



Copernicus Sentinel-6 Michael Freilich Product Notice (Altimetry LR NRT/STC)

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**Copernicus Sentinel-6 Michael Freilich Product Notice (Altimetry LR
NRT/STC)**

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1 INTRODUCTION

1.1 Purpose

This version of the document accompanies **the first public** release of data products from the Sentinel-6 Michael Freilich (S6A) mission. It was prepared by EUMETSAT with the support of the Mission Performance Working Group (MPWG) members and Mission Scientists.

As a living document, it will be regularly updated whenever changes are made to the entire Sentinel-6 satellite and/or ground segment that significantly impact the data quality, data performance, or data delivery to the users.

1.2 Scope

During this first half of the Sentinel-6 Commissioning Phase, the focus of the Calibration and Validation (Cal/Val) activities was on the **LR NRT** and **STC** products only. These products have been successfully validated and are released to the general public.

The products are generated at EUMETSAT, in the Payload Data Acquisition and Processing System known as PDAP.

This release is referred to the products generated with **PDAP v3.2.5**, identified in baseline collection field of the products filename as **F02**.

The product documentation relevant to the data release is provided at the locations described in Section 1.3.

Please note that the known anomalies are listed in Section 4.

1.2.1 PDP v3.2.5, baseline collection F02

Some important notes and caveats on the **first public** data release:

- This delivery covers ALT LR and MWR data processed in NRT and STC latency **from 22 June 2021 onward**.
- Products generated by **PDP v3.2.5** are clearly identified by the baseline collection **F02**, in the products filename, e.g.:
 - S6A_P4_2__LR_____20210526T213117_20210526T232706_20210526T234234_6949_020_047_024_EUM_OPE_NR_ **F02**.SEN6/S6A_P4_2__LR_STD__NR_020_047_20210526T213117_20210526T232706_ **F02**.nc

DISCLAIMER: ALT LR NRT/STC and MWR NRT/STC products covered by this release have been successfully validated; ALT HR, ALT LR NTC and MWR NTC products are still under validation.

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Applicable documents (see Section 1.5), are provided online: <https://www.eumetsat.int/altimetry-resources>

Please note that during Commissioning, this may include draft documents as some errors may be fixed, documentation aligned with the actual implementation, or clarifications added.

1.3.2 Data from EUMETSAT

How to access our data: <https://www.eumetsat.int/access-our-data>

Access to the data typically involves an initial registration process via our Earth Observation Portal: [Register for data](#)

S6A data are available on EUMETSAT Data Centre: <https://www.eumetsat.int/eumetsat-data-centre>

ALT Low Resolution (LR) NRT is also available on EUMETCast: <https://www.eumetsat.int/eumetcast>

- BUFR products are available in the ALT L2 SAFE packages and will be available on GTS once AR 1974 will be fixed, in July.

For questions concerning the provision of S6A data by EUMETSAT please e-mail the EUMETSAT Help Desk (ops@eumetsat.int).

1.3.3 Data from PO.DAAC

PO.DAAC provides, through their EarthData website, an exact copy of the products available from EUMETSAT.

If you have any issues accessing the data, please contact PO.DAAC through the forum for PO.DAAC users of Sentinel-6 data at [PO.DAAC Sentinel-6 forum](#). The forum has been pre-populated with some common questions and answers. Users can find example scripts to access data at PO.DAAC at <https://github.com/podaac/sentinel6>.

1.4 Questions regarding data content

For any questions or any issues that you find in the data that you feel are not covered by the anomalies mentioned later in this document, please e-mail the EUMETSAT Help Desk (ops@eumetsat.int).

1.5 Applicable Documents

ID	Reference and Version	Title
AD- 1	EUM/LEO-JASCS/SPE/17/901031	Sentinel-6/Jason-CS ALT Level 1 Product Generation Specification (L1 ALT PGS), v4C

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ID	Reference and Version	Title
AD- 2	EUM/LEO-JASCS/SPE/17/899201	Sentinel-6/Jason-CS ALT Level 1 Product Format Specification (L1 ALT PFS), v4B
AD- 3	EUM/LEO-JASCS/SPE/17/947129	Sentinel-6/Jason-CS ALT Level 1 NetCDF Dump, v4B
AD- 4	EUM/LEO-JASCS/SPE/17/901321	Sentinel-6/Jason-CS ALT Level 2 Product Generation Specification (L2 ALT PGS), v4C
AD- 5	EUM/LEO-JASCS/SPE/17/901187	Sentinel-6/Jason-CS ALT Level 2 Product Format Specification (L2 ALT PFS), v4B
AD- 6	EUM/LEO-JASCS/SPE/17/957846	Sentinel-6/Jason-CS ALT Level 2 NetCDF Dump, v4C
AD- 7	EUM/LEO-JASCS/SPE/17/899679	Sentinel-6/Jason-CS ALT Level-1 Auxiliary Data Specification (L1 ALT ADS), v4C
AD- 8	EUM/LEO-JASCS/SPE/17/900471	Sentinel-6/Jason-CS ALT Level-2 Auxiliary Data Specification (L2 ALT ADS), v4C
AD- 9	EUM/LEO-JASCS/SPE/17/899450	Sentinel-6/Jason-CS Generic Auxiliary Data Specification (GADS), v4C
AD- 10	EUM/LEO-JASCS/SPE/17/899011	Jason-CS/Sentinel-6 File Naming Convention
AD- 11	EUM/LEO-JASCS/SPE/17/897975	Sentinel-6/Jason-CS Generic Product Format Specification (GPFS)

All these documents are available on the documentation FTP in directory Documentation/Processing Specs.

1.6 Reference Documents

ID	Reference and Version	Title
RD- 1	https://cdn.eventsforce.net/files/ef-xnn67yq56ylyu/website/26/2.1_estelle_-_s6vt_agenciesvalidation.pdf	<i>Sentinel-6 Validation Team Meeting #2: Agencies Validation Activities</i>
RD- 2	Donlon, C. J., R. Cullen, L. Giulicchi, P. Vuilleumier, C. R. Francis, M. Kuschnerus, W. Simpson, A. Bouridah, M. Caleno, R. Bertoni, J. Rancaño, E. Pourier, A. Hyslop, J. Mulcahy, R. Knockaert, C. Hunter, A. Webb, M. Fornari, P. Vaze, S. Brown, J. Willis, S. Desai, J-D Desjonqueres, R. Scharroo, C. Martin-Puig, E. Leuliette, A. Egido, W. H. F. Smith, P. B., S. Le Gac, N. Picot, and G. Tavernier, 2021. The Copernicus Sentinel-6 Mission: Enhanced Continuity of Satellite Sea Level Measurements from Space, <i>Rem. Sens. Env.</i> 258 , https://doi.org/10.1016/j.rse.2021.112395	

1.7 Acronyms

Acronym	Definition
ADS	Auxiliary Data Specification
ADF	Auxiliary Data File
ALT	Altimeter
AMR	Advanced Microwave Radiometer

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Acronym	Definition
GADS	Generic Auxiliary Data Specification
JA3	Jason-3
HR	High Resolution
L0, L1, L2	Level 0, Level 1, Level 2
LR	Low Resolution
MPWG	Mission Performance Working Group
MWR	Microwave Radiometer
NRT	Near Real Time
NTC	Non Time Critical
OPE	Operational processing platform
P4	Poseidon 4 altimeter
PDAP	Payload Data Acquisition and Processing
PDP	Payload Data Processing
PFS	Product Format Specification
PGF	Product Generation Function (i.e., data processor)
PGS	Product Generation Specification
S6A	Sentinel-6 Michael Freilich (Sentinel-6A)
S6VT	Sentinel-6 Validation Team
STC	Short Time Critical
VAL	Processing platform for Validation

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2 PRODUCT OVERVIEW

2.1 Product suite

DISCLAIMER: ALT LR NRT/STC and MWR NRT/STC products have been successfully validated; ALT HR, ALT LR NTC and MWR NTC products are still under validation.

The original planning for data release is presented below. Note that the Cal/Val at this point was successfully completed for the ALT LR NRT/STC and MWR NRT/STC products, indicated in the column “Mid-commissioning”, even though ALT LR NTC and MWR NTC products represented in the table are now available as well.

Product	Latency	Format	Delivery Key Points	
			Mid-commissioning	By end of commissioning
ALT Low Resolution (LRM)	NRT	BUFR	L2	L2
		NetCDF	L2	L2
	STC	NetCDF	L1b, L2	L1b, L2
	NTC	NetCDF		L1b, L2
ALT High Resolution (SAR)	NRT	BUFR		L2
		NetCDF		L2
	STC	NetCDF		L1a, L1b, L2
	NTC	NetCDF		L1a, L1b, L2
MWR	NRT	NetCDF	L2	L2
	STC	NetCDF	L2	L2
	NTC	NetCDF		L2

Note 1: ALT Level 2 NetCDF products: reduced (1-Hz only) and standard (1-Hz and 20-Hz)

2.2 Product details

Please note that the coverage of the products varies by latency, that is:

- In NRT
 - ALT LR and MWR products cover a full orbit dump, i.e., from ground station overflight to ground station overflight. Both Kiruna and Fairbanks are used as ground stations, but only one of them is used per orbit.
 - ALT HR products are chopped up into 10-minute segments.

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- In STC and NTC
 - All products cover a full pass, “from pole to pole”, with the pass numbering convention identical to that of Jason-3.

2.3 Product and processing specifications

The specifications on the product format and the processing functions are presented in Section 1.5 as [AD-1] through [AD-11].

2.4 Product quality

A thorough analysis of the product quality was provided during the Second Sentinel-6 Validation Team Meeting in May 2021 [RD-1]. The main points of concern regarding LR data are:

- Range bias is very small (at the centimetre level).
- SWH and sigma0 show a significantly lower noise in S6A than in JA3.
- No significant bias is seen in the SWH measurements.
- Ku-band sigma0 is biased low by about 1.23 dB (1.31 dB for MLE3 retracking) with respect to JA3; this bias is accounted for before being fed into the wind speed algorithm to bring it in line with the ECMWF model wind speed.
- C-band sigma0 is biased low by about 1.64 dB with respect to JA3; the Ku- and C-band sigma0 are increased by 1.23 and 1.64 dB, respectively, before being fed into the rain flagging algorithm.
- As reported during the Sentinel-6 Validation Team meeting #2, all performance requirements with PDAP v3.2.5 are met as indicated in the table below.

	NRT 3 hours	STC 36 hours	Observed
Altimeter noise (Ku)	[1.2, 1.5, 2.4, 3.2] cm		[1.26, 1.45, 1.93, 2.37] at [1, 2.5, 8] m SWH
Altimeter noise (C)	[4.5, 5.7, 9.1, 12.0] cm		[4.5, 5.2, 7.9, 10.3] at [1, 2.5, 8] m SWH
Ionosphere	0.5 cm		0.1 cm
Sea State Bias	2.0 cm		0.2 cm (compared to J3)
Dry troposphere	0.8 cm	0.7 cm	Based on historical analysis
Wet Troposphere	1.2 cm	1.2 cm	0.2 cm (compared to J3) 0.8 cm (compared to ECMWF)

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Altimeter range RSS	2.93 cm	2.90 cm	< 2.5 cm with bias < 1 cm
RMS Orbit (Radial component)	5 cm	2 cm	NRT: < 2 cm STC: ~1 cm
Total RSS sea surface height	5.79 cm	3.53 cm	NRT: 3.3 cm (will still improve in new PDP) STC: 2.8 cm (will still improve in new PDP)
Significant wave height	15 cm + 5%		Far below 15 cm + 5%
Wind speed	1.5 m/s		1.3 m/s
Sigma naught	0.3 dB		0.15 dB

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3 PRODUCT RELEASE DESCRIPTIONS

3.1 First release to general public (PDAP v3.2.5)

Overview	
Mission	S6A
Sensor	P4/AMR-C
Product Notice ID	EUM/RSP/DOC/21/1230254
Version	1
Data Release Date	2021-06-22T09:00:00Z
Description	<p>First release of S6A data to the general public.</p> <p>This covers MWR and ALT LR NRT and STC data which have been successfully validated. MWR and ALT LR NTC are also provided but are still being validated.</p> <p>Further details and anomalies provided here relate to these data.</p>
Processing details	
Processing baseline	PDAP v3.2.5 <ul style="list-style-type: none"> • ALT L1 PGF v3.3.0 • ALT L2 PGF v3.2.9 • AMR PGF v3.2.0
Installation date	OPE: 2021-05-26T09:00:00Z
Further relevant information	
How to identify this baseline?	<p>The baseline number is F02, which can be found in the filename, the manifest (xfdumainfest.xml), or in the global attributes of the NetCDF files, i.e.:</p> <p>source = "Processing Baseline F02"</p>
Static auxiliary data files (changes since previous baseline are in red)	
<pre> S6A_MW_2_CONF_AX_20151008T000000_20991231T235959_20210330T000230_____EUM_OPE_AL_003.SEN6 S6A_P4_1_CHAN_AX_20151008T000000_20991231T235959_20201006T130723_____EUM_OPE_AL_001.SEN6 S6A_P4_1_CHAR_AX_20151008T000000_20991231T235959_20201006T130723_____EUM_OPE_AL_001.SEN6 S6A_P4_1_CONF_AX_20151008T000000_20991231T235959_20210329T235955_____EUM_OPE_AL_004.SEN6 S6A_P4_1_WEIG_AX_20151008T000000_20991231T235959_20201006T130724_____EUM_OPE_AL_001.SEN6 S6A_P4_2_CONF_AX_20151008T000000_20991231T235959_20210512T085916_____EUM_OPE_AL_008.SEN6 S6A_P4_2_MLUT_AX_20151008T000000_20991231T235959_20210329T235706_____EUM_OPE_AL_002.SEN6 S6A_P4_2_RLUT_AX_20151008T000000_20991231T235959_20210512T085908_____EUM_OPE_AL_002.SEN6 S6A_P4_2_SIGL_AX_20151008T000000_20991231T235959_20201006T130724_____EUM_OPE_AL_001.SEN6 S6A_P4_2_SSBH_AX_20151008T000000_20991231T235959_20210512T085907_____EUM_OPE_AL_002.SEN6 S6A_P4_2_SSDL_AX_20151008T000000_20991231T235959_20210512T085907_____EUM_OPE_AL_002.SEN6 S6A_P4_2_WNDH_AX_20151008T000000_20991231T235959_20210512T085908_____EUM_OPE_AL_002.SEN6 S6A_P4_2_WNDL_AX_20151008T000000_20991231T235959_20210512T085908_____EUM_OPE_AL_002.SEN6 S6A_P4_2_CHDN_AX_20151008T000000_20991231T235959_20210331T092737_____EUM_OPE_AL_004.SEN6 S6A_P4_2_CHDR_AX_20151008T000000_20991231T235959_20210331T092737_____EUM_OPE_AL_004.SEN6 S6_P4_2_CLIP_AX_20151008T000000_20991231T235959_20201006T130725_____EUM_OPE_AL_001.SEN6 S6_P4_2_DSTC_AX_20151008T000000_20991231T235959_20201006T130726_____EUM_OPE_AL_001.SEN6 S6_P4_2_GEOH_AX_20151008T000000_20991231T235959_20201006T130731_____EUM_OPE_AL_001.SEN6 S6_P4_2_ITD_AX_20151008T000000_20991231T235959_20201006T130733_____EUM_OPE_AL_001.SEN6 S6_P4_2_LTD1_AX_20151008T000000_20991231T235959_20201006T130734_____EUM_OPE_AL_001.SEN6 S6_P4_2_LTD2_AX_20151008T000000_20991231T235959_20201006T130734_____EUM_OPE_AL_001.SEN6 S6_P4_2_MAGG_AX_20151008T000000_20991231T235959_20201006T130750_____EUM_OPE_AL_001.SEN6 S6_P4_2_MDT_AX_20151008T000000_20991231T235959_20201006T130750_____EUM_OPE_AL_001.SEN6 S6_P4_2_MSSI_AX_20151008T000000_20991231T235959_20201006T130750_____EUM_OPE_AL_001.SEN6 </pre>	

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S6_P4_2_MSS2_AX_20151008T000000_20991231T235959_20201006T130753	EUM_OPE_AL_001.SEN6
S6_P4_2_MSSG_AX_20151008T000000_20991231T235959_20201006T130756	EUM_OPE_AL_001.SEN6
S6_P4_2_ODLE_AX_20151008T000000_20991231T235959_20201006T130759	EUM_OPE_AL_001.SEN6
S6_P4_2_OTD1_AX_20151008T000000_20991231T235959_20201006T130807	EUM_OPE_AL_001.SEN6
S6_P4_2_OTD2_AX_20151008T000000_20991231T235959_20201006T130808	EUM_OPE_AL_001.SEN6
S6_P4_2_POTD_AX_20151008T000000_20991231T235959_20201006T130826	EUM_OPE_AL_001.SEN6
S6_P4_2_S12P_AX_20151008T000000_20991231T235959_20201006T130827	EUM_OPE_AL_001.SEN6
S6_P4_2_SETD_AX_20151008T000000_20991231T235959_20201006T130827	EUM_OPE_AL_001.SEN6
S6_P4_CST_AX_20151008T000000_20991231T235959_20201006T130828	EUM_OPE_AL_001.SEN6
S6_P4_SURF_AX_20151008T000000_20991231T235959_20201006T130828	EUM_OPE_AL_001.SEN6

Known product anomalies

<i>Title and impact (LR = ALT LR products, HR = ALT HR products, AMR = AMR-C products)</i>	<i>NRT</i>	<i>STC</i>	<i>NTC</i>
AR 1627: LR waveforms clipping over bright targets	LR	LR	LR
AR 1629: Duplicate 20-Hz measurements	LR	LR	LR
AR 1751: Incorrect cycle and pass number on first pass of cycle	LR HR	LR HR	LR HR
AR 1753: Short LR L1B files produced in case of coverage by regular and archive dumps	LR HR	LR HR	LR HR
AR 1946: Median filter used in computing smoothed ionospheric correction does not work	LR HR	LR HR	LR HR
AR 1974: Obsolete S6 BUFR encoding sequence implemented for S6 BUFR in ALT L2 products	LR HR		
AR 1994: Anomalous jump on internal path delay in L1B	LR HR	LR HR	

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4 KNOWN OPEN PRODUCT ANOMALIES

For each of the known anomalies that are still open at the time of the release of this document, three bullet points indicate:

- Description
- Impact
- Fix planned

4.1 AR 1627: LR waveforms clipping over bright targets

- Over in-land waters and sea ice regions, several LR waveforms get clipped at the maximum value. This is observed in the LR I2Q2 waveforms, as they come from the instrument tracking channel. When the LR waveform is reconstructed from the SAR L1A data on ground, this effect is not observed. Therefore, it seems the anomaly originates from the on-board tracking.
- Geophysical estimates over some highly reflective in-land water bodies and sea ice will be degraded due to this effect.
- No adequate fix has been found yet for this **on-board** behaviour.

4.2 AR 1629: Duplicate 20-Hz measurements

- During the management of overlapping L0 products – in case of combinations of routine memory dumps (NR) and archive memory dumps (ND) –, the check of consecutive datation (to avoid jump to the past) does not take into account duplications. Hence duplicate (20-Hz) measurements can end up in L1B products.
- This then carries on to L2 products.
- The issue was mitigated in PDAP v3.1.1 and was not fixed in PDAP v3.2. It is traced to AR 1753: Short LR L1B files produced in case of coverage by regular and archive dumps; when that is fixed, so will be this anomaly.

4.3 AR 1751: Incorrect cycle and pass number on first pass of cycle

- Products for Pass 001 of *each cycle* are misnumbered in both STC and NTC. Cycle number N is written instead of cycle number N+1. For example:

```
S6A_P4_2_LR_____20210603T214924_20210603T224537_20210604T111845_3373_020_253_126_EUM_OPE_ST_F02.SEN6/  
S6A_P4_2_LR_____20210603T224537_20210603T234150_20210604T112522_3373_020_254_127_EUM_OPE_ST_F02.SEN6/  
S6A_P4_2_LR_____20210603T234150_20210604T003803_20210604T220112_3373_020_001_127_EUM_OPE_ST_F02.SEN6/  
S6A_P4_2_LR_____20210604T003803_20210604T013416_20210604T220920_3373_021_002_001_EUM_OPE_ST_F02.SEN6/
```

Note that the third should be cycle 21 (not 20) pass 1.

- Impacts HR and LR, L1 and L2 products, in STC and NTC. The wrong numbering is in the file names as well as in the global attributes.
- A full fix has been scheduled for the PDP version of September.

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4.4 AR 1753: Short LR L1B files produced in case of coverage by regular and archive dumps

- This anomaly is actually called “Failures in L2 HR processing in case of gaps in L2 LR input” but was later traced to the L1 processor. When both a short L0 LR product from an archive dump and a longer (covering) L0 LR product from regular dump, the L1 processor would inadvertently use the former instead of the latter as input, resulting in a short L1B LR file.
- This results also in a short L2 LR product, which then makes the production of the corresponding L2 HR product fail since the L2 LR product (required to extract the ionospheric correction) does not fully cover.
- The issue is expected to be fixed in PDP v3.3 (July).

4.5 AR 1946: Median filter used in computing smoothed ionospheric correction does not work

- The algorithm to compute the median, implemented as part of the ionospheric correction smoothing, does not sort the ionospheric values at all. Thus is median becomes just the value of the middle measurement in a series.
- This creates a bias in the ionospheric correction of about 0.6 mm, and thus also impacts the ssha in both LR and HR products.
- This is expected to be fixed in PDP v3.3 (July).

4.6 AR 1974: Obsolete S6 BUFR encoding sequence implemented for S6 BUFR in ALT L2 products

- BUFR products have been encoded using an old local encoding sequence (3-40-192). This is not the right sequence that was iterated and agreed for S6 with WMO. The S-6 ground segment BUFR encoding system should be using 3-40-019, which was published in November 2020. In addition, some headers required by GTS are missing in the BUFR products.
- BUFR products are not allowed into the GTS as they use local descriptors. They are available in the ALT L2 SAFE packages, will also go to EUMETCast, and can be decoded using the local descriptors available from EUMETSAT.
- A fix is expected in PDP v3.3 (July).

4.7 AR 1994: Anomalous jump on internal path delay in L1B

- In LR STC cycle 018, there is an anomalous jump of about 1 cm in the internal path delay stored in the PDAP L1B products. This jump is not physical since it is not observed in the long-term monitoring (LTM) files. It seems PDAP did not select the right calibration value and used a wrong (default) one.

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- This impacted (at least for a few products) the internal path delay value (range_cor_internal_delay_cal) in the L1B and hence the tracker range, as well as the range measurements and SSHA in L2 products.

This was found more prominently in LR NRT L1B where throughout the production we see this value flipping back and forth between 11.0 mm and (proper) values around 21.3 mm (during this cycle). It does not occur in NTC.

- This issue is under investigation and will likely be fixed in the PDP release in September.