CryoSat CRYO2ICE Orbit Raising Campaign QA4EO QC Summary

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QA4EO-VEG-OQC-REP-4214 *Issue: 1.0* *19 August 2020*

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AMENDMENT RECORD SHEET

The Amendment Record Sheet below records the history and issue status of this document.

ISSUE	DATE	REASON
1.0	19 August 2020	Initial Release to ESA for Review

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1. INTRODUCTION

CryoSat-2 was launched on 8th April 2010 with a Ku-band radar altimeter called SIRAL (SAR Interferometric Radar ALtimeter) [1]. ICESat-2 is a NASA mission launched in September 2018, with a LIDAR called ATLAS (Advanced Topographic Laser Altimeter System) as main payload, which consists of three laser beam pairs [1]. Both payloads, the CryoSat-2 radar on one side and the ICEsat-2 laser on the other, represent a unique opportunity for the cryosphere community to combine these science data with such a different payload characteristic [1].

An intensive study was undertaken by the Flight Dynamics team at ESOC in order to design a new reference orbit for CryoSat-2 to maximise the availability and quality of ICESat-2 and CryoSat-2 instrument footprint coincidences [1]. The CRYO2ICE campaign aims to raise the CryoSat-2 orbit by 900 metres to bring it in sync with IceSat-2, maximising the overlaps between the two missions over the arctic region, allowing for near-simultaneous measurements from both CryoSat-2's radar and ICESat-2's laser instruments. The first phase of joint observations is expected to start officially on 10th August 2020, after the successful completion of the orbit change.

Orbit raising activities were performed from 16/07/2020 until 31/07/2020 [1]. During this period, the QA4EO CryoSat QC team monitored data production between the orbit manoeuvres and performed detailed quality control checks on all Near Real Time (NRT) data generated. The NRT products are generated just 2-3 hours after data acquisition and therefore offers the first opportunity to confirm data quality and check for any anomalies as a result of the manoeuvres. Several periods of SIRAL unavailability occurred throughout the campaign as the SIRAL instrument had to be put in standby mode during the orbit control manoeuvres. All unavailability periods are reported on the CryoSat Unavailability Webpage.

1.1 Quality Control

All CryoSat ice and ocean products generated operationally are routinely monitored by the CryoSat Quality Control (QC) team (QA4EO-IDEAS consortium). Routine QC starts with the real-time monitoring of Level 0 data and auxiliary file availability and continues to daily checks of all Level 1B, Level 2 and Level 2I science products generated operationally. These activities aim to detect anomalies, support investigations, and prevent the distribution of poor quality data products to users.

During the CRYO2ICE campaign, the CryoSat QC team monitored data production between the orbit manoeuvres and performed detailed checks of all NRT data generated. This included checking for error flags in the data products and monitoring key L2 parameters for potential anomalies. This report contains a summary of the results of the detailed checks.

1.2 Reference Documents

RD.1 CryoSat-2 Manoeuvre Campaign July 2020 for ICEsat-2 resonance mission Operation Plan, ESA, C2-TN-ESC-FS-6864, v1.0

2. QC SUMMARY

The QC summary contains details of the QC checks performed on the NRT data during the orbit raising campaign. A brief summary of the QC checks is provided below:

- Data quality was nominal throughout and no data quality anomalies were observed in the data products.
- No anomalies observed in the L2 parameters monitored (range, backscatter, SSHA).
- Due to a delayed auxiliary file input, some L1B and L2 NRT products are missing the GIM Ionospheric correction, however this is not a mandatory input at NRT (affected days 23/07/2020; 26/07/2020; 27/07/2020).

The full results of daily quality checks are available in the CryoSat Daily Performance Reports. The exact times of all planned and unplanned data unavailability periods are reported on the CryoSat Unavailability Webpage.

2.1 Data Coverage

The CryoSat orbit raising activities were undertaken during the period 16/07/2020 until 31/07/2020. The coverage of our detailed QC checks is outlined in Table 2-1 below.

Table 2-1 Coverage of detailed QC checks

Data type	Levels	Period covered by detailed QC	Report frequency
FDM	L1 & L2	16/07/2020 – 31/07/2020	Daily
NOP	L1 & L2	16/07/2020 – 31/07/2020	Daily
IOP	L1 & L2	16/07/2020 – 31/07/2020	Daily
NRT SAR & SARIn	L1 & L2	16/07/2020 – 31/07/2020	Every 5-days

2.2 FDM

FDM products are LRM products generated in NRT typically 2-3 hours after data sensing acquisition, using the DORIS Navigator Orbit, and with geophysical corrections computed from the Forecast meteorological Auxiliary Data Files (ADFs) where available.

Table 2-2 Status of QC checks performed on FDM data 16/07-31/07/2020

QC Check	Status
Production completeness	**Nominal**
Product Quality check	**Nominal**
Product Format check	**Nominal**

ADF Usage check	Due to delays at SSALTO following orbit manoeuvres, AUXI IONGIM files were delayed causing some products to be missing the GIM Ionospheric Correction. AUXI IONGIM files were delayed on the following occasions: • **23/07/2020** All products missing GIM Ionospheric Correction from 00h - 12h due to the delayed Meteo AUXI IONGIM • **26-27/07/2020**: All products missing GIM Ionospheric Correction due to the delayed Meteo AUXIIONGIM
Cal Usage check	**Nominal**
STR Usage check	**Nominal**
Measurements confidence flags	**Nominal**
Correction error flags	Due to delays at SSALTO following orbit manoeuvres, AUXI IONGIM files were delayed causing some products to be missing the GIM Ionospheric Correction. AUXI IONGIM files were delayed on the following occasions: • **23/07/2020** All products missing GIM Ionospheric Correction from 00h - 12h due to the delayed Meteo AUXI IONGIM • **26-27/07/2020**: All products missing GIM Ionospheric Correction due to the delayed Meteo AUXIIONGIM
L2 Parameters check	**Nominal**

2.3 NOP

Near Real Time Ocean Products (NOP) are generated in NRT typically 2-3 hours after data sensing acquisition, using the DORIS Navigator Orbit and with geophysical corrections computed from the Forecast meteorological Auxiliary Data Files (ADFs) where available.

Table 2-3 Status of QC checks performed on NOP data 16/07-31/07/2020

QC Check	Status
Production completeness	**Nominal**
Product Quality check	**Nominal**
Product Format check	**Nominal**
ADF Usage check	Due to delays at SSALTO following orbit manoeuvres, AUXI IONGIM files were delayed causing some products to be missing GIM Ionospheric Correction AUXI IONGIM files were delayed on the following occasions: • **23/07/2020** All products missing GIM Ionospheric Correction from 00h - 12h due to the delayed Meteo AUXI IONGIM • **26-27/07/2020**: All products missing GIM Ionospheric Correction due to the delayed Meteo AUXIIONGIM
Cal Usage check	**Nominal**
STR Usage check	**Nominal**
Measurements confidence flags	**Nominal**
Correction error flags	Due to delays at SSALTO following orbit manoeuvres, AUXI IONGIM files were delayed causing some products to be missing GIM Ionospheric Correction

	AUXI IONGIM files were delayed on the following occasions: • **23/07/2020** All products missing GIM Ionospheric Correction from 00h - 12h due to the delayed Meteo AUXI IONGIM • **26-27/07/2020**: All products missing GIM Ionospheric Correction due to the delayed Meteo AUXIIONGIM
L2 Parameters check	**Nominal**

2.4 NRT SAR & SARIn

NRT SAR and SARIn products are the SAR and SARIn equivalents to FDM, again generated in NRT typically 2-3 hours after data sensing acquisition. They use the DORIS Navigator Orbit, and with geophysical corrections computed from the Forecast meteorological Auxiliary Data Files (ADFs) where available.

Table 2-4 Status of QC checks performed on NRT SAR and SIN data 16/07-31/07/2020

QC Check	Status
Production completeness	**Nominal**
Product Quality check	**N/A**
Product Format check	**N/A**
ADF Usage check	Due to delays at SSALTO following orbit manoeuvres, AUXI IONGIM files were delayed causing some products to be missing GIM Ionospheric Correction AUXI IONGIM files were delayed on the following occasions: • **23-24/07/2020** All products missing GIM Ionospheric Correction from 00h - 12h due to the delayed Meteo AUXI IONGIM • **26-27/07/2020**: All products missing GIM Ionospheric Correction due to the delayed Meteo AUXIIONGIM
Cal Usage check	**Nominal**
STR Usage check	**Nominal**
Measurements confidence flags	**Nominal**
Correction error flags	Due to delays at SSALTO following orbit manoeuvres, AUXI IONGIM files were delayed causing some products to be missing GIM Ionospheric Correction AUXI IONGIM files were delayed on the following occasions: • **23-24/07/2020** All products missing GIM Ionospheric Correction from 00h - 12h due to the delayed Meteo AUXI IONGIM • **26-27/07/2020**: All products missing GIM Ionospheric Correction due to the delayed Meteo AUXIIONGIM
L2 Parameters check	**Nominal**

2.5 IOP

Intermediate Ocean Products (IOP) are generated 2-3 days after data sensing acquisition for medium-range ocean forecasting and use DORIS preliminary orbits (CNES Medium

Orbit Ephemeris) with geophysical corrections computed from Analysis metrological ADFs, and when these are not available in time, the Forecast metrological ADFs.

Table 2-5 Status of QC checks performed on IOP data 16/07-31/07/2020

QC Check	Status
Production completeness	**Nominal**
Product Quality check	**Nominal**
Product Format check	**Nominal**
ADF Usage check	**Nominal**
Cal Usage check	**Nominal**
STR Usage check	**Nominal**
Measurements confidence flags	**Nominal**
Correction error flags	**Nominal**
L2 Parameters check	**Nominal**

3. UNAVAILABILITY PERIODS

Several periods of SIRAL unavailability occurred throughout the campaign as the SIRAL instrument had to be put in standby mode during the orbit control manoeuvres. Table 3-1 shows the exact times of unavailability periods caused by orbit manoeuvres during the orbit raising campaign. All unavailabilities have been added to the CryoSat webpage: https://earth.esa.int/web/guest/missions/cryosat/unavailability-periods

Table 3-1 Unavailability periods

Unavailability Start Time (UTC)	Unavailability Stop Time (UTC)	Planned/ Unplanned	Reason	SIRAL Mode Affected
2020-07-30 22:23:17	2020-07-31 00:10:28	Planned	Orbit Manoeuvre	All
2020-07-27 22:26:11	2020-07-28 05:09:47	Planned	Orbit Manoeuvre	All
2020-07-23 22:30:22	2020-07-24 05:14:33	Planned	Orbit Manoeuvre	All
2020-07-20 21:44:06	2020-07-21 04:29:06	Planned	Orbit Manoeuvre	All
2020-07-16 21:48:52	2020-07-16 23:35:09	Planned	Orbit Manoeuvre	All

4. L2 PARAMETER ANALYSIS

The following section provides plots and statistics of some key science parameters extracted from the L2 products during the orbit raising campaign. Analysis of these parameters provides a means of verifying the successful generation of scientific parameters and the use of the appropriate auxiliary corrections.

4.1 FDM

4.1.1 Range to Ocean Surface (1 Hz)

The 'Range to Ocean Surface' was analysed for both the CFI and OCOG retrackers. The mean and standard deviation values remained stable throughout the orbit raising campaign, as seen in Figure 4-1.

Table 4-1 Range to Ocean Surface (1 Hz) Values

	Range CFI Retracker (1Hz)		Range OCOG Retracker (1Hz)	
Date	**Mean (km)**	**St. dev. (km)**	**Mean (km)**	**St. dev. (km)**
16/07/2020	726.99	36.04	728.55	12.51
17/07/2020	726.82	41.06	728.93	12.33
18/07/2020	727.53	33.3	728.88	11.29
19/07/2020	727.14	36.16	728.79	10.05
20/07/2020	727.12	37.93	728.84	13.24
21/07/2020	727.35	38.09	729.15	11.37
22/07/2020	727.95	30.7	729.1	9.38
23/07/2020	727.06	39.06	729.02	9.38
24/07/2020	727.77	36.77	729.39	12.87
25/07/2020	727.77	34.24	729.21	11.09
26/07/2020	727.95	33.24	729.27	11.62
27/07/2020	727.83	33.66	729.19	11.81
28/07/2020	727.69	40.39	729.72	12.12
29/07/2020	727.32	40.22	729.34	12.04
30/07/2020	727.64	39.63	729.52	13.93
31/07/2020	727.63	37.48	729.4	10.35

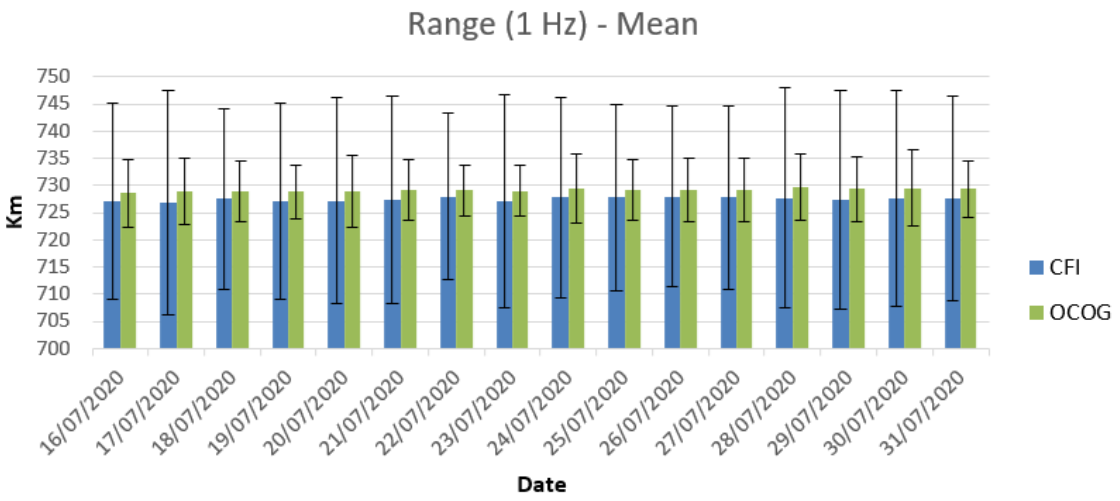

Figure 4-1 Range (1 Hz) Mean (bars) and Standard Deviation (error bars)

4.1.2 Backscatter (1 Hz)

Backscatter was analysed for both the CFI and OCOG retrackers. Mean and standard deviation values remained stable throughout the orbit raising campaign as seen in Figure 4-2.

Table 4-2 Backscatter (1 Hz) Values

	Backscatter CFI Retracker (1Hz)		Backscatter OCOG Retracker (1Hz)	
Dates	**Mean (dB)**	**St. dev. (dB)**	**Mean (dB)**	**St. dev. (dB)**
16/07/2020	11.21	15.26	8.74	2.71
17/07/2020	11.41	17.48	8.76	3.49
18/07/2020	11.04	14.03	8.71	3.12
19/07/2020	11.35	15.29	8.9	2.14
20/07/2020	11.42	16.09	8.89	2.87
21/07/2020	11.35	16.17	8.82	2.76
22/07/2020	11.11	12.89	8.86	2.36
23/07/2020	11.26	16.58	8.68	2.05
24/07/2020	11.07	15.57	8.6	3.21
25/07/2020	11.2	14.46	8.82	3.1
26/07/2020	11.01	14.01	8.67	2.58
27/07/2020	11.11	14.2	8.76	2.72
28/07/2020	11.3	17.18	8.66	3.63
29/07/2020	11.43	17.11	8.8	3.02
30/07/2020	11.37	16.86	8.77	3.19
31/07/2020	11.27	15.89	8.76	2.59

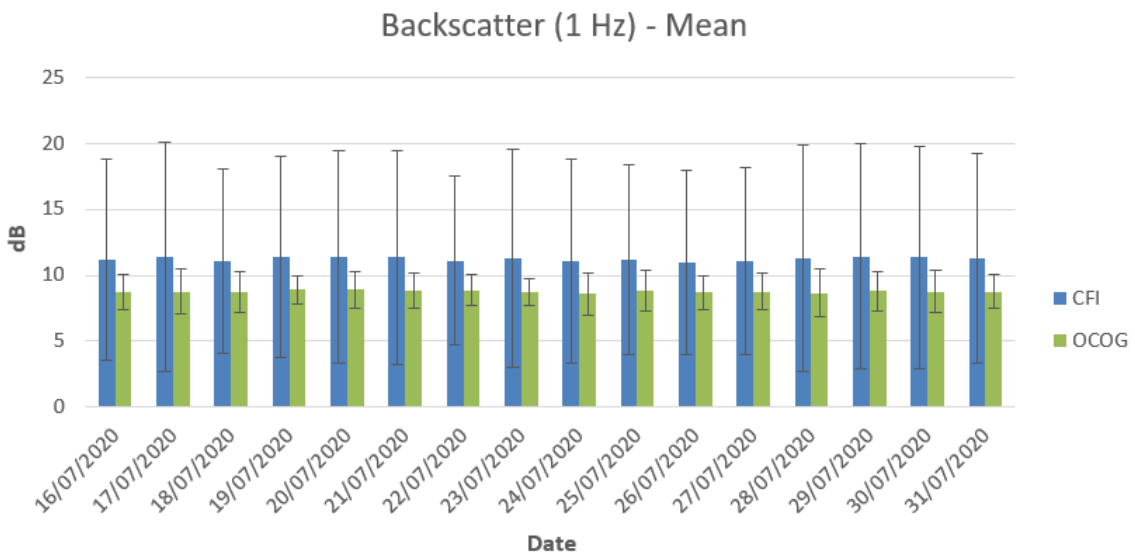

Figure 4-2 Backscatter (1Hz) Mean (bars) and Standard Deviation (error bars)

4.2 NOP

4.2.1 Range to Ocean Surface (1 Hz)

The 'Range to Ocean Surface' was analysed for both the Ocean and OCOG retrackers. The OCOG retracker is only used in LRM products (NOPM). Mean and standard deviation values remained stable throughout the orbit raising campaign as seen in Figure 4-3.

Table 4-3 Range to Ocean Surface (1 Hz) Values

	Range: Ocean Retracker (1 Hz)						Range: OCOG Retracker (1 Hz)	
	NOPM		NOPN		NOPR		NOPM	
Date	Mean (km)	St dev (km)	Mean (km)	St dev (km)	Mean (km)	St dev (km)	Mean (km)	St dev (km)
16/07/2020	728.76	9.51	740	14.48	733.68	12.35	728.72	9.5
17/07/2020	729.06	9.46	740.34	14.22	732.52	12.665	729	9.43
18/07/2020	729.08	9.49	741.15	14.13	733.01	12.408	729.03	9.47
19/07/2020	729.98	9.47	739.61	14.37	733	12.65	728.92	9.46
20/07/2020	729.14	9.55	739.62	14.65	732.96	12.546	729.07	9.54
21/07/2020	729.33	9.3	738.08	14.32	735.52	12.502	729.28	9.29
22/07/2020	729.43	9.37	737.21	14.86	732.21	12.237	729.37	9.37
23/07/2020	729.08	9.44	739.19	14.58	734.57	12.213	729.02	9.38
24/07/2020	729.69	9.24	735.7	14.55	734.35	12.07	729.63	9.22
25/07/2020	729.31	9.26	740.14	14.42	734.08	12.003	729.27	9.25
26/07/2020	729.5	9.18	738.21	14.72	732.9	11.92	729.44	9.17
27/07/2020	729.32	9.27	742.08	13.44	734.08	12.219	729.28	9.26
28/07/2020	729.99	9.11	735.32	14.5	733.47	11.49	729.94	9.1
29/07/2020	729.38	9.11	741.45	13.36	733.53	12.54	729.35	9.09
30/07/2020	729.85	9.06	734.1	11.21	732.66	11.22	729.79	9.05
31/07/2020	729.41	9.08	739.04	13.33	734.2	11.7	729.37	9.07

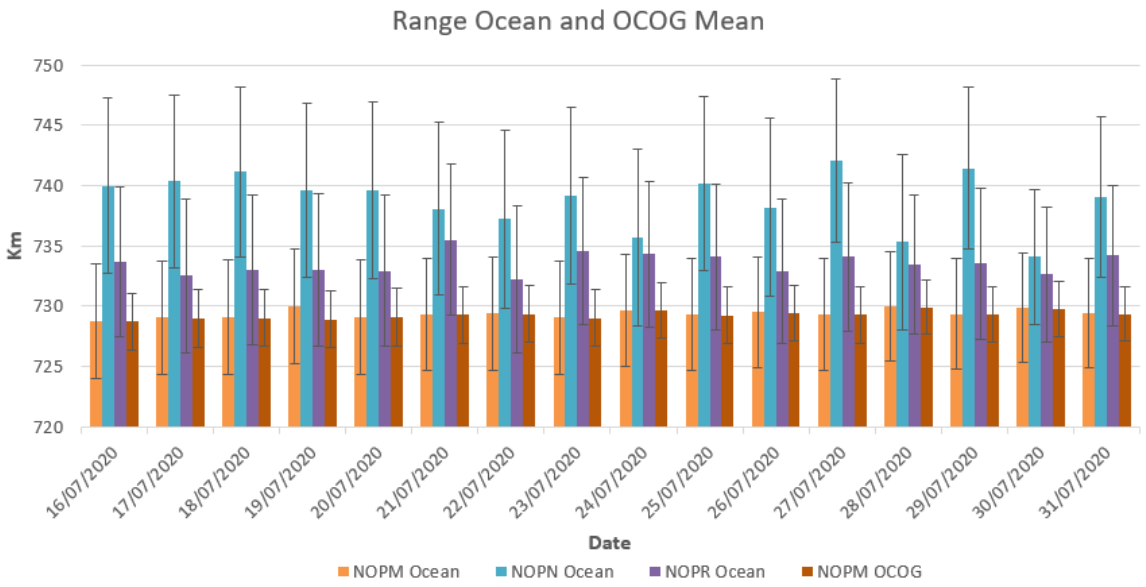

Figure 4-3 Range (OCOG and Ocean Retrackers) Mean (bars) and Standard Deviation (error bars)

4.2.2 Sea Surface Height Anomaly (1 Hz and 20 Hz)

Sea surface height anomaly (SSHA) statistics for 1 Hz and 20 Hz remained stable throughout the orbit raising campaign. Statistics are missing for 27/07/2020, when the AUXI IONGIM file was missing at the time of processing and therefore the SSHA was not computed.

Table 4-4 NOPM SSHA Statistics

	SSHA (1 Hz)		SSHA (20 Hz)	
	Mean (m)	St. dev. (m)	Mean (m)	St. dev. (m)
16/07/2020	0	0.1	0	0.2
17/07/2020	0	0.1	0	0.2
18/07/2020	0	0.1	0	0.4
19/07/2020	0	0.1	0	0.2
20/07/2020	0	0.2	0	0.5
21/07/2020	0	0.1	0	0.2
22/07/2020	0	0.1	0	0.2
23/07/2020	0	0.2	0	0.2
24/07/2020	0	0.1	0	0.3
25/07/2020	0	0.2	0	0.2
26/07/2020	0	0.1	0	0.3
27/07/2020	N/A	N/A	N/A	N/A
28/07/2020	0	0.1	0	0.2
29/07/2020	0	0.1	0	0.2
30/07/2020	0	0.1	0	0.3
31/07/2020	0	0.1	0	0.2

Table 4-5 NOPN SSHA Statistics

	SSHA (1 Hz)		SSHA (20 Hz)	
	Mean (m)	St. dev. (m)	Mean (m)	St. dev. (m)
16/07/2020	0.8	4.3	0.8	4.9
17/07/2020	0.4	3	0.4	3.1
18/07/2020	1.2	5.5	1.5	6.1
19/07/2020	0.3	2.4	0.3	2.8
20/07/2020	0.7	4.1	0.8	4.7
21/07/2020	0.2	1.8	0.3	2.4
22/07/2020	0.4	3.2	0.5	3.9
23/07/2020	0.9	4	1.2	5.2
24/07/2020	0.3	2.7	0.4	3.4
25/07/2020	1.1	4.9	1.2	5.4
26/07/2020	0.2	2.7	0.4	3.2
27/07/2020	N/A	N/A	N/A	N/A
28/07/2020	0.5	3.2	0.7	4
29/07/2020	0.4	2.7	0.6	3.8
30/07/2020	0.2	2.7	0.4	3.2
31/07/2020	0.9	4.2	1.2	5.5

Table 4-6 NOPR SSHA Statistics

	SSHA (1 Hz)		SSHA (20 Hz)	
	Mean (m)	St. dev. (m)	Mean (m)	St. dev. (m)
16/07/2020	0	0.6	0	1
17/07/2020	0	0.7	0	1
18/07/2020	0	0.4	0	1.1
19/07/2020	0	0.6	0	1.1
20/07/2020	0	0.5	-0.1	1
21/07/2020	0	0.5	0	1.2
22/07/2020	0	0.7	0	0.9
23/07/2020	0	0.7	0	1
24/07/2020	0	0.5	-0.1	1
25/07/2020	0	0.7	0	1.1
26/07/2020	0	0.3	0	1
27/07/2020	N/A	N/A	N/A	N/A
28/07/2020	0	0.4	0	1.1
29/07/2020	0	0.5	0	1.1
30/07/2020	0	0.3	0	0.1
31/07/2020	0	0.4	0	0.9

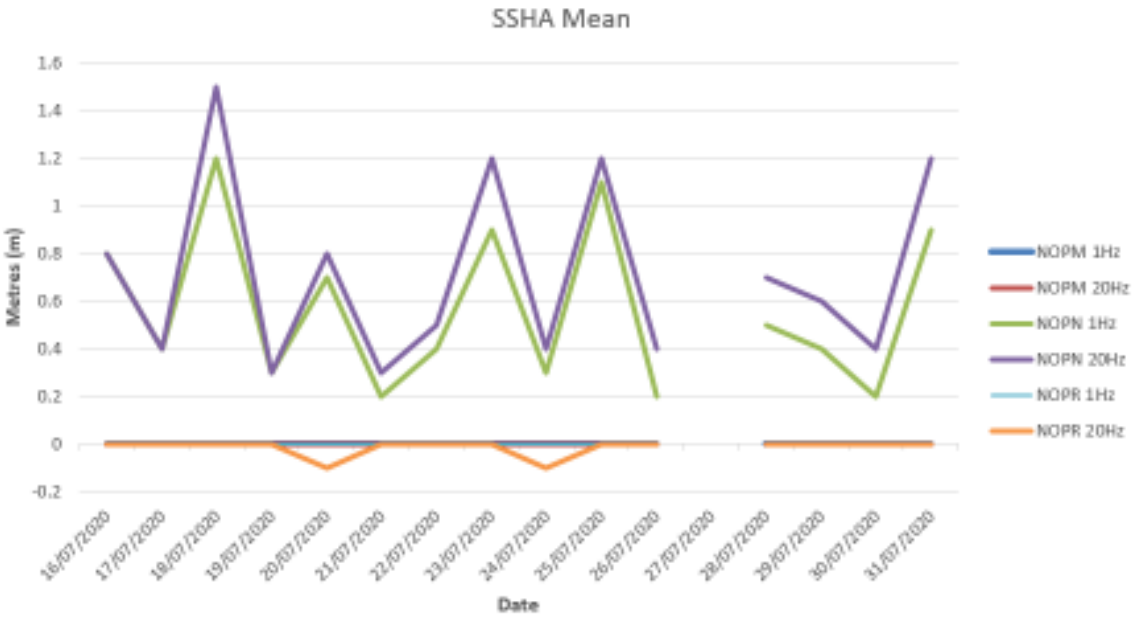

Figure 4-4 SSHA Mean Time Series

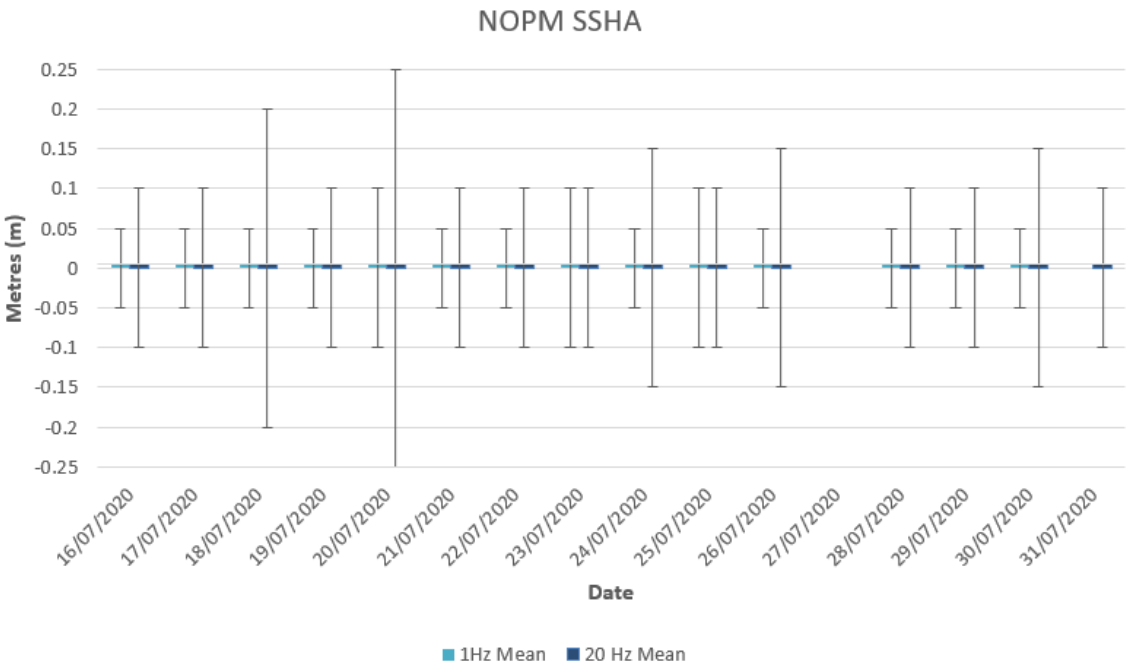

Figure 4-5 NOPM SSHA Mean (bars) and Standard Deviation (error bars)

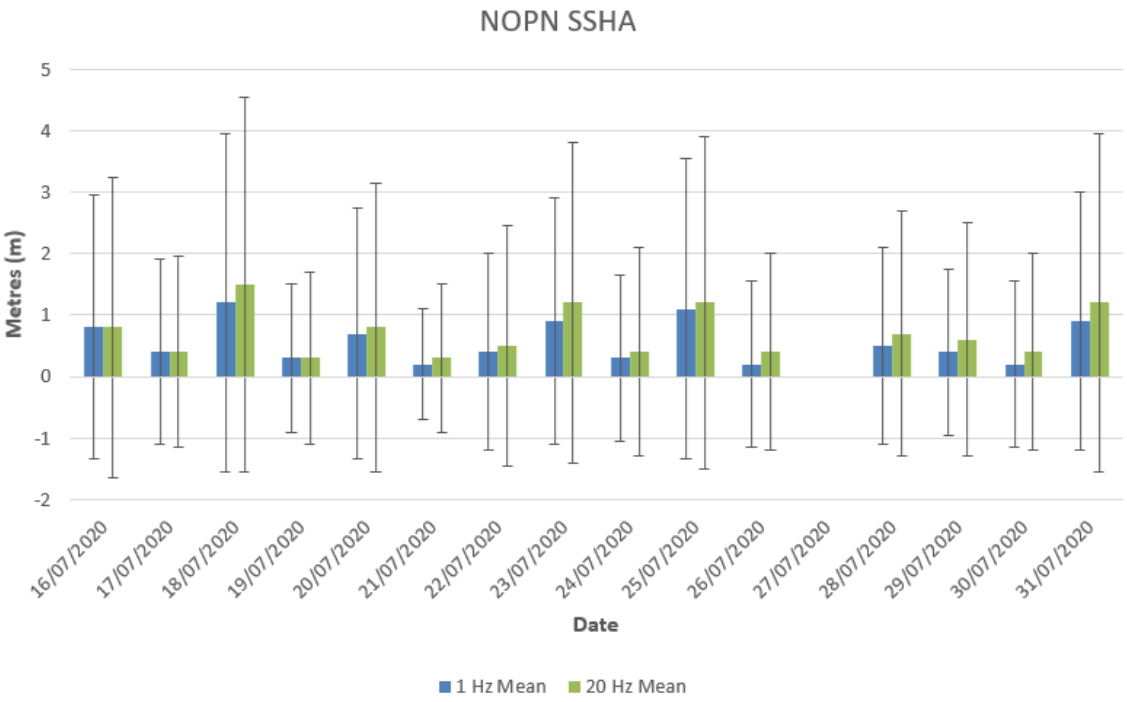

Figure 4-6 NOPN SSHA Mean (bars) and Standard Deviation (error bars)

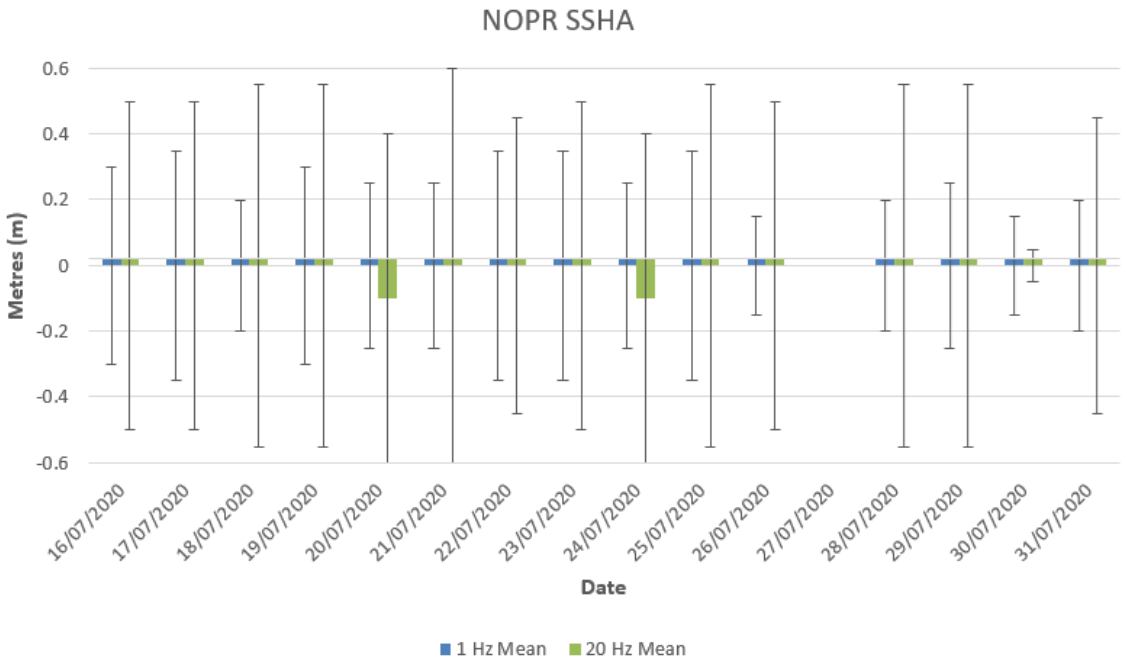

Figure 4-7 NOPR SSHA Mean (bars) and Standard Deviation (error bars)

4.2.3 Sigma-0 (1 Hz and 20 Hz)

Sigma-0 (or backscatter) was analysed for both the Ocean and OCOG retrackers. The OCOG retracker is only used in LRM products (NOPM). Sigma-0 statistics for both Ocean and OCOG retrackers remained stable throughout the orbit raising campaign.

Table 4-7 NOPM Sigma-0 (Ocean Retracker) Statistics

	Sigma-0 (1 Hz)		Sigma-0 (20 Hz)	
	Mean (dB)	St. dev. (dB)	Mean (dB)	St. dev. (dB)
16/07/2020	11.1	2.1	10.5	3.4
17/07/2020	11.1	2	10.6	3.3
18/07/2020	11.2	2	10.6	3.4
19/07/2020	11.2	1.9	10.6	3.3
20/07/2020	11.1	2.1	10.6	3.5
21/07/2020	11.1	2	10.6	3.2
22/07/2020	11.1	2.1	10.5	3.4
23/07/2020	11	1.8	10.4	3.2
24/07/2020	10.9	1.8	10.4	3.2
25/07/2020	11.1	2	10.6	3.3
26/07/2020	11	1.9	10.4	3.3
27/07/2020	11.1	1.9	10.5	3.3
28/07/2020	10.9	1.8	10.5	3.2
29/07/2020	11.1	1.8	10.5	3.3
30/07/2020	11.1	2	10.7	3.2
31/07/2020	11.1	1.9	10.6	3.3

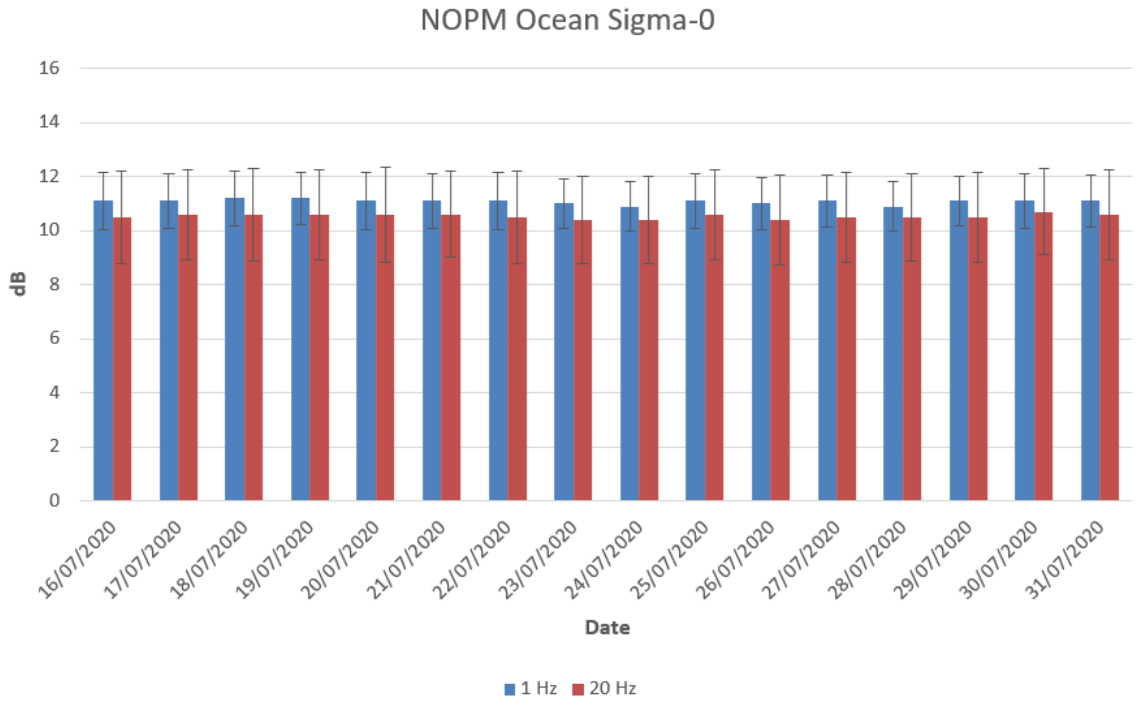

Figure 4-8 NOPM Ocean Retracker Sigma-0 Mean (bars) and Standard Deviation (error bars)

Table 4-8 NOPN Sigma-0 (Ocean Retracker) Statistics

	Sigma-0 (1 Hz)		Sigma-0 (20 Hz)	
	Mean (dB)	St. dev. (dB)	Mean (dB)	St. dev. (dB)
16/07/2020	12.1	4.3	9.4	12.5
17/07/2020	11.4	3.3	9.2	12.2
18/07/2020	11.8	4.2	9.4	12.8
19/07/2020	11.8	3.7	9.5	11.6
20/07/2020	11.9	4.2	9	13.2
21/07/2020	12.4	4.4	9.1	12.4
22/07/2020	12.8	5.3	8.8	13.1
23/07/2020	11.7	4.2	8.8	12
24/07/2020	12	4.5	8.6	13.1
25/07/2020	11.4	3.8	8.3	12.1
26/07/2020	11.9	4.1	9.1	13
27/07/2020	11.3	4.6	8.9	12.4
28/07/2020	12.2	5.2	9.9	12.7
29/07/2020	11.6	4.4	9	12.2
30/07/2020	11.2	4.4	7.2	11.8
31/07/2020	11.7	4.5	9.7	12.4

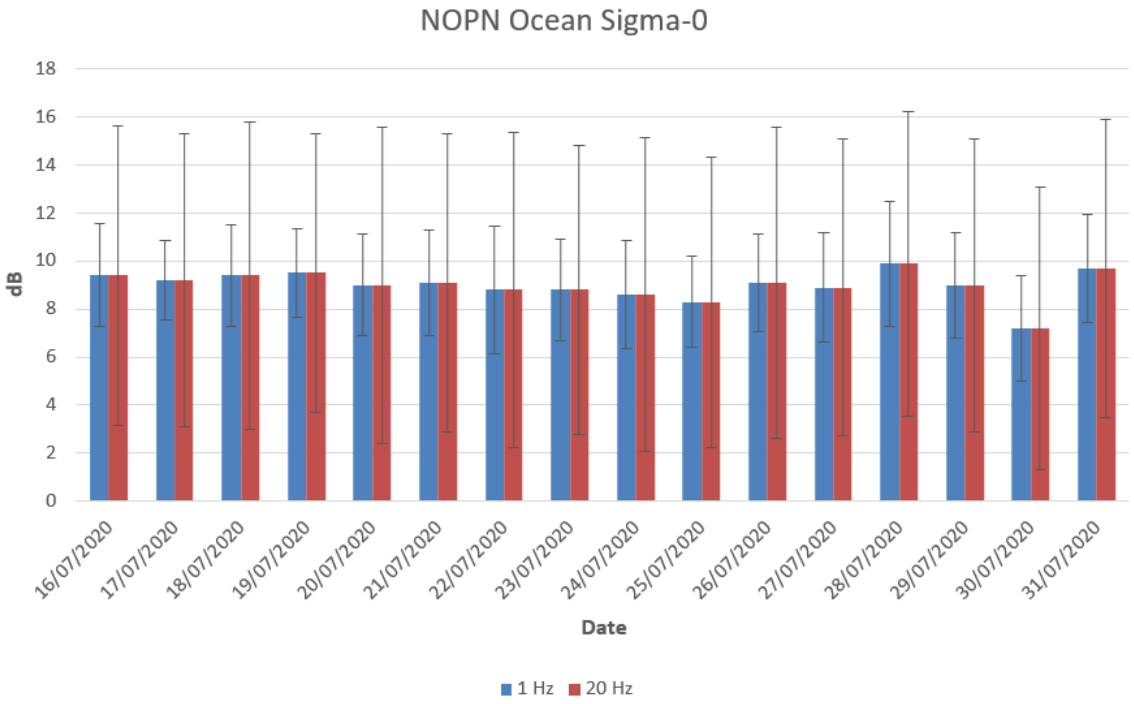

Figure 4-9 NOPN Ocean Retracker Sigma-0 Mean (bars) and Standard Deviation (error bars)

Table 4-9 NOPR Sigma-0 (Ocean retracker) Statistics

	Sigma-0 (1 Hz)	Sigma-0 (20 Hz)

	Mean (dB)	St. dev. (dB)	Mean (dB)	St. dev. (dB)
16/07/2020	12.1	3.7	17.4	10.6
17/07/2020	12.3	3.9	17	9.5
18/07/2020	12.2	4.1	17.1	10.1
19/07/2020	11.9	3.3	16.9	9.5
20/07/2020	12.5	3.7	17.9	10.1
21/07/2020	12.1	3.9	17.8	10.2
22/07/2020	12	3.4	17.2	10.1
23/07/2020	12.4	4.3	18.3	10.5
24/07/2020	12.6	3.9	18.7	10.6
25/07/2020	12	3.5	17.4	10.2
26/07/2020	11.9	3.6	16.9	10
27/07/2020	12.3	3.9	17.9	10.1
28/07/2020	12.1	4	17.4	10.1
29/07/2020	12.4	4.7	17.1	10.3
30/07/2020	12.2	3.9	14.9	7.9
31/07/2020	12.3	3.8	17.5	10.8

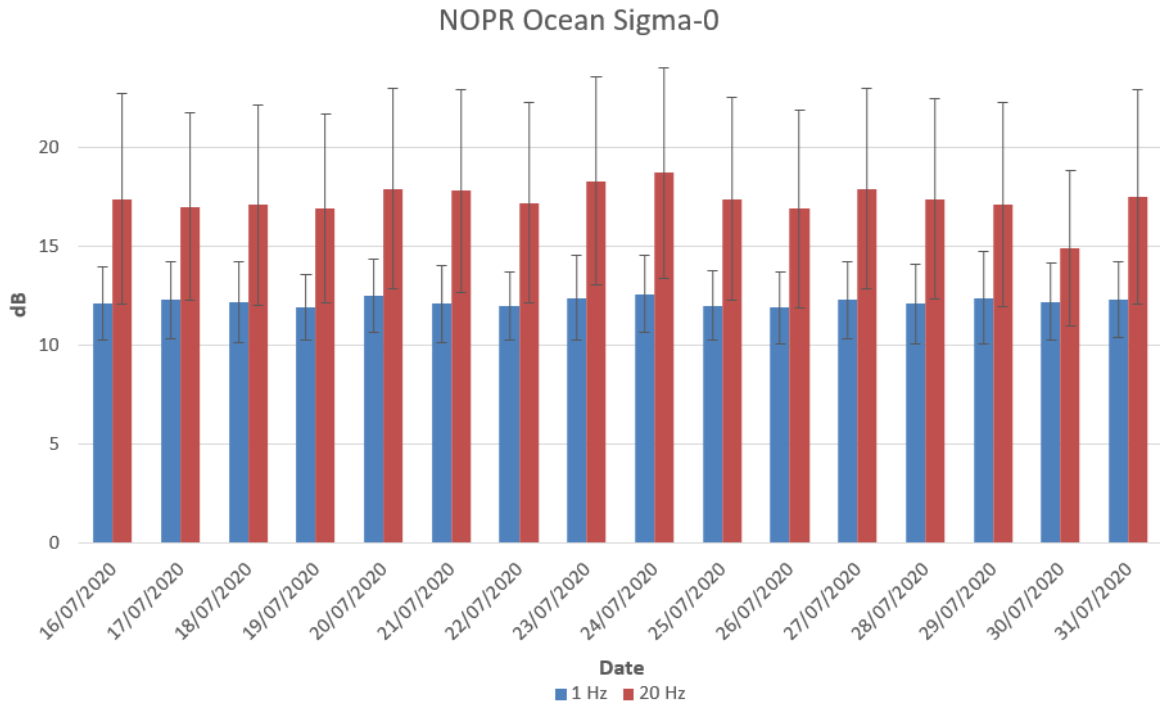

Figure 4-10 NOPR Ocean Retracker Sigma-0 Mean (bars) and Standard Deviation (error bars)

Table 4-10 NOPM OCOG Sigma-0 Statistics

	Sigma-0 (1 Hz)		Sigma-0 (20 Hz)	
	Mean (dB)	St. dev. (dB)	Mean (dB)	St. dev. (dB)
16/07/2020	9.3	2.3	9.9	5.6

17/07/2020	9.4	2.3	9.8	5.4
18/07/2020	9.4	2.2	10	5.7
19/07/2020	9.4	2.2	9.9	5.4
20/07/2020	9.4	2.3	10	5.7
21/07/2020	9.3	2.2	9.8	5.3
22/07/2020	9.3	2.3	10.1	5.9
23/07/2020	9.2	2.1	9.8	5.5
24/07/2020	9.1	2	9.9	5.5
25/07/2020	9.3	2.2	10	5.6
26/07/2020	9.2	2.1	9.7	5.4
27/07/2020	9.3	2.2	9.9	5.6
28/07/2020	9.1	2	9.8	5.3
29/07/2020	9.3	2.1	10	5.6
30/07/2020	9.3	2.3	9.8	5.2
31/07/2020	9.3	2.1	10	5.8

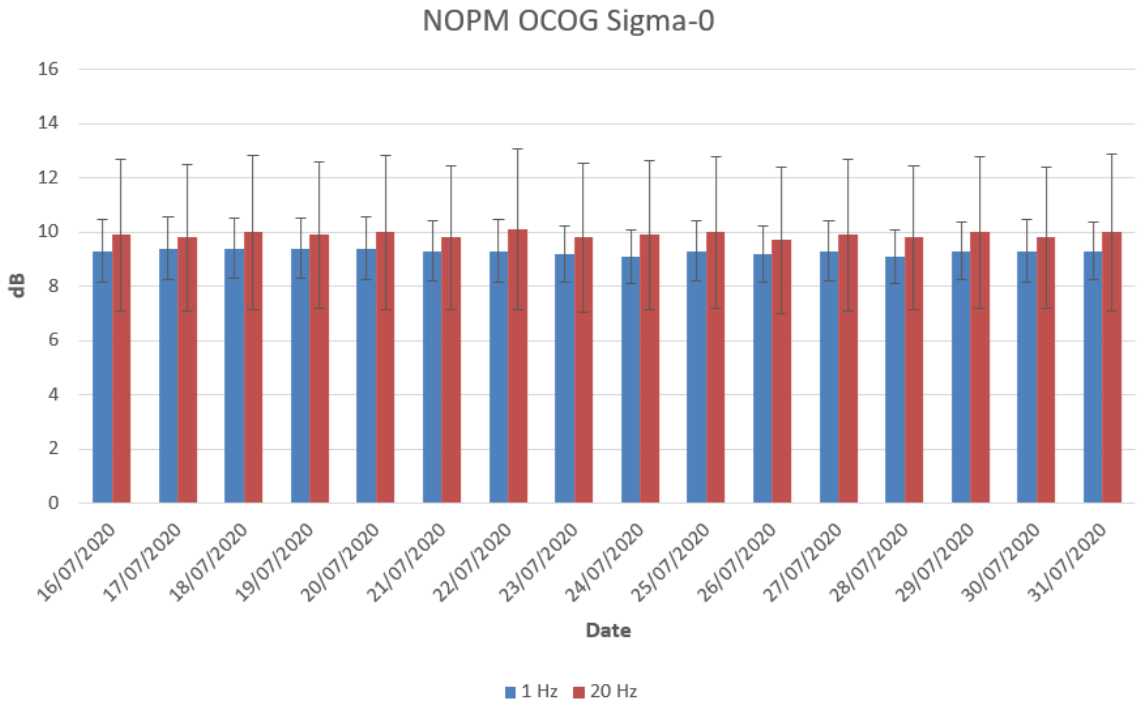

Figure 4-11 NOPM OCOG Retracker Sigma-0 Mean (bars) and Standard Deviation (error bars)

4.3 NRT SAR & SARIn

Table 4-11 Sea Surface Height (Retracker 1) 20Hz Statistics

	Sea Surface Height (Retracker 1) 20Hz			
	SAR Mean (m)	SAR St. dev. (m)	SIN Mean (m)	SIN St. dev. (m)
16/07/2020 – 20/07/2020	-2.44	24.76	19.45	115.29

21/07/2020 – 25/07/2020	-2.29	26.18	16.50	98.49
26/07/2020 – 30/07/2020	-1.70	22.43	18.26	107.56

Table 4-12 Sea Surface Height Anomaly 20Hz Statistics

	Sea Surface Height Anomaly 20Hz			
	SAR Mean (m)	SAR St. dev. (m)	SIN Mean (m)	SIN St. dev. (m)
16/07/2020 – 20/07/2020	0.023	0.611	0.030	0.906
21/07/2020 – 25/07/2020	0.017	0.543	-0.010	0.755
26/07/2020 – 30/07/2020	-0.023	0.549	0.020	1.140