

## ***Sentinel-6/Jason-CS ALT Level 2 Product Format Specification (L2 ALT PFS)***

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## Change Record

<b>Version</b>	<b>Date of Version</b> <i>as on profile</i>	<b>Document Change Request (DCR) Number</b> <i>if applicable</i>	<b>Description of changes</b>
1 Draft	06/02/2017		First version
1A	07/02/2017		Initial version for internal review
1B	14/02/2017		Version released for System PDR
1C	13/04/2017		Version pre-released for the PDAP ITT. <ul style="list-style-type: none"> <li>- RID_024 from the system addressed in section 2.</li> <li>- RID_032 from the system PDR addressed in section 5. Size is in bytes unless otherwise specified.</li> <li>- Variables revisited to better accommodate the radiometer outputs</li> </ul>
1D	10/05/2017		Radiometer derived variables updated in accordance with NASA/JPL documentation [AD-4]. Include reference to BUFR format. To be specified in future releases of this document. Modified variables frequency and band in accordance with L2 PGS v1D
1E	13/11/2017		Harmonized classification categories of L1A/B and L2
1F	24/01/2018		Version prepared for PDAP KO
2	24/01/2018	JCS_DCR_11	Version released for PDAP KO
2A	16/04/2018		Updated description and organisation of NetCDF groups. Further specify packing of netCDF variables.
2B	19/04/2018	JCS_DCR_68	Version released for PDAP data package #2.
2C	19/09/2018		Minor updates in Table 3-3. Long names used for global attributes when applicable. The names are aligned with L2 variable names [MPWG-23]. Added "xref_radiometer_level2" global attribute to specify input radiometer file in use for the generation of L2 [MPWG-23]. Added "xref_altimeter_level2_lr" global attribute to specify input altimeter L2 LR file for HR processing.
2D	24/10/2018		Corrected internal file names. Added "xref_internal_tide" global attribute for internal tide model reference. Corrected C-band information in Table 3-2. Clarified the absence of the "data_01" group in the reduced data file.
3	25/10/2018	JCS_DCR_143	Version released for the System Check Point#2/CDR

**Sentinel-6/Jason-CS ALT Level 2 Product Format Specification (L2  
ALT PFS)**

3A	10/04/2019	JCS_DCR_184	Fixed typos. Responded to S6MAG reviews. Section 1.4: added missing acronyms. Section 3.2 and Table 4-1: now maintaining the data_01 layer in the reduced NetCDF data files. Section 4.2.1.1: avoid unlimited dimensions. Section 4.2.1.2: clarified that NaNs shall be represented by the _FillValue.
4	19/11/2019	JCS_DCR_314	Changed "Sentinel-6/Jason-CS" to "Jason-CS/Sentinel-6".
4B	17/09/2020	JCS_DCR_436	Reverted to "Sentinel-6/Jason-CS" (changes not marked) Added xref_sig0_exp_table

## Table of Contents

<b>1</b>	<b>INTRODUCTION.....</b>	<b>6</b>
1.1	Purpose and scope .....	6
1.2	Applicable documents .....	6
1.3	Reference documents .....	6
1.4	Acronyms.....	7
1.5	Document structure .....	7
<b>2</b>	<b>LEVEL 2 PRODUCTS OVERVIEW.....</b>	<b>8</b>
2.1	Product structure.....	8
2.2	Product content.....	8
2.3	Product list .....	8
2.4	File naming convention.....	8
<b>3</b>	<b>LEVEL 2 PRODUCT FORMAT SPECIFICATIONS .....</b>	<b>10</b>
3.1	Level 2 package description .....	10
3.2	Level 2 data file overview .....	11
<b>4</b>	<b>LEVEL 2 DETAILED DESCRIPTION OF THE PRODUCT CONTAINER.....</b>	<b>13</b>
4.1	Manifest file .....	13
4.2	Measurement data files .....	13
4.2.1	Altimeter L2 LR and L2 HR (P4_2_LR____, P4_2_HR____).....	13
4.2.1.1	L2 product dimensions .....	13
4.2.1.2	L2 product variables and attributes.....	13
4.2.1.3	L2 NetCDF product global attributes.....	14
<b>5</b>	<b>PRODUCT SIZE .....</b>	<b>16</b>

## List of Tables

Table 2-1:	Altimeter Level 2 product list .....	8
Table 3-1:	Altimeter Level 2 product composition .....	10
Table 3-2:	Level 2 product contents in terms of frequency band and posting rate .....	11
Table 3-3:	L2 variables grouping for the ALT L2 PFS .....	12
Table 4-1:	L2 dimensions. 'yes' indicates that a dimension is available in either LR or HR products, 'no' if not.....	13
Table 4-2:	Altimeter Level 2 global attributes.....	14

## 1 INTRODUCTION

### 1.1 Purpose and scope

This document is the Level 2 Product Format Specification (PFS) for the Altimeter for the products made by the Sentinel-6/Jason-CS Payload Data Processing (PDP) within the Payload Data Acquisition and Processing (PDAP) facilities.

The altimeter Level 2 shall be compliant with the Standard Archive Format for Europe (SAFE) latest version as indicated in [AD- 1].

### 1.2 Applicable documents

<b>AD- 1</b>	EUM/LEO-JASCS/SPE/17/897975	Sentinel-6/Jason-CS Generic Product Format Specifications (GPFS)
<b>AD- 2</b>	EUM/LEO-JASCS/SPE/17/899011	Sentinel-6/Jason-CS Generic File Naming Convention
<b>AD- 3</b>	EUM/LEO-JASCS/SPE/17/912241	Sentinel-6/Jason-CS – Metadata Specification
<b>AD- 4</b>	JPL D-97812	Sentinel-6 Project AMR Science Data Product Description Document
<b>AD- 5</b>	EUM/LEO-JASCS/SPE/17/957846	Sentinel-6/Jason-CS ALT Level 2 NetCDF Dump
<b>AD- 6</b>	EUM/LEO-JASCS/SPE/19/1059000	Sentinel-6/Jason-CS ALT Level 2 BUFR Format Specification

### 1.3 Reference documents

<b>RD- 1</b>	EUM/LEO-JASCS/SPE/17/899201	Sentinel-6/Jason-CS Altimeter Level 1 Product Format Specification (L1 ALT PFS)
<b>RD- 2</b>	EUM/LEO-JASCS/DEF/13/695184	Sentinel-6 Glossary of Terms and Acronyms Document

## 1.4 Acronyms

<b>Acronym</b>	<b>Meaning</b>
AMR	Advanced Microwave Radiometer
CF	Climate and Forecast (Convention)
GNSS	Global Navigation Satellite System
HKTM	House Keeping Telemetry
LR	Low Resolution (i.e. pulse limited altimetry)
ISP	Instrument Source Packets
HR	High Resolution (i.e. SAR mode)
NetCDF	Network Common Data Format
PDAP	Payload Data Acquisition and Processing
PDP	Payload Data Processing
PFS	Product Format Specification
RAW	Raw (full) SAR mode
RMC	Range Migration Correction
RO	Radio Occultation
SAFE	Standard Archive Format for Europe (SAFE)
TM	Telemetry

## 1.5 Document structure

Section 1 provides the introduction to this document. It includes the purpose, scope, applicable documents, reference documents and the acronyms.

Section 2 introduces the Level 2 products for the altimeter on Sentinel-6/Jason-CS.

Section 3 sets out conventions for the Level 2 product format specifications.

Section 4 provides a detailed description of the Level 2 product container/package.

Section 5 details the Level 2 product size.

## 2 LEVEL 2 PRODUCTS OVERVIEW

### 2.1 Product structure

The Sentinel-6/Jason-CS Level 2 products are generated by the PDP from Level 1 products. The Level 2 products are produced in the form of packages. Each package contains a set of files grouped together to form the Level 2 product, and thus it is also referred to as a container. The words container and package are used interchangeably throughout this document. The package format is described in detail in [AD- 1], and it will not be revisited in this document. Within this document we will describe the specifics of the Level 2 package contents only.

### 2.2 Product content

The altimeter Level 2 products are a container (or package) with different files:

- The *manifest file* provides information related to the folder contents, and it is of relevance for monitoring and archiving purposes within the PDP.
- The *measurement data file(s) (EO data product)* are in NetCDF or BUFR format and contain the science data processed to Level 2.

A SAFE package does not need to contain a representation file [AD- 1] since all Level 2 products are in NetCDF or BUFR format which are self-describing.

The Sentinel-6/Jason-CS altimeter Level 2 product shall also be released in BUFR format in NRT. The product format specification of the BUFR data and their link with the Level 2 NetCDF variables are described in [AD- 6].

### 2.3 Product list

The complete list of Level 2 altimeter products for the Sentinel-6/Jason-CS mission is provided in Table 2-1. Altimeter Level 2 product list. Each product has been named following the information included in [AD- 2]. A detailed description of the products contents is provided in future sections of this document.

**Table 2-1. Altimeter Level 2 product list**

<b>Product type</b>	<b>Description</b>
P4_2__HR_____	Level 2 product derived either from RAW or RMC, or the combination of both
P4_2__LR_____	Level 2 product derived from the LR

### 2.4 File naming convention

The file naming convention for Level 2 products is defined in [AD- 2]. Examples of the name of the SAFE folders of HR and LR products are:

<b>Product type</b>	<b>Example of SAFE folder name</b>
P4_2__HR_____	S6A_P4_2__HR_____20150101T102500_20150101T114000_20160712T125000_4500_050_215_107_EUM_REP_ST_F02.SEN6
P4_2__LR_____	S6A_P4_2__LR_____20150101T102500_20150101T114000_20160712T125000_4500_050_215_107_EUM_REP_ST_F02.SEN6



**Sentinel-6/Jason-CS ALT Level 2 Product Format Specification (L2  
ALT PFS)**

Inside the SAFE folders the NetCDF files are stored. They have a more concise file name:

<b><i>Product type</i></b>	<b><i>Example of file name</i></b>
P4_2__HR____ (standard)	S6A_P4_2__HR_STD__ST_050_215_20150101T102500_20150101T114000_ F02.nc
P4_2__HR____ (reduced)	S6A_P4_2__HR_RED__ST_050_215_20150101T102500_20150101T114000_ F02.nc
P4_2__LR____ (standard)	S6A_P4_2__LR_STD__ST_050_215_20150101T102500_20150101T114000_ F02.nc
P4_2__LR____ (reduced)	S6A_P4_2__LR_RED__ST_050_215_20150101T102500_20150101T114000_ F02.nc

### 3 LEVEL 2 PRODUCT FORMAT SPECIFICATIONS

#### 3.1 Level 2 package description

In the following table the composition of the package is specified for Level 2 products.

**Table 3-1: Altimeter Level 2 product composition**

Product Type		Description			
P4_2__HR_____ P4_2__LR_____ _____		This is the generic package describing the structure of the Level 2 ALT for the Sentinel-6/Jason-CS mission			
Product Level	Diss. Timeliness	Product Category			
1	NRT/STC/NTC	L2 Products available to the user community			
Product Dissemination Unit		Number of Package components	Number of Measurement Data Files	Number of Manifest Files	Number of Ancillary Data Files
N/A		3	2	1	0
File name		Composition			
xfdumanifest.xml		Contains information about the product composition. Its aim is to describe the data files contained in the Level 2 package			
P4_2__HR_STD_*.nc P4_2__LR_STD_*.nc		The "standard" data file includes the standard 1 Hz and 20 Hz Ku and C bands parameters for the LR product, but only the Ku band information for the HR			
P4_2__HR_RED_*.nc P4_2__LR_RED_*.nc		The "reduced" data file includes all 1 Hz Ku and C band parameters for the LR, and all Ku only for the HR.			

Each Level 2 product (LR or HR) includes three files:

- A *manifest file* (xfdumanifest.xml) whose secondary metadata accommodate the specific information for the Level 2 [AD- 3].
- Two *measurement data files* (standard and reduced), each with a different number of variables. The standard data file includes 1 Hz and 20 Hz measurements for the Ku- and C-bands as well as geophysical corrections at 1 Hz and some at 20 Hz. The reduced data file contains only 1 Hz measurements for the Ku- and C-bands as well as geophysical corrections at 1 Hz. Note that the HR data products only contain Ku-band measurements, whereas LR data products contain both Ku-band and C-band measurements.

The Level 2 products contents in terms of frequency band and posting rate are summarized in Table 3-2.

**Table 3-2: Level 2 product contents in terms of frequency band and posting rate**

Product type	File name	Ku-band		C-band	
		1-Hz	20-Hz	1-Hz	20-Hz
P4_2_HR_____	P4_2_HR_STD_*.nc	yes	yes	no	no
	P4_2_HR_RED_*.nc	yes	no	no	no
P4_2_LR_____	P4_2_LR_STD_*.nc	yes	yes	yes	yes
	P4_2_LR_RED_*.nc	yes	no	yes	no

### 3.2 Level 2 data file overview

The measurement data files will be NetCDF-4. The NetCDF-4 format and conventions for all Sentinel-6/Jason-CS products are described in [AD- 1] and are applicable to this document.

The NetCDF variables within the L2 products have been divided into several categories for their better understanding. These categories of variables need not appear in all Level 2 products, and the variables contained in these categories are not identical across the different products. Note that the categories used here are different from those in the L1 PFS [RD- 1], given their different scope.

This classification shall not be confused with the NetCDF-4 grouping (NetCDF-4 accepts the definition of groups within files). The latter is done in the Level 2 to group 20-Hz and 1-Hz dimensions and variables, as well as to group data related to the Ku- and C-band measurements. The Level 2 variables will be grouped as follows:

- *data\_20*, which contains up to two subgroups:
  - *ku*, grouping all 20-Hz Ku-band measurements and corrections;
  - *c*, grouping all 20-Hz C-band measurements and corrections (LR only).
- *data\_01*, which contains the 1-Hz time dimension and all 1-Hz variables common to both Ku- and C-band measurement, and up to two subgroups:
  - *ku*, grouping all 1-Hz Ku-band measurements and corrections unique to Ku-band;
  - *c*, grouping all 1-Hz C-band measurements and corrections unique to C-band (LR only).

Thus, for 1-Hz data all common variables will be together within the *data\_01* group (indicated by *x* in Table 3-3, and [AD- 5]), while two sub-groups (*ku* and *c*) are defined to contain all variables specific to Ku-band and C-band, respectively. For 20-Hz there are no common variables, so all variables are distributed either in the *ku* or *c* subgroups (or both), depending on whether they pertain to the Ku-band measurements and time tags, to the C-band measurements and their respective time tags. Global attributes will all be in the root of the NetCDF file (indicated in the tables by / or *x*).

Since the reduced data file contains only 1-Hz data, there is no *data\_20* group, leaving only the *data\_01* group with subgroups *ku* and *c*. This makes the reduced data file simply an extraction of the standard data file, copying the global variables and attributes and the entire *data\_01* group.

**Table 3-3: L2 variables grouping for the ALT L2 PFS**

ID	Classification Name	L2 LR		L2 HR	
		data_01	data_20	data_01	data_20
A	Time and counter variables	x	ku, c	x	ku
B	Orbit and attitude variables	x	ku, c	x	ku
C	Configuration and quality variables		ku, c		ku
D	Altimeter range variables		ku, c		ku
E	Altimeter power variables	ku, c	ku, c	ku	ku
F	Altimeter engineering variables				
G	Altimeter characterization variables				
H	Surface type variables	x	ku, c	x	ku
I	Waveform related variables (L1A)				
J	Waveform related variables (L1B, L2)		ku, c		ku
K	Waveform related variables (CAL1 L1B)				
L	Stack characterization variables				
M	Calibration variables				
N	Burst calibration variables				
O	Ocean retracking variables		ku, c		ku
P	Retracking derived ocean variables	ku, c	ku, c	ku	ku
Q	OCOG measurements and re-tracker variables		ku, c		ku
R	Instrument corrections	ku, c	ku, c	ku	ku
S	Propagation corrections variables	x, ku, c	ku	x, ku	ku
T	Reference surface variables	x	ku	x	ku
U	Geophysical variables	x	ku	x	ku
V	Environmental variables	x		x	
W	Radiometer variables	x		x	
X	Additional flag variables	x	ku	x	ku
-	Global Attributes	/	/	/	/

## 4 LEVEL 2 DETAILED DESCRIPTION OF THE PRODUCT CONTAINER

### 4.1 Manifest file

A detailed description of the manifest primary and secondary data for the Level 2 is given in [AD- 3].

### 4.2 Measurement data files

#### 4.2.1 Altimeter L2 LR and L2 HR (P4\_2\_\_LR\_\_\_\_, P4\_2\_\_HR\_\_\_\_)

Sentinel-6/Jason-CS L2 products are NetCDF-4 and CF-1.7 compliant. A NetCDF file includes *dimensions*, *variables*, *attributes* and *global attributes*. The specifics for the L2 are provided hereafter.

##### 4.2.1.1 L2 product dimensions

The L2 *dimensions* are given in Table 4-1. To prevent inefficient data storage, dimensions in the NetCDF files shall have *limited* dimensions, so *unlimited* dimensions shall be avoided.

**Table 4-1: L2 dimensions. ‘yes’ indicates that a dimension is available in either LR or HR products, ‘no’ if not.**

<b>L2 Dimensions</b>				
<b>Group</b>	<b>Dimension</b>	<b>Description</b>	<b>LR</b>	<b>HR</b>
data_20/ku	time	Number of 20-Hz measurements for Ku-band	yes	yes
data_20/c	time	Number of 20-Hz measurements for C-band	yes	no
data_01	time	Number of 1-Hz measurements	yes	yes

##### 4.2.1.2 L2 product variables and attributes

A complete list of Level 2 NetCDF variables and their associated attributes is provided as an Excel spreadsheet in the applicable document [AD- 5].

The variable names consist of lower case letters, numbers, and underscores.

The attributes to the NetCDF variables are one or more of the following, as listed in the various columns with the same name in [AD- 5]:

- long\_name (type: char)
- standard\_name (type: char)
- units (type: char)
- calendar (type: char)
- tai\_utc\_difference (type: double)
- leap\_second (type: char)

- scale\_factor (type: double)
- add\_offset (type: double)
- \_FillValue (type: same as variable, defined in column “Format”)
- flag\_values (type: same as variable, defined in column “Format”)
- flag\_mask (type: same as variable, defined in column “Format”)
- flag\_meanings (type: char)
- quality\_flag (type: char)
- coordinates (type: char)
- source (type: char)
- comment (type: char)

The variable names and the values of the associated attributes shall be configurable.

In case a field in the Excel spreadsheet is empty, the associated attribute shall not be added to the variable.

Please note that the attributes scale\_factor and add\_offset have an impact on the way a variable is written to the NetCDF product. The value written in the NetCDF product shall be determined as:

$$\text{value\_product} = \text{rint} ((\text{variable} - \text{add\_offset}) / \text{scale\_factor})$$

Invalid values (i.e. NaNs) shall be represented by the \_FillValue.

#### 4.2.1.3 L2 NetCDF product global attributes

A number of global attributes of the Level 2 NetCDF products are defined in [AD- 1]. In addition to those, the Level 2 NetCDF products shall contain the global attributes given in Table 4-2. When multiple file names are to be listed, they are to be separated by a comma followed by a space.

**Table 4-2: Altimeter Level 2 global attributes**

Global Attributes	Description	Product
<b>Input products information</b>		
xref_altimeter_level1b	<i>name of the L1B altimeter input file(s)</i>	LR, HR
xref_altimeter_level2_lr	<i>name of the L2 altimeter LR input file</i>	HR
xref_radiometer_level2	<i>name of the L2 radiometer input file</i>	LR, HR
<b>Processing information</b>		
xref_altimeter_characterization	<i>name of the characterization file</i>	LR, HR
xref_altimeter_characterization_array	<i>name of the characterization array file</i>	LR, HR
xref_constants	<i>name of the constant file</i>	LR, HR
xref_processor_configuration	<i>name of the configuration file(s)</i>	LR, HR
<b>Auxiliary files information</b>		

**Sentinel-6/Jason-CS ALT Level 2 Product Format Specification (L2  
 ALT PFS)**

Global Attributes	Description	Product
xref_attitude	<i>name of the attitude file(s) - 'none' in case no attitude file is used</i>	LR, HR
xref_center_of_mass	<i>source of the centre of mass information: - centre of mass file name - characterization file name</i>	LR, HR
xref_dac	<i>Dynamic Atmospheric Correction file</i>	LR, HR
xref_depth_or_elevation	<i>ocean depth and land elevation file</i>	LR, HR
xref_distance_to_coast	<i>distance to coast file</i>	LR, HR
xref_doris_uso	<i>name of the USO file(s) - 'none' in case no USO file is used</i>	LR, HR
xref_geoid	<i>geoid file</i>	LR, HR
xref_geoid_slopes	<i>MSS/geoid slopes map file</i>	LR, HR
xref_iono_cor_gim	<i>GIM ionospheric correction file</i>	LR, HR
xref_internal_tide	<i>internal tide model file</i>	LR, HR
xref_load_tide_sol1	<i>load tide solution 1 file</i>	LR, HR
xref_load_tide_sol2	<i>load tide solution 2 file</i>	LR, HR
xref_manoeuvre	<i>source of the manoeuvre flags information</i>	LR, HR
xref_mean_dynamic_topography	<i>mean dynamic topography file</i>	LR, HR
xref_mean_sea_surface_sol1	<i>mean sea surface solution 1 file</i>	LR, HR
xref_mean_sea_surface_sol2	<i>mean sea surface solution 2 file</i>	LR, HR
xref_meteo_gauss_grid	<i>meteo Gaussian grid file</i>	LR, HR
xref_meteorological_files	<i>meteorological files</i>	LR, HR
xref_modeled_corrections	<i>modelled corrections LUT file</i>	LR, HR
xref_ocean_tide_sol1	<i>ocean tide solution 1 file</i>	LR, HR
xref_ocean_tide_sol2	<i>ocean tide solution 1 file</i>	LR, HR
xref_orbit	<i>name of the orbit file(s)</i>	LR, HR
xref_pole_location	<i>pole location file</i>	LR, HR
xref_pressure_clim	<i>S1/S2 climatological pressure file</i>	LR, HR
xref_pressure_var	<i>S1/S2 pressure variability file</i>	LR, HR
xref_sea_state_bias	<i>sea state bias file</i>	LR, HR
xref_sig0_expectation	<i>expected sigma0 table</i>	LR
xref_solid_earth_tide	<i>solid earth tide file</i>	LR, HR
xref_surface_classification	<i>surface classification file</i>	LR, HR
xref_wind_speed_alt	<i>altimeter wind speed algorithm file</i>	LR, HR

## **5 PRODUCT SIZE**

The altimeter Level 2 NetCDF product size is provided in [AD- 5].

The altimeter Level 2 BUFR product size is provided in [AD- 6].