SWOT Nadir GDR
Synthetic cyclical Cal/Val report

Cycle 030

2025-03-17 07:21:05 to 2025-04-07 04:06:09

Processing Baseline S v2.01

Reference: SALP-RP-MAO-OP-17755-CN-030

Nomenclature: SWOT Nadir GDR Synthetic cyclical Cal/Val report

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1 Introduction

SWOT (Surface Water Ocean Topography) is a joint project including NASA, CNES, the Canadian Space Agency and the UK Space Agency. The SWOT satellite carries onboard a wide-swath altimeter-interferometer in Ka-Band (KaRIn), a classical nadir-looking altimeter, as well as the usual complement on altimetry satellites: precise location systems and radiometer.

The SWOT Nadir Quality Assessment reports are generated under SALP contract supported by CNES at the CLS Environment & Climate Business Unit.

A detailed description of the mission is available on AVISO website (https://www.aviso.altimetry.fr/en/missions/current-missions/swot.html). Products description can be found in the SWOT Level-2 Nadir Altimeter products User Guide (https://www.aviso.altimetry.fr/fileadmin/documents/data/tools/SALP-ST-M-EA-17043-CN_0104.pdf) and dataset standards are described in Jason-3 GDR-F user handbook (https://www.aviso.altimetry.fr/fileadmin/documents/data/tools/hdbk_j3.pdf).

Since cycle 029, SWOT NALT Geophysical Data Record (GDR) datasets has transitioned from Version F 1.04 to Version S 2.01. Information about this change can be found here (https://www.aviso.altimetry.fr/en/news/front-page-news/news-detail.html?tx_ttnews%5Btt_news%5D=3084) with a dedicated release note (https://www.aviso.altimetry.fr/fileadmin/documents/data/tools/SWOT_L2_GDR_NALT_VersionS_Release_Note_20250516.pdf).

The purpose of this document is to report the major features of the data quality from the SWOT Nadir mission over ocean. The objectives are to:

- Provide a data quality assessment
- Provide users with necessary information for data processing
- Report any change likely to impact data quality at any level, from instrument status to software configuration
- Present the major useful results for this cycle.

2 Cycle overview

This document reports results from SWOT Nadir GDRs over **cycle 030, spanning from 2025-03-17 07:21:05 to 2025-04-07 04:06:09.**

This cycle has been produced with the Processing Baseline S v2.01, and the processing software references L1 library=V6.2p1, L2 library=V7.2p1p3, Processing Pilot=5.2.6.

581 netCDF pass files are provided over the 584 expected (passes 037(pass lost), 510 and 511(SSR Anomaly) are missing).

SWOT Nadir is able to track data with several onboard tracker modes: POSEIDON-3C instrument implements three main tracking modes:

- The autonomous acquisition and tracking mode (M1),
- The DIODE acquisition and autonomous tracking mode (M2),
- The DIODE & DEM mode (M3).

and certain automatic transitions can also be authorized by the user, as is the case in M4 to M4bis modes. Over cycle 030, SWOT Nadir altimeter (POS-3C) operates in DIODE + DEM tracking with auto transition and direct transition from Open Loop to Close Loop (=M4bis mode) mode.

Users are advised of the following known limitations in the dataset:

- The adaptive retracker has not yet been calibrated, so the adaptive retracker variables should be used with caution.

Over this cycle, the following specific events happened :

- CNG calibration for pass 193 on 2025-03-24 from 04:15:00 to 04:48:03.
- OCM SLOT for passes 499 and 500 on 2025-04-04 from 03:12:39 to 03:49:43.

The main metric that describes the data quality is the one derived from the analysis of sea surface variability at crossovers. Using a selection to remove shallow waters (1000 m), areas of high ocean variability and high latitudes (> |50°|), the crossover standard deviation over the cycle is 4.87 cm for SWOT Nadir MLE4. This first metric is in line with usual values that are obtained on altimetry mission.

Summary of the main performances are listed in the table 1:

Cycle 030	**MLE4**	**Adaptive**
Percentage of missing measurements over open ocean	**0.98%**	
Percentage of rejected measurements over open ocean	**16.50%**	**15.72%**
of which rejected due to sea ice	**13.93%**	
of which rejected with threshold verification (after land and ice removed)	**2.57%**	**1.79%**
Crossover standard deviation on geographical selection	**4.87cm**	**5.00cm**

Table 1: Summary of cycle 030 performances over open ocean.

3 Data coverage and edited measurement

This section presents results that illustrate data quality over this cycle. These products' verifications are produced operationally, to allow long-term monitoring of missing and edited measurements.

3.1. Data coverage

The map below (Figure 1) illustrates 1Hz missing measurements relative to the satellite nominal ground track for SWOT Nadir GDR dataset.

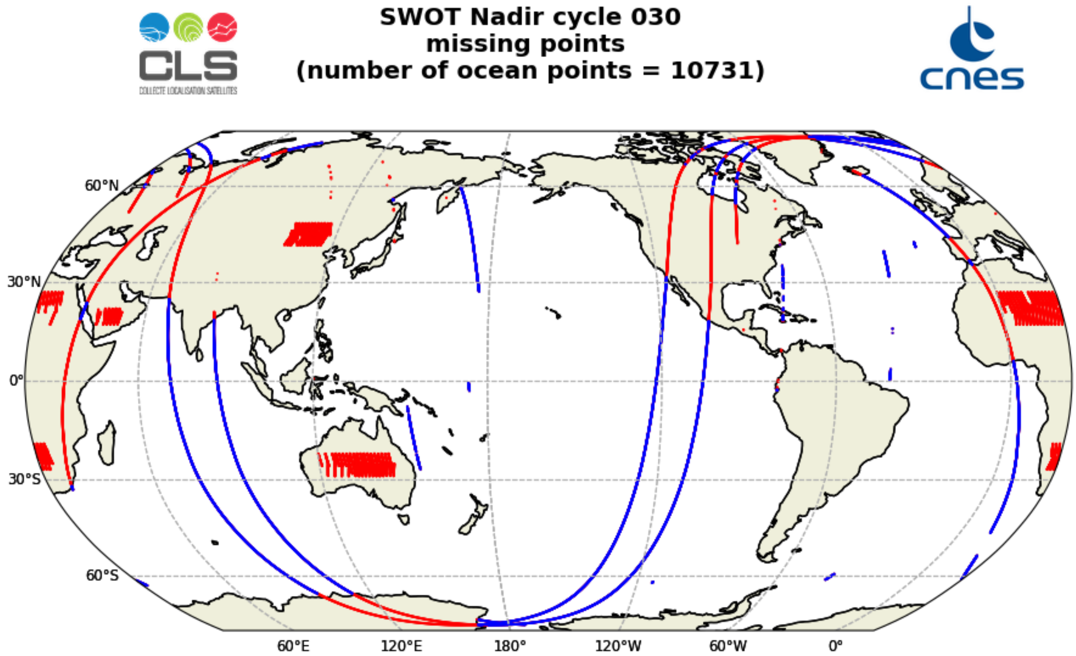


Figure 1: Map of missing measurements for SWOT Nadir GDR cycle 030

Over this cycle, there are missing data over ocean for :

- passes 034 to 038 on 2025-03-18 from 11:50:27 to 15:13:38 with respectively **6.60 %, 8.01 %, 84.62 %, 100.00 % and 14.92 %** of missing data over ocean due to multiple PLTM gaps at Kiruna [KRX] station.
- pass 126 on 2025-03-21 from 18:38:14 to 19:16:31 : **82.02 %** over ocean due to gaps in the received pass at Inuvik [IVB] station.
- pass 140 on 2025-03-22 from 06:40:16 to 06:50:00 : **21.96 %** over ocean due to multiple PLTM gaps at Kiruna [KRX] station.
- pass 193 on 2025-03-24 from 04:15:01 to 04:48:02 : **19.31 %** over ocean due to the CNG calibration.
- passes 224 and 225 on 2025-03-25 from 06:42:55 to 07:33:23 : **1.63 % and 1.36 %** over ocean due to multiple PLTM gaps at Kiruna [KRX] station.
- pass 337 on 2025-03-29 from 08:04:56 to 08:05:22 : **0.98 %** over ocean due to a SSR anomaly.
- passes 476 and 477 on 2025-04-03 from 06:43:38 to 08:07:07 : **12.11 % and 8.26 %** over ocean data due to multiple PLTM gaps at Kiruna [KRX] station.

- pass 481 on 2025-04-03 from 11:02:50 to 11:25:55 : **0.40 %** over ocean due to multiple PLTM gaps at Kiruna [KRX] station.
- passes 509 to 512 on 2025-04-04 from 11:34:08 to 13:41:04 : **12.67 %, 100.00 %, 100.00 % and 16.86 %** over ocean due to a SSR anomaly.

The monitoring of the percentage of missing measurements is represented in Figure 2. Values have been computed over ocean for each track of the cycle. The mean percentage is equal to **0.98 %** over the complete cycle.

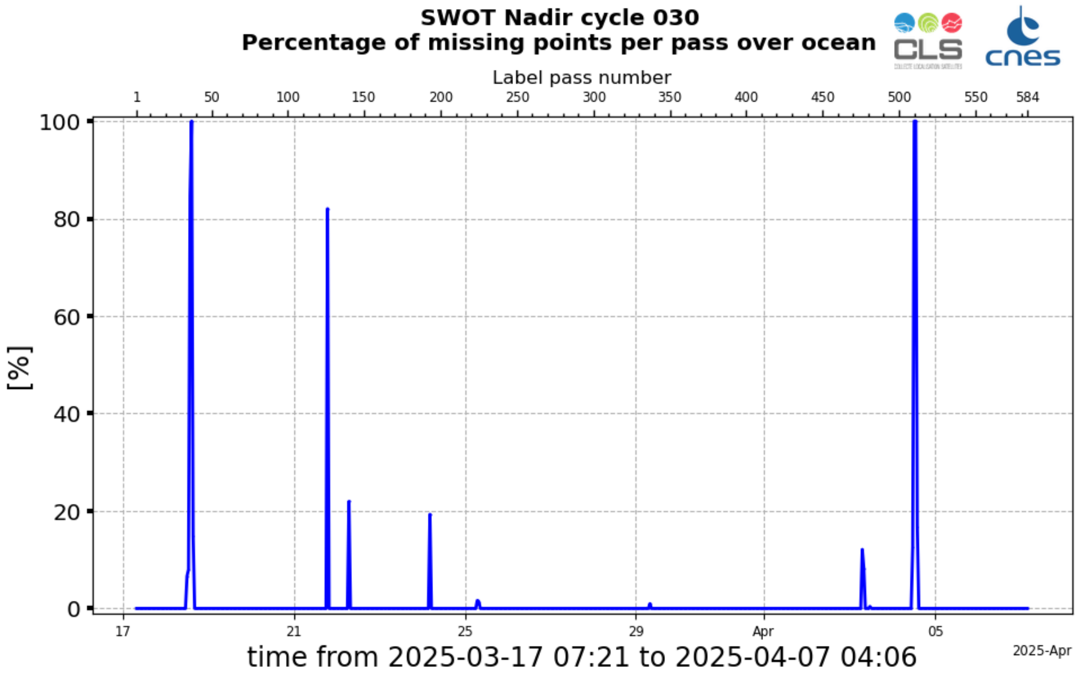


Figure 2: Monitoring of the percentage per pass of missing data over ocean, for SWOT Nadir GDR cycle 030

3.2. Edited measurements

The editing criteria are defined as minimum and maximum thresholds for various parameters. Measurements are edited if at least one parameter does not lie within the thresholds. These thresholds are expected to remain constant throughout SWOT Nadir mission, so that monitoring the number of edited measurements allows a survey of data quality.

The percentage of points removed by each criterion is given in the table 2. These percentages also include points with undefined values. Note that these statistics are obtained with measurements over ocean only (using surface_classification_flag) and already edited by ice flag (using ice_flag).

The percentage of measurements with sea ice is of **13.93 %** (2.24 % when limited to ocean at |latitude|<66°) .

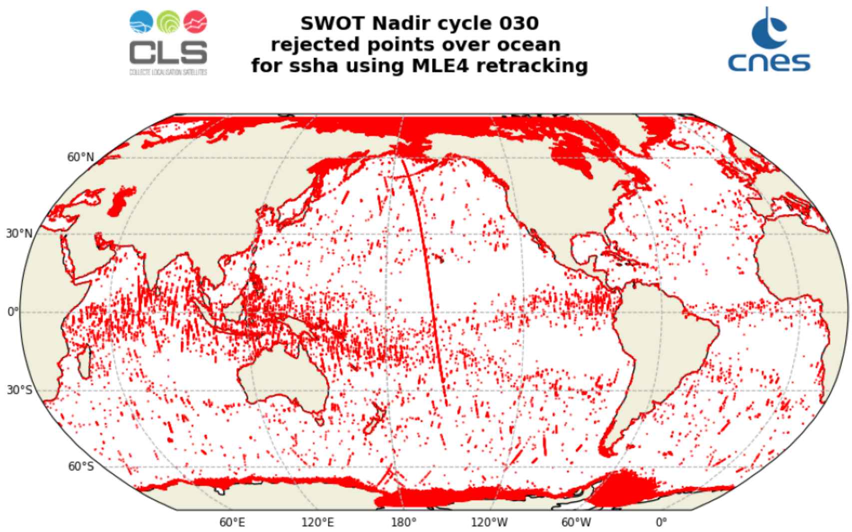
Parameters	Thresholds		Rejected	
	Minimun	Maximum	MLE4	Adaptive
sea surface height anomaly	-2 m	2 m	1.70 %	0.84 %
sea surface height	-130 m	100 m	0.52 %	0.08 %
square off nadir angle	-0.2 deg^2	0.64 deg^2	0.44 %	0.44 %
swh	0 m	11 m	0.44 %	0.04 %
range number	10	20	0.66 %	0.25 %
range std	0 m	0.2 m	1.31 %	0.85 %
sigma0	7 dB	30 dB	0.43 %	0.36 %
sigma0 number	10	20	0.66 %	0.23 %
sigma0 std	0 dB	1 dB	1.33 %	1.04 %
wind speed	0 m/s	30 m/s	0.91 %	0.66 %
sea state bias	-0.5 m	0 m	0.40 %	0.01 %
ionospheric correction	-0.4 m	0.04 m	0.77 %	0.66 %
radiometer wtc	-0.5 m	-0.001 m	0.22 %	0.22 %
dry tropospheric correction	-2.5 m	-1.9 m	0.00 %	0.00 %
dynamical atmospheric correction	-2 m	2 m	0.00 %	0.00 %
ocean tide height	-5 m	5 m	0.00 %	0.00 %
internal tide	-5 m	5 m	0.00 %	0.00 %
pole tide height	-15 m	15 m	0.00 %	0.00 %
solid earth tide height	-1 m	1 m	0.00 %	0.00 %
Global statistics of edited measurements by thresholds			2.57 %	1.79 %

Table 2: Table of parameters used for editing and the corresponding percentages of edited measurements for each parameter for SWOT Nadir MLE4 and Adaptive, over cycle 030

The measurements rejected during the editing process are shown on the maps below, for MLE4 and Adaptive data (Figure 3). Equatorial wet zones or zones with sea ice appear on the maps as regions with less valid data, as it is also the case for other altimeters: measurements are corrupted by rain or sea ice. They were therefore removed by editing.

Over this cycle, one part of pass is rejected over ocean:

- pass 500 on 2025-04-04 from 03:20:31 to 04:01:01 : **54.07 %** due to undefined retracking outputs and radiometer wet tropospheric correction because of an OCM SLOT maneuver.



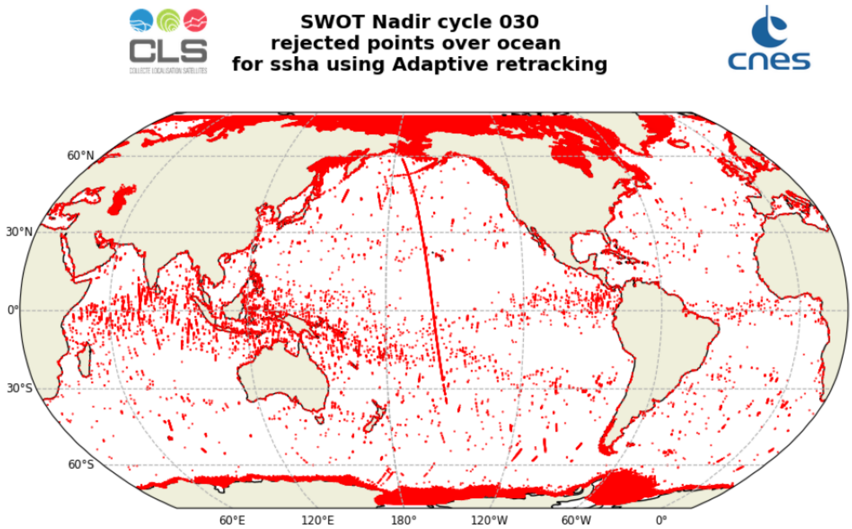


Figure 3: Edited measurements for SWOT Nadir over cycle 030

4 Geophysical parameter analysis

The monitoring of instrumental and geophysical parameters is crucial to detect potential drifts or jumps in long-term time series. These verifications are produced operationally to allow systematic monitoring of the main relevant parameters. When possible, comparisons with ERA5 model data and/or with Sentinel-6A-MF data are performed. Note that Sentinel-6A-MF L2 GDR/NTC standards changed twice to F09 on 10-02-2024 and to G01 on 13-03-2025.

4.1. Significant Wave Height

Ku-band wave estimations derived from altimeter measurements are monitored in this section. Wave height may reach several meters. Normalized histograms over cycle are plotted on the figure below for MLE4 and Adaptive. MLE4 SWH is centered around **2.68** m for MLE4 and **2.63** m for Adaptive. It shows the consistency between the two retrackings. Furthermore, values are coherent with ERA5 model and Sentinel-6A-MF estimations.

SWOT Nadir
Significant Wave Height

	nbr	min	mean	median	max	std
MLE4 from cycle 001	2.668e+07	0.233	2.582	nan	11	1.331
S6A MLE4 over SN cycle 030	1.179e+06	0	2.796	2.479	11	1.381
ERA5 over cycle 030	9.065e+05	0.094	2.561	2.257	10.76	1.262
Adaptive over cycle 030	9.168e+05	0.003	2.625	2.319	11	1.289
MLE4 over cycle 030	9.084e+05	0.233	2.683	2.379	11	1.329

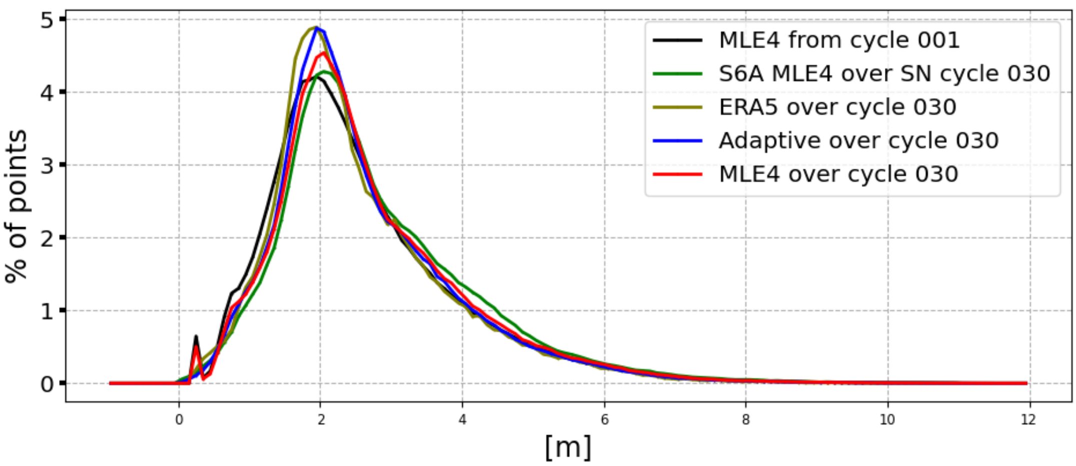


Figure 4: Ku-band Significant Wave Height histogram computed over cycle 030 (red line for SWOT Nadir MLE4 and blue line for SWOT Nadir Adaptive, green for Sentinel-6A-MF (LR MLE4) and dark green for ERA5) and from cycle 001 (SWOT Nadir, MLE4 only, black line)

Maps are plotted for MLE4 data separating ascending and descending passes (top Figure 5). Comparisons to ERA5 (middle) and Adaptive (bottom) are also shown on blue/red maps of Figure 5.

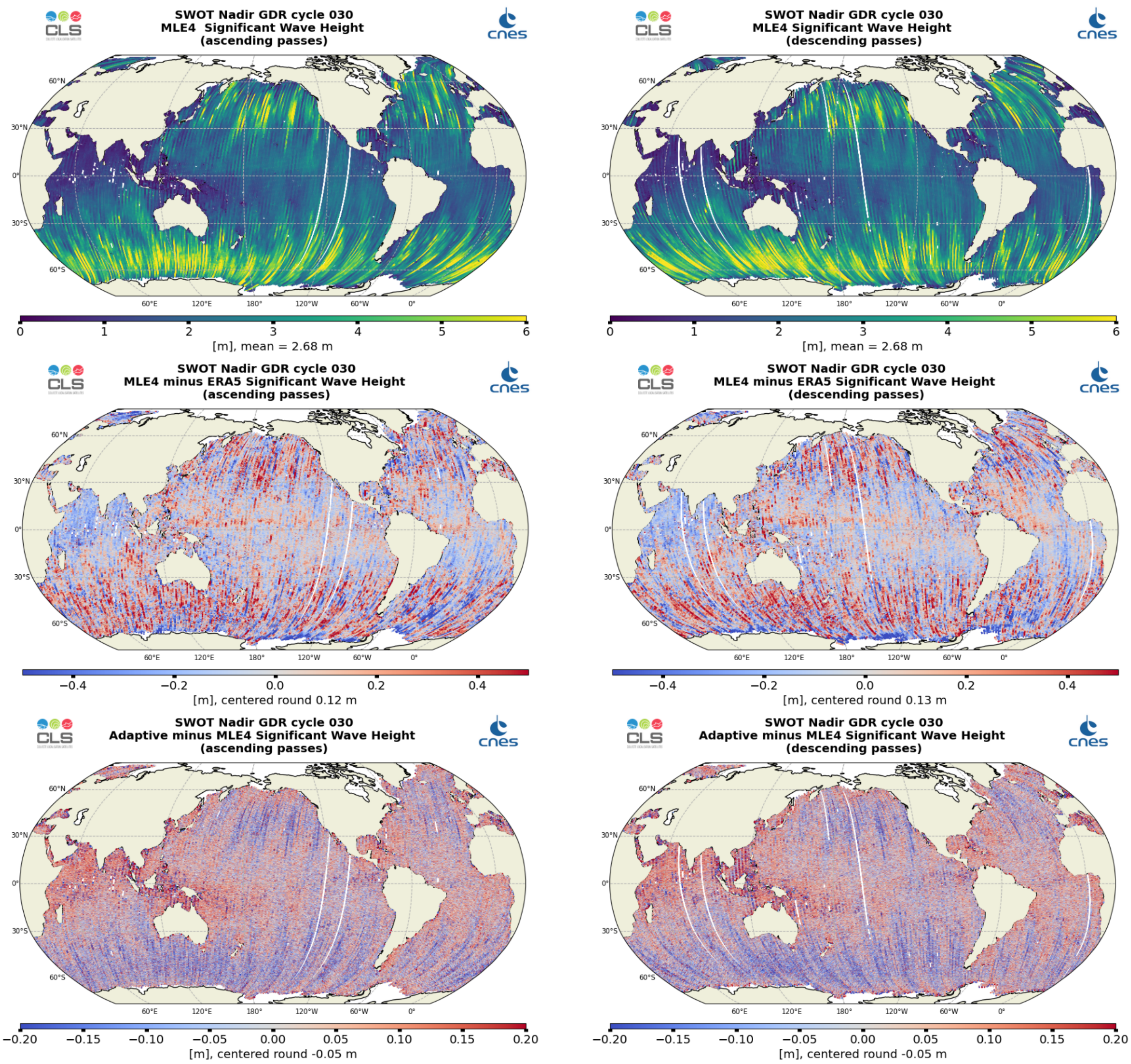


Figure 5: Along-track maps of Ku-band Significant Wave Height over cycle 030 for SWOT Nadir MLE4 (top), MLE4 minus model (middle) or Adaptive minus MLE4 (bottom), ascending passes (left) and descending passes (right)

The daily average of Ku-band SWH for SWOT Nadir is plotted on Figure 6 from cycle 001. It shows the similar features between SWOT Nadir and ERA5 waves, both for MLE4 and Adaptive, and with Sentinel-6A-MF (despite Sentinel-6A and SWOT are not looking at exactly the same ocean).

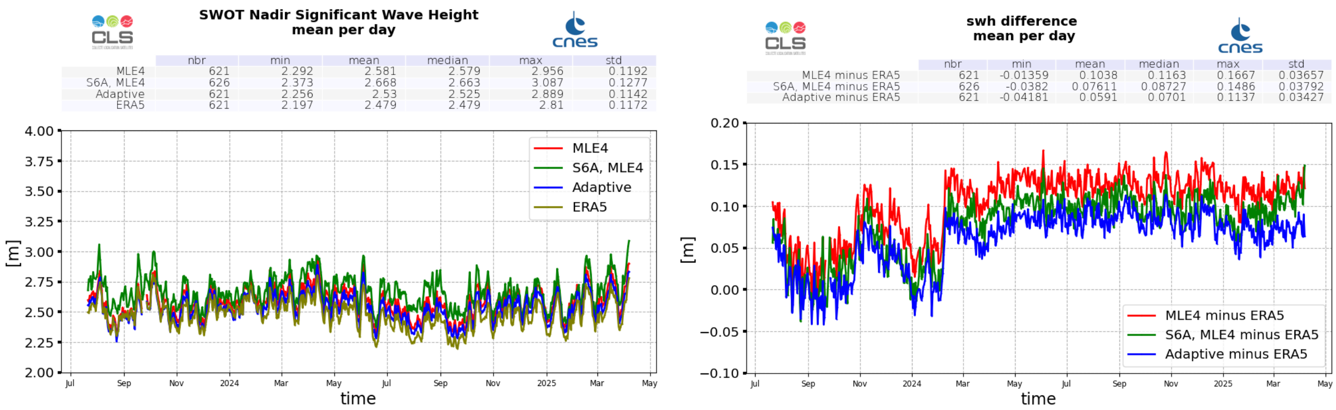
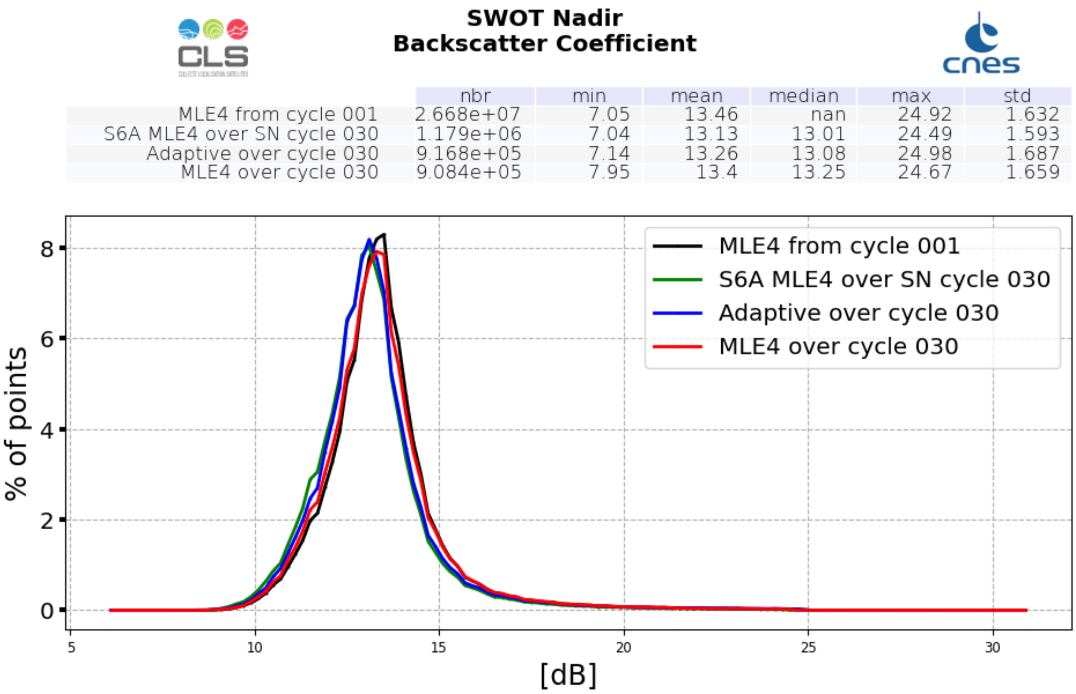


Figure 6: Ku-band Significant Wave Height daily monitoring from cycle 001 to 030, for SWOT Nadir, ERA5 model estimated at SWOT locations, and Sentinel-6A-MF (LR MLE4) (left), and difference with ERA5 model (right)

4.2. Backscattering coefficient

Ku-band backscattering coefficient is centered around **13.40** dB for MLE4 and around **13.26** dB for Adaptive (Figure 7). Ku-band backscattering coefficients present similar features between MLE4 and Adaptive, as shown on the maps (Figure 8), and on the daily monitoring (Figure 9).
Maps are plotted for MLE4 data separating ascending and descending passes (top Figure 8). Adaptive minus MLE4 difference (bottom) is also shown on blue/red map of Figure 8.
Sentinel-6A change of processing baseline to F09 implied a +0.91dB jump on 10-02-2024 (green curve on Figure 9).


SWOT Nadir
Backscatter Coefficient

	nbr	min	mean	median	max	std
MLE4 from cycle 001	2.668e+07	7.05	13.46	nan	24.92	1.632
S6A MLE4 over SN cycle 030	1.179e+06	7.04	13.13	13.01	24.49	1.593
Adaptive over cycle 030	9.168e+05	7.14	13.26	13.08	24.98	1.687
MLE4 over cycle 030	9.084e+05	7.95	13.4	13.25	24.67	1.659

Figure 7: Ku-band Backscattering coefficient histogram computed over cycle 030 (red line for SWOT Nadir MLE4 and blue line for SWOT Nadir Adaptive, green for Sentinel-6A-MF (LR MLE4)) and from cycle 001 (SWOT Nadir, MLE4 only, black line)

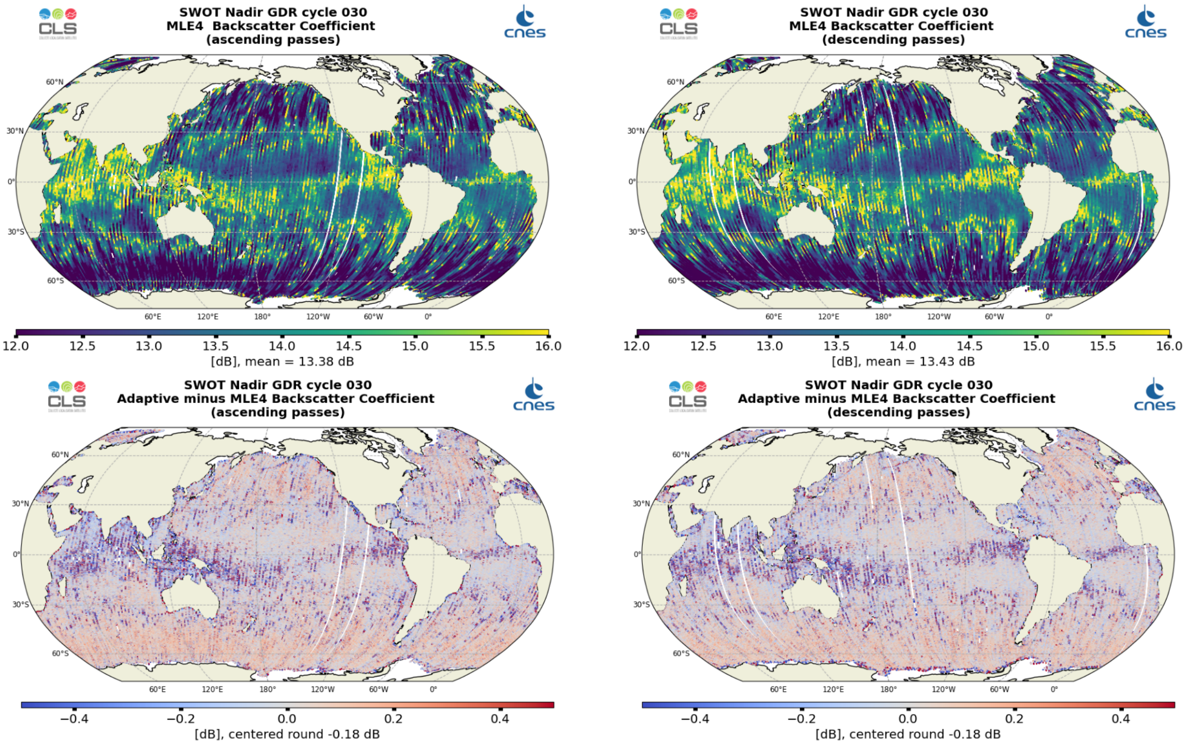
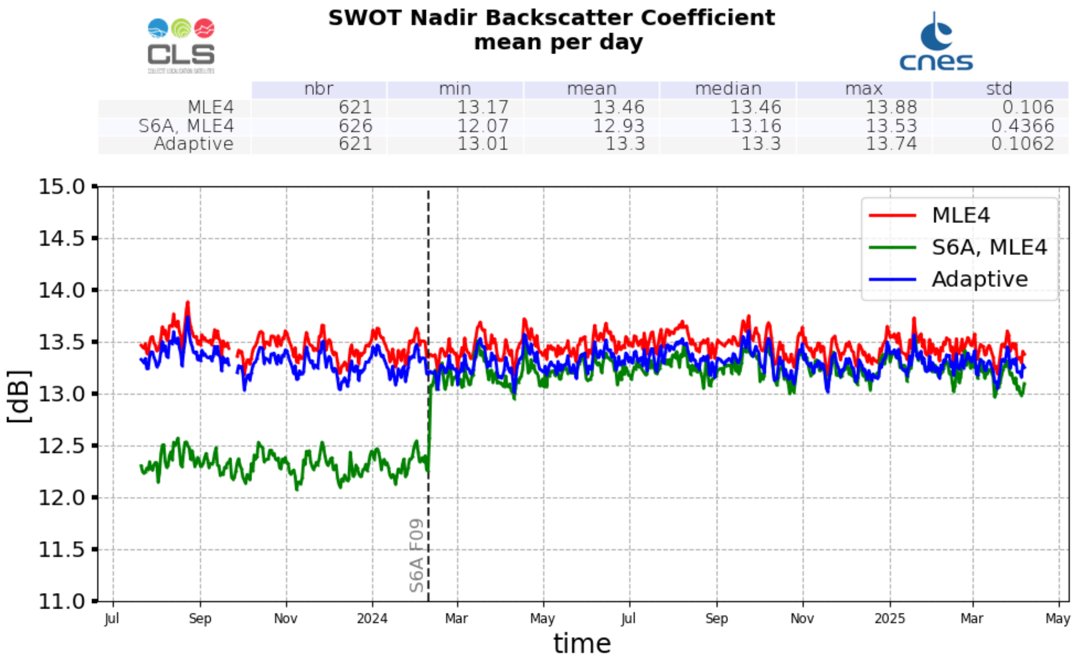


Figure 8: Along-track maps of Ku-band backscatter coefficient sigma0 over cycle 030 for SWOT Nadir MLE4 (top) or Adaptive minus MLE4 difference (bottom), ascending passes (left) and descending passes (right)



	nbr	min	mean	median	max	std
MLE4	621	13.17	13.46	13.46	13.88	0.106
S6A, MLE4	626	12.07	12.93	13.16	13.53	0.4366
Adaptive	621	13.01	13.3	13.3	13.74	0.1062

Figure 9: Ku-band Backscattering coefficient daily monitoring from cycle 001 to 030, for SWOT Nadir and Sentinel-6A-MF

4.3. Altimeter Wind Speed

Altimeter wind speed is derived from backscattering coefficient and significant wave height using Collard algorithm. To allow wind speed computation, a calibration bias is applied on the backscattering coefficient. Since cycle 029, on 2025-02-24, SWOT Nadir change of processing baseline to S 2.01 implied a -0.65 m/s jump due to change on sigma0 bias applied for wind speed computation. As a result, since that change, wind speed estimations are aligned with ERA5 model.

SWOT Nadir Wind Speed

	nbr	min	mean	median	max	std
MLE4 from cycle 001	2.668e+07	0	8.471	nan	27.84	3.804
S6A MLE4 over SN cycle 030	1.179e+06	0	8.092	7.69	27.5	3.705
ERA5 over cycle 030	9.065e+05	0.008	7.8	7.433	24.02	3.65
Adaptive over cycle 030	9.168e+05	0	9.424	9.35	27.8	4.035
MLE4 over cycle 030	9.084e+05	0	7.904	7.53	26.43	3.709

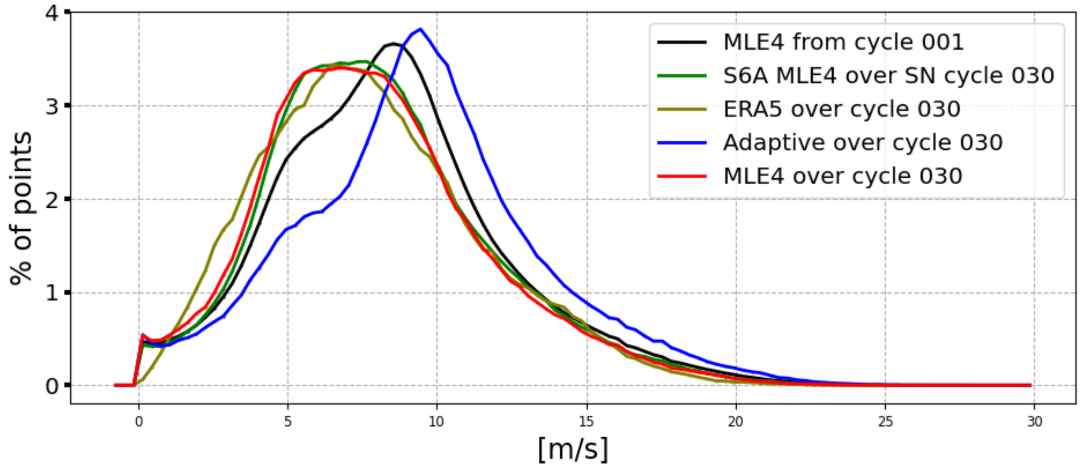


Figure 10: Altimeter Wind Speed histogram computed over cycle 030 (red line for SWOT Nadir MLE4 and blue line for SWOT Nadir Adaptive, green for Sentinel-6A-MF (LR MLE4)) and from cycle 001 (SWOT Nadir, MLE4 only, black line)

Maps are plotted for MLE4 data separating ascending and descending passes (top Figure 11). Comparisons to ERA5 (middle) and Adaptive (bottom) are also shown on blue/red maps of figure 11.

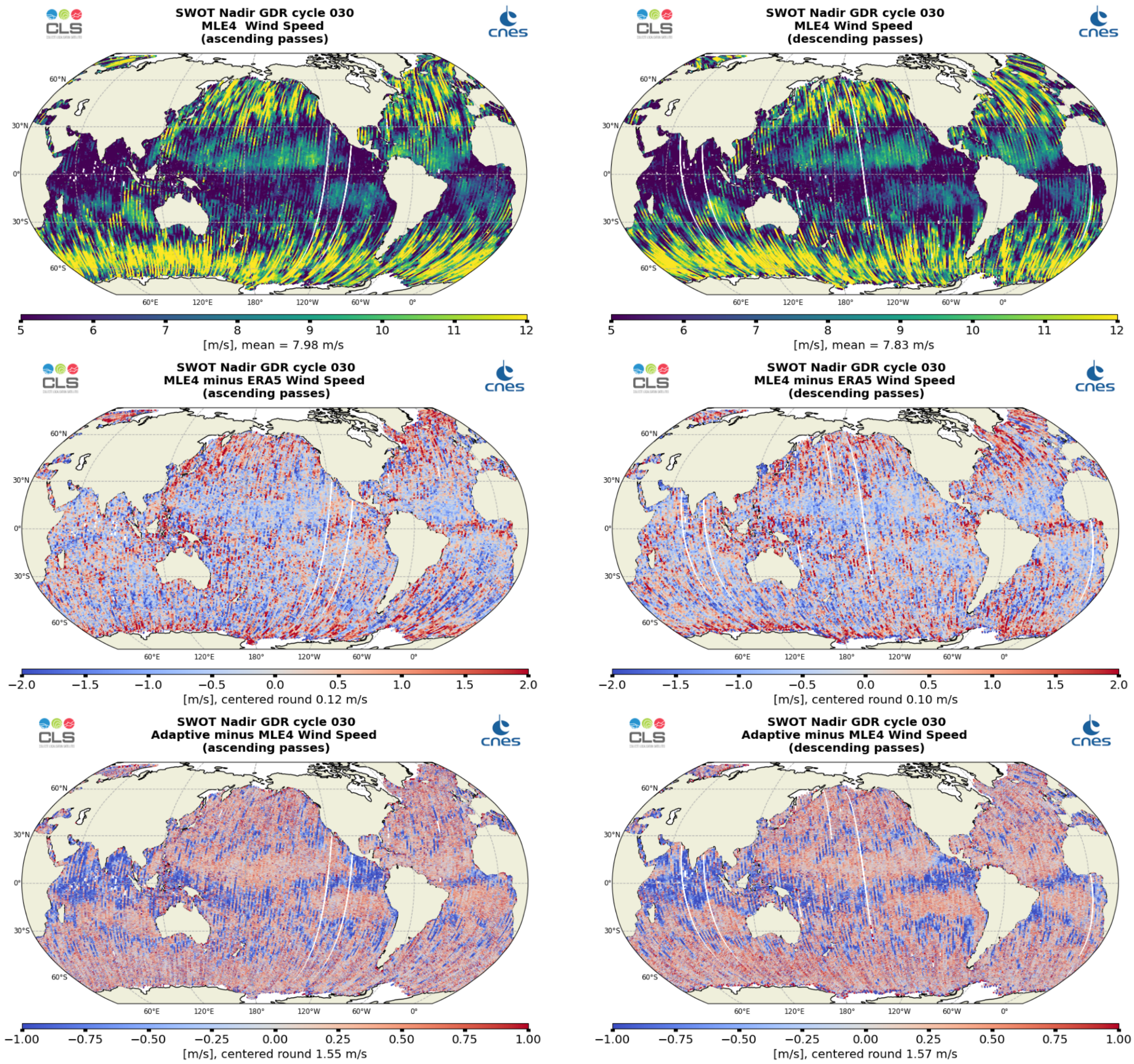


Figure 11: Along-track maps of Altimeter Wind Speed over cycle 030 for SWOT Nadir MLE4 (top), MLE4 minus ERA5 (middle) or Adaptive minus MLE4 (bottom), ascending passes (left) and descending passes (right)

The daily average from cycle 001 shows the wind speed values centered around **8.47** m/s for MLE4 and **9.27** m/s for Adaptive.

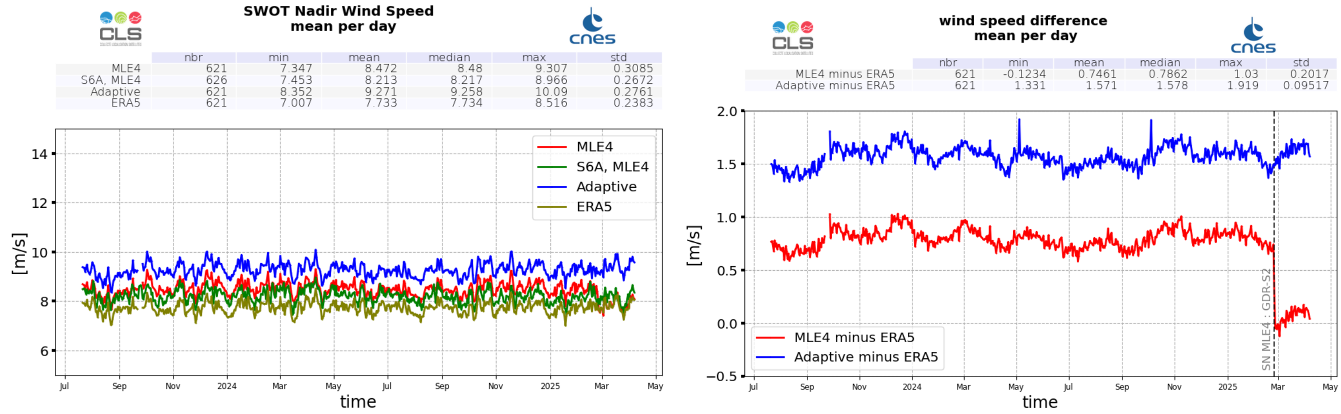


Figure 12: Wind Speed daily monitoring from cycle 001 to 030 for SWOT Nadir GDR, ERA5 model, and Sentinel-6A-MF (LR MLE4) (left), and daily mean difference with ERA5 (right)

4.4. Ionospheric correction

Over this cycle, altimeter filtered ionospheric correction is centered around **-6.32** cm for MLE4 retrievals and around **-5.93** cm for Adaptive retrievals.
SWOT Nadir altimeter minus GIM model ionospheric corrections difference is monitored over science phase on right par of Figure 15. Average biases are observed : **0.71** cm for MLE4 and **1.10** cm for Adaptive.

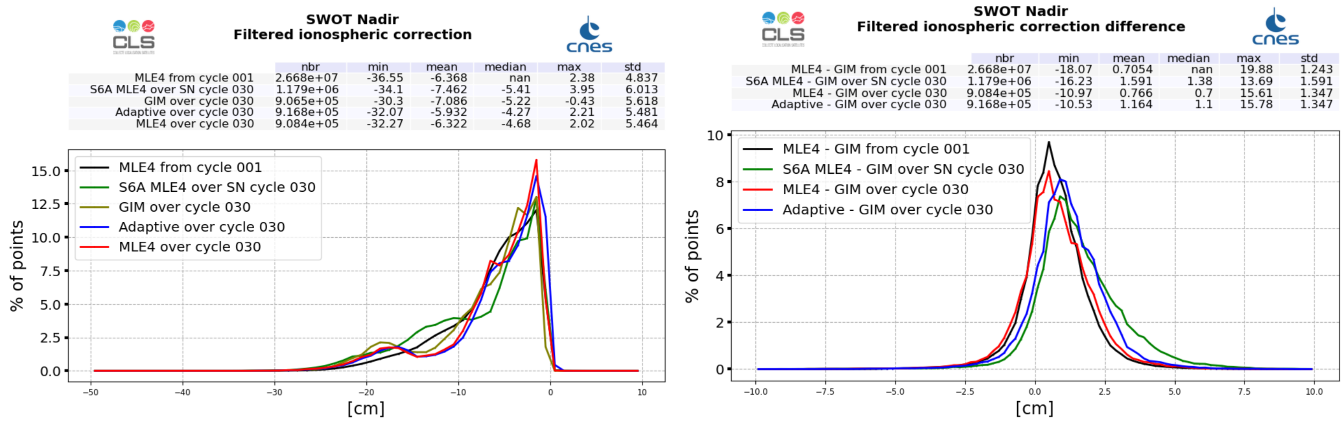


Figure 13: GIM model (dark green) and altimeter filtered ionosphere correction histogram computed over cycle 030 (red line for SWOT Nadir MLE4 and blue line for SWOT Nadir Adaptive, green for Sentinel-6A-MF (LR MLE4)) and from cycle 001 (SWOT Nadir, MLE4 only, black line) (left). Difference between filtered altimeter and GIM model (right).

Maps are plotted for MLE4 data separating ascending and descending passes (top Figure 14). Comparisons to GIM (middle top) and Adaptive (middle bottom) are also shown on blue/red maps of Figure 14. As this correction is strongly linked both to solar activity and day/night time measurements, corresponding local hours are plotted on bottom maps of Figure 14. On 2024-10-10 to 2024-10-11, as well as on 2024-05-11, solar storms degraded GIM ionospheric correction, resulting in downward spikes in the monitoring of the filtered iono - GIM iono for both SWOT Nadir and Sentinel-6A-MF.

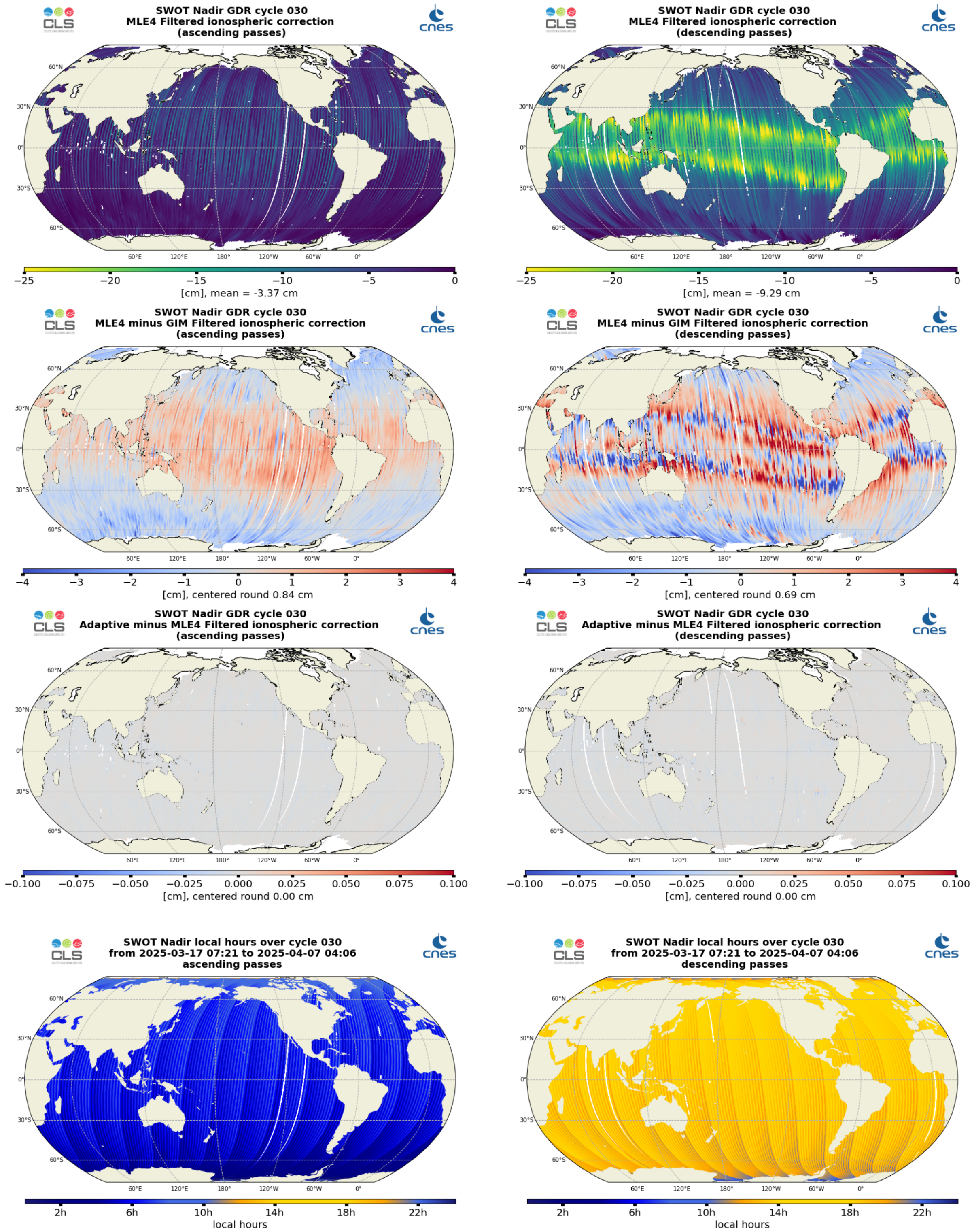


Figure 14: Along-track maps of filtered ionosphere correction over cycle 030 for SWOT Nadir MLE4 (top), MLE4 minus GIM (middle top) or Adaptive minus MLE4 (middle bottom), and local hours (bottom), for ascending passes (left) and descending passes (right)

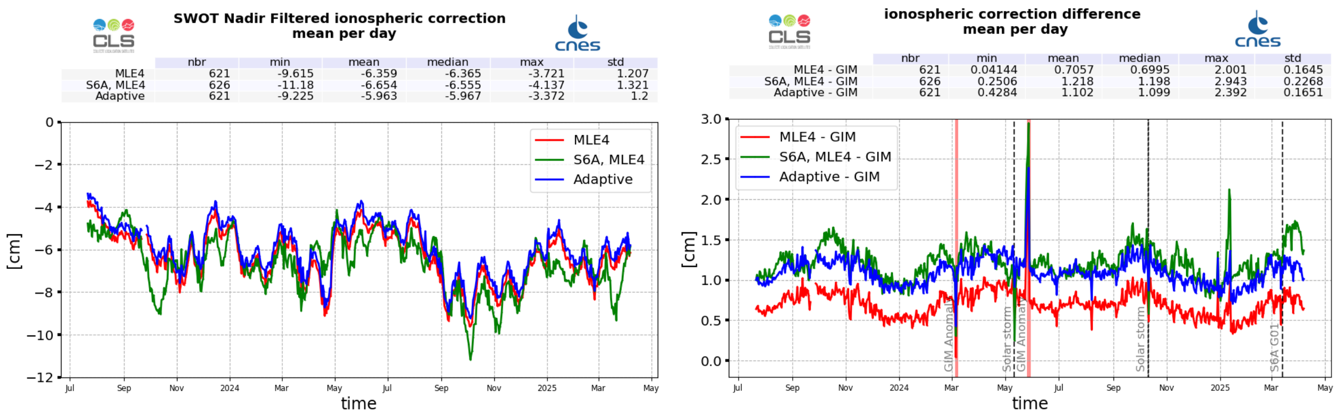


Figure 15: SWOT Nadir MLE4 (red), Adaptive (blue) and Sentinel-6A-MF (LR MLE4) (green) filtered ionosphere correction daily monitoring from cycle 001 to 030 (left) and difference with GIM model (right)

4.5. Mispointing

Note that as there is no square off nadir angle values on Adaptive retraking algorithm, only MLE4 values are shown here. Over this cycle, SWOT Nadir mispointing deduced from waveforms through MLE4 retracking is centered around **0.009** deg^2. This slight mispointing values are stable in time (Figure 18) and coherent for this cycle with the overall science phase as seen on the histogram (Figure 16).
On 2024-05-04 and on 2024-10-04, mispointing is higher than usual but still within thresholds, due to gyro calibrations (red peak on Figure 18).
Note that Sentinel-6A change of processing baseline to G01 implied a -0.04 deg^2 jump on 2025-03-13 (green curve on Figure 18).

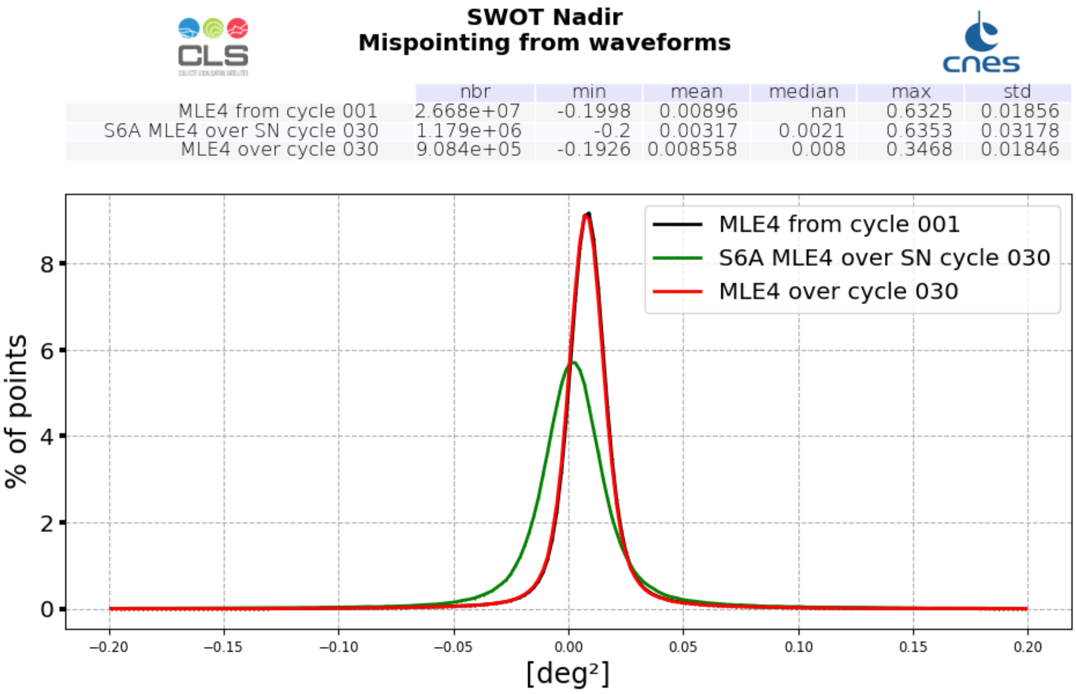


Figure 16: Mispointing histogram computed over cycle 030 (solid line) and from cycle 4 (dashed line)

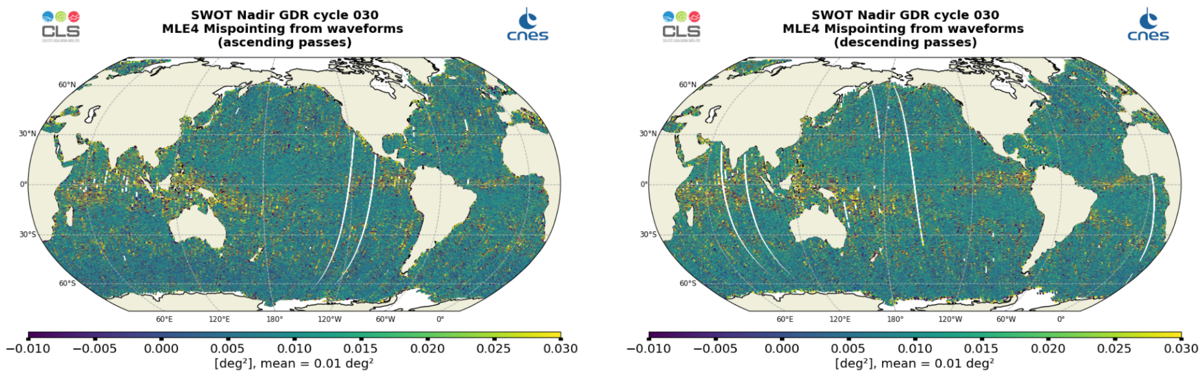


Figure 17: Along-track maps of mispointing over cycle 030 for SWOT Nadir MLE4, ascending passes (left) and descending passes (right)

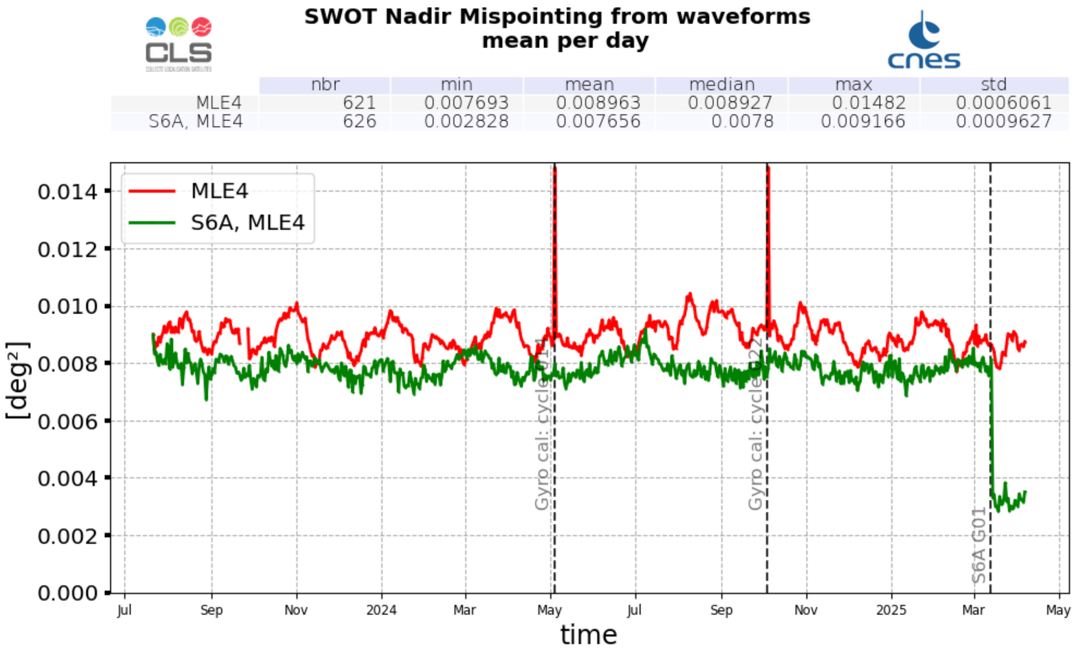


Figure 18: Mispointing daily monitoring from SWOT cycle 001 to 030 for SWOT Nadir GDR (red) and Sentinel-6A-MF (green)

4.6. Radiometer parameters

For the SWOT mission, the Wet Tropospheric Correction is measured by a radiometer with two independant beams on either side of the nadir. Then, an interpolation using the two beams is performed to obtain the Wet Tropospheric Correction on each 1Hz altimeter measurement. To assess the quality of the WTC, it is compared to the WTC computed from the ECMWF model, available every 6 hours. The model WTC is linearly interpolated at both radiometers measurement's location and Nadir locations.

Note: A new calibration file has been used since cycle 23, with updated coefficients for AMR S2, reducing the bias observed between AMR S1 and AMR S2

GDR-S2 update: interpolation at nadir can be degraded when the measurements of one beam are rejected, and interpolation is made only with the other beam measurements, creating artefacts on the SSHA measurements. With the new GDR-S2 standard (beginning at Cycle 29), these cases are flagged as degraded by the Wet Tropospheric Correction interpolation quality flag (rad_wet_tropo_cor_interp_flag = 1) avalaible in the L2NALT products. Therefore, for Nadir, only Wet Tropospheric Correction interpolated with the two radiometer beams are considered valid (rad_wet_tropo_cor_interp_flag = 0).

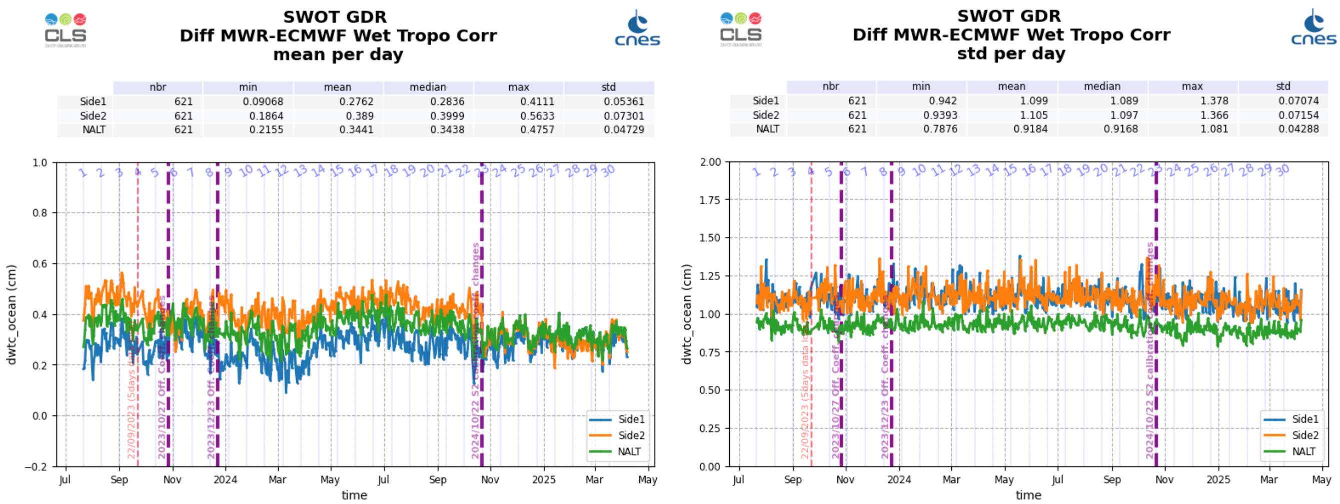


Figure 19: Daily monitoring of mean (left) and standard deviation (right) of the difference between AMRs wet tropospheric correction and ECMWF wet tropospheric correction for the side 1 (blue), the side 2 (orange) and the Nadir (green), computed from cycle 001 to cycle 030

To assess the intercalibration between the two radiometers, the Wet Tropospheric Correction gradient between each Side 1 AMR measurements and the closer Side 2 AMR measurements is calculated. The same operation is made between the Nadir and the two radiometers. Variations in these metrics can be used to check whether or not radiometers are subject to instrumental drift.

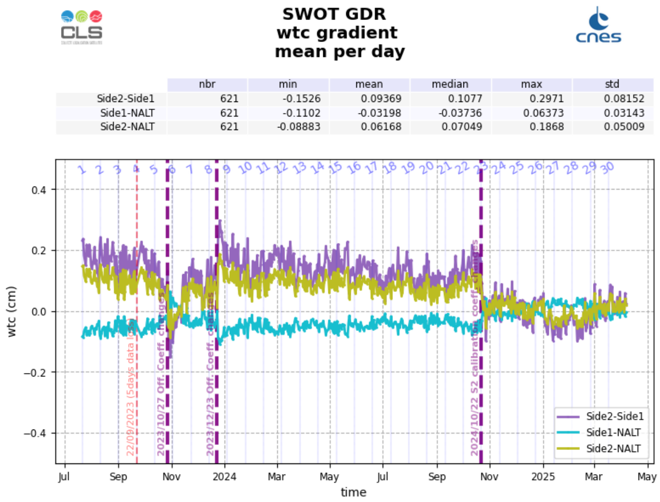


Figure 20: Daily monitoring of the wet tropospheric correction gradient between AMR Side 1 and AMR Side 2 (purple), AMR Side 1 and Nadir (cyan), and AMR Side 2 and Nadir (yellow), from Cycle 001 to 030

Comparison between radiometer and ECMWF wet troposphere correction highlights the good agreement between the two solutions. This difference is monitored using daily average in order to detect any jumps or anomaly (Figure 23), this indicator is stable around **0.31** cm, with a standard deviation value of **0.95** cm.

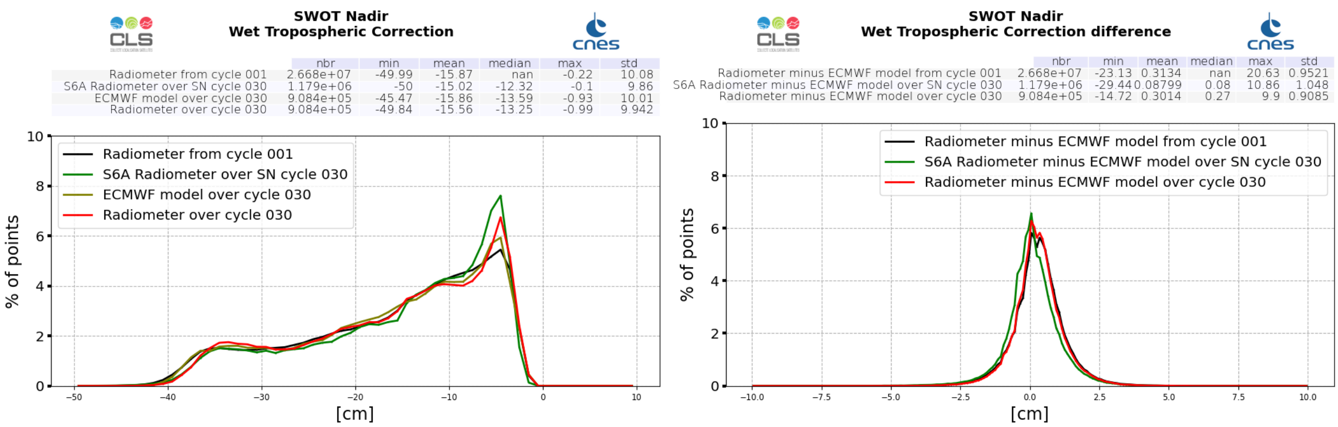


Figure 21: Histogram of wet troposphere corrections : SWOT Nadir radiometer (left) and difference with ECMWF model (right), computed over cycle 030 and from cycle 001 (black line)

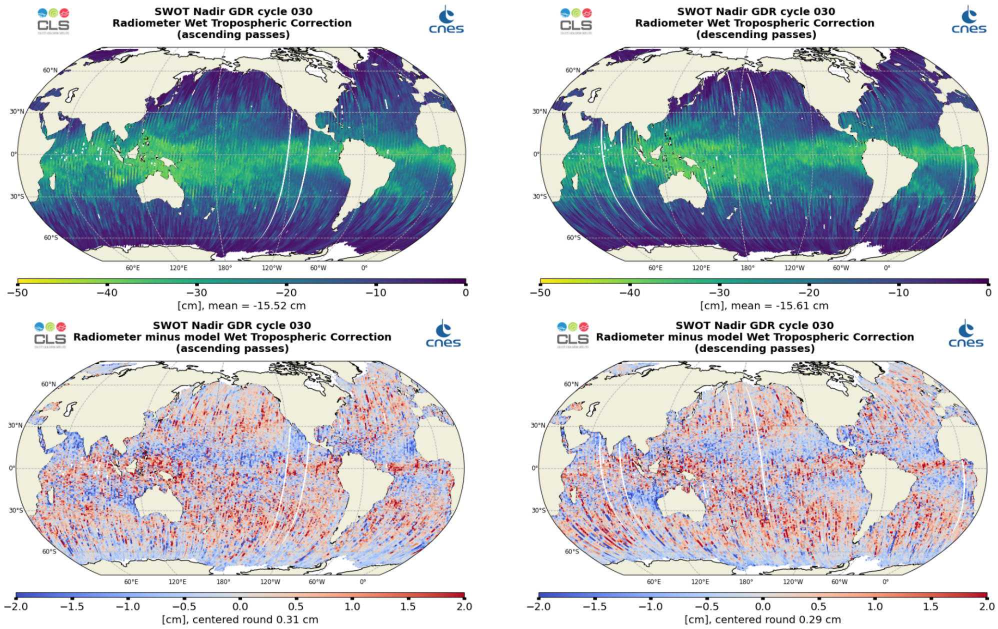


Figure 22: Along-track maps of the interpolated to Nadir AMRs wet tropospheric corrections (top) and radiometer minus ECMWF model difference of wet tropospheric corrections (bottom), computed over cycle 030

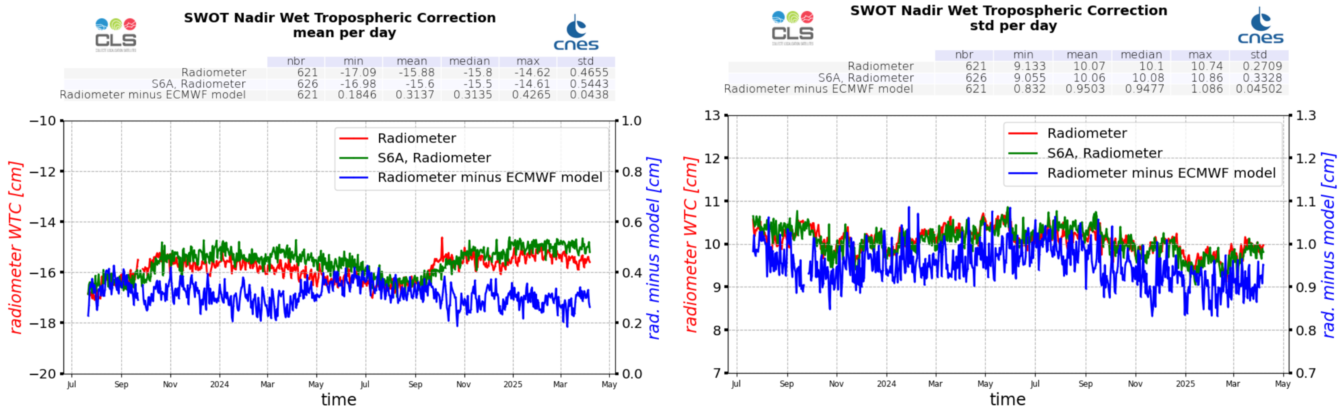


Figure 23: Daily monitoring of mean (left) and standard deviation (right) of the interpolated to Nadir AMRs wet tropospheric corrections (red) and radiometer minus ECMWF model difference of wet tropospheric corrections (blue), computed from cycle 001 to 030. Sentinel-6A-MF radiometer monitoring in green.

Note: Some geolocation anomalies in the L2RAD data can degraded the quality of the radiometer products interpolation to the nadir. These anomalies may be caused by OCM or Yaw Flip maneuvers, missing information on L2RADs geolocation (in these cases, L2RADs are positioned on the nadir track), or anomaly linked to data gaps.

Over Cycle 030, major AMR geolocation problems occur on:

- Pass 499 and 500 on 2025-04-04 from 03:12:39 to 03:49:43: anomaly due to an OCM SLOT maneuver.

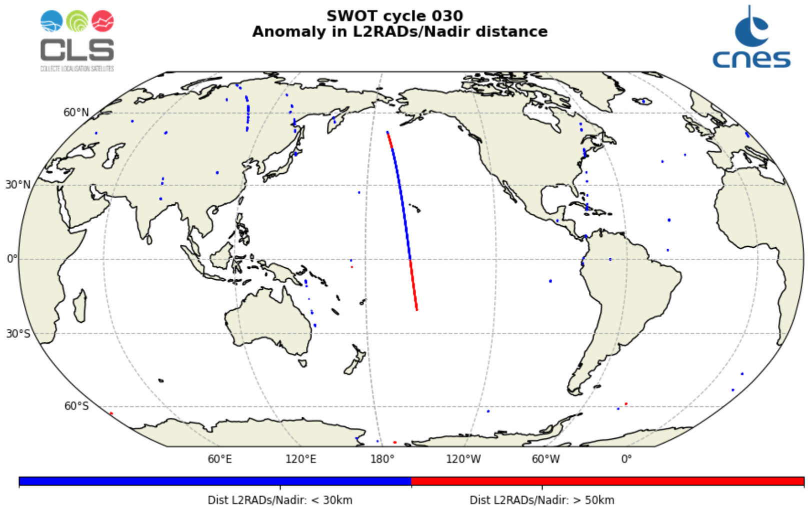


Figure 24: Map of the anomalies detected in the L2RADs/Nadir distance over the cycle 030

5 Sea Surface Height Anomaly

Over this cycle, SSHA is centered around **6.01** cm in MLE4, **3.30** cm in Adaptive (global along-track average).

Maps presented on Figure 26 show homogeneous patterns for MLE4 and Adaptive retrackings.

SWOT Nadir
Sea Surface Height Anomaly

	nbr	min	mean	median	max	std
MLE4 from cycle 001	2.668e+07	-200	6.233	nan	199.9	10.97
S6A MLE4 over SN cycle 030	1.179e+06	-200	4.241	3.87	199.5	10.46
Adaptive over cycle 030	9.168e+05	-198.9	3.301	3.01	167.8	10.43
MLE4 over cycle 030	9.084e+05	-198.1	6.006	5.7	142.4	10.34

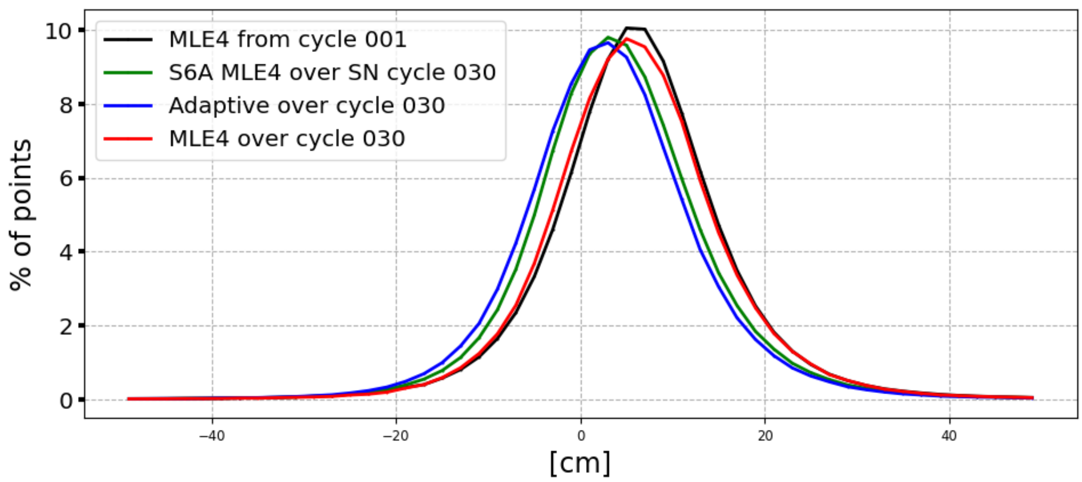


Figure 25: SSHA histogram computed over cycle 030 (red line for SWOT Nadir MLE4 and blue line for SWOT Nadir Adaptive, green for Sentinel-6A-MF (LR MLE4)) and from cycle 001 (SWOT Nadir, MLE4 only, black line)

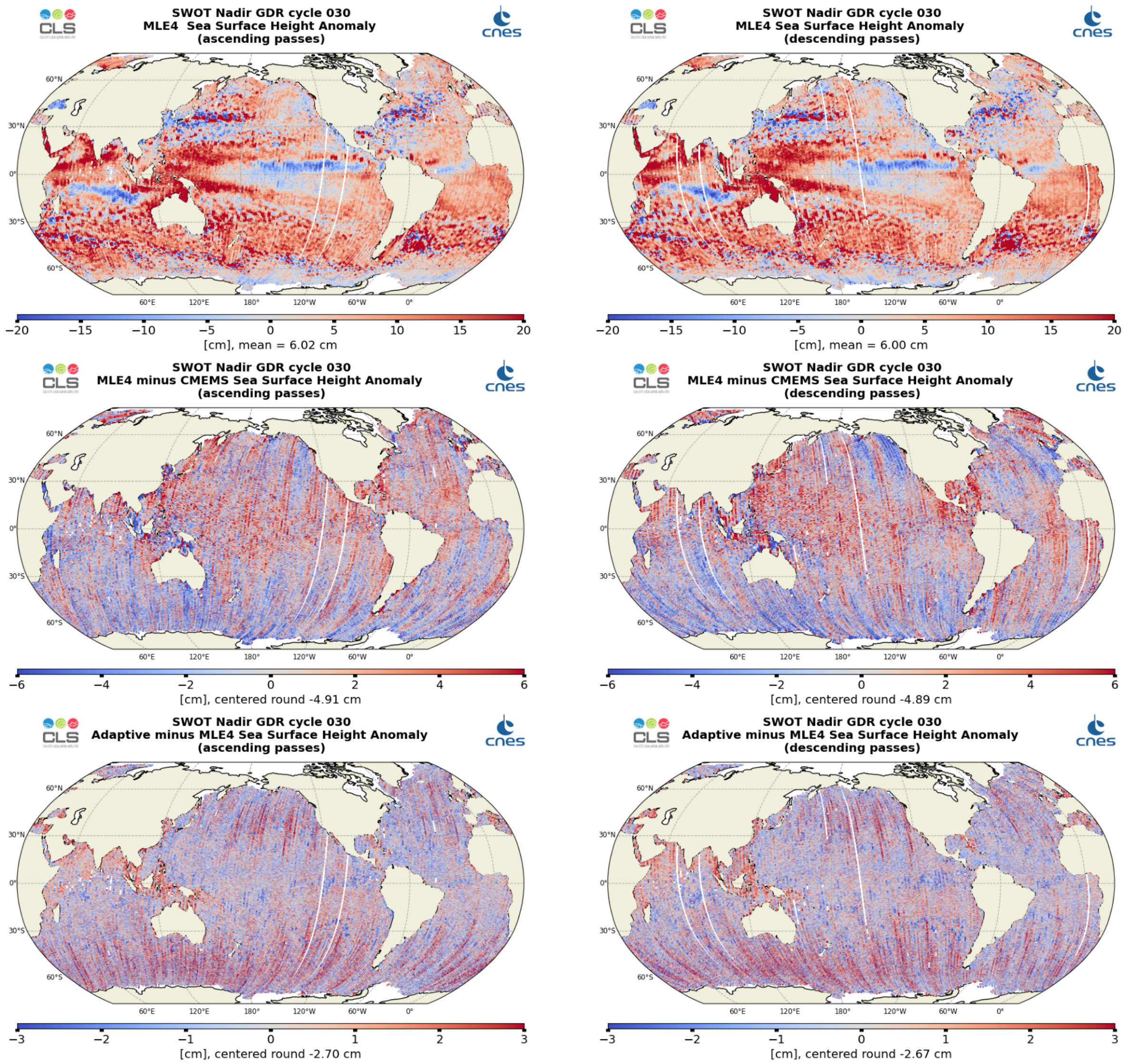


Figure 26: Along-track maps of SSHA over cycle 030 for SWOT Nadir MLE4 (top), MLE4 minus CMEMS (middle) or Adaptive minus MLE4 (bottom), ascending passes (left) and descending passes (right)

Long term time monitoring allow to detect any jump or drift. In the plot below, the daily mean of SSHA, using a selection on open ocean (surface_classification_flag = 0) and valid data [part 3.2.] follow the same variations for SWOT Nadir MLE4 and Adaptive. Along track ssha standard deviation is stable around **10.49** cm.

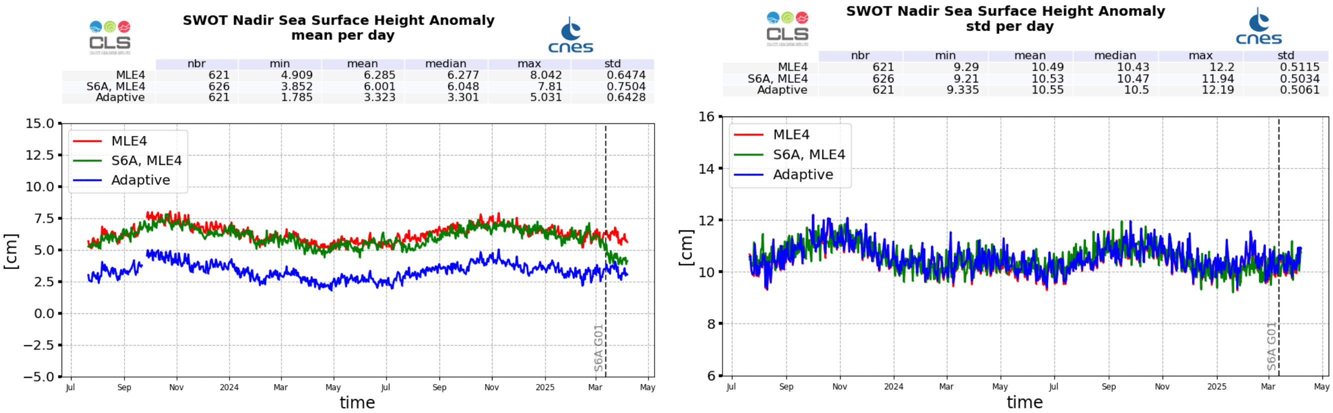


Figure 27: SSHA daily monitoring from cycle 001 to 030, for SWOT Nadir GDR

6 Crossover Analysis

6.1. Mono mission crossover

Sea Surface Height crossover differences are the SSH differences between ascending and descending passes where they cross each other. Crossover differences are systematically analysed to estimate data quality and the Sea Surface Height (SSH) performances. SSH crossover differences are computed from the valid data, with a maximum time lag of 10 days, in order to limit the effects of ocean variability which are a source of error in the performance estimation. The mean SSH crossover differences should ideally be close to zero and standard deviation should ideally be small.

Nevertheless, SLA varies also within 10 days, especially in high variability areas. Furthermore, due to lower data availability (due to seasonal sea ice coverage), models of several geophysical corrections are less precise in high latitude. Therefore, an additional geographical selection - removing shallow waters, areas of high ocean variability and high latitudes (> |50| deg) - is applied for cyclic monitoring.

After data editing, applying additional geographical selection and SWOT Nadir standards, the crossover standard deviation over this cycle is about 4.87 cm in MLE4, 5.00 cm in Adaptive.

The maps of the mean differences at crossovers (4 by 4 degrees by bins) are plotted for the current cycle (top) and from cycle 001 onwards (bottom), for MLE4 (left) and Adaptive (right) on Figure 28.

The mean and standard deviation of SSH differences at crossovers are plotted as a function of time on a daily basis on Figure 29. The statistics are computed after data editing and using the geographical selection criteria ($|latitude| < |50|°$, bathymetry < -1000m, ocean variability (computed over several years) $<$ 0.2m). Please note that temporal serie is done until 10 days before the end of the cycle in order to take into account the drifting period of 10 days that allows to compute significant indicators. The results are in line between MLE4, and Adaptive data, with the same temporal evolution.

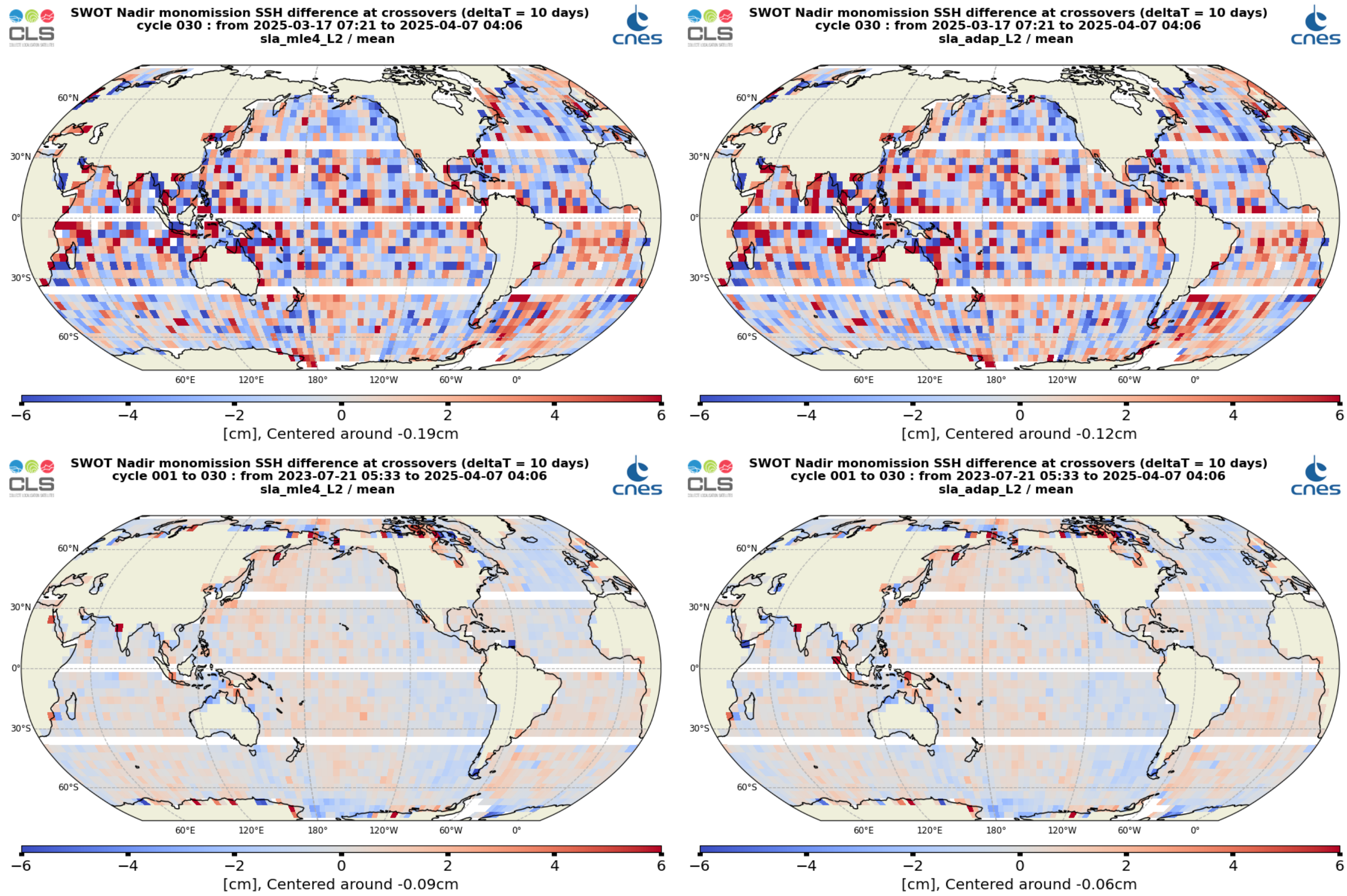
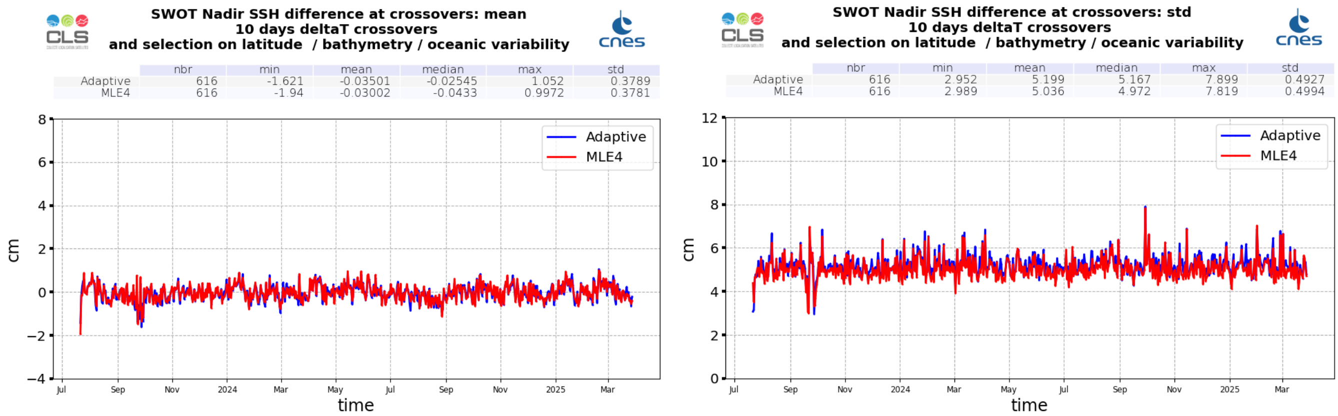


Figure 28: Mean SSH difference at crossovers for SWOT Nadir MLE4 (left) and Adaptive (right) cycle 030(top) and from cycle 001 to cycle 030 (bottom)



	nbr	min	mean	median	max	std
Adaptive	616	-1.621	-0.03501	-0.02545	1.052	0.3789
MLE4	616	-1.94	-0.03002	-0.0433	0.9972	0.3781

	nbr	min	mean	median	max	std
Adaptive	616	2.952	5.199	5.167	7.899	0.4927
MLE4	616	2.989	5.036	4.972	7.819	0.4994

Figure 29: Monitoring of SSH difference at crossovers for SWOT Nadir MLE4 (red) and Adaptive (blue) : mean (left) and standard deviation (right), from cycle 001 to 030

6.2. Multi-mission crossover

The map of the mean SSH differences at Sentinel-6 MF LR crossovers (3 by 3 degree bin) is plotted on figure 30 and figure 31. This map does not show strong anomalies and highlights the consistency between the two missions. Please note that temporal serie is done until 10 days before the end of the cycle in order to take into account the drifting period of 10 days that allows to compute significant indicators.

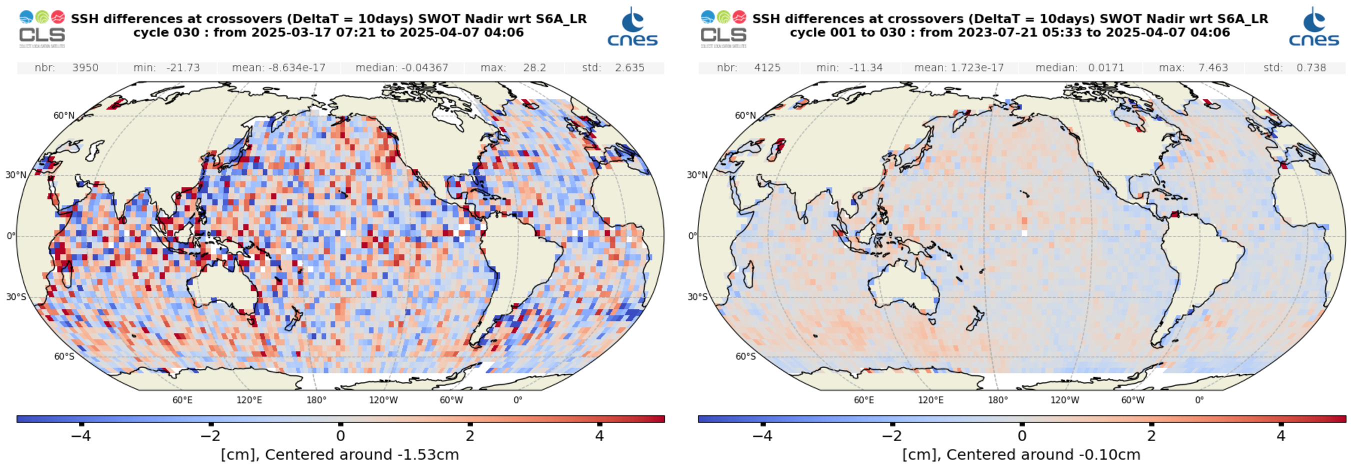


Figure 30: Mean SSH difference at crossovers between SWOT Nadir MLE4 and Sentinel-6 MF LR MLE4 over cycle 030 (left) and from cycle 001 onwards (right)

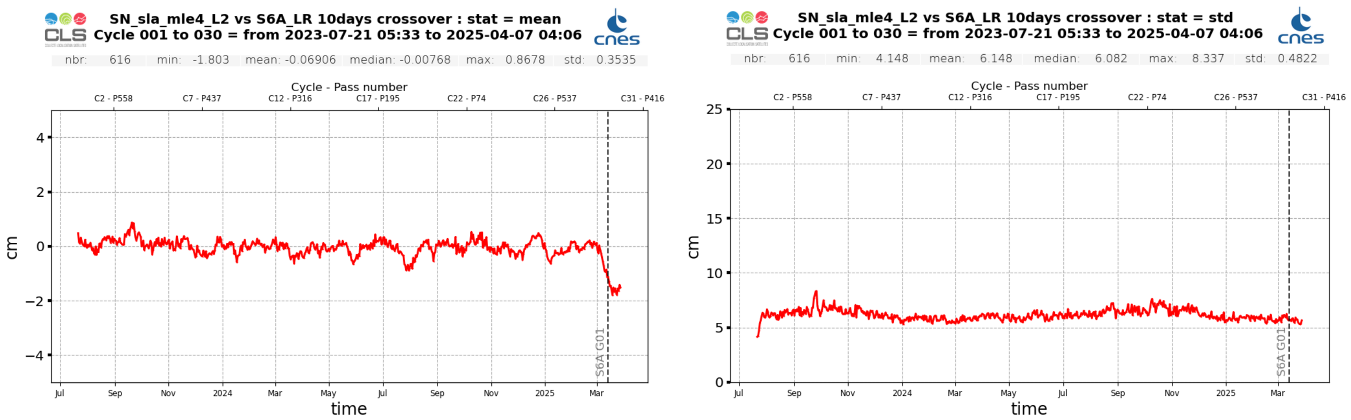


Figure 31: Daily monitoring of SSH difference at crossovers between SWOT Nadir MLE4 and Sentinel-6 MF LR MLE4 from cycle 001 onwards : mean (left) and standard deviation (right)

7 Conclusion

These results highlight the good quality of SWOT Nadir GDR products over ocean. The performances observed at crossovers over this cycle, and the sea level and other parameters derived from the altimeter show good metrics and good consistency with the Sentinel-6A-MF reference mission.

References

[1] Description of the mission on AVISO website (https://www.aviso.altimetry.fr/en/missions/current-missions/swot.html).

[2] SWOT Level-2 Nadir Altimeter products User Guide. SALP-ST-M-EA-17043-CN, edition 1.4, Oct 2022 (https://www.aviso.altimetry.fr/fileadmin/documents/data/tools/SALP-ST-M-EA-17043-CN_0104.pdf)

[3] Jason-3 GDR-F user handbook (https://www.aviso.altimetry.fr/fileadmin/documents/data/tools/hdbk_j3.pdf).