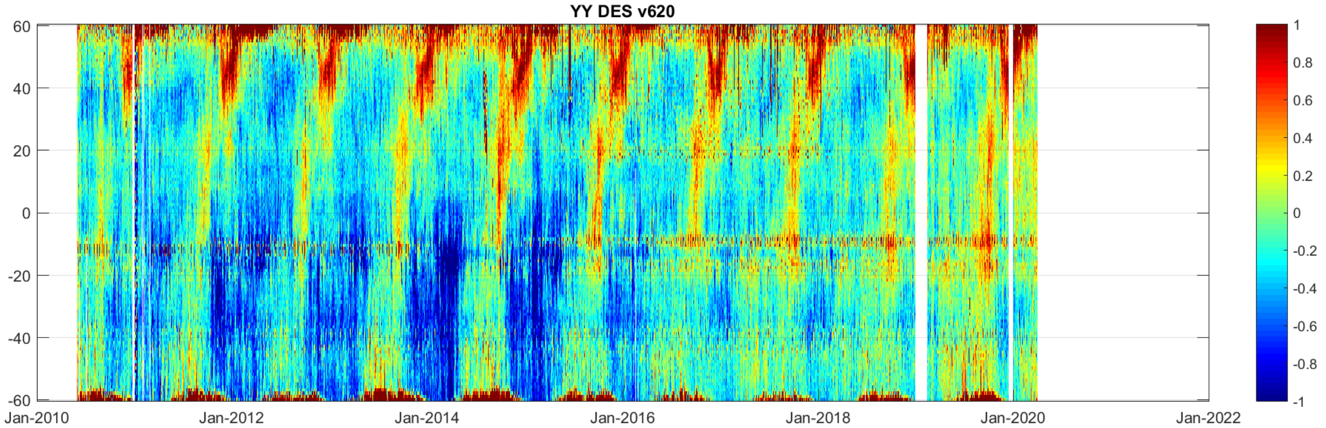


Figure 43: BT stability over the ocean, for YY polarization and Descending passes in Kelvin.

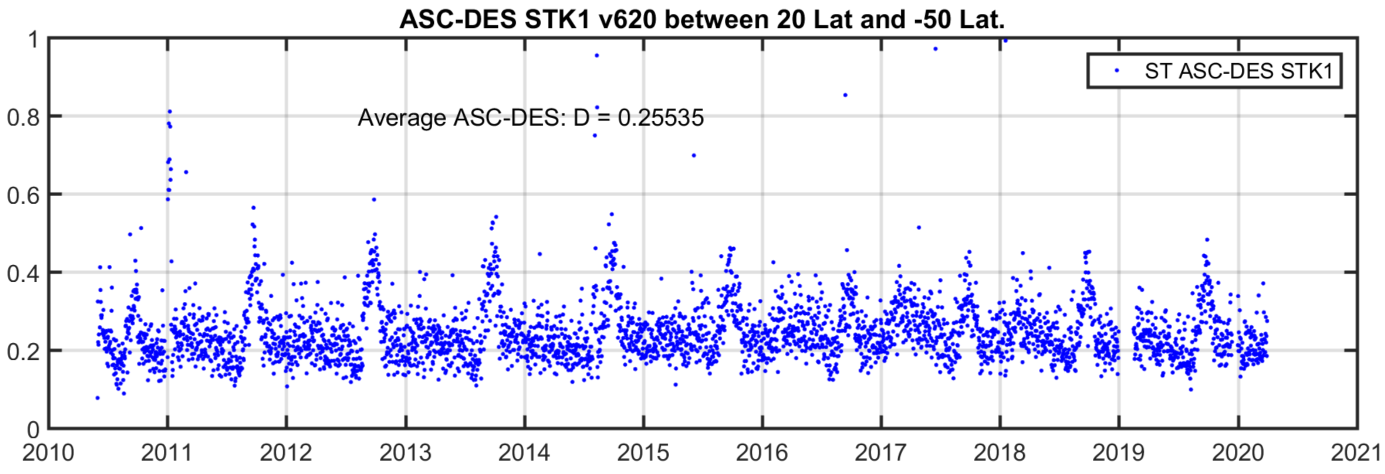


Figure 44: BT short-term stability trends (ASC-DES) for Stokes 1, XX and YY polarizations

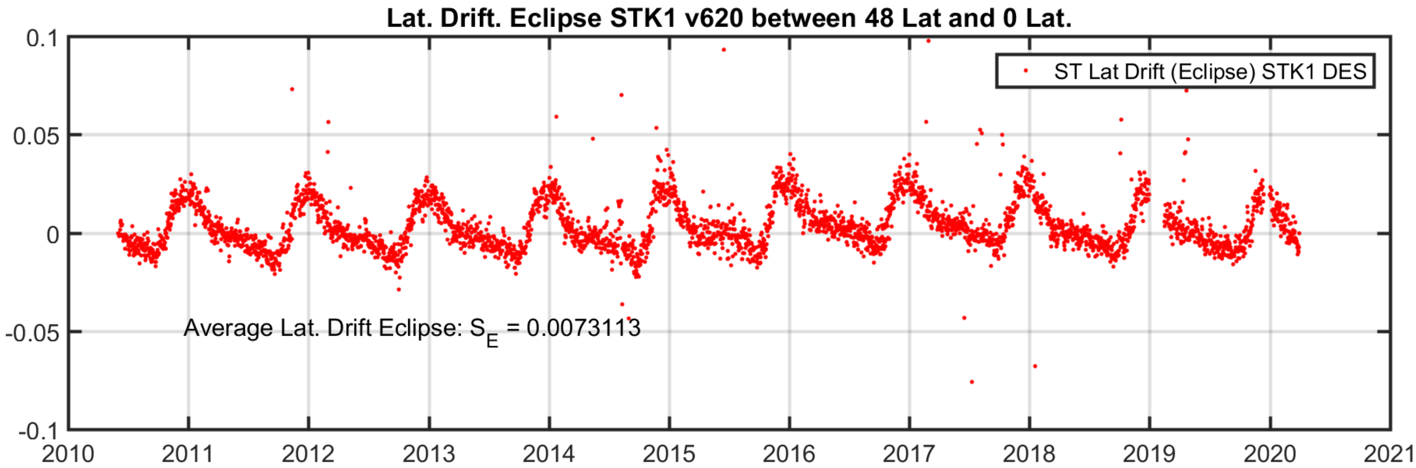


Figure 45: BT short term stability at Eclipse regions, for Stokes 1, XX and YY polarizations

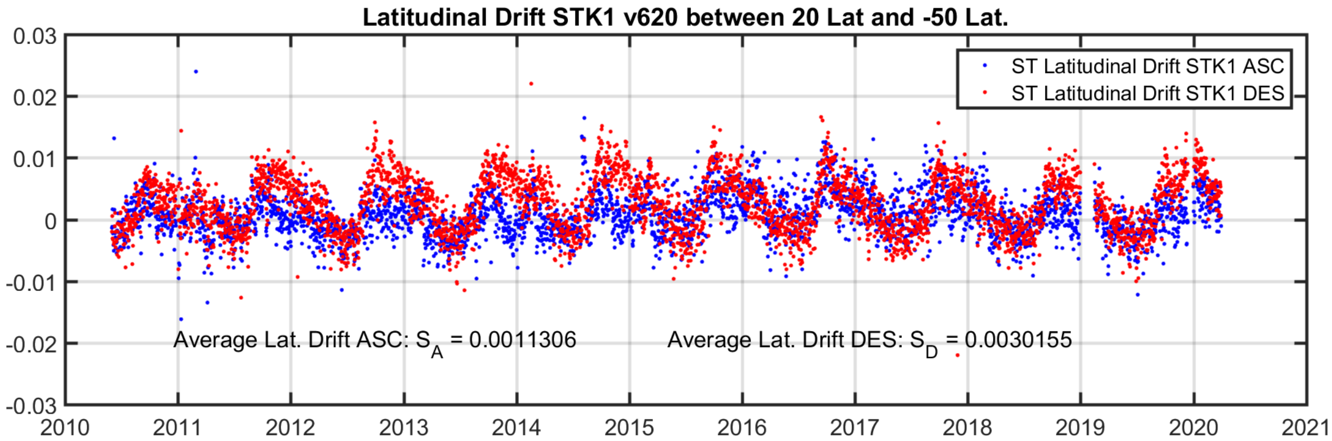


Figure 46: BT short term stability (Latitudinal drift) for ASC-DES Stokes 1, XX and YY polarizations.

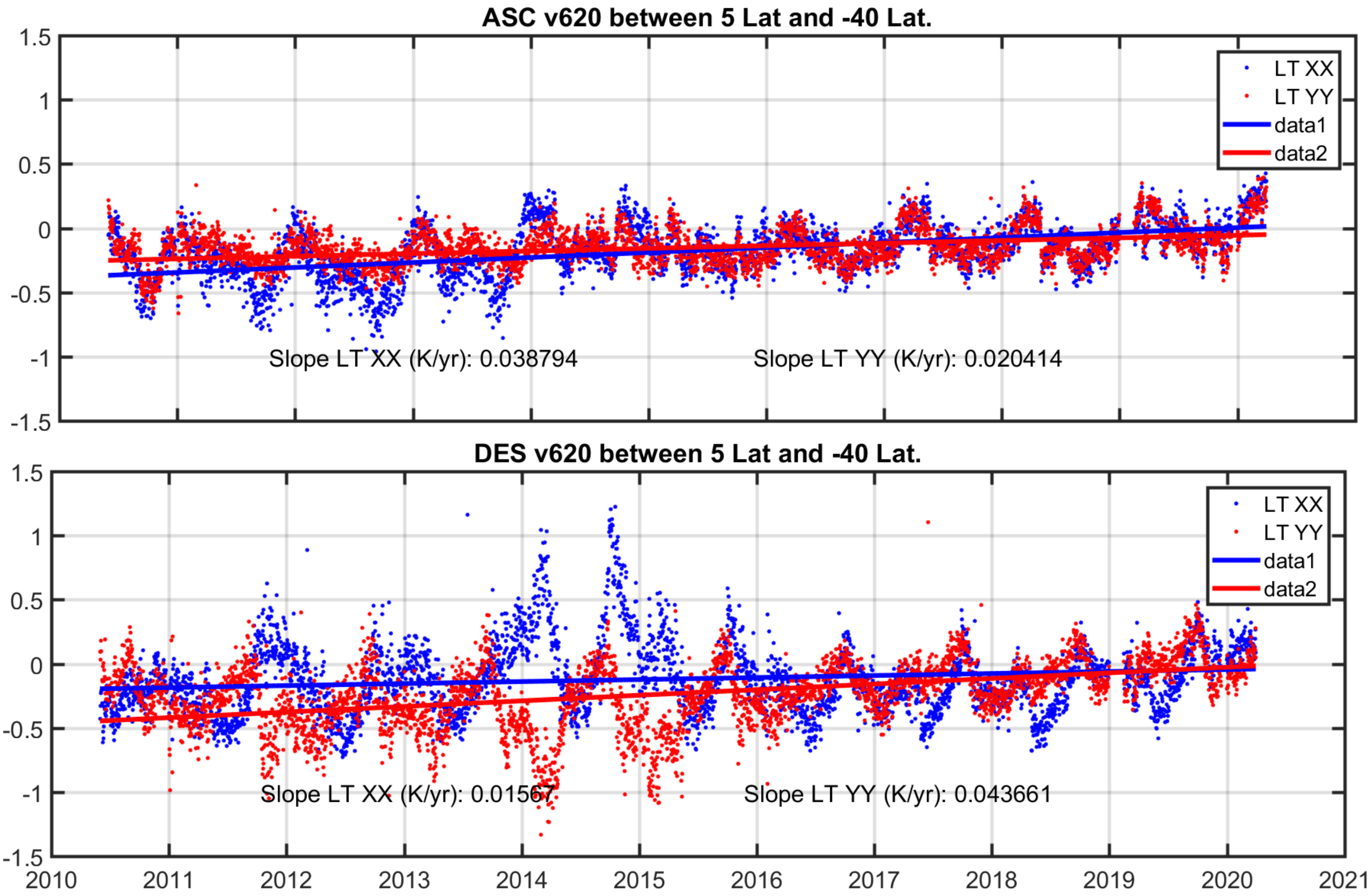


Figure 47: BT long term stability (ASC/DES), for XX and YY polarizations.

5.5 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.

3) From 01/01/2020 to 14/01/2020: OTT files were not generated due to an out of data IGRF-12 model.

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

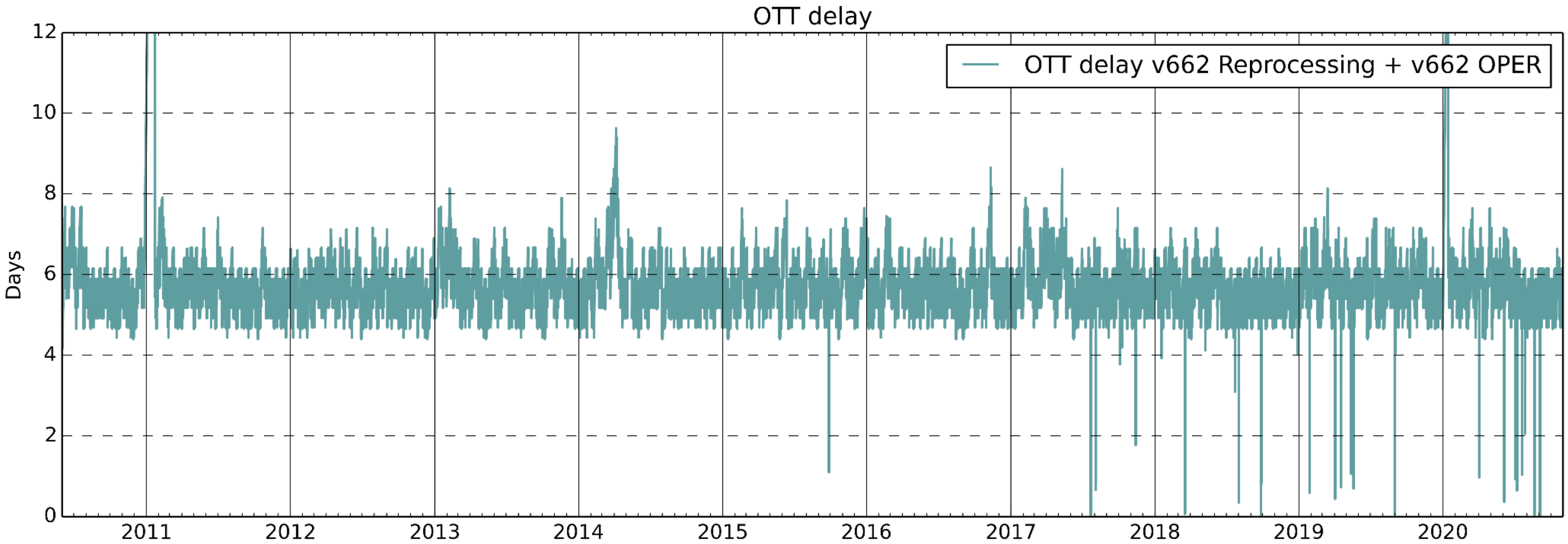


Figure 48: OTT delay per semi-orbit (Delta time between each L2OS product start time and the OTT correction validity start time file).

5.6 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) as reported in the product header.

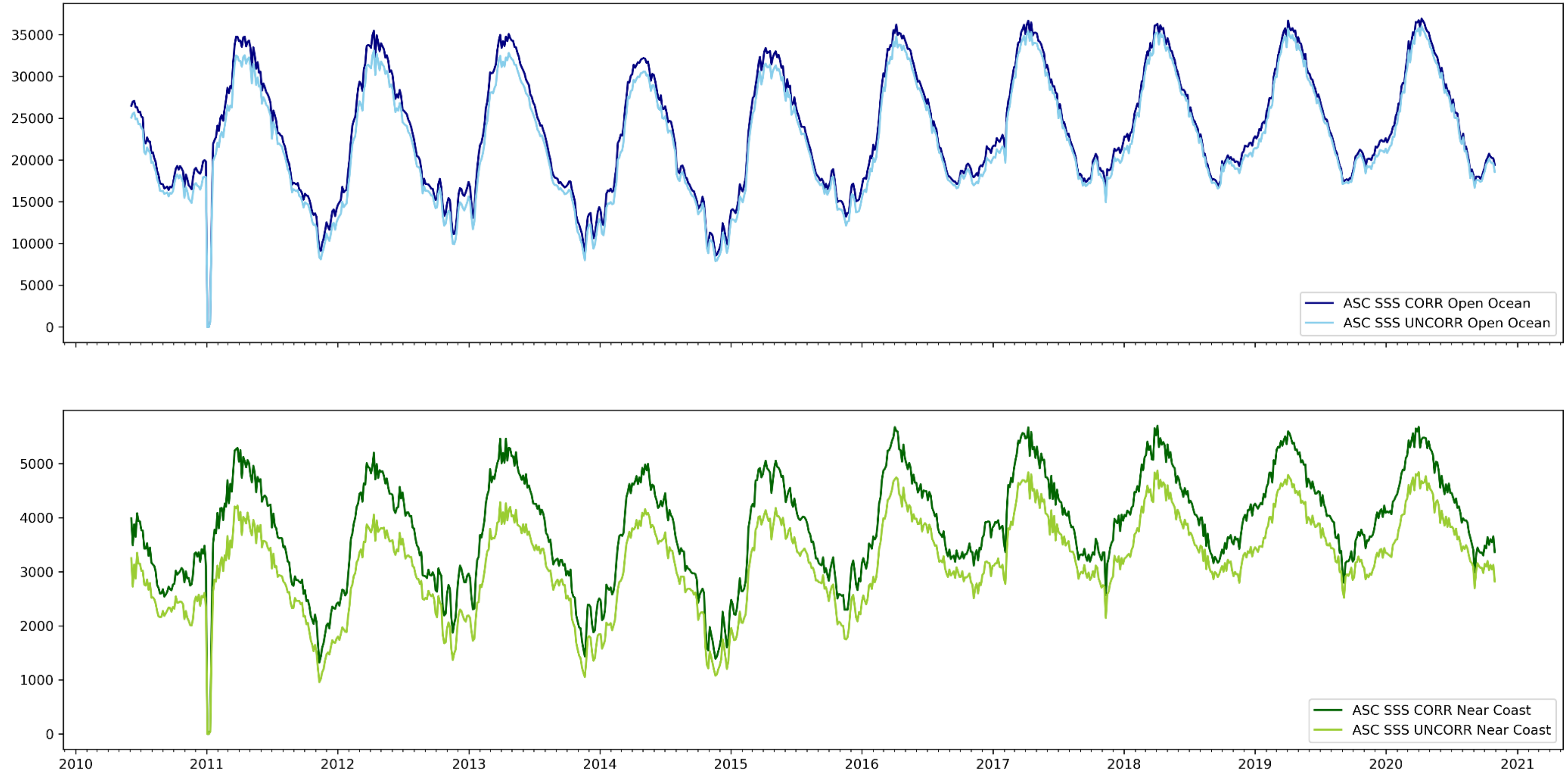
These ‘Good Quality’ retrievals are taken into account for two different areas: Open Ocean (more than 800km away from coastline) and Near Coast (within 800 km from the coastline).

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 seasonal variation in the number of good retrieval is mainly due to the criteria used to classify the data. This criteria is based on the following flags contained in the product:

- fg_ctrl_many_outliers
- fg_ctrl_sunglint
- fg_ctrl_moonglint
- fg_ctrl_gal_noise
- fg_ctrl_num_meas_low
- fg_sc_suspect_ice
- fg_sc_rain
- fg_sc_TEC_gradient

This criteria, will be reviewed in the next version of the L2OS processor and aligned with the “good quality” criteria recommended by the Expert Support Laboratory based on the following flags contained in the product:

- fg_ctrl_range
- fg_ctrl_sigma
- fg_ctrl_chi2
- fg_ctrl_chi2_P
- fg_ctrl_marq
- fg_ctrl_reach_maxiter



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

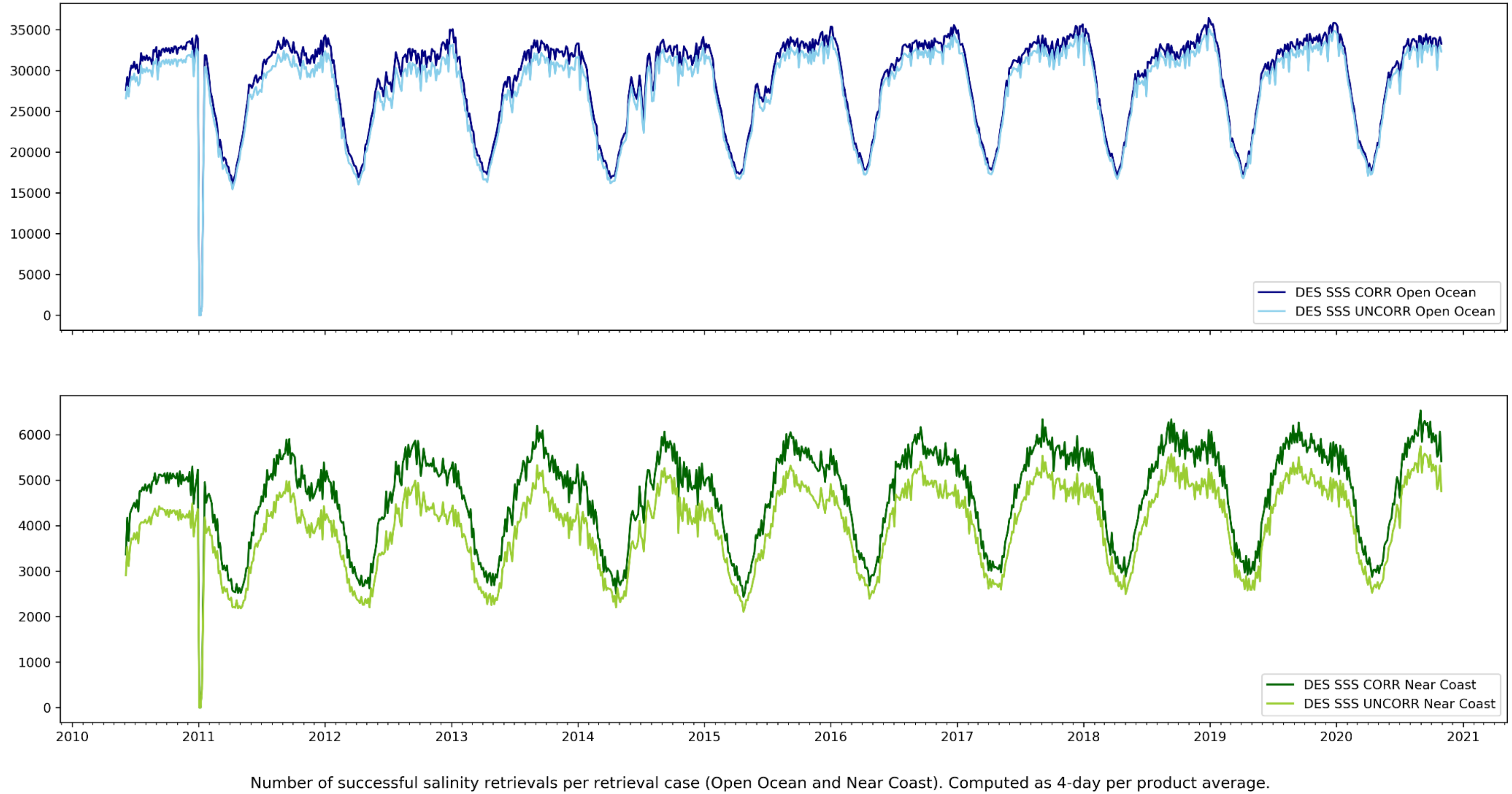


Figure 50: DES Open Ocean and Near Coast L2OS Good Quality Retrievals

5.7 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.

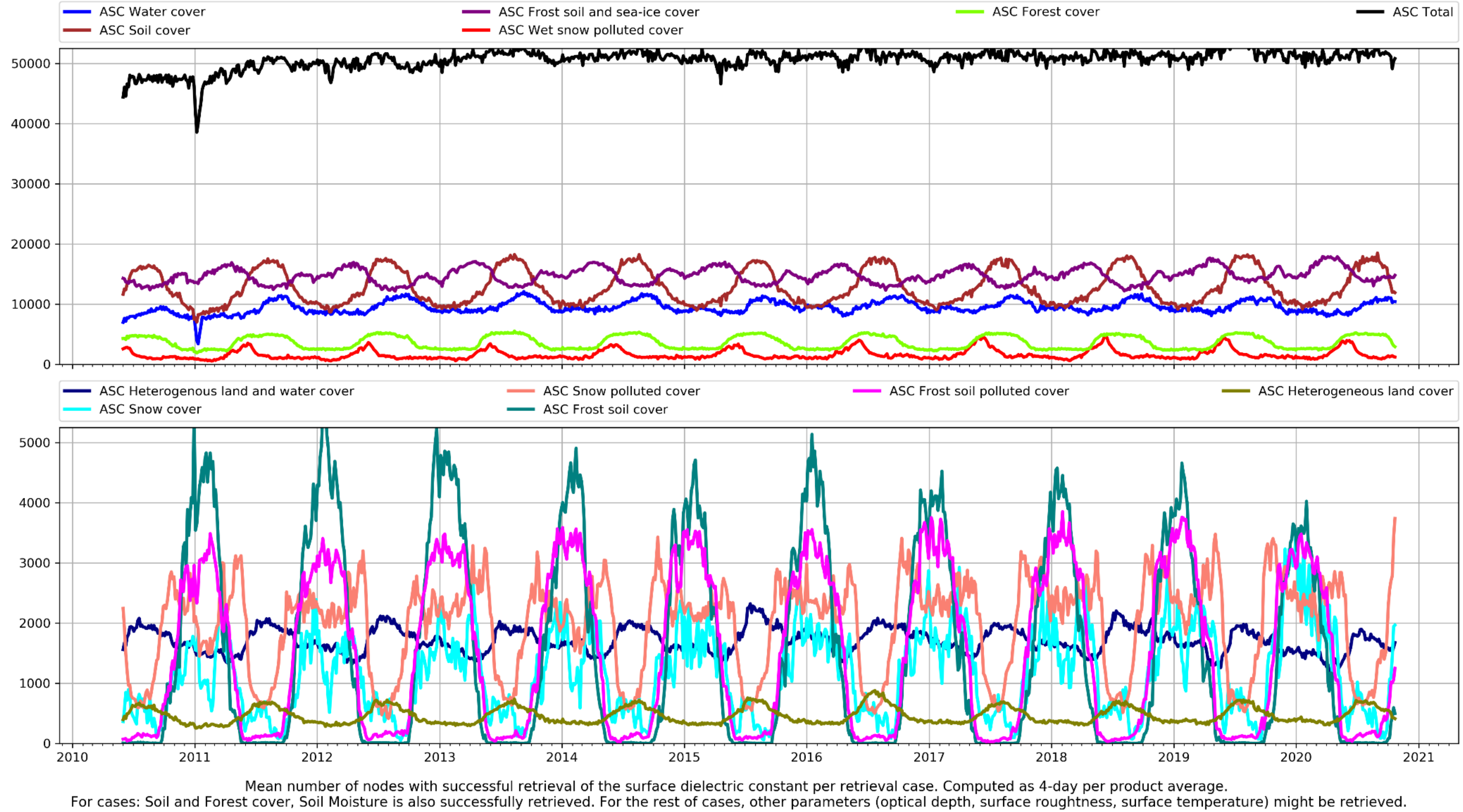


Figure 51: L2SM v650 Mean Retrievals Absolute - ASC

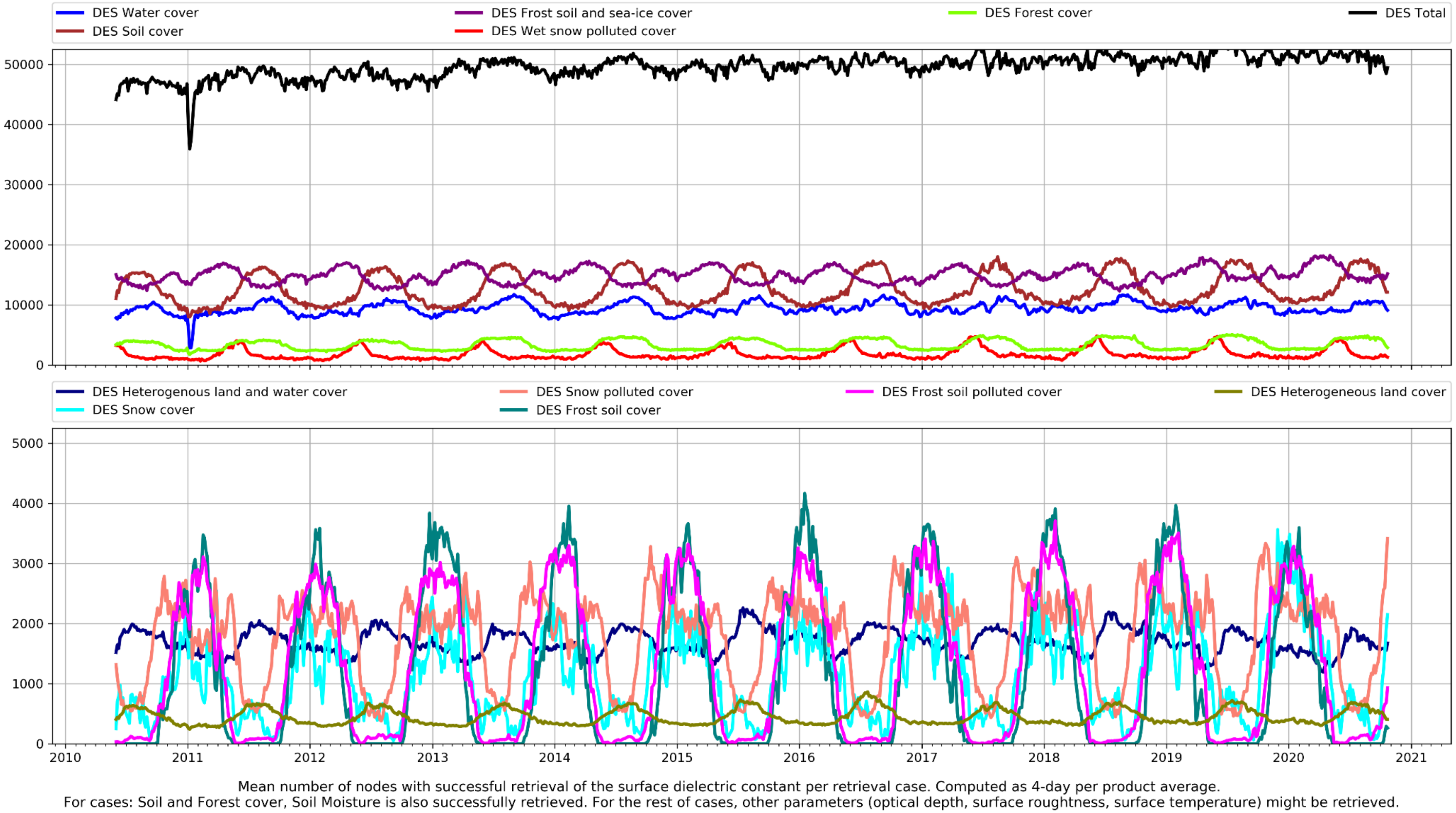


Figure 52: L2SM v650 Mean Retrievals Absolute - DES

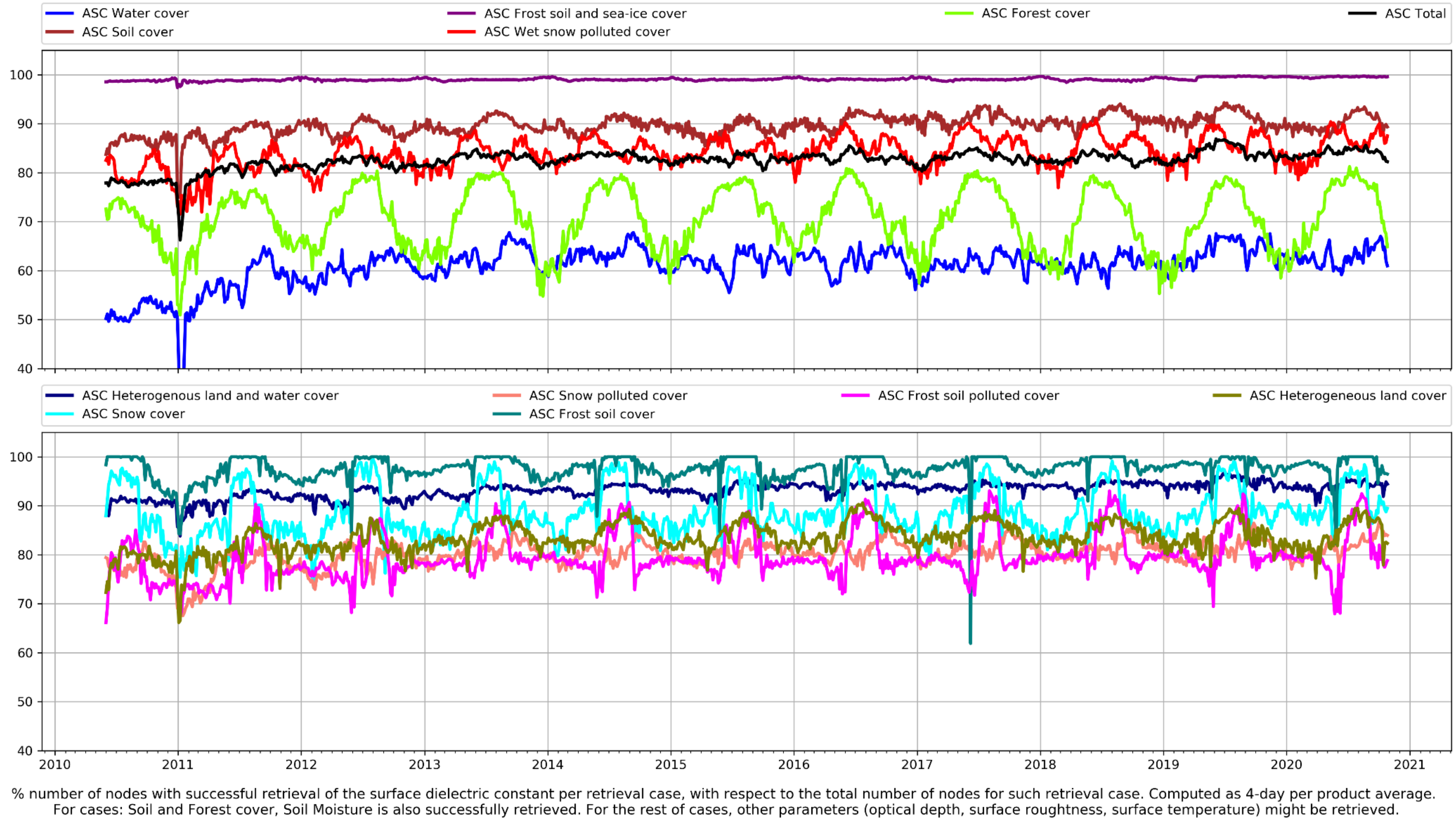
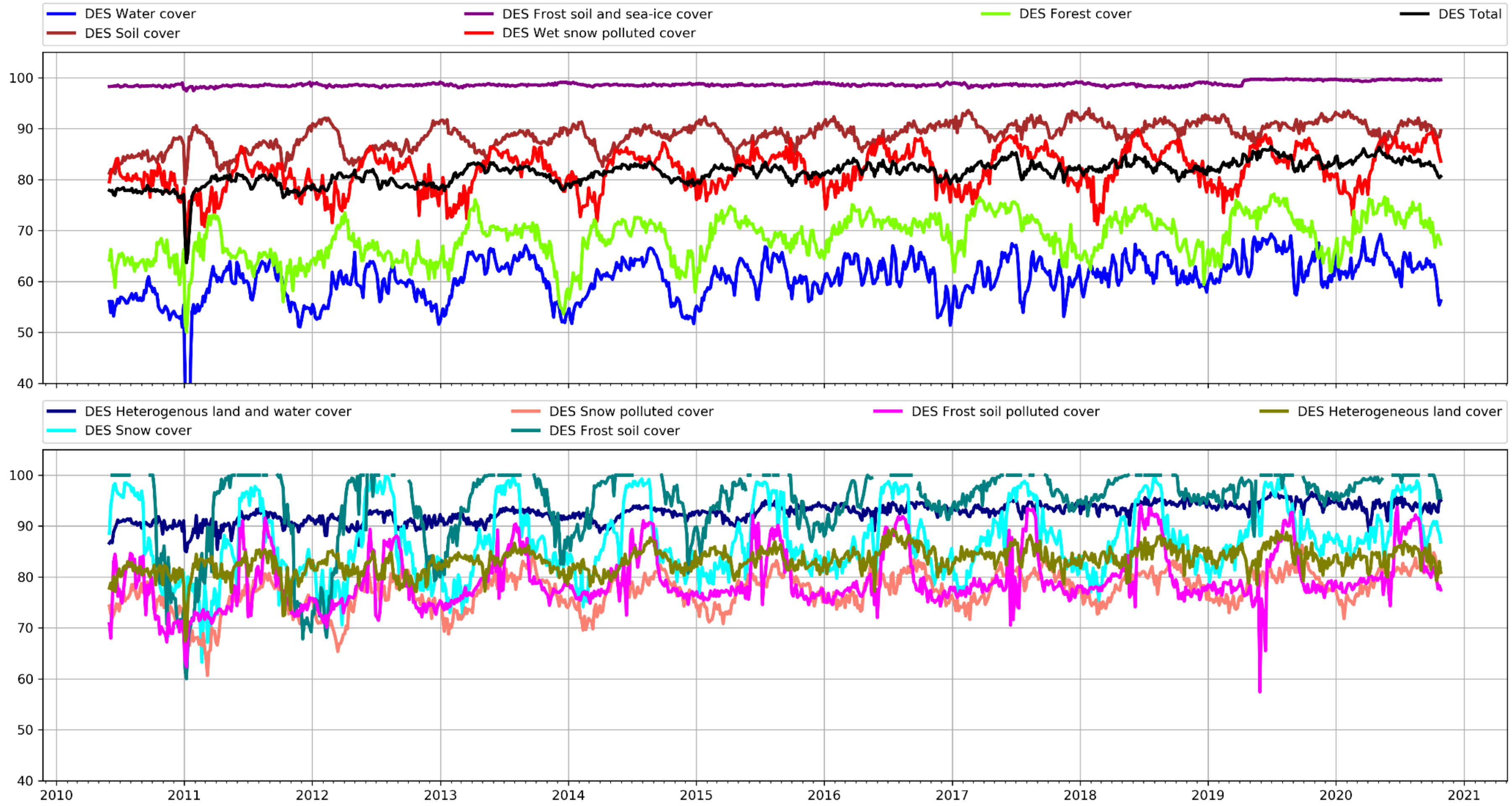


Figure 53: L2SM v650 Mean Retrievals Relative - ASC



% 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 roughness, surface temperature) might be retrieved.

Figure 54: L2SM v650 Mean Retrievals Relative - DES

5.8 Pi-MEP: SSS Time series with Argo Buoys.

This section presents the systematic analysis of the Sea Surface Salinity difference between SMOS Level 2 measurements and in-situ (Argo buoys) measurements, specifically the time series of the monthly median and standard deviation of them from the SMOS Pi-MEP. For more information about the match-up database used to derive the differences please see the full monthly report from the SMOS Pilot-Mission Exploitation Platform for SSS available here (https://pimep.ifremer.fr/diffusion/smos-l2-v662_monthly-update/).

SMOS Pi-MEP is a project funded by ESA focused on validation of various satellite derived SSS products. The project gathers together European expertise groups (IFREMER, OceanDataLab, OceanScope) as well as NASA Expert Laboratories. For more detail on the project, please visit the SMOS Pilot-Mission Exploitation Platform (Pi-MEP).

Ascending and Descending Orbits.

For Figure 55:

- The *top panel* shows the time series of the monthly median SSS estimated over the full Global Ocean Pi-MEP region for both SMOS SSS L2 v662 satellite SSS product (in black) and the Argo in situ dataset (in blue) at the collected Pi-MEP match-up pairs.
- The *middle panel* shows the time series of the monthly median of ΔSSS (Satellite - Argo) for the collected Pi-MEP match-up pairs and estimated over the full Global Ocean Pi-MEP region.
- The *bottom panel* shows the time series of the monthly standard deviation of the ΔSSS (Satellite - Argo) for the collected Pi-MEP match-up pairs and estimated over the full Global Ocean Pi-MEP region.

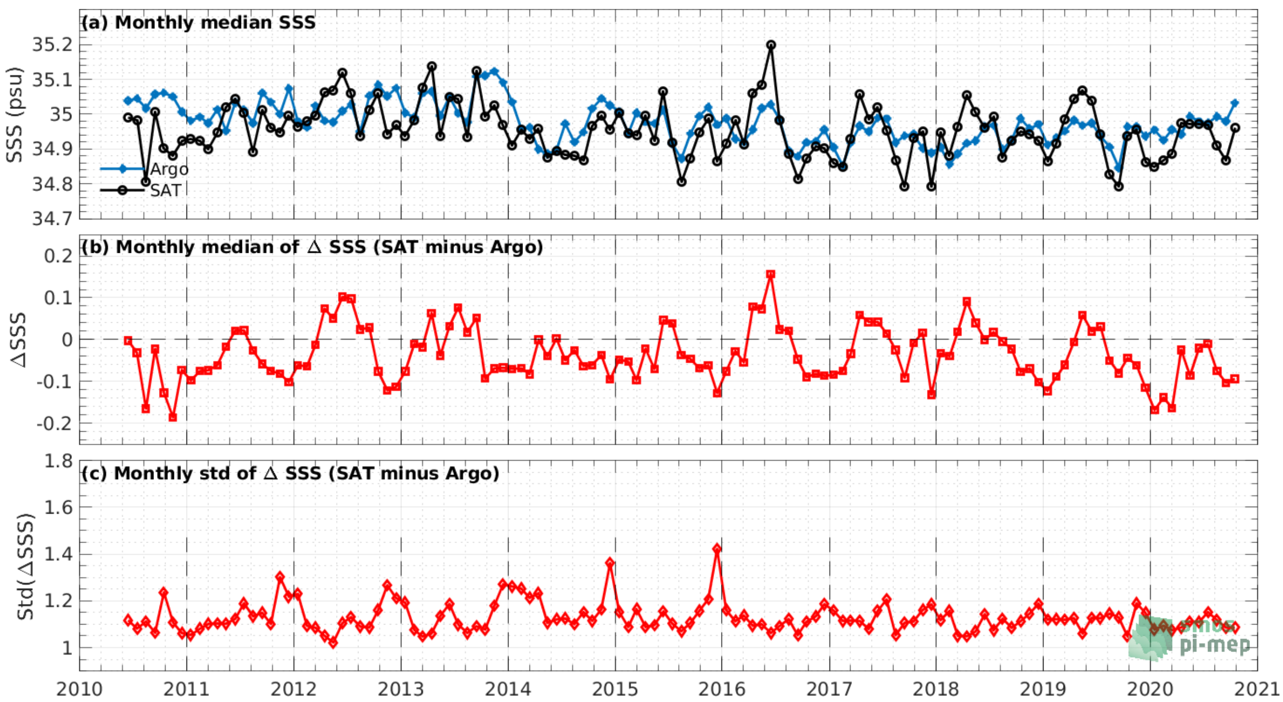


Figure 55 - Time series of the monthly median SSS (top), median of ΔSSS (Satellite - Argo) and Std of ΔSSS (Satellite - Argo) over the Global Ocean Pi-MEP region considering all match-ups collected by the Pi-MEP.

Ascending Orbits

For **Error! Reference source not found.**:

- The *top panel* shows the time series of the monthly median SSS estimated over the full Global Ocean Pi-MEP region for both SMOS SSS L2 v662 satellite SSS product (in black) and the Argo in situ dataset (in blue) at the collected Pi-MEP match-up pairs.
- The *middle panel* shows the time series of the monthly median of ΔSSS (Satellite - Argo) for the collected Pi-MEP match-up pairs and estimated over the full Global Ocean Pi-MEP region.
- The *bottom panel* shows the time series of the monthly standard deviation of the ΔSSS (Satellite - Argo) for the collected Pi-MEP match-up pairs and estimated over the full Global Ocean Pi-MEP region.

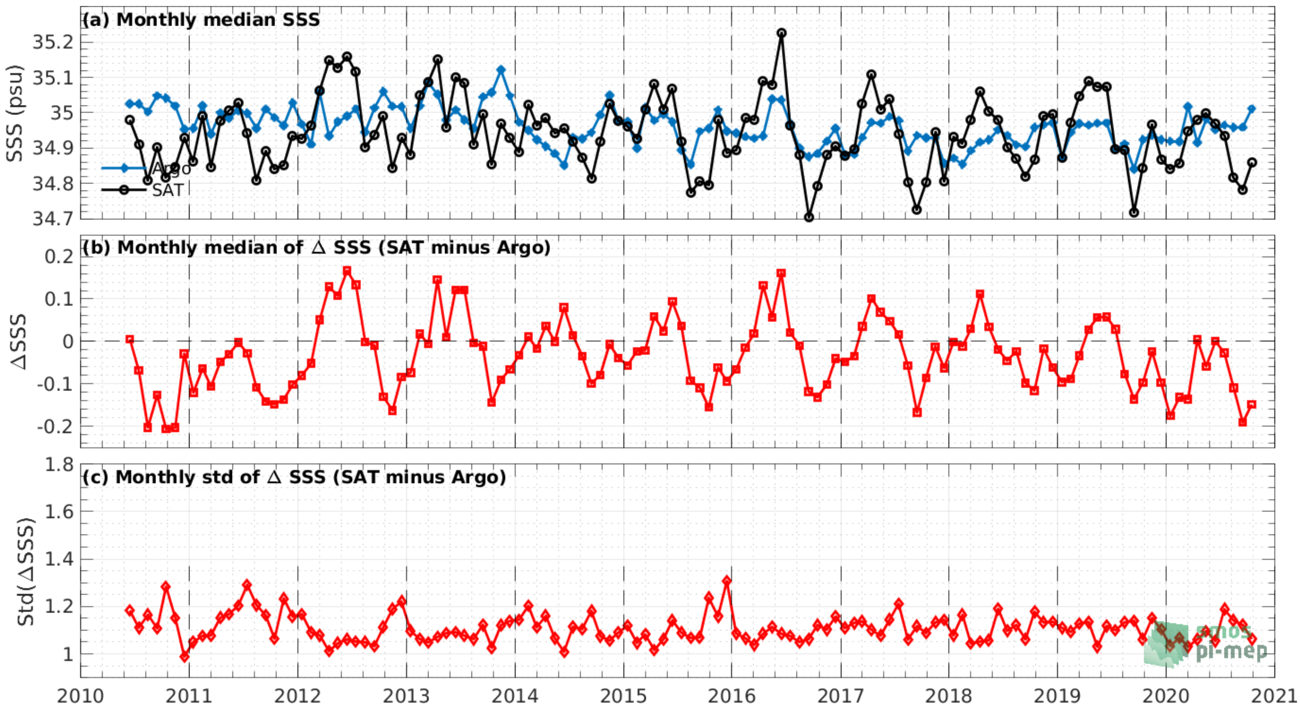


Figure 56 - Time series of the monthly median SSS (top), median of ΔSSS (Satellite - Argo) and Std of ΔSSS (Satellite - Argo) over the Global Ocean Pi-MEP region considering only ascending orbits from all match-ups collected by the Pi-MEP.

Descending Orbits

For Figure 57:

- The *top panel* shows the time series of the monthly median SSS estimated over the full Global Ocean Pi-MEP region for both SMOS SSS L2 v662 satellite SSS product (in black) and the Argo in situ dataset (in blue) at the collected Pi-MEP match-up pairs.
- The *middle panel* shows the time series of the monthly median of ΔSSS (Satellite - Argo) for the collected Pi-MEP match-up pairs and estimated over the full Global Ocean Pi-MEP region.
- The *bottom panel* shows the time series of the monthly standard deviation of the ΔSSS (Satellite - Argo) for the collected Pi-MEP match-up pairs and estimated over the full Global Ocean Pi-MEP region.

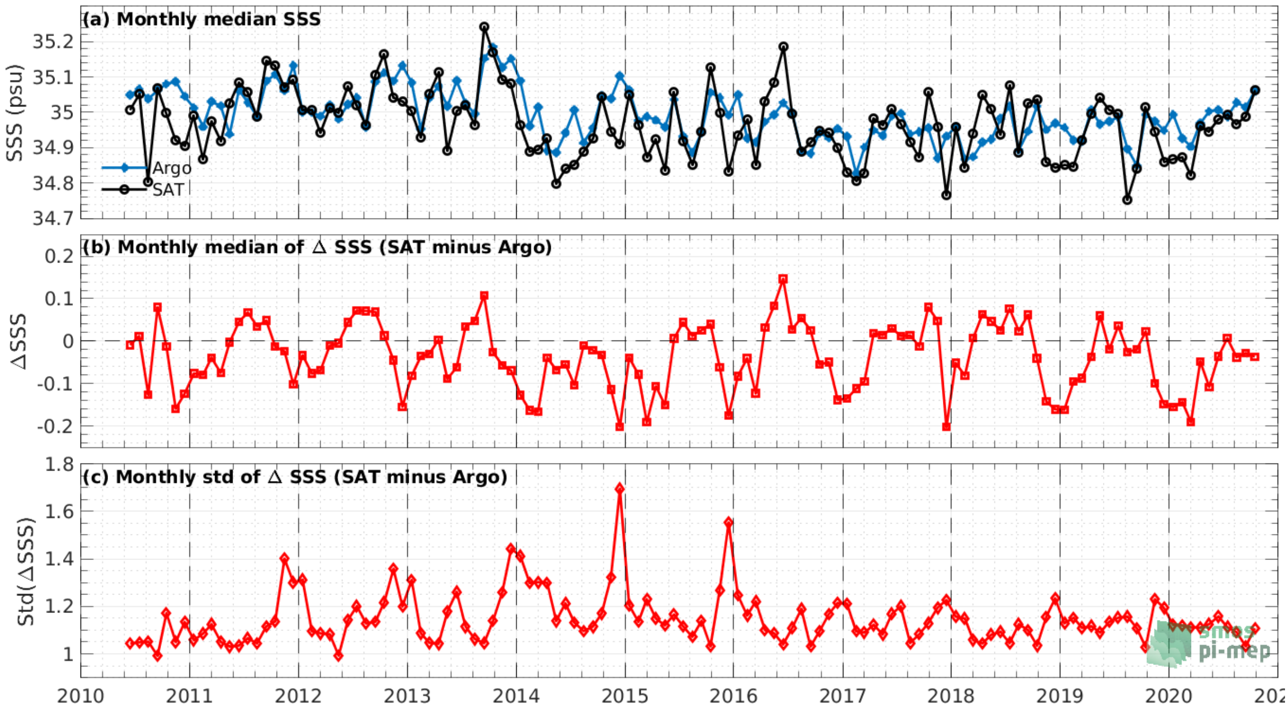


Figure 57 - Time series of the monthly median SSS (top), median of ΔSSS (Satellite - Argo) and Std of ΔSSS (Satellite - Argo) over the Global Ocean Pi-MEP region considering only descending orbits from all match-ups collected by the Pi-MEP.

6. PRODUCT QUALITY ANALYSIS

Level 1 data quality for October 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 October 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
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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
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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 **SM_OPER_AUX_CNFOSF_20201028T000000_20201128T000000_001_030_3.EEF** **SM_OPER_AUX_CNFOSF_20210118T000000_20210222T000000_001_030_3.EEF**	**Yes**
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_DFFLAI	**SM_OPER_AUX_DFFLAI_20210101T000000_20210111T014000_600_001_3** **SM_OPER_AUX_DFFLAI_20210111T000000_20210121T014000_600_001_3** **SM_OPER_AUX_DFFLAI_20210121T000000_20210203T014000_600_001_3** **SM_OPER_AUX_DFFLAI_20210203T000000_20210213T014000_600_001_3** **SM_OPER_AUX_DFFLAI_20210213T000000_20210223T014000_600_001_3** **SM_OPER_AUX_DFFLAI_20210223T000000_20210302T014000_600_001_3** **SM_OPER_AUX_DFFLAI_20210302T000000_20210312T014000_600_001_3** **SM_OPER_AUX_DFFLAI_20210312T000000_20210322T014000_600_001_3** **SM_OPER_AUX_DFFLAI_20210322T000000_20210402T014000_600_001_3** **SM_OPER_AUX_DFFLAI_20210402T000000_20210412T014000_600_001_3** **SM_OPER_AUX_DFFLAI_20210412T000000_20210422T014000_600_001_3** **SM_OPER_AUX_DFFLAI_20210422T000000_20210501T014000_600_001_3** **SM_OPER_AUX_DFFLAI_20210501T000000_20210511T014000_600_001_3** **SM_OPER_AUX_DFFLAI_20210511T000000_20210521T014000_600_001_3** **SM_OPER_AUX_DFFLAI_20210521T000000_20210601T014000_600_001_3** **SM_OPER_AUX_DFFLAI_20210601T000000_20210611T014000_600_001_3** **SM_OPER_AUX_DFFLAI_20210611T000000_20210621T014000_600_001_3** **SM_OPER_AUX_DFFLAI_20210621T000000_20210630T014000_600_001_3** **SM_OPER_AUX_DFFLAI_20210630T000000_20210710T014000_600_001_3** **SM_OPER_AUX_DFFLAI_20210710T000000_20210720T014000_600_001_3** **SM_OPER_AUX_DFFLAI_20210720T000000_20210730T014000_600_001_3** **SM_OPER_AUX_DFFLAI_20210730T000000_20210809T014000_600_001_3** **SM_OPER_AUX_DFFLAI_20210809T000000_20210819T014000_600_001_3** **SM_OPER_AUX_DFFLAI_20210819T000000_20210829T014000_600_001_3** **SM_OPER_AUX_DFFLAI_20210829T000000_20210909T014000_600_001_3** **SM_OPER_AUX_DFFLAI_20210909T000000_20210919T014000_600_001_3** **SM_OPER_AUX_DFFLAI_20210919T000000_20210929T014000_600_001_3** **SM_OPER_AUX_DFFLAI_20210929T000000_20211008T014000_600_001_3** **SM_OPER_AUX_DFFLAI_20211008T000000_20211018T014000_600_001_3** **SM_OPER_AUX_DFFLAI_20211018T000000_20211028T014000_600_001_3** **SM_OPER_AUX_DFFLAI_20211028T000000_20211108T014000_600_001_3** **SM_OPER_AUX_DFFLAI_20211108T000000_20211118T014000_600_001_3** **SM_OPER_AUX_DFFLAI_20211118T000000_20211128T014000_600_001_3** **SM_OPER_AUX_DFFLAI_20211128T000000_20211207T014000_600_001_3** **SM_OPER_AUX_DFFLAI_20211207T000000_20211217T014000_600_001_3** **SM_OPER_AUX_DFFLAI_20211217T000000_20220101T014000_600_001_3**	**Yes**

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AUX_DFFXYZ	SM_OPER_AUX_DFFXYZ_20050101T000000_20500101T000000_001_003_3	No
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AUX_DISTAN	SM_OPER_AUX_DISTAN_20050101T000000_20500101T000000_001_011_3	No
AUX_DTBCUR	SM_OPER_AUX_DTBCUR_20200107T195122_20500101T000000_625_001_8 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
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AUX_GAL_SM	SM_OPER_AUX_GAL_SM_20050101T000000_20500101T000000_001_003_3	No
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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__20200107T195122_20500101T000000_625_001_8 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__20200107T195122_20500101T000000_625_001_8 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__20200107T195122_20500101T000000_625_001_8 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__20200107T195122_20500101T000000_625_001_8 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__20200107T195122_20500101T000000_625_001_8 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__20200107T195122_20500101T000000_625_001_8 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_440_001_1.EEF	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_v2.05_SMOS_Auxiliary_Data_File_List_20201027_signed.pdf

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