



SWOT Nadir GDR Synthetic cyclical Cal/Val report

Cycle 042

2025-11-22 16:22:01 to 2025-12-13 13:07:04

Processing Baseline S v2.01

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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 the Cyclical Report n° 041 onwards, the SWOT NALT and RAD datasets presented in the following analyses are computed using uniformly the updated to Version S 2.01 (GDR-S2) for the entire study period. Indeed it was previously computed using GDR-F data up to cycle 028 and GDR-S2 data from cycle 029. Information about the change of standard 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 042, spanning from 2025-11-22 16:22:01 to 2025-12-13 13:07:04.**

This cycle has been produced with the Processing Baseline S v2.01, and the processing software references L1 library=V6.2p1, L2 library=V7.5p1, Processing Pilot=5.4.3.

571 netCDF pass files are provided over the 584 expected (no files for passes 127, 153-157, 210-212, 302, 489-491 mainly due to data transmission issues at Inuvik [IVK] Station).

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 042, 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 :

- SADM CRUISE SLOT on 2025-12-09 from 17:21:59 to 17:26:39 (P477-478)
- OCM SLOT on 2025-12-12 from 21:29:16 to 22:06:20 (P566-567)
- SSR ANOMALY on 2025-11-30 from 03:26:12 to 03:45:04 (P209)

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 ($> |50^\circ|$), the crossover standard deviation over the cycle is **4.61** 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 042	MLE4	Adaptive
Percentage of missing measurements over open ocean	3.77%	
Percentage of rejected measurements over open ocean	18.88%	18.71%
of which rejected due to sea ice	16.32%	
of which rejected with threshold verification (after land and ice removed)	2.55%	2.39%
Crossover standard deviation on geographical selection	4.61cm	4.76cm

Table 1: Summary of cycle 042 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.

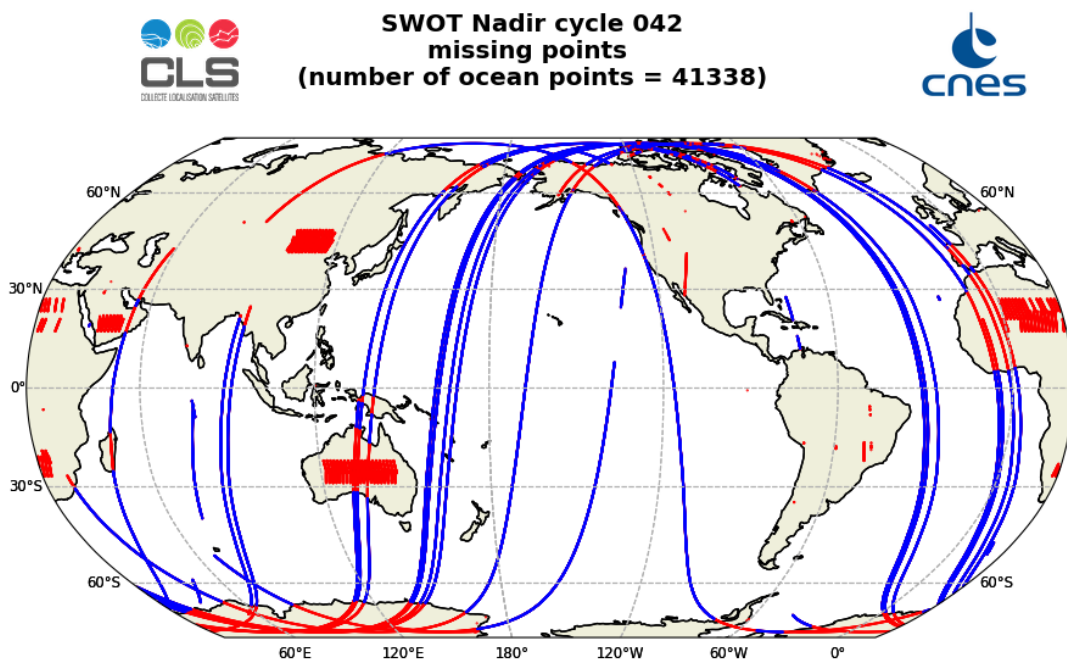


Figure 1: Map of missing measurements for SWOT Nadir GDR cycle 042

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

- pass 044 on 2025-11-24 from 05:31:52 to 05:32:10 : **0.73 %** over ocean due to data gaps.
- pass 076 on 2025-11-25 from 08:58:13 to 09:02:48 : **12.90 %** over ocean due to data gaps.
- pass 106 on 2025-11-26 from 10:26:47 to 10:28:29 : **5.15 %** over ocean due to data gaps.
- passes 126 to 128 on 2025-11-27 from 03:44:03 to 05:19:17 with respectively **81.51 %**, **100%** and **6.65 %** over ocean due to data lost at Inuvik [IVK] Station.
- passes 132 and 133 on 2025-11-27 from 09:28:53 to 10:04:12 with respectively **7.44 %** and **89.14 %** over ocean due to data lost at Inuvik [IVK] Station.
- pass 135 on 2025-11-27 from 11:21:42 to 11:24:12 : **8.23 %** over ocean due to data lost at Inuvik [IVK] Station.
- pass 148 on 2025-11-27 from 22:51:34 to 22:53:02 : **5.28 %** over ocean due to data lost.
- passes 152 to 158 on 2025-11-28 from 02:25:08 to 07:05:39 with respectively **56.58 %**, **100% x 5** and **12.20%** over ocean due to data lost at Inuvik [IVK] Station.
- pass 161 on 2025-11-28 from 09:39:01 to 10:05:24 : **90.15 %** over ocean due to data gaps.

- pass 165 on 2025-11-28 from 13:30:30 to 13:30:44 : **0.53 %** over ocean due to data gaps.
- passes 209 to 213 on 2025-11-30 from 03:29:47 to 06:33:15 with respectively **9.74 %**, **100% x 3** and **35.73 %** over ocean due to corrupted data after SSR Anomaly.
- pass 273 on 2025-12-02 from 09:49:45 to 09:59:49 : **36.81 %** over ocean due to gap between down-links at Inuvik [IVK] Station.
- passes 301 to 303 on 2025-12-03 from 10:24:26 to 11:52:32 with respectively **12.39 %**, **100%** and **93.51 %** over ocean due to data lost at Inuvik [IVK] Station.
- pass 347 on 2025-12-05 from 01:51:05 to 01:51:21 : **0.68 %** over ocean due to data gaps.
- passes 400 to 401 on 2025-12-06 from 23:10:08 to 23:57:08 with respectively **16.74 %** and **70.89 %** over ocean due to data gaps.
- pass 404 on 2025-12-07 from 02:34:41 to 02:35:50 : **3.44 %** over ocean due to data gaps.
- passes 488 to 492 on 2025-12-10 from 02:20:56 to 05:29:39 with respectively **65.67 %**, **100% x 3** and **16.71 %** over ocean due to due to data lost at Inuvik [IVB] Station.

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 **3.77 %** over the complete cycle.

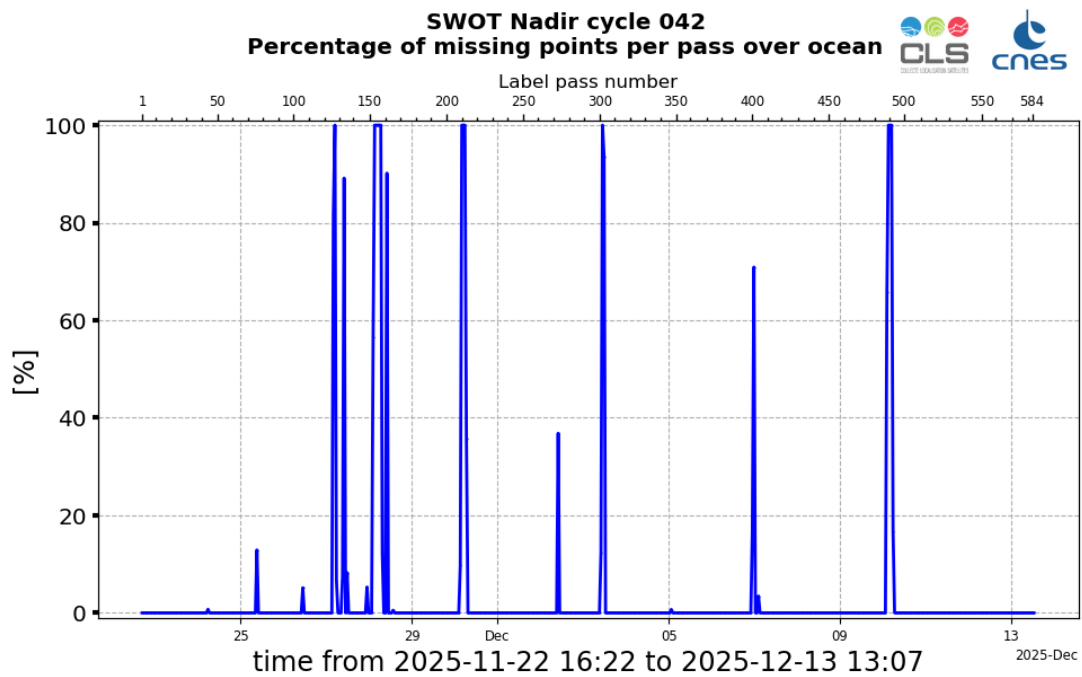


Figure 2: Monitoring of the percentage per pass of missing data over ocean, for SWOT Nadir GDR cycle 042

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 **16.32 %** (4.00 % when limited to ocean at $|\text{latitude}| < 66^\circ$).

Parameters	Thresholds		Rejected	
	Minimum	Maximum	MLE4	Adaptive
sea surface height anomaly	-2 m	2 m	1.85 %	1.80 %
sea surface height	-130 m	100 m	0.51 %	0.10 %
square off nadir angle	-0.2 deg ²	0.64 deg ²	0.42 %	0.42 %
swh	0 m	11 m	0.42 %	0.03 %
range number	10	20	0.65 %	0.28 %
range std	0 m	0.2 m	1.27 %	0.84 %
sigma0	7 dB	30 dB	0.41 %	0.32 %
sigma0 number	10	20	0.64 %	0.26 %
sigma0 std	0 dB	1 dB	1.36 %	1.04 %
wind speed	0 m/s	30 m/s	0.80 %	0.58 %
sea state bias	-0.5 m	0 m	0.38 %	0.01 %
ionospheric correction	-0.4 m	0.04 m	0.89 %	0.80 %
radiometer wtc	-0.5 m	-0.001 m	0.20 %	0.20 %
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			2.55 %	2.39 %

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 042

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, parts of passes are rejected over ocean (points with positive ice flag are not considered here AND only parts of passes with > 15 % are mentioned) :

- pass 567 on 2025-12-12 from 21:48:38 to 22:16:56 : **46.18 %** due to undefined retracking outputs and radiometer wet tropospheric correction because of an OCM SLOT.

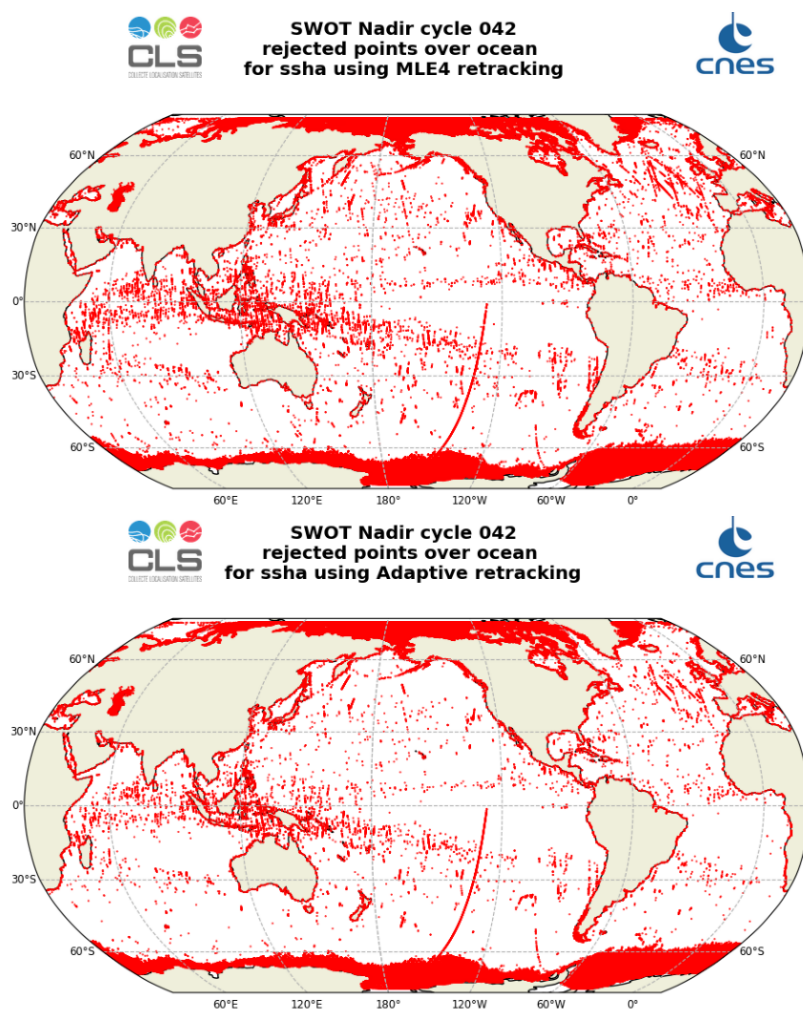


Figure 3: Edited measurements for SWOT Nadir over cycle 042

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 **2.41** m for MLE4 and **2.37** m for Adaptive. It shows the consistency between the two retrackings. Furthermore, values are coherent with ERA5 model and Sentinel-6A-MF estimations.

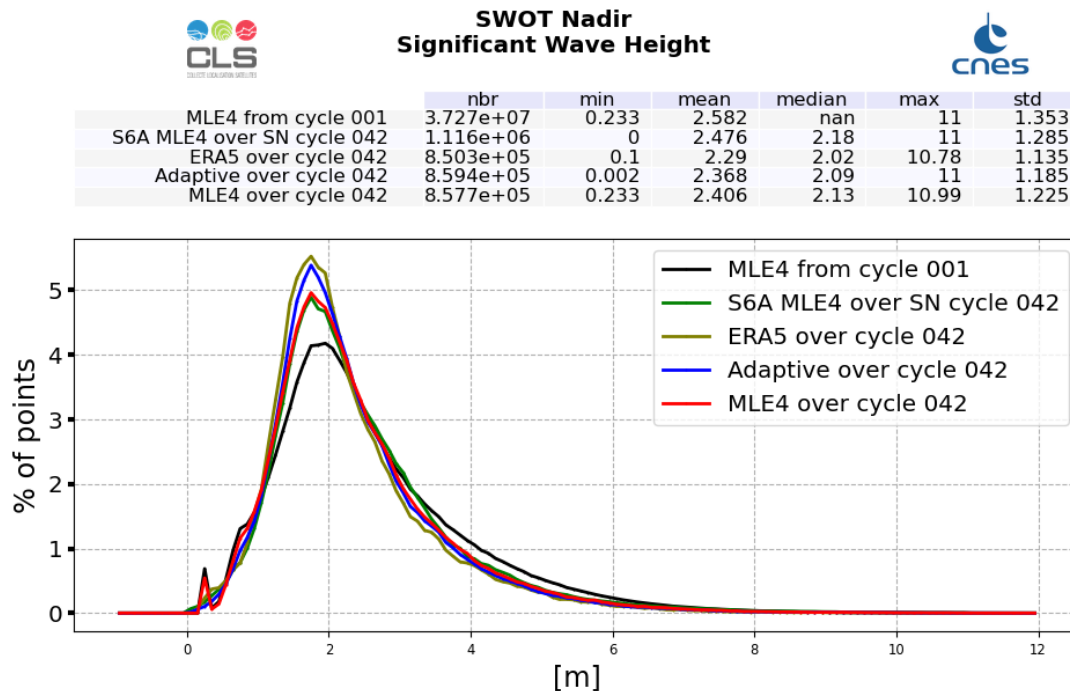


Figure 4: Ku-band Significant Wave Height histogram computed over cycle 042 (red line for SWOT Nadir MLE4 and blue line for SWOT Nadir Adaptive, green for Sentinel-6A-MF (LR MLE4) and dark green for ERA5) and from cycle 001 (SWOT Nadir, MLE4 only, black line)

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.

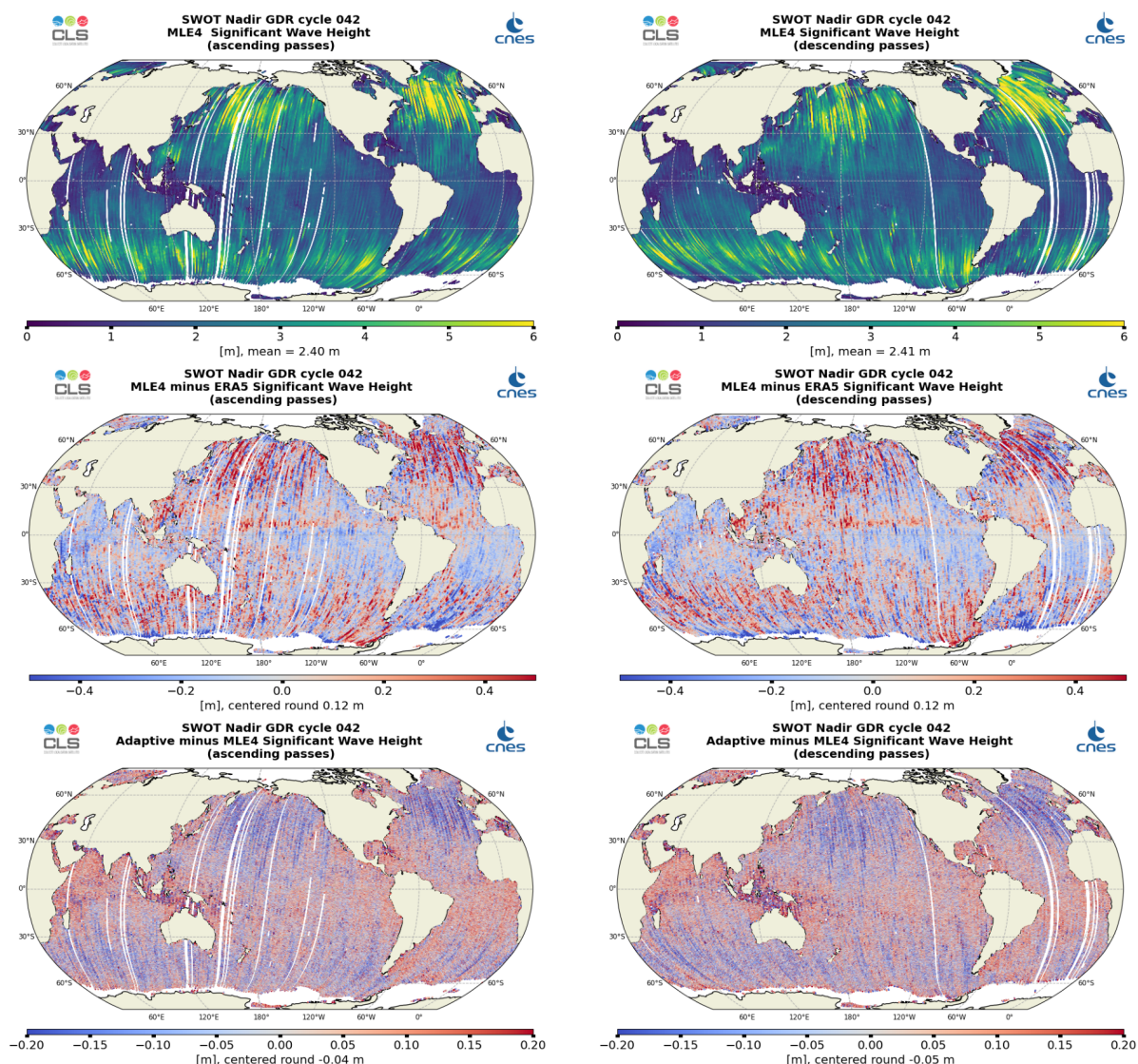


Figure 5: Along-track maps of Ku-band Significant Wave Height over cycle 042 for SWOT Nadir MLE4 (top), MLE4 minus model (middle) or Adaptive minus MLE4 (bottom), ascending passes (left) and descending passes (right)

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).

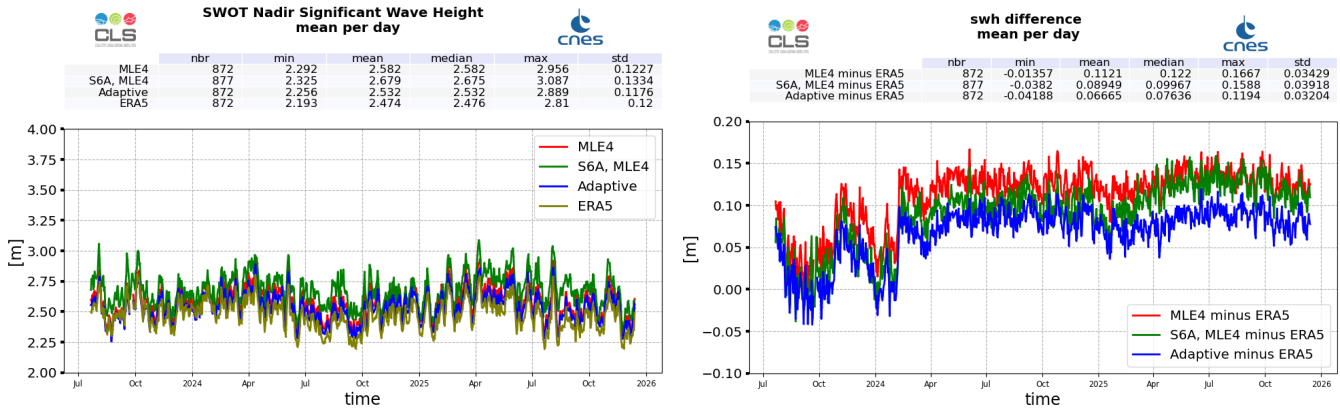


Figure 6: Ku-band Significant Wave Height daily monitoring from cycle 001 to 042, for SWOT Nadir, ERA5 model estimated at SWOT locations, and Sentinel-6A-MF (LR MLE4) (left), and difference with ERA5 model (right)

4.2. Backscattering coefficient

Ku-band backscattering coefficient is centered around **13.57** dB for MLE4 and around **13.40** 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).

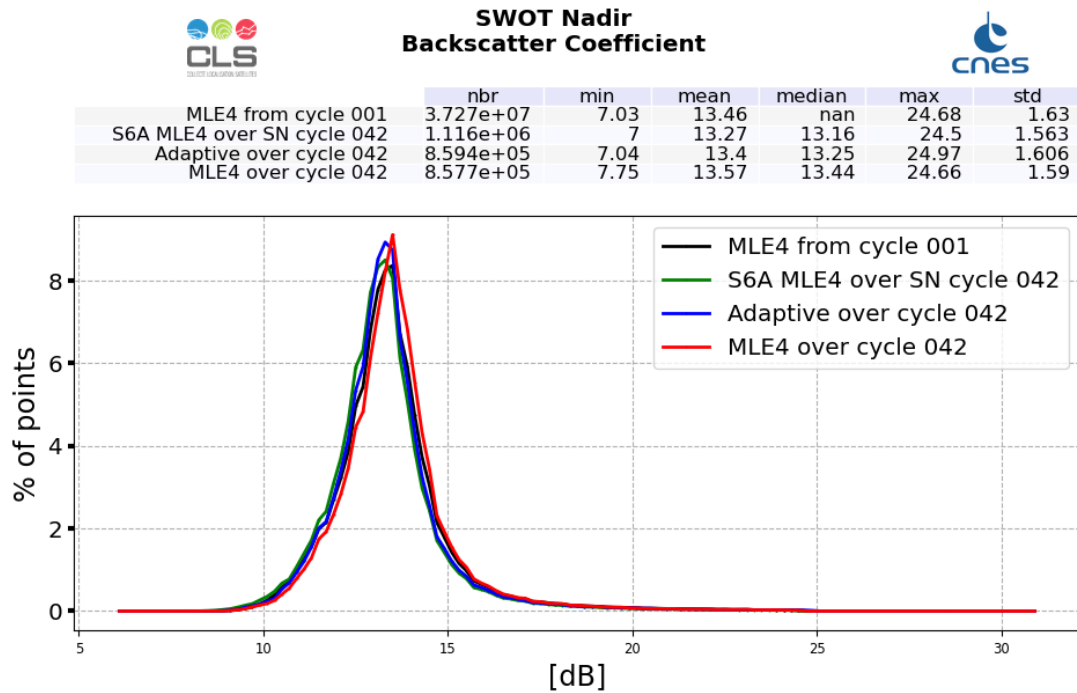


Figure 7: Ku-band Backscattering coefficient histogram computed over cycle 042 (red line for SWOT Nadir MLE4 and blue line for SWOT Nadir Adaptive, green for Sentinel-6A-MF (LR MLE4)) and from cycle 001 (SWOT Nadir, MLE4 only, black line)

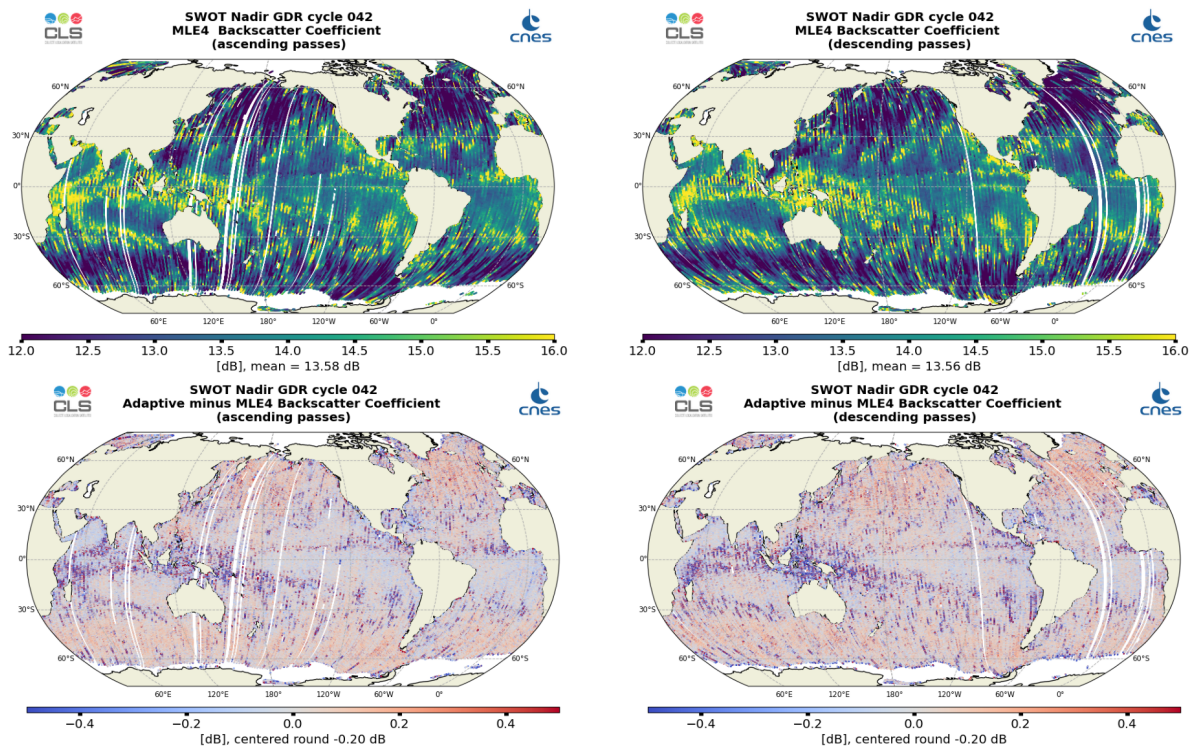


Figure 8: Along-track maps of Ku-band backscatter coefficient σ_0 over cycle 042 for SWOT Nadir MLE4 (top) or Adaptive minus MLE4 difference (bottom), ascending passes (left) and descending passes (right)

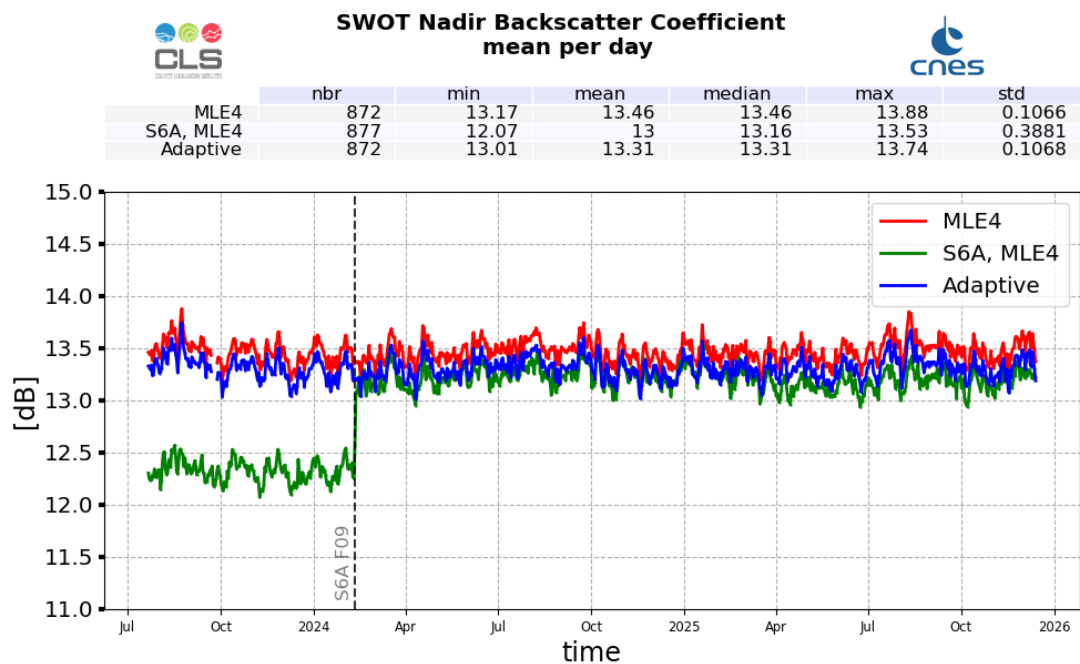


Figure 9: Ku-band Backscattering coefficient daily monitoring from cycle 001 to 042, for SWOT Nadir and Sentinel-6A-MF

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.

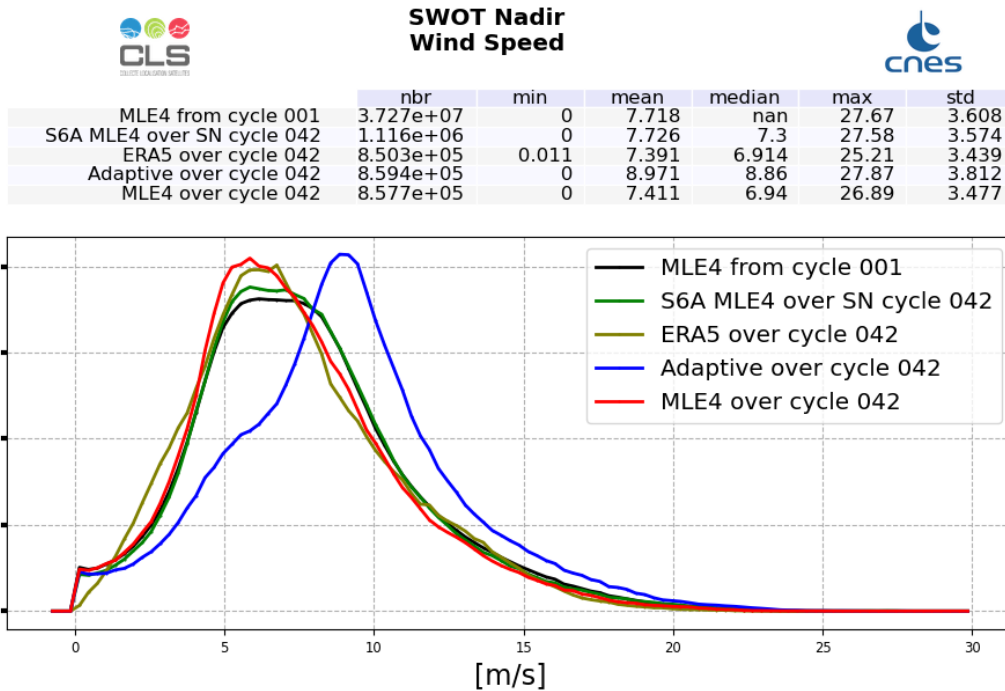


Figure 10: Altimeter Wind Speed histogram computed over cycle 042 (red line for SWOT Nadir MLE4 and blue line for SWOT Nadir Adaptive, green for Sentinel-6A-MF (LR MLE4)) and from cycle 001 (SWOT Nadir, MLE4 only, black line)

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.

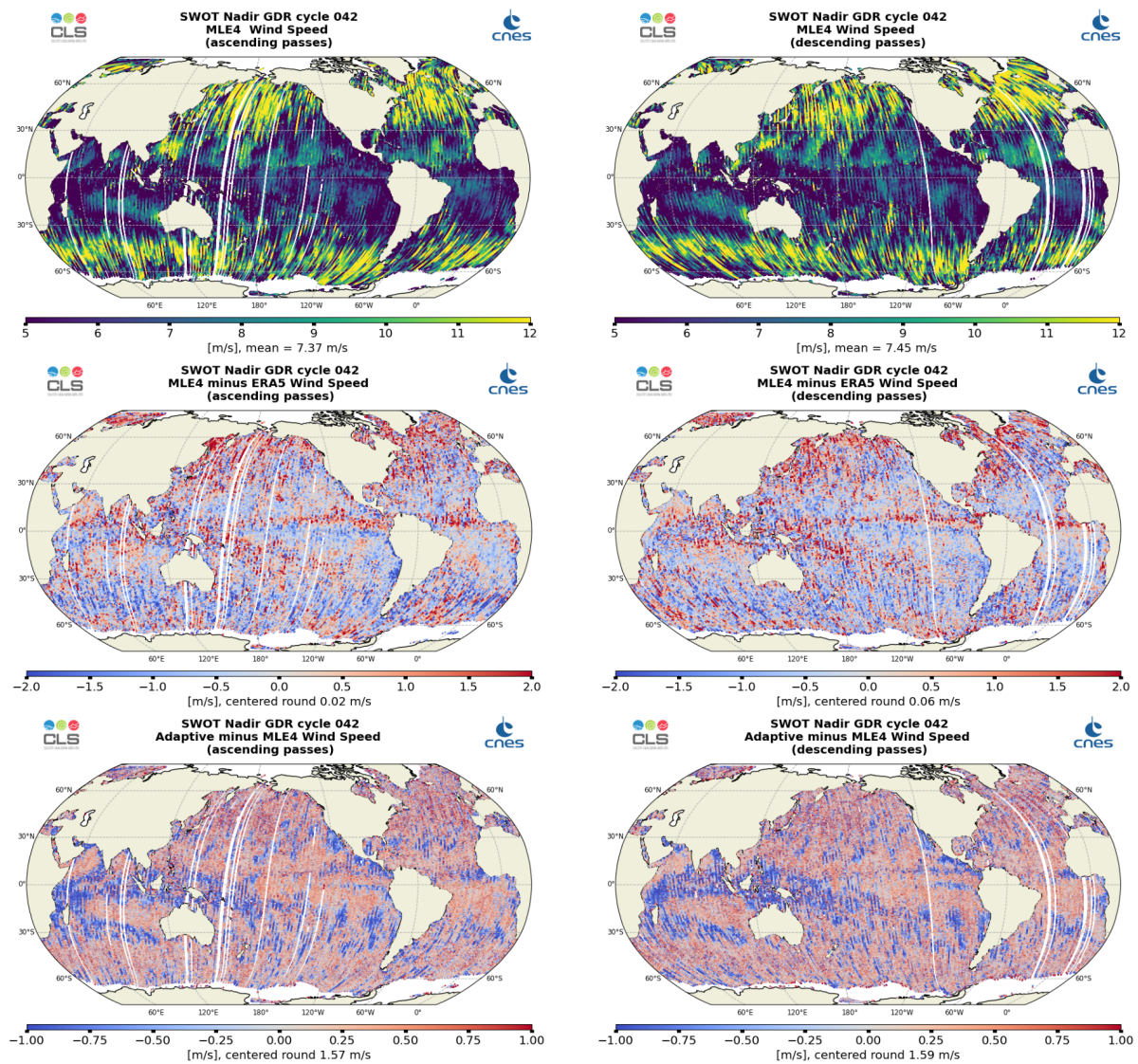


Figure 11: Along-track maps of Altimeter Wind Speed over cycle 042 for SWOT Nadir MLE4 (top), MLE4 minus ERA5 (middle) or Adaptive minus MLE4 (bottom), ascending passes (left) and descending passes (right)

The daily average from cycle 001 shows the wind speed values centered around **7.72** m/s for MLE4 and **9.26** m/s for Adaptive.

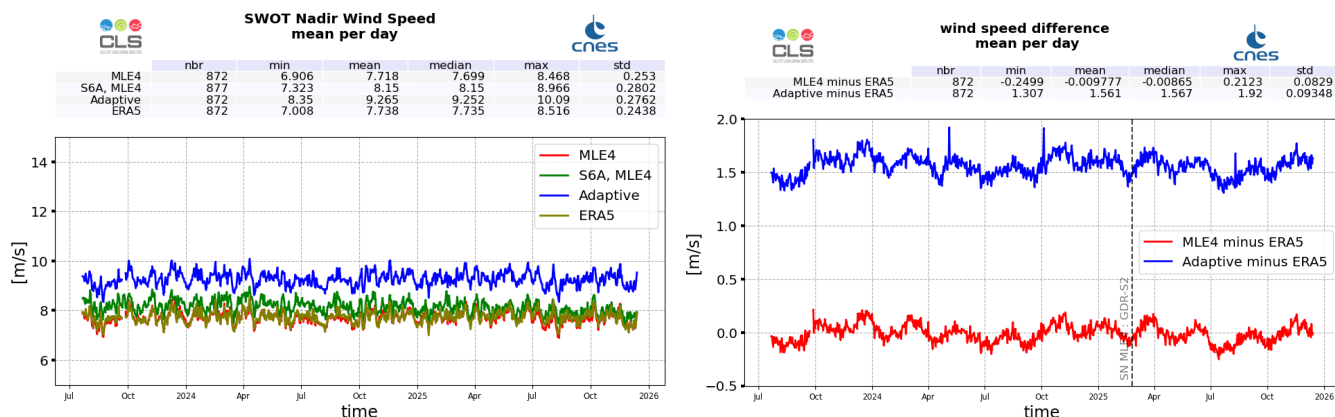


Figure 12: Wind Speed daily monitoring from cycle 001 to 042 for SWOT Nadir GDR, ERA5 model, and Sentinel-6A-MF (LR MLE4) (left), and daily mean difference with ERA5 (right)

4.4. Ionospheric correction

Over this cycle, altimeter filtered ionospheric correction is centered around **-5.67** cm for MLE4 retrievals and around **-5.25** 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 : **0.69** cm for MLE4 and **1.10** cm for Adaptive.

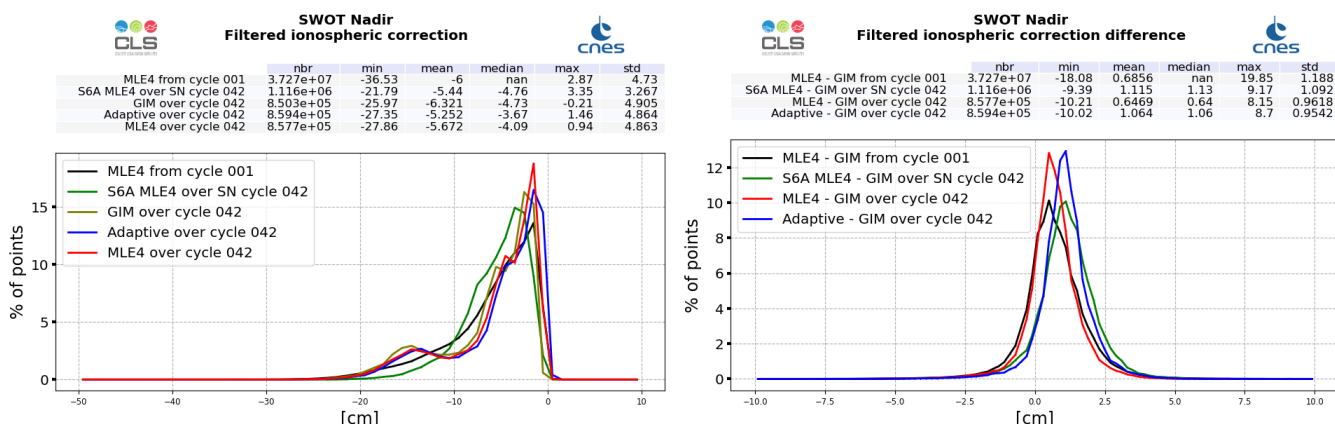


Figure 13: GIM model (dark green) and altimeter filtered ionosphere correction histogram computed over cycle 042 (red line for SWOT Nadir MLE4 and blue line for SWOT Nadir Adaptive, green for Sentinel-6A-MF (LR MLE4)) and from cycle 001 (SWOT Nadir, MLE4 only, black line) (left). Difference between filtered 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.

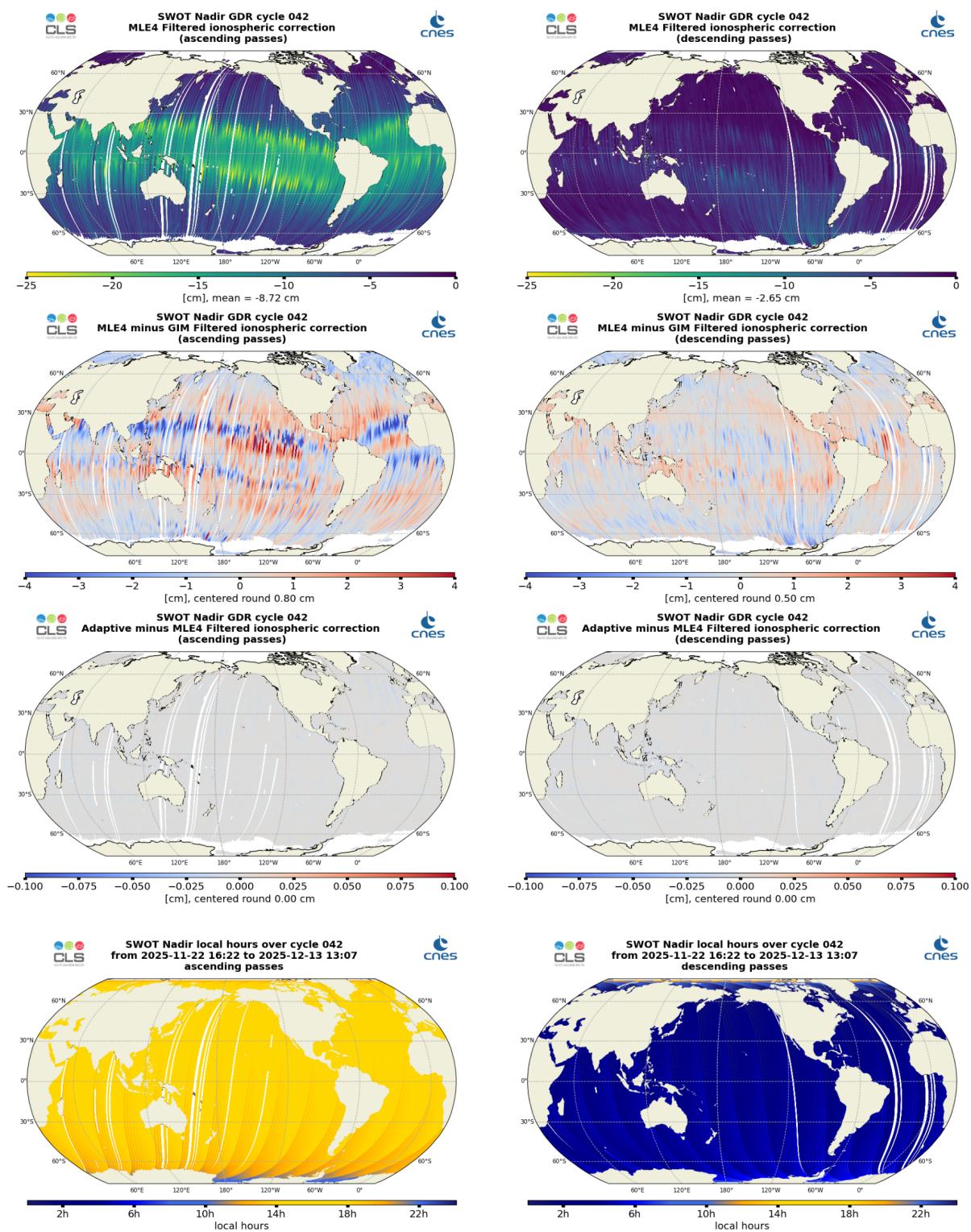


Figure 14: Along-track maps of filtered ionosphere correction over cycle 042 for SWOT Nadir MLE4 (top), MLE4 minus GIM (middle top) or Adaptive minus MLE4 (middle bottom), and local hours (bottom), for ascending passes (left) and descending passes (right)

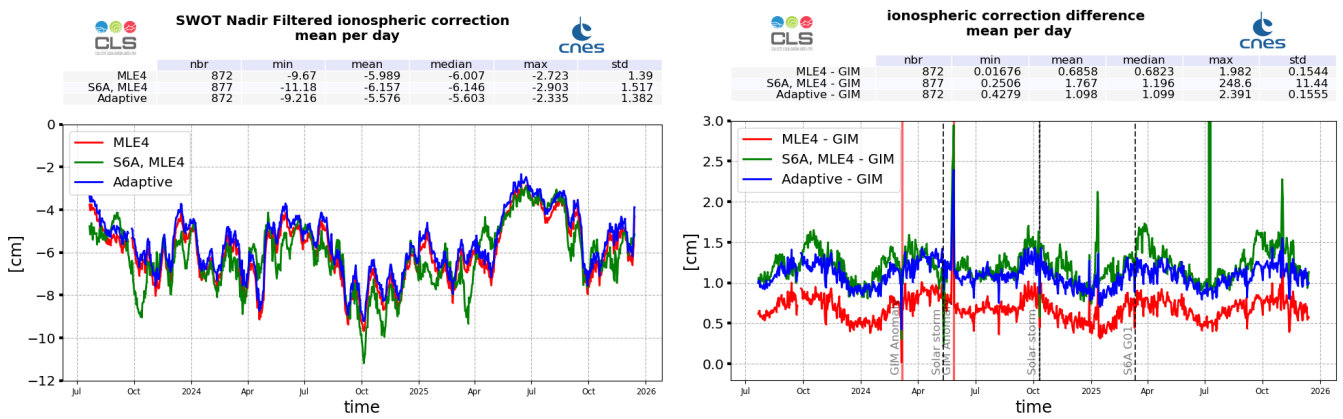


Figure 15: SWOT Nadir MLE4 (red), Adaptive (blue) and Sentinel-6A-MF (LR MLE4) (green) filtered ionosphere correction daily monitoring from cycle 001 to 042 (left) and difference with GIM model (right)

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 retraking is centered around **0.009 deg²**. 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 deg² jump on 2025-03-13 (green curve on Figure 18).

		nbr	min	mean	median	max	std
CLS	MLE4 from cycle 001	3.727e+07	-0.1998	0.009011	nan	0.6325	0.01864
	S6A MLE4 over SN cycle 042	1.116e+06	-0.2	0.003418	0.0022	0.6362	0.03304
	MLE4 over cycle 042	8.577e+05	-0.1854	0.009473	0.0089	0.5805	0.01849

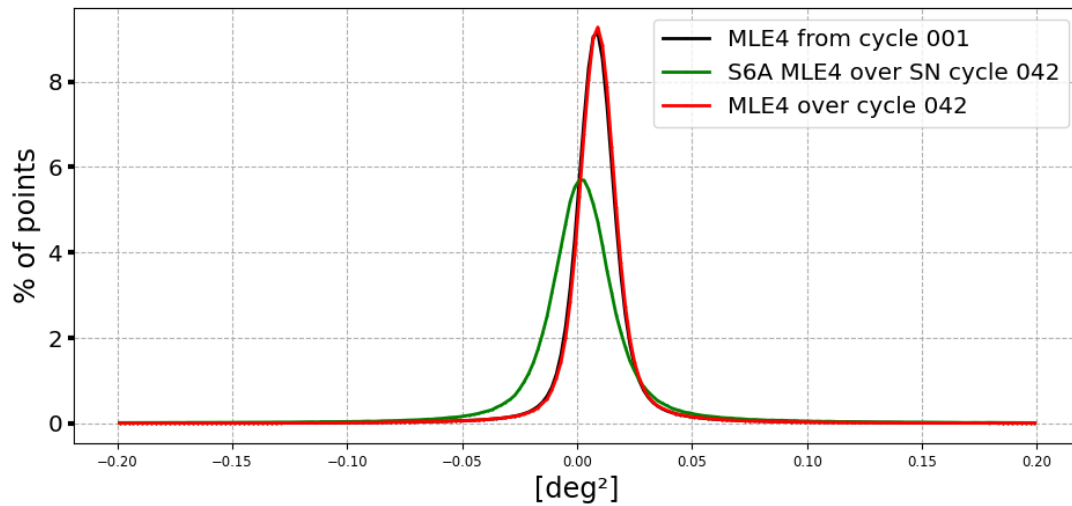


Figure 16: Mispointing histogram computed over cycle 042 (solid line) and from cycle 4 (dashed line)

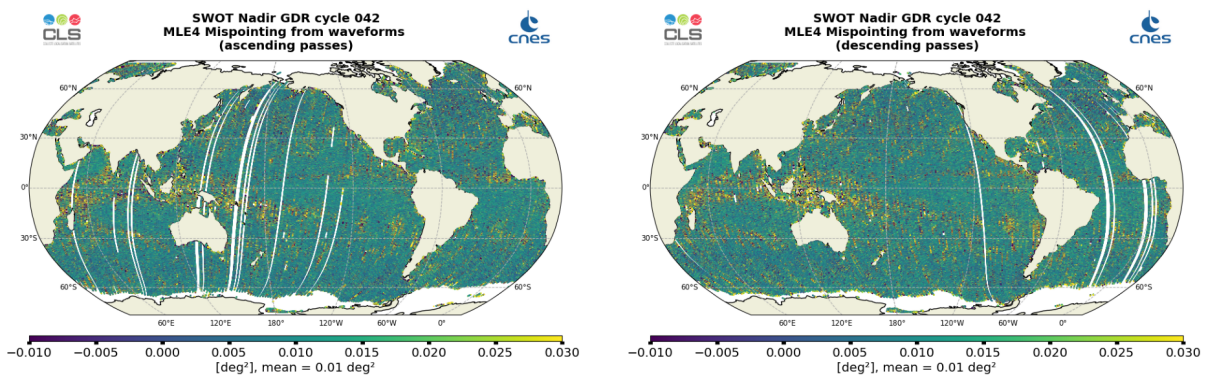


Figure 17: Along-track maps of mispointing over cycle 042 for SWOT Nadir MLE4, ascending passes (left) and descending passes (right)

SWOT Nadir Mispointing from waveforms mean per day

	nbr	min	mean	median	max	std
MLE4	872	0.007693	0.009015	0.008975	0.01576	0.0006186
S6A, MLE4	877	0.002776	0.006478	0.007593	0.009166	0.002039

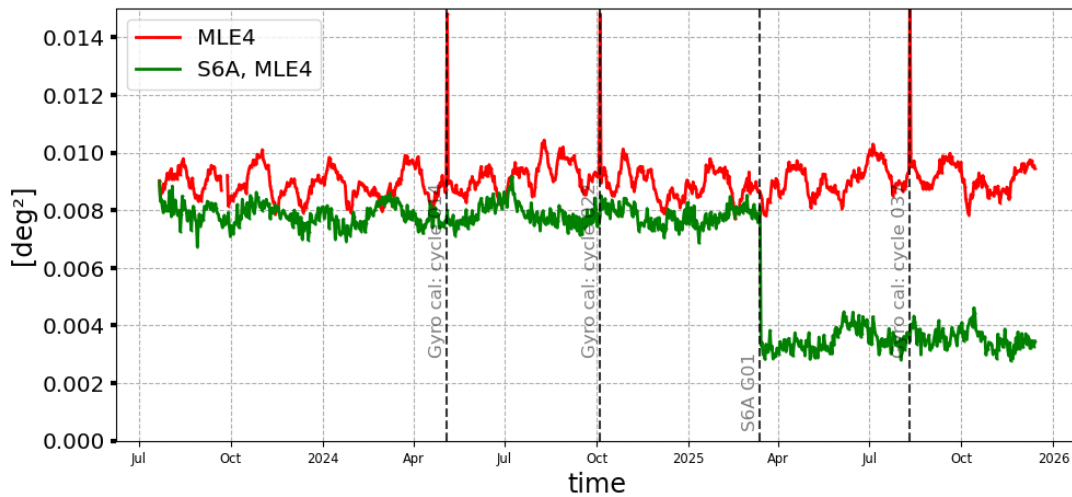


Figure 18: Mispointing daily monitoring from SWOT cycle 001 to 042 for SWOT Nadir GDR (red) and Sentinel-6A-MF (green)

4.6. Radiometer parameters

For the SWOT mission, the Wet Tropospheric Correction is measured by a radiometer with two independent 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.

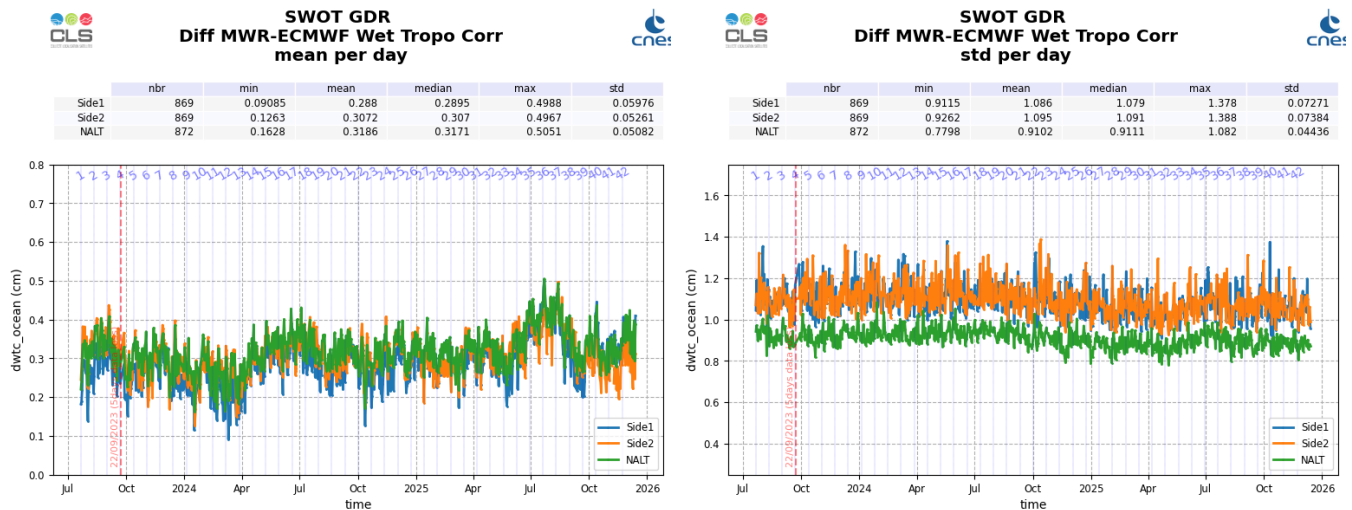


Figure 19: Daily monitoring of mean (left) and standard deviation (right) of the difference between AMRs wet tropospheric correction and ECMWF wet tropospheric correction for the side 1 (blue), the side 2 (orange) and the Nadir (green), computed from cycle 001 to cycle 042

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.

	nbr	min	mean	median	max	std
Side2-Side1	869	-0.1498	0.002815	0.005356	0.1359	0.0506
Side1-NALT	869	-0.04342	0.004063	0.002503	0.06304	0.01938
Side2-NALT	869	-0.08679	0.008008	0.01054	0.09101	0.03112

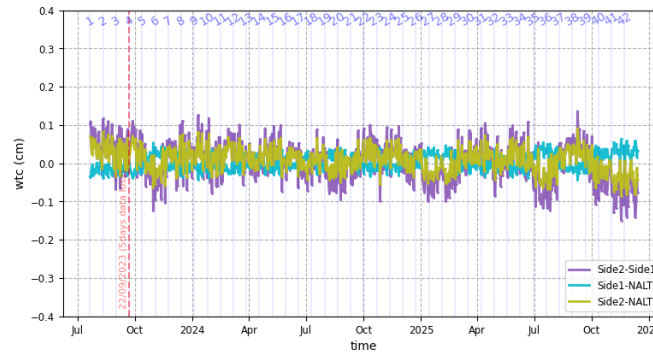


Figure 20: Daily monitoring of the wet tropospheric correction gradient between AMR Side 1 and AMR Side 2 (purple), AMR Side 1 and Nadir (cyan), and AMR Side 2 and Nadir (yellow), from Cycle 001 to 042

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 **0.29 cm**, with a standard deviation value of **0.94 cm**.

	nbr	min	mean	median	max	std
Radiometer from cycle 001	3.727e+07	-50	-15.9	nan	-0.19	10.02
S6A Radiometer over SN cycle 042	1.116e+06	-49.98	-14.97	-12.69	-0.1	9.353
ECMWF model over cycle 042	8.577e+05	-43.78	-15.46	-13.38	-0.53	9.544
Radiometer over cycle 042	8.577e+05	-49.68	-15.14	-13.12	-0.53	9.455

	nbr	min	mean	median	max	std
Radiometer minus ECMWF model from cycle 001	3.727e+07	-30.1	0.288	nan	39.96	0.9456
S6A Radiometer minus ECMWF model over SN cycle 042	1.116e+06	-24.22	0.09894	0.11	9.51	1.063
Radiometer minus ECMWF model over cycle 042	8.577e+05	-21.35	0.3255	0.3	12.94	0.9032

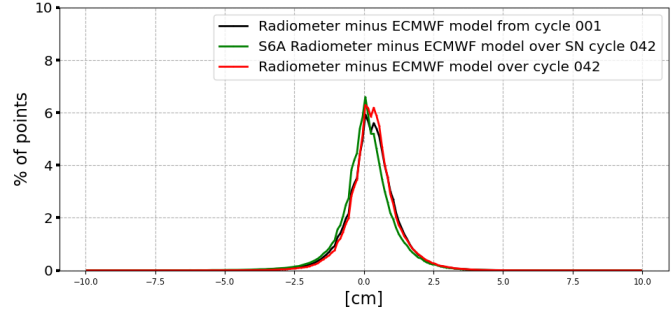
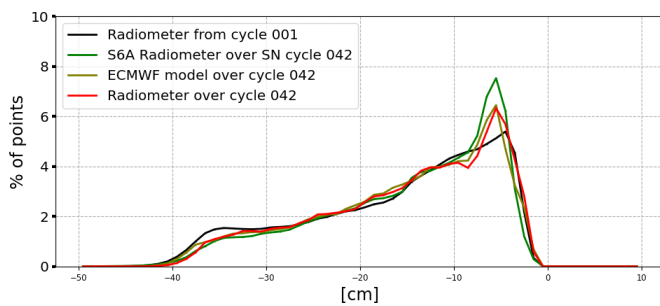


Figure 21: Histogram of wet troposphere corrections : SWOT Nadir radiometer (left) and difference with ECMWF model (right), computed over cycle 042 and from cycle 001 (black line)

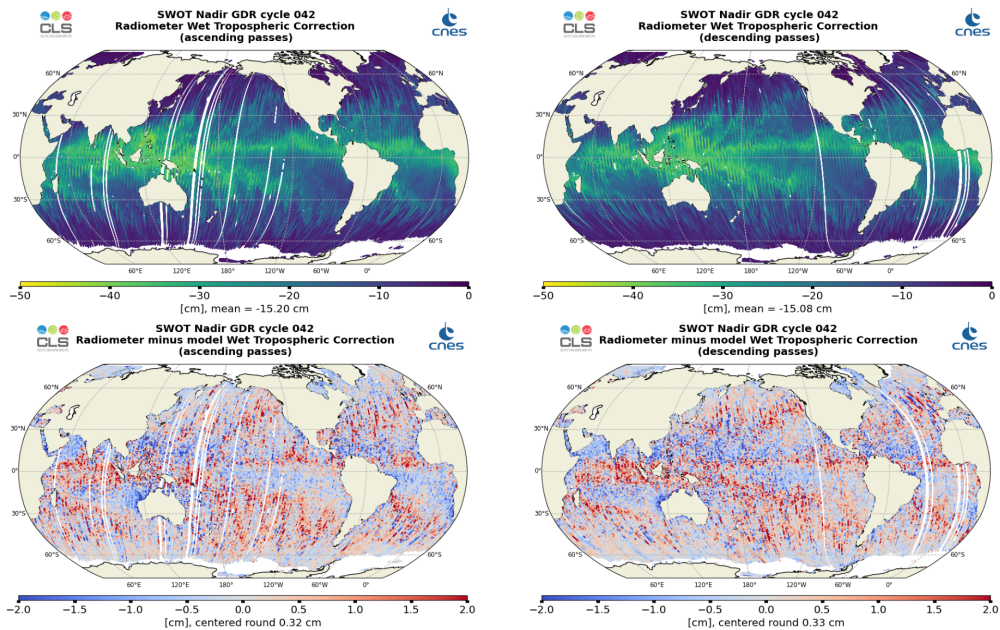


Figure 22: Along-track maps of the interpolated to Nadir AMRs wet tropospheric corrections (top) and radiometer minus ECMWF model difference of wet tropospheric corrections (bottom), computed over cycle 042

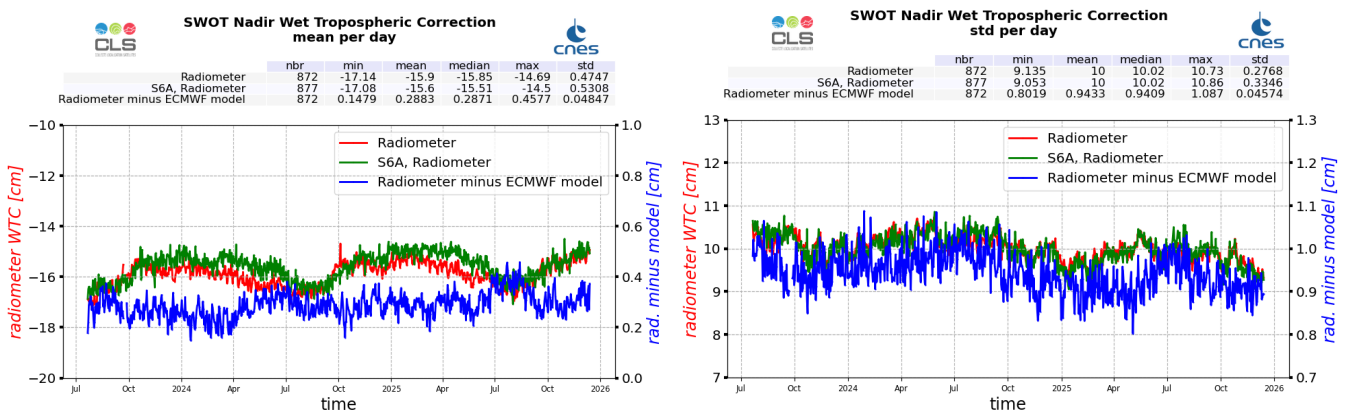


Figure 23: Daily monitoring of mean (left) and standard deviation (right) of the interpolated to Nadir AMRs wet tropospheric corrections (red) and radiometer minus ECMWF model difference of wet tropospheric corrections (blue), computed from cycle 001 to 042. Sentinel-6A-MF radiometer monitoring in green.

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 042, major AMR geolocation problems occur on:

- Pass 401 on 2025-12-06 from 23:48:50 to 23:58:03: anomaly due to incorrect location of certain AMR measurements, located on nadir measurements for both beams. This follows a data gap due to a downlink degraded (reported in SSAM reports).
- Pass 496 on 2025-12-10 from 09:28:57 to 09:33:20: anomaly due to incorrect location of certain AMR measurements, located on nadir measurements for both beams.No matches with events listed

in SSAM reports.

- Pass 566/567 on 2025-12-12 from 21:29:16 to 22:06:20: anomaly due to a OCM SLOT maneuver.

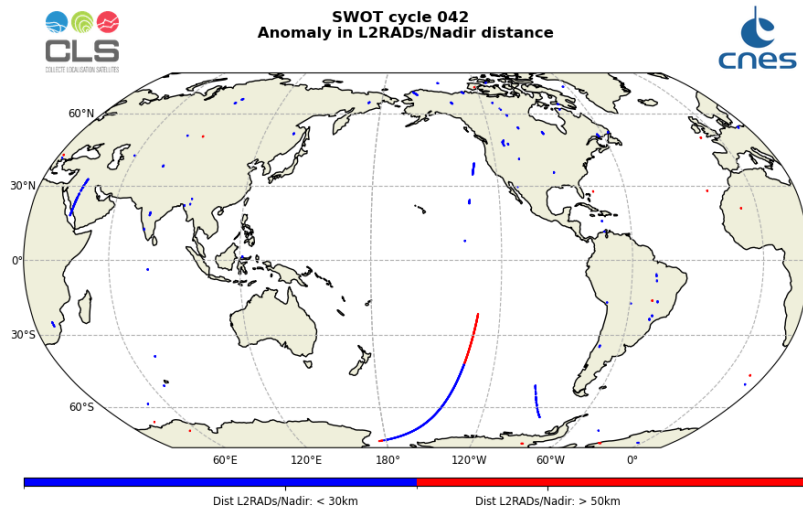


Figure 24: Map of the anomalies detected in the L2RADs/Nadir distance over the cycle 042

5 Sea Surface Height Anomaly

Over this cycle, SSHA is centered around **7.18** cm in MLE4, **4.35** cm in Adaptive (global along-track average).

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

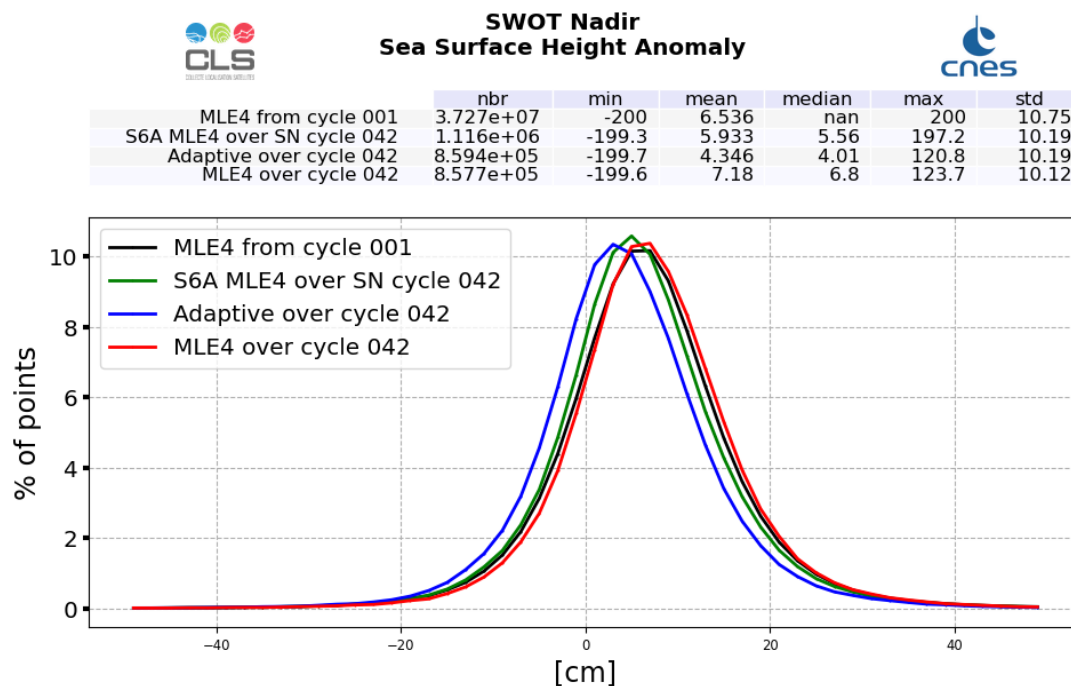


Figure 25: SSHA histogram computed over cycle 042 (red line for SWOT Nadir MLE4 and blue line for SWOT Nadir Adaptive, green for Sentinel-6A-MF (LR MLE4)) and from cycle 001 (SWOT Nadir, MLE4 only, black line)

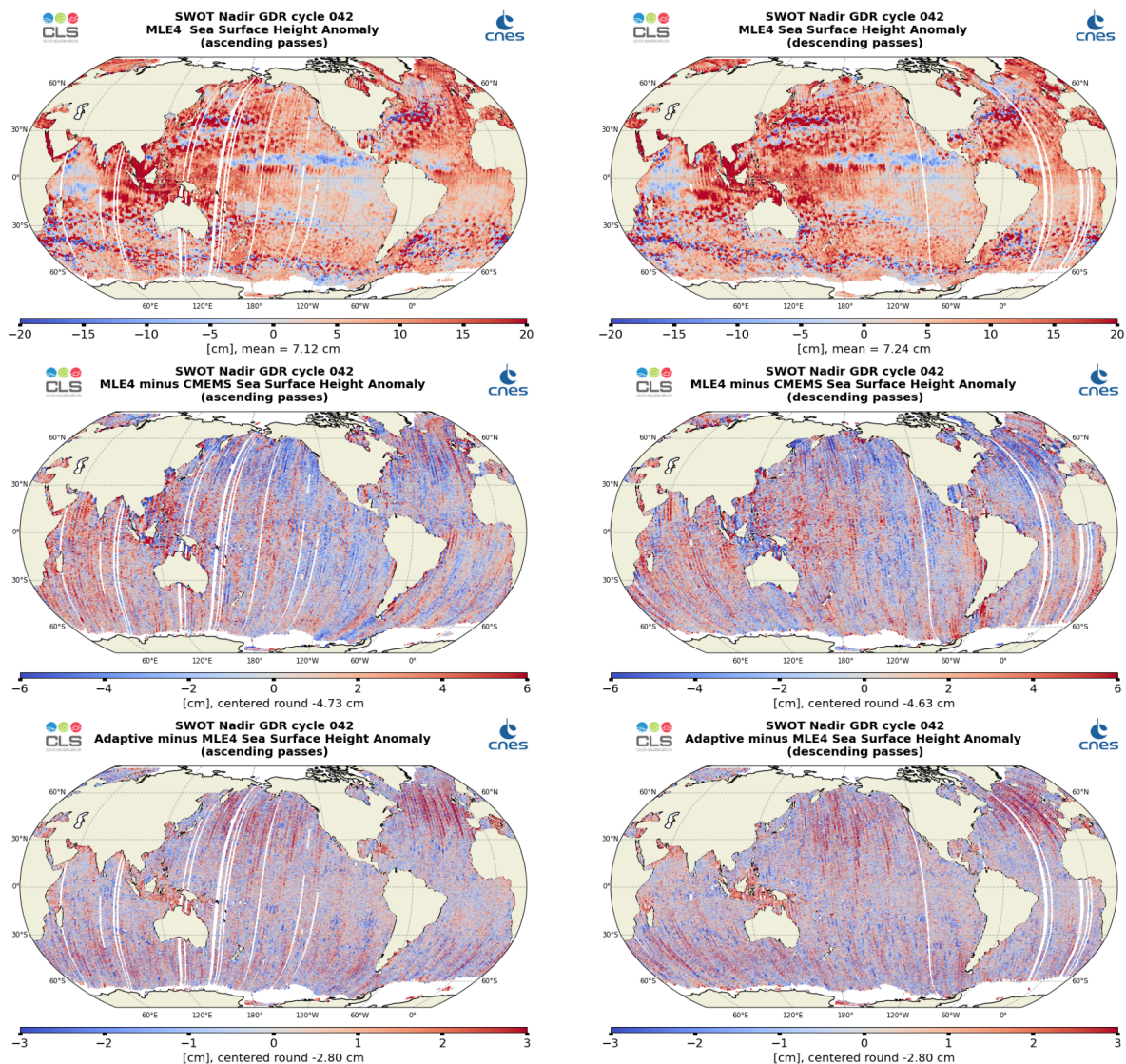


Figure 26: Along-track maps of SSHA over cycle 042 for SWOT Nadir MLE4 (top), MLE4 minus CMEMS (middle) or Adaptive minus MLE4 (bottom), ascending passes (left) and descending passes (right)

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 **10.36** cm.

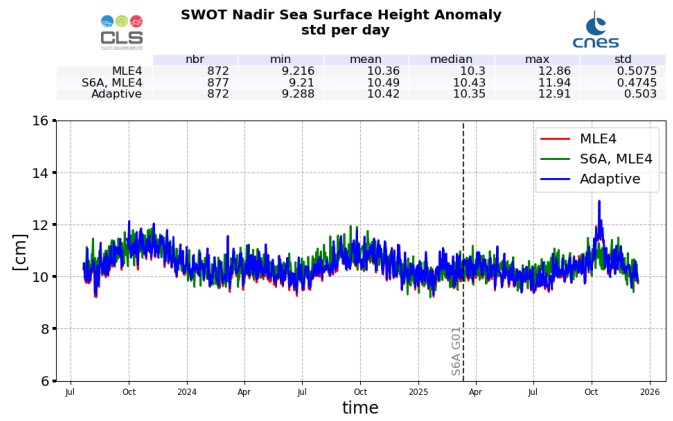
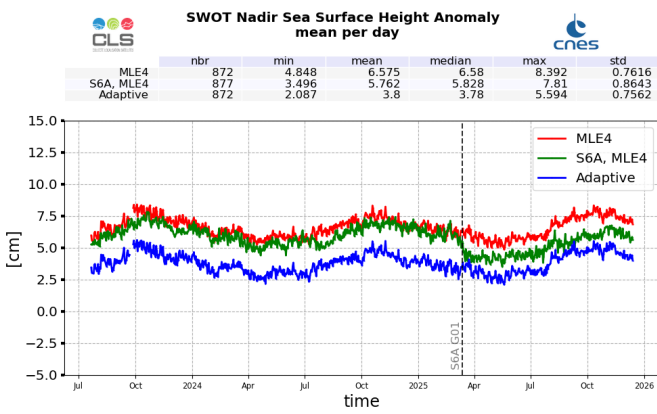


Figure 27: SSHA daily monitoring from cycle 001 to 042, for SWOT Nadir GDR

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 **4.61** cm in MLE4, **4.76** 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 ($|\text{latitude}| < |50|^\circ$, bathymetry $< -1000\text{m}$, ocean variability (computed over several years) $< 0.2\text{m}$). 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.

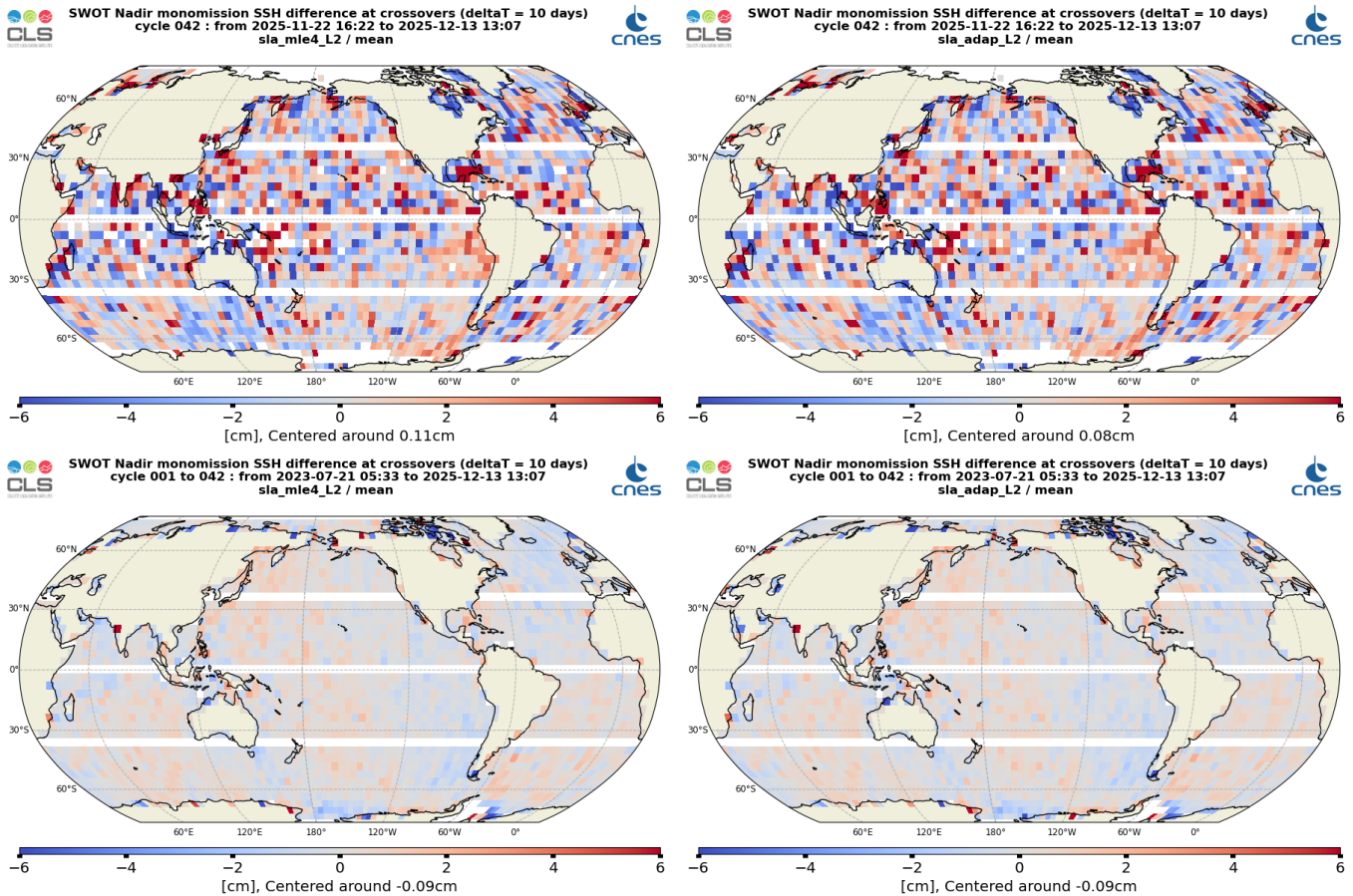


Figure 28: Mean SSH difference at crossovers for SWOT Nadir MLE4 (left) and Adaptive (right) cycle 042(top) and from cycle 001 to cycle 042 (bottom)

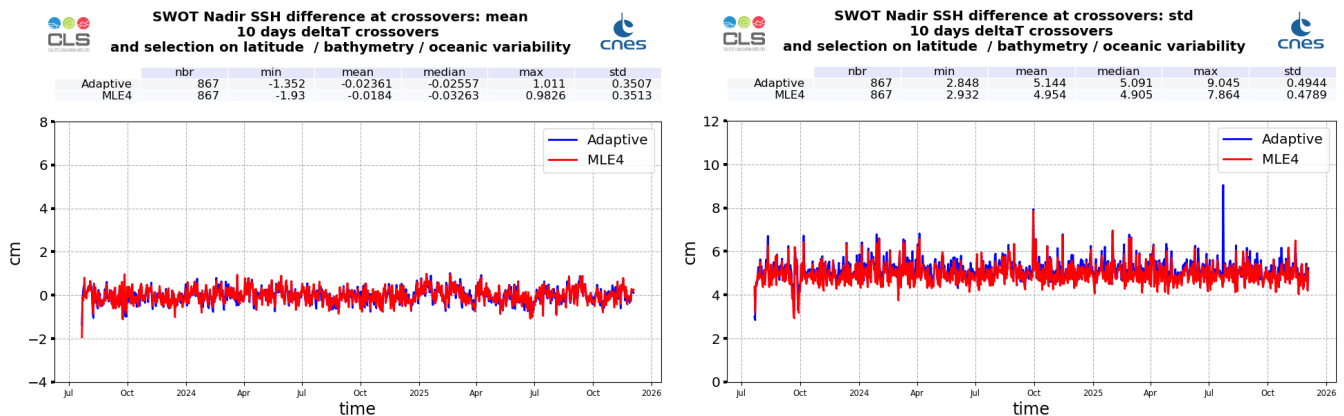


Figure 29: Monitoring of SSH difference at crossovers for SWOT Nadir MLE4 (red) and Adaptive (blue) : mean (left) and standard deviation (right), from cycle 001 to 042

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.

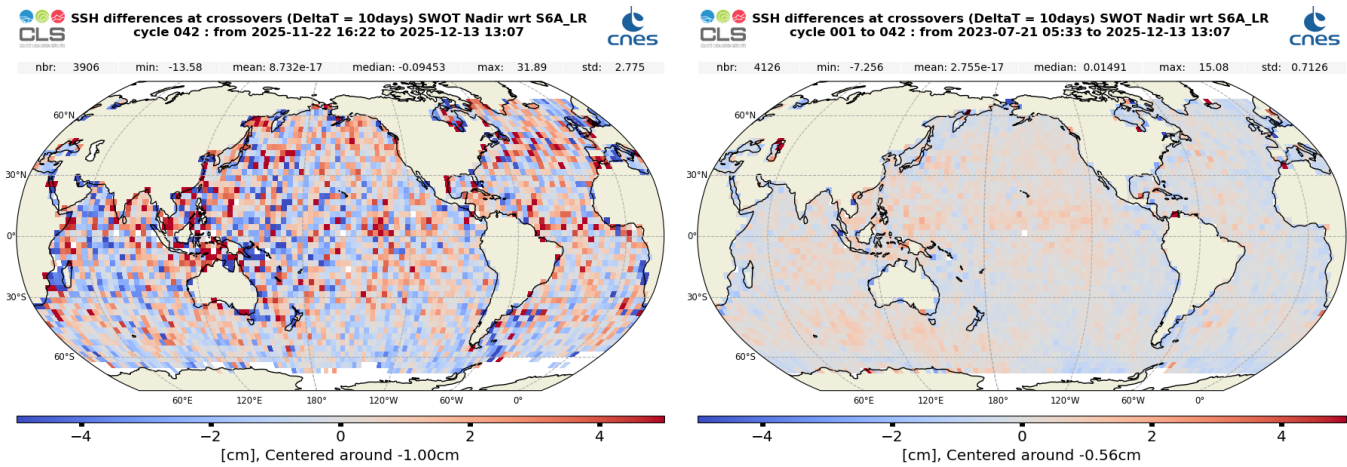


Figure 30: Mean SSH difference at crossovers between SWOT Nadir MLE4 and Sentinel-6 MF LR MLE4 over cycle 042 (left) and from cycle 001 onwards (right)

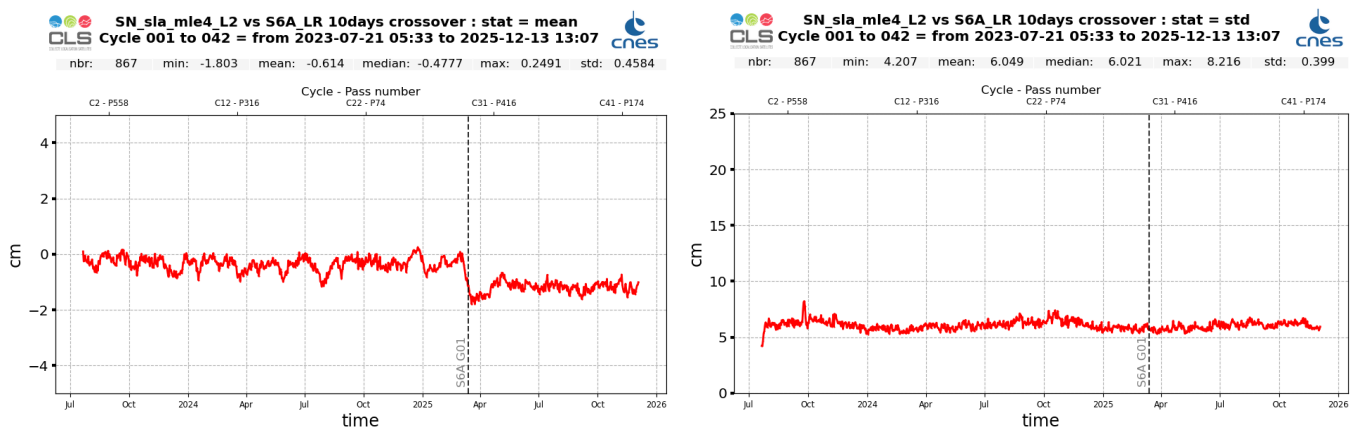


Figure 31: Daily monitoring of SSH difference at crossovers between SWOT Nadir MLE4 and Sentinel-6 MF LR MLE4 from cycle 001 onwards : mean (left) and standard deviation (right)

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).