



BIOMASS Processing Suite IODD

PROCESSORS INPUT & OUTPUT DATA DEFINITION
DOCUMENT

Ref: BIO-BPS-IODD-ARE-010112

Issue: 3.1.2

Date: 29/09/2025

Document Information

Title	BIOMASS Processing Suite IODD
Internal Ref.	
External Ref.	BIO-BPS-IODD-ARE-010112
Date	29/09/2025
Issue	3.1.2
Pages	56

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Change history

Date	Issue	Change	Author
15/10/2021	1.0	First issue of the document	D. D'Aria
17/12/2021	1.0.1	Post-PDR1 issue of the document: - PDR1-64, PDR1-65, PDR1-71, PDR1-78, PDR1-85, PDR1-93, PDR1-3-5: Clarified distinction between Auxiliary Products and Internal Resources; I/O tables updated accordingly; no more needed interfaces removed following PDR1 resolutions (ALL) - PDR1-72: Interfaces required information added, needed (ALL) - PDR1-73: IGRF model update to version 13 (Sec. 3.2.8) - PDR1-76: Update mechanism clarified for dynamic internal resources (Sec. 3.2.11, 4.2.4) - PDR1-79: RX Only products added (Sec. 3) - PDR1-80: Clarification about Sx_RAW__0M products (non) slicing added (Sec. 3.2.2) - PDR1-81: Clarification about TEC maps compression added (Sec. 3.2.6) - PDR1-82: Clarifications about AUX_CLM__ classification and update rate added (Sec. 3.2.7) - PDR1-83: Clarifications about DEM classification and size added (Sec. 3.2.11) - PDR1-84: FP_AGB_L2A product type replaced with FP_GN__L2A one; L3 Processor outputs product types updated (Sec. 5, 7) - PDR1-86: Figure added (Sec. 6.3.1) - PDR1-87: Details about SCS products ancillary data added (Sec. 3.2.13) - PDR1-88: LCM internal resource made mandatory (Sec. 4.1) - PDR1-89: DEM internal resource made static, BIOMASS DTM removed (Sec. 3.2.11) - PDR1-90, PDR1-2-5: Details about EGM2008 geoid added (Sec. 3.2.11) - PDR1-91: Clarification about stacks per tile cardinality added (Sec. 2.2, 2.3) - PDR1-94, PDR1-99: Details about AUX_CLM__ auxiliary product added (Sec. 3.2.7) - PDR1-95: Interfaces sources information added, wherever needed (ALL) - PDR1-96: Interfaces spatial coverage information added, wherever needed (ALL)	F. Banda R. Piantanida

Date	Issue	Change	Author
		- PDR1-97: Interfaces sizing information added, wherever available (ALL) - PDR1-98: Details about AUX_TEC___ auxiliary product added (Sec. 3.2.6) - PDR1-100: AUX_GMF___ reference link updated (Sec. 1.5, 3.2.8) - PDR1-101: Details about DEM added (Sec. 3.2.11) - PDR1-103: Details about LCM added (Sec. 4.2.4) - PDR1-104: Note about FP_FD__L2A product added (Sec. 5.1) - PDR1-3-3: PARC_INFO_ product type corrected (Sec. 3.1, 3.2.12)	
23/03/2022	1.1	CDR1 issue of the document - L1a and L1c products average sizes updated to keep into account azimuth resampling step (Sec. 3.2.13, 3.2.15, 3.2.17, 4.2.5) - L1c products definition updated to include only 3 polarizations (Sec. 4.2.5, 4.2.6) - Added details about AUX_TEC___ and AUX_CLM___ auxiliary files content and retrieval strategies (Sec. 3.2.6, 3.2.7) - PDR1-60: Cardinality of Stack Processor output products updated (Sec. 4.1) - PDR1-89: Clarification about DEM size added (Sec. 3.2.11) - PDR1-97: Average size of LOS and LOM products added (Sec. 3.2.1, 3.2.2, 3.2.3)	F. Banda R. Piantanida
23/05/2022	1.1.1	Post-CDR1 issue of the document - CDR1-013: Number of channels for STA_P outputs updated (Sec. 4.2.5, 4.2.6) - CDR1-077: Processing of RX-Only mode data moved back to a dedicated task, reverting RID PDR1-41 (Sec. 3.1) - CDR1-216: STA_P outputs cardinality set back to inputs one (Sec. 4.1)	F. Banda R. Piantanida
28/10/2022	1.1.2	CDR2 issue of the document - L1_P AUX_CLM___ interface removed (Sec. 3) - STA_P and L2A_P LCM internal resource replaced with FNF one (Sec. 4, 5) - L2A_P and L2B_AGB_P DEM internal resource removed (Sec. 5, 6.3) - L2A_P TFN internal resource removed (Sec. 5) - L2B_FH_P LCM internal resource removed (Sec. 6.2)	F. Banda R. Piantanida

Date	Issue	Change	Author
		- FOS removed from CAL_AB internal resource options (Sec. 6.3.2.5) - Volumes of L1a/b/c products update to take into account products compression strategies (Sec. 3.2, 4.2) - Volumes of L2 and L3 products update to take into account alignment with the other documents and products compression strategies (Sec. 5, 6, 7) - TBDs solved throughout all the document (ALL)	
08/02/2023	1.1.3	FAT1 issue of the document: - Added dedicated section on L1 Framing Processor (Sec. 8) and rest of the document updated accordingly - Volumes of L1a/c products updated to take into account agreed compression ratio for phase component (2,5 instead of 2) (Sec. 3.2.12, 3.2.16, 4.2.5)	R. Piantanida
16/6/2023	3.0	PDR3 issue of the document: - Updated section 6.3 (L2b_AGB) - Note on L2B FD integration, still to be consolidated (section 7)	P. Mazzucchelli S. Jourdain
04/08/2023	3.0.1	Post-PDR3 issue of the document - BPSPDR3-13, BPS-PDR3-63: removed references to FP_FH__L2B in L2B_AGB_P and corrected editorials where needed - BPSPDR3-4: corrected L2B_AGB related editorials - BPSPDR3-2: updated tab 7 caption and fig. 12	R. Piantanida P. Mazzucchelli
17/11/2023	3.0.2	CDR3 issue of the document: - BPSPDR3-63: corrected editorials - BPSPDR3-2: corrected cardinality in Tab. 7 - Updated L3 section	P. Mazzucchelli N. Paillou
26/01/2024	3.0.3	DeltaFAT2 issue of the document - BPS-447: STA_P DEM internal resource removed (Sec. 4.2) - BPSCDR2-39: Added reference in section 4.2.3 - BPSCDR3-11: Updated nomenclature (TD) - BPSFAT2-24, BPSFAT2-25: Updated description and references for AUX_GMF__ auxiliary file (Sec. 3.2.7) - BPSFAT2-26: Updated description and references for AUX_TEC__ auxiliary file (Sec. 3.2.6)	R. Piantanida F. Boniardi P. Mazzucchelli
05/02/2024	3.0.4	Post-CDR3 issue of the document Modifications linked to L3 products	N. Paillou
17/05/2024	3.0.5	Post-DeltaFAT2 issue of the document BPS-494, BPSFAT2-71: DEM database description updated (Sec. 3.2.9)	R. Piantanida F. Boniardi P. Mazzucchelli

Date	Issue	Change	Author
		- BPSFAT2-25: Links to GMF references updated (Sec. 1.5) - BPSFAT2-26: AUX_TEC description updated (Sec. 3.2.6) - BPSDFAT2-8: GMF moved to L1_P internal resources (Sec. 3) - Added TBD/TBC Table	
06/09/2024	3.0.6	FAT3 issue of the document	R. Piantanida F. Boniardi P. Mazzucchelli
07/03/2025	3.1	Post-FAT3 issue of the document	R. Piantanida F. Boniardi P. Mazzucchelli
30/04/2025	3.1.1	Post-FAT3 issue of the document L3 correction: LCM removed from output, LCM_{in} renamed LCM. L3 product removed from optional inputs.	N. Paillou
28/05/2025	3.1.2	Post-FAT3 issue of the document L3 correction: removal of the L3 former product reference in FP_FH__L3T et FP_AGB_L3T	N. Paillou

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1. Introduction

1.1. Context

BIOMASS is ESA's 7th Earth Explorer mission. The purpose of the BIOMASS is to reduce the uncertainty in the worldwide spatial distribution and dynamics of forest biomass in order to improve current assessments and future projections of the global carbon cycle. This objective will be achieved by the implementation of a P-band SAR mission, providing global maps of forest biomass stocks, forest disturbance and growth.

The BIOMASS mission will also provide 3D views of forests through the "tomographic" phase and will also support additional science needs arising from the opportunity to explore the Earth for the first time with a P-band SAR system from space offering the possibility to "see" below the vegetated areas and in beneath bare soil or icy regions.

To achieve its challenging objectives, the BIOMASS mission requires a specific data processing strategy that combines different technologies at different processing level in order to generate the final Above Ground Biomass global map.

1.2. Scope of the document

This document contains the BIOMASS Processing Suite input/output data definition. It provides the full list of all input and output data (including products, auxiliary files, external databases...) for the BPS facility.

For each Data a specific Data description table is defined to quickly grasp the main data features. The table also contains the reference to the data format specification.

This document relies on inputs and assumptions coming from the BIOMASS production model document that is then a recommended introductory reading.

1.3. Acronyms

Acronym	Description
AD	Applicable Document
AGB	Above Ground Biomass
ARESIS	Advanced Remote Sensing and Systems
BPS	BIOMASS Processing Suite
DEM	Digital Elevation Model
DGM	Detected Ground-range Multi-looked
ESA	European Space Agency

Acronym	Description
FA	Forest Assembly
FD	Forest Disturbance
FH	Forest Height
GC	Global Cycle
GN	Ground cancelled product
INT	Interferometric Phase
L0	Level-0 product
L1a	Level-1a product
L1b	Level-1b product
L1c	Level-1c product
L1M	Level-1 Monitoring product
L1S	Level-1 Standard product
L2a	Level-2a product
L2b	Level-2b product
L3	Level-3 product
PARC	Polarimetric Active Radar Calibrator
PF	Processing Facility
PFD	Product Format Specification Document
RD	Reference Document
RXO	RX-Only product
SAR	Synthetic Aperture Radar
SCS	Single-look Complex Slant-range
STA	Coregistered Stack
TBD	To Be Defined
TBC	To Be Confirmed
TOM	Tomographic Phase

1.4. TBD / TBC Table

Section	TBD / TBC	Page
1.6	BTK_WEB: link must be defined	11

1.5. Applicable documents

- [AD1] BIOMASS Production Model, BIO-ESA-EOPG-EEGS-TN-0046, issue 3.5
- [AD2] [BPS_TN_PRODMOD] BIOMASS Production Model – Technical Note, I/R 1/2/1
- [AD3] [BPS_ICD] BPS Interface Control Document, I/R 3/0

1.6. Reference documents

- [RD1] [BPS_L0_PFD] BIOMASS L0 Product Format Definition, I/R 2/4
- [RD2] [BPS_L1_PFD] BIOMASS L1a/b/c Products Format Specification, I/R 1/2/5
- [RD3] [BPS_FD_PFD] BIOMASS FD L2a,b products format specification, I/R 3/0
- [RD4] [BPS_FH_PFD] BIOMASS FH L2a,b products format specification, I/R 3/0
- [RD5] [BPS_AGB_PFD] BIOMASS AGB L2a,b products format specification, I/R 3/0
- [RD6] [BPS_AUX_FMT] BPS Auxiliary Product Format, I/R 3/2
- [RD7] Earth Observation Mission Software File Format Specification, PE-ID-ESA-GS-584, issue 1.4
- [RD8] Copernicus DEM Product Handbook, June 2020, Version:2.1
- ~~[RD9] Schepaschenko, D., Chave, J., Phillips, O.L. et al. The Forest Observation System, building a global reference dataset for remote sensing of forest biomass. Sci Data 6, 198 (2019).~~
- ~~[RD10] Forest Observation System – Global forest plot data for earth observation and land surface modelling, <http://forest-observation-system.net/>~~
- [RD11] ORNL DAAC for Biogeochemical Dynamics, <https://daac.ornl.gov/>
- [RD12] Product User Guide and Specification ICDR Land Cover 2016-2020, 21/06/2021, ECMWF COPERNICUS REPORT Copernicus Climate Change Service
https://datastore.copernicus-climate.eu/documents/satellite-land-cover/D5.3.1_PUGS_ICDR_LC_v2.1.x_PRODUCTS_v1.1.pdf
- [RD13] Land cover classification gridded maps,
<https://cds.climate.copernicus.eu/cdsapp#!/dataset/satellite-land-cover?tab=overview>
- [RD14] Format description of IONEX 1, <https://files.igs.org/pub/data/format/ionex1.pdf>, February 1998
- [RD15] ESA GNSS Science Support Centre, <http://navigation-office.esa.int/products/gnss-products/>
- [RD16] Global Data Center, <ftp://igs.ensg.ign.fr/pub/igs/products/ionosphere/>
- [RD17] NASA CDDIS - GNSS Atmospheric Products,
https://cddis.nasa.gov/Data_and_Derived_Products/GNSS/atmospheric_products.html
- [RD18] International Reference Ionosphere (IRI),
https://ccmc.gsfc.nasa.gov/modelweb/models/iri2016_vitmo.php

- [RD19] GeographicLib – Magnetic models
<https://geographiclib.sourceforge.io/C++/doc/magnetic.html>
- [RD20] <https://www.aqisoft.com/downloads/geoids>
- [RD21] Copernicus Space Component Data Access,
<https://spacedata.copernicus.eu/documents/20123/121286/Copernicus+DEM+Open+HTTPS+Access.pdf/36c9adad-8488-f463-af43-573e68b7f481?t=1669283200177>
- [RD22] Copernicus Data Access – ESA User Licence,
https://spacedata.copernicus.eu/documents/20126/0/CSCDA_ESA_Mission-specific+Annex+%281%29.pdf/83b44c0a-244a-7ba3-b00c-b578a34e88a7?t=1604070311399
- [RD23] ESA GNSS Science Support Centre (documentation), http://navigation-office.esa.int/GNSS_based_products.html
- [RD24] Pyglow, <https://github.com/timduly4/pyglow>
- [RD25] [ESA-EOPG-EOEP-TN-48] BIOMASS L1 Virtual Frame Processor Technical Note, I/R 1/0
- [RD26] https://daac.ornl.gov/GEDI/guides/GEDI_L4A_AGB_Density.html
- [RD27] <https://ceos.org/gst/icesat2-boreal-biomass.html>
- [RD28] Geomagnetic poles, <https://www.ncei.noaa.gov/products/wandering-geomagnetic-poles>
- [RD29] [BPS_SUM] BPS Software User Manual, I/R 2/2
- [RD30] BTK_WEB: official link TBD
- [RD31] [BPS-TN-CAL_AB] Technical note on CAL_AB I/R 1/0
- [RD32] SRTM Collection User Guide,
https://lpdaac.usgs.gov/documents/179/SRTM_User_Guide_V3.pdf
- [RD33] SRTM data access, <https://www.earthdata.nasa.gov/sensors/srtm>
- [RD34] [BPS_L3_PFD] BIOMASS L3 Products Format Definition, I/R 3/0

2. Introduction and Overall BPS Data Flow

2.1. BIOMASS mission data acquisition scheme

To effectively review the overall BIOMASS production model and the IODD, we summarise here the expected BIOMASS acquisition strategy at mission level.

BIOMASS Mission foresees three main phases:

- Phase 1, 5 months, Commissioning, and Instrument Calibration
- Phase 2, Tomographic Phase, Global cycle duration: 14 months, 1 Global Cycle
- Phase 3, Interferometric Phase, Global cycle duration: 7.5 months, 6 Global Cycles

The Tomographic Phase Global Cycle is furthermore arranged into Major Cycles, that are composed as depicted in the following figure.

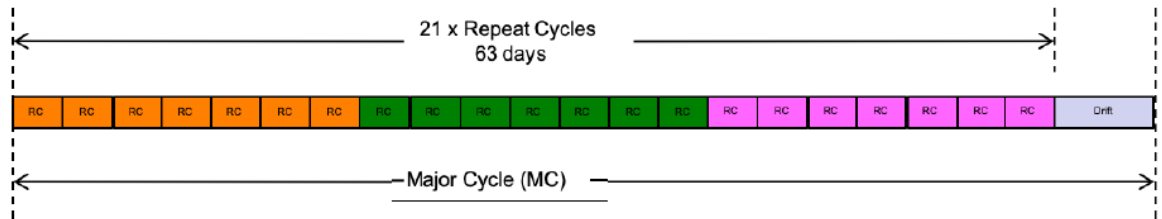


Fig.1 The Tomographic Phase acquisition scheme: 1 Global Cycle (425 days), composed by more than 6 Major Cycles (63 days + orbit drift manoeuvre). A major cycle is composed by 3 Minor cycles (21 days each, one for each of the three swaths) that contain the 7 stackable SAR acquisitions.

The same scheme with different numbers is also implemented in the Interferometric Phase.

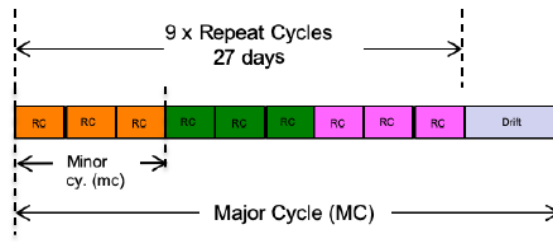


Fig.2 The Interferometric Phase acquisition scheme: each Global Cycle (228 days) is composed by more than 6 Major Cycles (27 days + orbit drift manoeuvre). A major cycle is composed by 3 Minor cycles (9 days each, one for each of the three swaths) that contain the 3 stackable SAR acquisitions.

2.2. BPS high-level production model

The high-level functional processing scheme is depicted in Fig.3 for TOM phase and in Fig.4 for INT phase. As already defined in the applicable “BIOMASS Production Model” [AD1][AD2], the processing at functional level foresees the following steps:

- **L1 Processing:** the BIOMASS image formation step, taking in input 1 L0 slice and generating in output $N \geq 1$ L1 frames;
- **Stack Processing:** the coregistration and stacking processing step that will define the required 7-images Tomographic stacks or the 3-images Interferometric stacks. It includes stack phase calibration;
- **L2a Processing:** processing step for each stack that provides the inputs to the further products Tile Generation performed by the L2b processors. *For one GC the number of stacks varies mainly with latitude, approximately from a minimum of two at the Equator (ascending/descending) to about six at higher latitudes (three ascending/descending pairs);*
- **L2b Processing:** processing that aggregates all the stack-based L2a products insisting on the same location on ground (Tile) in the same time interval and generates a single BIOMASS L2b product. A different number of stacks may be available for each DGG tile, based on tile dimensions and swath coverage (which is not related to DGG tiling pattern);
- **L3 Processing:** consolidation processing removing discontinuities in L2b products.

An additional processing tool is provided as part of BPS, i.e., the **L1 Framing** one, which is in charge of computing the L1 frames start and stop times needed to trigger the L1 processing step.

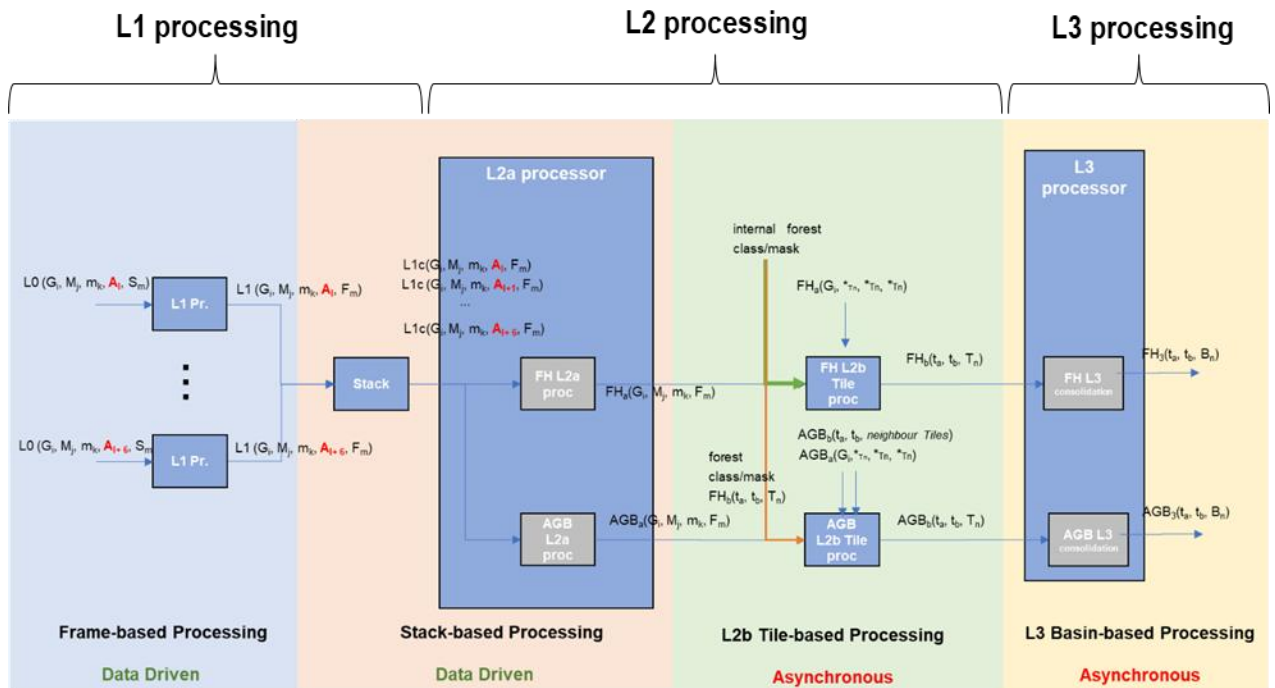


Fig.3 Biomass High-level processing scheme from L0 data to L3 products, TOM phase. Blue boxes represent single processing units. L2a and L3 are unique configurable processors for all products [AD1].

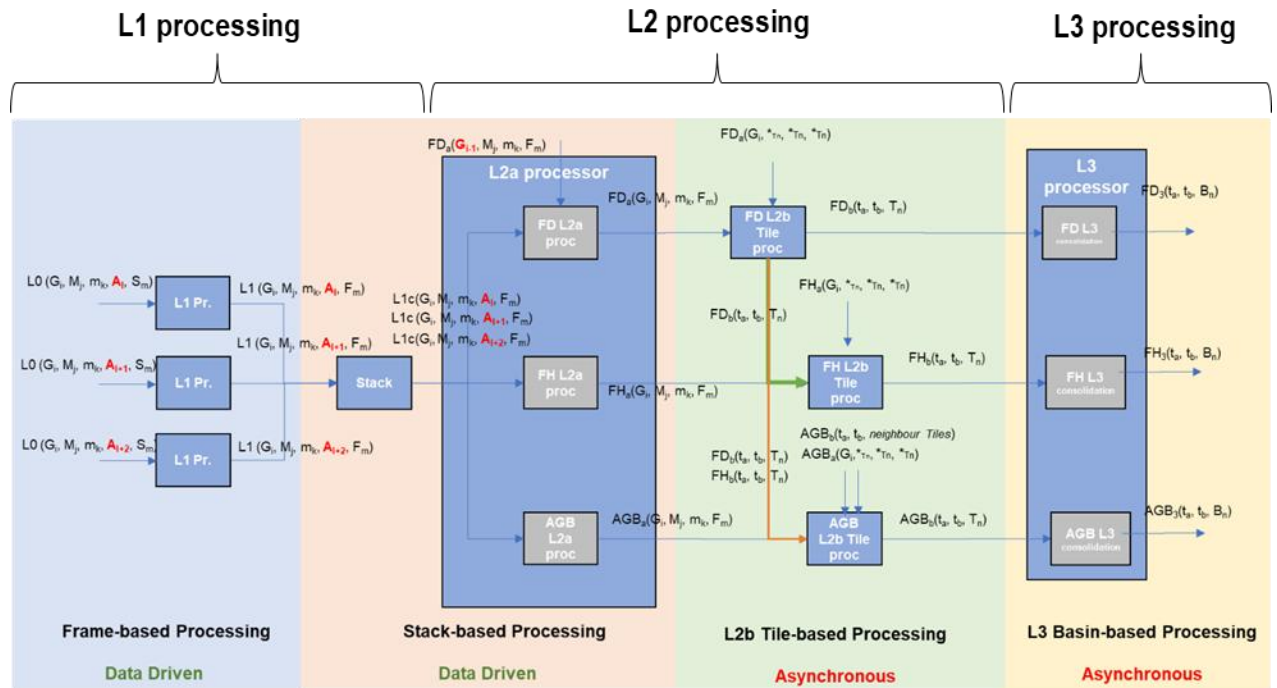


Fig.4 Biomass High-level processing scheme from L0 data to L3 products, INT phase. Blue boxes represent single processing units. L2a and L3 are unique configurable processors for all products [AD1].

NOTE: Regarding stack images cardinality, their number can vary (not always 3 or 7) due to contingency reasons and it can go up to 8 in TOM phase.

NOTE: Regarding AGB, the nomenclature AGB L2a (AGB_a) indicates the processing unit and flow, whereas the product for AGB flow at L2a is the ground cancelled product (GN) [AD1][AD2].

2.3. IODD figure graphical conventions

In the following sections the various BPS processors input/output interfaces are described. For each processor a figure and a table with all the interfaces are reported and for each interface a dedicated table is filled, showing its main characteristics and retrieval information. Here below adopted templates are reported.

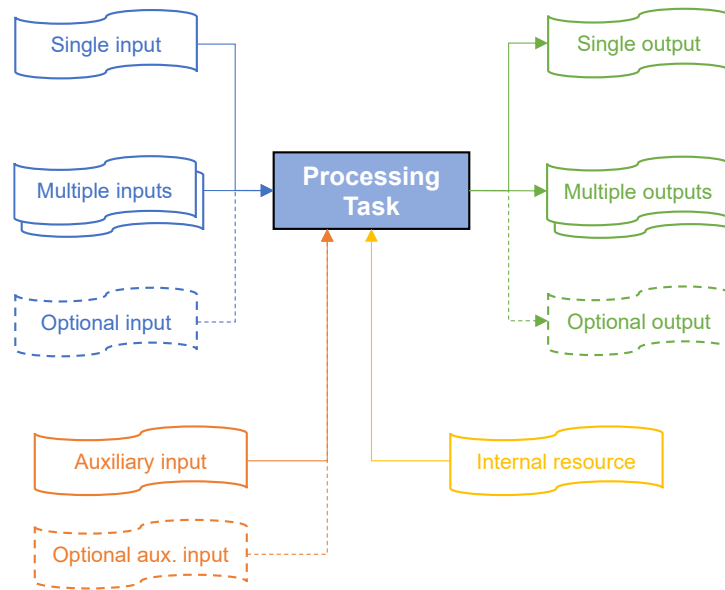


Fig.5 Generic processor interfaces.

Product Type	Description	Type	I/O	Mandatory	Cardinality

Data Description table	
Name	
ID	
Sub-ID	
Type	
Content description	
Format brief	
Format specification ref.	
Number of channels	
Average size	
Timeliness	
Source	
Refresh rate	
Remarks	

Tab.1 Generic processor I/O data summary table and generic interface description table (respectively).

Throughout the whole document the following symbols and notations are adopted to fill I/O data summary tables:

- Product Type legend:
 - Sx: BIOMASS beams, i.e., S1, S2, S3;
 - c: BIOMASS scattering responses, i.e., 1 (for Gt1), 2 (for Gt2), X, Y;
- Cardinalities legend:
 - F: number of L1 frames in a L0 slice;
 - A: number of images in a stack, i.e., 3 for Interferometric (INT) Phase, 7 for Tomographic (TOM) Phase;
 - T: number of stacks per tile (which is latitude dependent);
 - TT (total), TB (boundary), TI (inside): number of L2a/L2b products over current and surrounding tiles;
 - TE: number of existing L2b product over current tiles. L3 processor take in input TE AGB and FH L2b products and TE-1 AGB and FH L3 products;
 - B: number of tiles in a basin;
 - x, y: cardinality is x *or* y (if x=0 the input is optional and not mandatory);
 - x..y: cardinality is *any number between* x and y (if x=0 the input is optional and not mandatory).

Moreover, the following understanding and terminology is adopted to classify interfaces:

- Auxiliary Products:
 - provided in input to the processor through Job Order (as part of list of inputs)
 - dynamic (updated on a regularly basis)
- Internal resources:
 - provided in input to the processor through container mounting point specified in Job Order (as part of list of configuration files)
 - static (or updated on-demand upon specific conditions)
 - shared by various processors (provided together with the processors or made available to the processors)

3. L1 Processor IODD

3.1. I/O Data summary

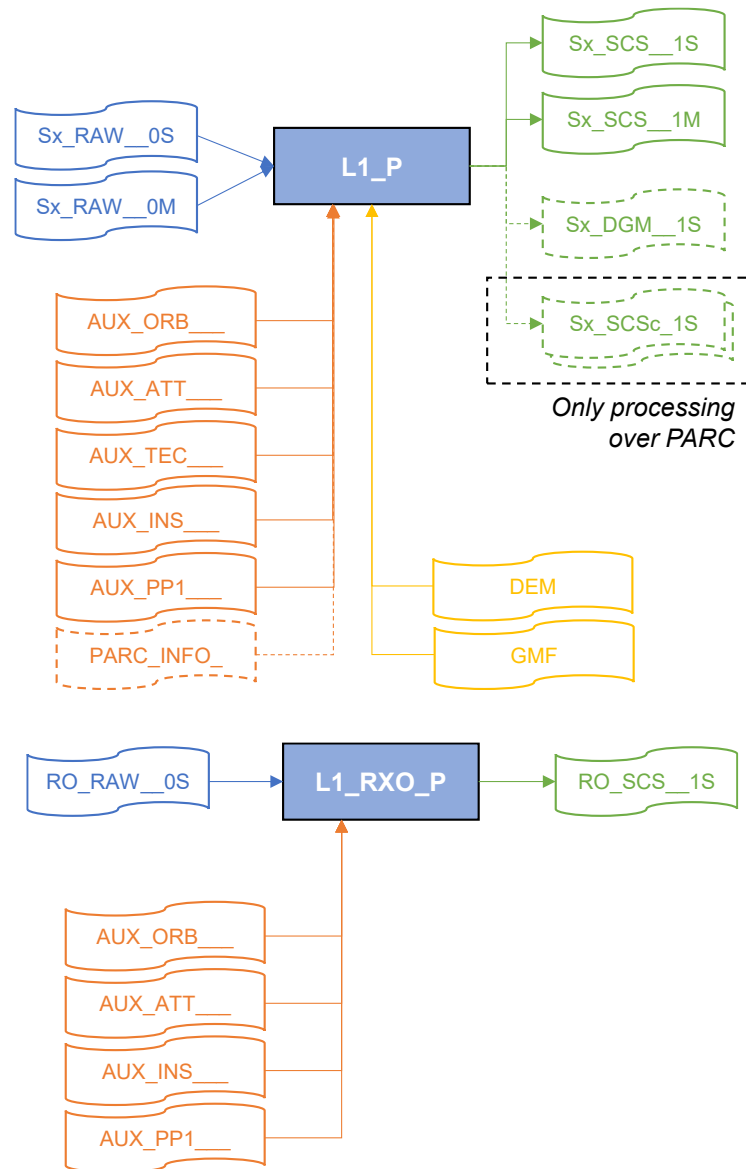


Fig.6 L1 Processor (Standard and RX-Only) interfaces.

Product Type	Description	Type	I/O	Mandatory	Cardinality
Sx_RAW__0S	Stripmap Level-0 – Standard product	Product	I	Y	1

Sx_RAW__0M	Stripmap Level-0 – Monitoring product	Product	I	Y	1
RO_RAW__0S*	RX Only Mode Level-0 – Standard product	Product	I	Y	1
AUX_ORB__	Auxiliary Orbit	Auxiliary file	I	Y	1
AUX_ATT__	Auxiliary Attitude	Auxiliary file	I	Y	1
AUX_TEC__	Auxiliary TEC Map	Auxiliary file (database)	I	Y	1
AUX_INS__	Auxiliary Instrument Parameters	Auxiliary file	I	Y	1
AUX_PP1__	Auxiliary L1 Processing Parameters	Auxiliary file	I	Y	1
DEM	Digital Elevation Model	Internal resource (database)	I	Y	1
GMF	Geomagnetic Field	Internal resource (database)	I	Y	1
PARC_INFO_	Auxiliary Calibration Site Information	Auxiliary file	I	N	0, 1
Sx_SCS__1S	Stripmap L1 SCS – Standard product	Product	O	Y	1
Sx_SCS__1M	Stripmap L1 SCS – Monitoring product	Product	O	Y	1
Sx_DGM__1S	Stripmap L1 DGM – Standard product	Product	O	N	0..1
Sx_SCS_1S	Stripmap L1 SCS Calibration – Standard product	Product	O	N	0, 4
RO_SCS__1S*	RX Only Mode L1 SCS – Standard product	Product	O	Y	1

** Sx_* and RO_* input and output products are referred to two different tasks of L1 Processor (Standard and RX-Only, respectively), as depicted in the figures above.*

Tab.2 Level-1 processor (Standard and RX-Only) input/output data summary

3.2. Detailed I/O data description

3.2.1. Sx_RAW__0S

Data Description table	
Name	Stripmap Level-0 – Standard product
ID	Sx_RAW__0S
Sub-ID	The x in the ID identifies the BIOMASS swath: - S1_RAW__0S - S2_RAW__0S - S3_RAW__0S
Type	Product
Content description	This product contains a set of BIOMASS RAW Instruments Source Packets and the relevant metadata information
Format brief	The format is a folder-based one, including only binary files (packets streams) (except for MPH).
Format specification ref.	[RD1]
Number of channels	A Level-0 product contains four channels: two for measurement data (one for RX H pol, one for RX V pol), two for instrument ancillary data (as above).
Average size	~1500MB
Timeliness	L0 data generation is driven by the availability of new ISP in the PDGS. L0 data are sliced according to the policies defined in the BPS production model
Source	BIOMASS PDGS
Refresh rate	N.A.
Remarks	None

3.2.2. Sx_RAW__0M

Data Description table	
Name	Stripmap Level-0 – Monitoring product
ID	Sx_RAW__0M
Sub-ID	The x in the ID identifies the BIOMASS swath: - S1_RAW__0M - S2_RAW__0M - S3_RAW__0M
Type	Product
Content description	This product is identical to Sx_RAW__0S one, but with just calibration and noise ISP and not sliced.
Format brief	The format is a folder-based one, including only binary files (packets streams) (except for MPH).

Data Description table	
Format specification ref.	[RD1]
Number of channels	A Level-0 product contains four channels: two for measurement data (one for RX H pol, one for RX V pol), two for instrument ancillary data (as above).
Average size	Few MB
Timeliness	L0 data generation is driven by the availability of new ISP in the PDGS. L0 monitoring data are not sliced.
Source	BIOMASS PDGS
Refresh rate	N.A.
Remarks	None

3.2.3. RO_RAW__0S

Data Description table	
Name	RX Only Mode Level-0 – Standard product
ID	RO_RAW__0S
Sub-ID	N.A.
Type	Product
Content description	This product contains a set of BIOMASS RAW Instruments Source Packets and the relevant metadata information. Differently from Sx_RAW__0S products, no signal is transmitted in this acquisition mode. In addition, in this case preamble, postamble and interleaved calibration sequences are not present in the acquisition timeline.
Format brief	The format is a folder-based one, including only binary files (packets streams) (except for MPH).
Format specification ref.	[RD1]
Number of channels	A Level-0 product contains four channels: two for measurement data (one for RX H pol, one for RX V pol), two for instrument ancillary data (as above).
Average size	~1500MB
Timeliness	L0 data generation is driven by the availability of new ISP in the PDGS. L0 data are sliced according to the policies defined in the BPS production model
Source	BIOMASS PDGS
Refresh rate	N.A.
Remarks	None

3.2.4. AUX_ORB__

Data Description table	
Name	Auxiliary Orbit
ID	AUX_ORB__
Sub-ID	N.A.
Type	Auxiliary file
Content description	This auxiliary file contains orbital information covering a time span including input Sx_RAW__0S product one.
Format brief	XML file (Earth Observation Ground Segment File format standard)
Format specification ref.	[RD7]
Number of channels	N.A.
Average size	< 5MB (per file)
Timeliness	Made available to L1 processor together with Sx_RAW__0S product.
Source	BIOMASS PDGS
Refresh rate	N.A.
Remarks	None

3.2.5. AUX_ATT__

Data Description table	
Name	Auxiliary Attitude
ID	AUX_ATT__
Sub-ID	N.A.
Type	Auxiliary file
Content description	This auxiliary file contains attitude information covering a time span including input Sx_RAW__0S product one.
Format brief	XML file (Earth Observation Ground Segment File format standard)
Format specification ref.	[RD7]
Number of channels	N.A.
Average size	< 5MB (per file)
Timeliness	Made available to L1 processor together with Sx_RAW__0S product.
Source	BIOMASS PDGS
Refresh rate	N.A.
Remarks	None

3.2.6. AUX_TEC__

Data Description table	
Name	Auxiliary TEC Map
ID	AUX_TEC__

Data Description table	
Sub-ID	N.A.
Type	Auxiliary file (database)
Content description	This input interface stands for the IONEX maps providing the vertical Total Electron Content (vTEC/RMS values in 0.1 TECU). Each map covers one day and contains 13 layers (one each 2 hours, from 00:00 to 24:00 included). Each layer is sampled on -87.5:2.5:87.5 deg latitude and -180:5:180 longitude grid. Regarding the accuracy, the RMS values in regions well covered with GNSS receivers are typically <1-2 TEC units (1 TECU is 16cm for GPS L1), while for poorly covered regions like the oceans, it can be significantly more (in excess of 15 TECU). Used during ionospheric correction step.
Format brief	IONEX 1 format, compressed Note that since GPS Week 2238 compression is GZIP one (.gz extension), while before this date UNIX compress and decompress programs were used (.z extension). Data decompression, including management of different compression strategies, is in charge to L1 Processor.
Format specification ref.	[RD14]
Number of channels	N.A.
Average size	< 500KB (per compressed map)
Timeliness	Made available to L1 processor together with Sx_RAW__0S product. Ionosphere products are available in: • a predicted solution, available both 1- and 2-days prior; • a rapid solution with a latency of less than 8-32 hours; • a final solution with a latency of approximately 11 days. Considering the best balance between accuracy and latency, the selected solution is rapid one.
Source	[RD15] (documentation: [RD23]) Maps from different analysis centres are available at this source. The ones to be selected are the ESA/ESOC rapid ones (ESA0OPSRAP_YYYYDDD0000_01D_01H_GIM.INX.gz, considering naming convention after GPS Week 2238).
Refresh rate	Dynamic (IONEX maps are issued daily by the IGS associated analysis centres).
Remarks	None

3.2.7. AUX_INS__

Data Description table	
Name	Auxiliary Instrument Parameters

Data Description table	
ID	AUX_INS____
Sub-ID	N.A.
Type	Auxiliary file
Content description	This is the BPS configuration file containing all the instrument-related parameters to be used during processing.
Format brief	XML + binary (for antenna patterns) files
Format specification ref.	[RD6]
Number of channels	N.A.
Average size	< 5 MB
Timeliness	Immediately available
Source	BIOMASS PDGS
Refresh rate	On demand (e.g., on specific events during satellite lifetime, like instrument parameters changes)
Remarks	None

3.2.8. AUX_PP1____

Data Description table	
Name	Auxiliary L1 Processing Parameters
ID	AUX_PP1____
Sub-ID	N.A.
Type	Auxiliary file
Content description	This is the configuration file of the L1 processor containing all the processing parameters for each functional block.
Format brief	XML file
Format specification ref.	[RD6]
Number of channels	N.A.
Average size	< 1 MB
Timeliness	Immediately available
Source	BIOMASS PDGS
Refresh rate	On demand (e.g., on specific events during satellite lifetime, like recalibration activities)
Remarks	None

3.2.9. DEM

Data Description table	
Name	Digital Elevation Model (DEM)
ID	DEM
Sub-ID	N.A.

Data Description table	
Type	Internal resource (database)
Content description	This internal database contains all the possible supported DEM by BPS, being: - Copernicus DEM: the Copernicus DEM at 90 m resolution, worldwide coverage. Copernicus DEM is delivered as a collection of 1°x1° tiles. The Copernicus DEM instances are available in Geographic Coordinates. The horizontal reference datum is the World Geodetic System 1984 (WGS84-G1150; EPSG 4326). The vertical reference datum is the Earth Gravitational Model 20081 (EGM2008; EPSG 3855) at 2.5 minute resolution; - SRTM: as Copernicus DEM, at 90 m resolution, worldwide coverage, delivered as a collection of 1°x1° tiles. The horizontal reference datum is the World Geodetic System 1984 (WGS84-G1150; EPSG 4326). The vertical reference datum is EGM96 Geoid Height File; including the corresponding geoid files, and for the future also BIOMASS DTM.
Format brief	- Copernicus DEM: tiles format is folder based (.tar encapsulated), binary GeoTIFF + XML metadata (DGED), main layer is elevation in meters, 32 Bit, floating point. The DGED format contains quality layers as well. <i>Only elevation map (no ancillary), will be used</i> - EGM2008: tif format - SRTM: tiles format is hgt ones (.zip encapsulated) - EGM96: tif format
Format specification ref.	Copernicus DEM: [RD8] SRTM: [RD32]
Number of channels	1
Average size	- Copernicus DEM: entire database 220GB, one tile 13MB (100GB and 5.8MB respectively w/out ancillary masks) - EGM2008: 200 MB - SRTM: entire database 25GB - EGM96: 5MB
Timeliness	Immediately available
Source	BIOMASS PDGS (proxy) - Copernicus DEM: ESA Copernicus [RD21] (FTP at PRISM) - SRTM: EarthData collection [RD33] - EGM2008 and EGM96: NGA – Office of Geomatics [RD20] (Download)
Refresh rate	Copernicus DEM: static, can be updated on demand if deemed necessary (yearly updates potentially available, replacing previous product)

Data Description table	
	SRTM: static, v1 is used
Remarks	Copernicus DEM 90 m dataset is available worldwide with a free license [RD22]. Access to DEM tiles is managed directly by L1 Processor. In particular, the DEM ingestion routine is designed to "query" the DEM database through an index file that can be generated offline (a Python tool is available and will be provided within BPS software package) and that contains paths to tiles and their geographical coverage. In this way tiles can be physically organized as preferred without particular constraints. For SRTM no index file is needed. Selection of proper DEM to be used during processing is done at configuration level (AUX_PP1).

3.2.10. GMF

Data Description table	
Name	Geomagnetic Field
ID	GMF
Sub-ID	N.A.
Type	Internal resource (database)
Content description	This internal database contains the Geomagnetic Field Model auxiliary data files (IGRF-13, i.e., 13th Generation IGRF Schmidt semi-normalised spherical harmonic coefficients, degree n=1,13 in units nanoTesla for IGRF and definitive DGRF main-field models (degree n=1,8 nanoTesla/year for secular variation (SV))) Used during ionospheric correction step.
Format brief	Binary (.cof) + XML format (XML file is used to store geomagnetic poles coordinates)
Format specification ref.	[RD19] + [RD28] (for geomagnetic poles)
Number of channels	N.A.
Average size	< 50KB
Timeliness	Immediately available
Source	[RD19] + [RD28] Geomagnetic poles file full format is described in [RD29]
Refresh rate	Dynamic (new IGRF coefficients are updated regularly (several years between updates); geomagnetic poles are updated yearly)
Remarks	GeographicLib library is used to compute the geomagnetic field values in the specified format (see details in [RD19])

3.2.11. PARC_INFO_

Data Description table	
Name	Auxiliary Calibration Site Information
ID	PARC_INFO_
Sub-ID	N.A.
Type	Auxiliary file
Content description	This input interface stands for the auxiliary data file containing the transponder information including the geographic position and the scattering delays. This interface is used by the L1 processor to activate the dedicated processing for scenes acquired on the transponder (standard + processing with custom range delay for IRF measurement).
Format brief	XML file
Format specification ref.	[RD6]
Number of channels	N.A.
Average size	< 1 MB
Timeliness	N.A.
Source	BIOMASS PDGS
Refresh rate	Static (no changes are foreseen in the transponder information)
Remarks	None

3.2.12. Sx_SCS__1S

Data Description table	
Name	Stripmap L1 SCS – Standard product
ID	Sx_SCS__1S
Sub-ID	The x in the ID identifies the BIOMASS swath: - S1_SCS__1S - S2_SCS__1S - S3_SCS__1S
Type	Product
Content description	This product contains a SAR focused data, internally radiometric calibrated, in zero-Doppler slant range-azimuth geometric projection, at natural geometric spacing, with ionospheric corrections applied and with associated ancillary data (RFI mask, sigma- and gamma-nought maps, ionospheric corrections and autofocus maps, denoising maps, latitude/longitude/height maps, incidence and elevation angles maps).
Format brief	The format is a folder-based one, including GeoTIFF and NetCDF files for binary data and XML files for annotation data.
Format specification ref.	[RD2]
Number of channels	A L1 product contains four channels, one for each polarisation.
Average size	225-600 MB (considering compression)

Data Description table	
Timeliness	L1 product generation is driven by the availability of new L0 product in the PDGS. L1 data are framed according to the policies defined in the BPS production model.
Source	BPS L1 processor
Refresh rate	N.A.
Remarks	None

3.2.13. Sx_SCS__1M

Data Description table	
Name	Stripmap L1 SCS – Monitoring product
ID	Sx_SCS__1M
Sub-ID	The x in the ID identifies the BIOMASS swath: - S1_SCS__1M - S2_SCS__1M - S3_SCS__1M
Type	Product
Content description	This product is identical to Sx_SCS__1S one, but with just the annotation files.
Format brief	As Sx_SCS__1S
Format specification ref.	[RD2]
Number of channels	A L1 product contains four channels, one for each polarisation.
Average size	< 50MB (only annotation files)
Timeliness	L1 product generation is driven by the availability of new L0 product in the PDGS. L1 data are framed according to the policies defined in the BPS production model.
Source	BPS L1 processor
Refresh rate	N.A.
Remarks	None

3.2.14. Sx_DGM__1S

Data Description table	
Name	Stripmap L1 DGM – Standard product
ID	Sx_DGM__1S
Sub-ID	The x in the ID identifies the BIOMASS swath: - S1_DGM__1S - S2_DGM__1S - S3_DGM__1S
Type	Product

Data Description table	
Content description	This product contains a SAR focused data radiometrically calibrated, amplitude detected, multi-looked, projected in zero-Doppler ground range-azimuth onto a reference ellipsoid resampled at a regular spacing on ground with associated ancillary data.
Format brief	The format is a folder-based one, including GeoTIFF and NetCDF files for binary data and XML files for annotation data.
Format specification ref.	[RD2]
Number of channels	A L1 product contains four channels, one for each polarisation.
Average size	115-200 MB (considering compression)
Timeliness	L1 product generation is driven by the availability of new L0 product in the PDGS. L1 data are framed according to the policies defined in the BPS production model.
Source	BPS L1 processor
Refresh rate	N.A.
Remarks	None

3.2.15. Sx_SCS_1S

Data Description table	
Name	Stripmap L1 SCS Calibration – Standard product
ID	Sx_SCS_1S
Sub-ID	The x in the ID identifies the BIOMASS swath: - S1_SCS_1S - S2_SCS_1S - S3_SCS_1S The c in the ID identifies the BIOMASS scattering response: - Sx_SCS1_1S (for Gt1) - Sx_SCS2_1S (for Gt2) - Sx_SCSX_1S - Sx_SCSY_1S
Type	Product
Content description	This is a set of 4 products (one per scattering response) identical to Sx_SCS_1S one but cut just over the PARC and with the corresponding delay compensated.
Format brief	As Sx_SCS_1S
Format specification ref.	[RD2]
Number of channels	Each product contains four channels, one for each polarisation.
Average size	Few tens of MB (just small portion of data)
Timeliness	Products generation is driven by the availability of new L0 product in the PDGS acquired over PARC.

Data Description table	
Source	BPS L1 processor
Refresh rate	N.A.
Remarks	None

3.2.16. RO_SCS__1S

Data Description table	
Name	RX Only Mode L1 SCS – Standard product
ID	RO_SCS__1S
Sub-ID	N.A.
Type	Product
Content description	This product contains only noise received by the instrument when no signal is transmitted, processed through the same processing chain generating Sx_SCS__1S products (i.e., SAR focused data, internally radiometric calibrated, in zero-Doppler slant range-azimuth geometric projection, at natural geometric spacing, with ionospheric corrections applied and with associated ancillary data).
Format brief	The format is a folder-based one, including GeoTIFF and NetCDF files for binary data and XML files for annotation data.
Format specification ref.	[RD2]
Number of channels	A L1 product contains four channels, one for each polarisation.
Average size	225-600 MB (considering compression)
Timeliness	L1 product generation is driven by the availability of new L0 product in the PDGS. L1 data are framed according to the policies defined in the BPS production model.
Source	BPS L1 processor
Refresh rate	N.A.
Remarks	None

4. Stack Processor IODD

4.1. I/O Data summary

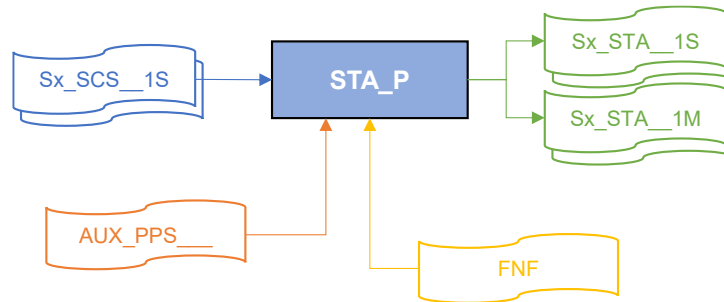


Fig.7 Stack Processor interfaces.

Product Type	Description	Type	I/O	Mandatory	Cardinality
Sx_SCS__1S	Stripmap Level-1 – SCS product	Product	I	Y	2..A
AUX_PPS__	Auxiliary Stack Processing Parameters	Auxiliary file	I	Y	1
FNF	Forest/Non-Forest mask	Internal resource (database)	I	Y	1
Sx_STA__1S	Stripmap L1 Coregistered stack – Standard product	Product	O	Y	2..A
Sx_STA__1M	Stripmap L1 Coregistered stack – Monitoring product	Product	O	Y	2..A

Tab.3 Stack processor input/output data summary

4.2. Detailed I/O data description

4.2.1. Sx_SCS__1S

See the data description table in Sec. 3.2.12.

4.2.2. AUX_PPS__

Data Description table	
Name	Auxiliary Stack Processing Parameters
ID	AUX_PPS___
Sub-ID	N.A.
Type	Auxiliary file
Content description	This is the configuration file of the Stack processor containing all the processing parameters for each functional block.
Format brief	XML file
Format specification ref.	[RD6]
Number of channels	N.A.
Average size	< 1 MB
Timeliness	Immediately available
Source	BIOMASS PDGS
Refresh rate	On demand (e.g., on specific events during satellite lifetime, like recalibration activities)
Remarks	None

4.2.3. FNF

Data Description table	
Name	Forest/Non-Forest mask
ID	FNF
Sub-ID	N.A.
Type	Internal resource (database)
Content description	This internal database contains the forest/non-forest mask resulting from the aggregation of LCM classes (see Sec. for LCM description and notes below this table for aggregation rule). Main LCM characteristics are preserved, <i>i.e.</i> , 0.002778° grid spacing (approximately 300 m at the equator), geographic coordinate system (GCS) based on the World Geodetic System 84 (WGS84) reference ellipsoid as Coordinate Reference System, temporal resolution one year. Pixels assume Boolean values (0: non-forest, 1: forest).
Format brief	BPS internal resource, COG format (same as LCM, see section 6.3.2.5)
Format specification ref.	[RD12]
Number of channels	1
Average size	The size of one global forest/non-forest product is around 330 MB.
Timeliness	Immediately available
Source	BIOMASS PDGS (proxy) C3S LC maps are available through the C3S Climate Data Store (CDS): [RD13] (Download, registration required)

Data Description table	
	A dedicated Python tool (TBD) will be provided within BPS software package to perform classes aggregation and FNF generation [RD30]
Refresh rate	Yearly (latest product is available for one year before the year of request), replacing previous product
Remarks	The LCM products are made available to the public by ESA and the consortium on the condition to credit the ESA Climate Change Initiative and in particular its Land Cover project as the source of the CCI-LC database.

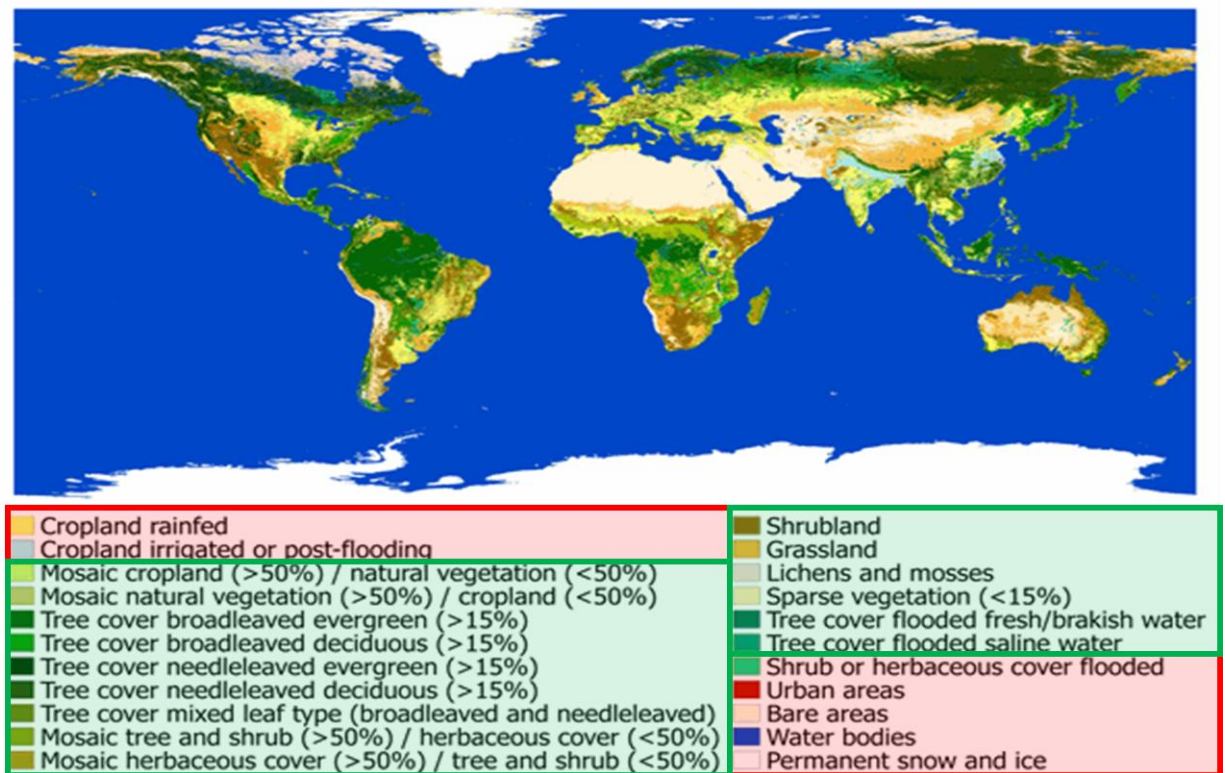


Fig.8 Aggregation of LCM classes to get FNF mask (green: classes corresponding to forest; red: classes corresponding to non-forest).

4.2.4. Sx_STA__1S

Data Description table	
Name	Stripmap L1 Coregistered stack – Standard product
ID	Sx_STA__1S
Sub-ID	The x in the ID identifies the BIOMASS swath: - S1_STA__1S - S2_STA__1S - S3_STA__1S
Type	Product

Data Description table	
Content description	This product contains a Level-1 product calibrated in phase, polarimetry and radiometry (accounting also for atmospheric effects) and coregistered. The product includes also ancillary annotations (e.g., metadata and orbits, SKP phase screens, geocoding and geometry information, RFI mask, wavenumbers).
Format brief	The format is a folder-based one, including GeoTIFF and NetCDF files for binary data and XML files for annotation data.
Format specification ref.	[RD2]
Number of channels	A stack product can contain three or four channels, depending on configurations parameters regarding polarizations management. Each product contains a single image, while a logical stack is composed by three (INT) or seven (TOM) stack products.
Average size	225-600 MB (considering compression) in case of 4 channels (as Sx_SCS__1S product) 175-475 MB (considering compression) in case of just 3 polarizations
Timeliness	L1c data generation is driven by the availability of a complete focused stack from L1 processor in the PDGS according to the policies defined in the BPS production model.
Source	BPS Stack processor
Refresh rate	N.A.
Remarks	None

4.2.5. Sx_STA__1M

Data Description table	
Name	Stripmap L1 Coregistered stack – Monitoring product
ID	Sx_STA__1M
Sub-ID	The x in the ID identifies the BIOMASS swath: - S1_STA__1M - S2_STA__1M - S3_STA__1M
Type	Product
Content description	This product is identical to Sx_STA__1S one, but with just the annotation files.
Format brief	As Sx_STA__1S
Format specification ref.	[RD2]
Number of channels	A stack product can contain three or four channels, depending on configurations parameters regarding polarizations management. Each product contains a single image, while a logical stack is composed by three (INT) or seven (TOM) stack products.
Average size	< 50MB (only annotation files)

Data Description table	
Timeliness	L1c data generation is driven by the availability of a complete focused stack from L1 processor in the PDGS according to the policies defined in the BPS production model.
Source	BPS Stack processor
Refresh rate	N.A.
Remarks	None

5. L2a Processor IODD

5.1. I/O Data summary

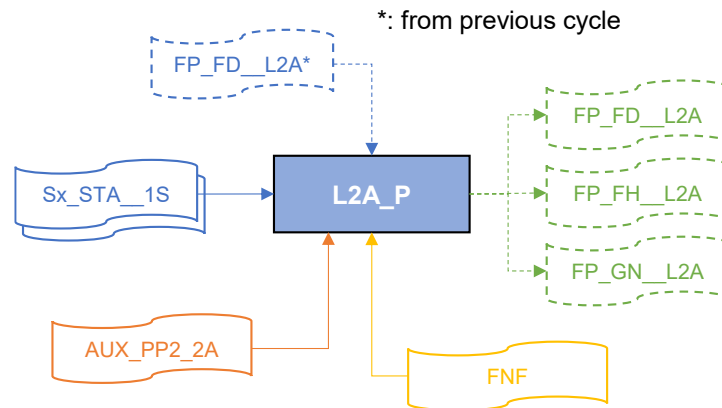


Fig.9 L2a Processor interfaces.

Product Type	Description	Type	I/O	Mandatory	Cardinality
Sx_STA__1S	Stripmap Level-1 – Coregistered stack product	Product	I	Y	2..A
FP_FD__L2A*	L2a Forest Disturbance product	Product	I	N	0, 1
AUX_PP2_2A	Auxiliary L2a Processing Parameters	Auxiliary file	I	Y	1
FNF	Forest/Non-Forest mask	Internal resource (database)	I	Y	1
FP_FD__L2A	L2a Forest Disturbance product	Product	O	N	0, 1
FP_FH__L2A	L2a Forest Height product	Product	O	N	0, 1
FP_GN__L2A	L2a Ground Cancelled product	Product	O	N	0, 1

* FP_FD__L2A product from previous global cycle.

Tab.4 Level-2a processor input/output data summary

5.2. Detailed I/O data description

5.2.1. Sx_STA__1S

See the data description table in Sec. 4.2.4.

5.2.2. AUX_PP2_2A

Data Description table	
Name	Auxiliary L2a Processing Parameters
ID	AUX_PP2_2A
Sub-ID	N.A.
Type	Auxiliary file
Content description	This is the configuration file of the L2a processor containing all the processing parameters for each functional block, setup and which product is requested (FD, FH, GN, all or a combination).
Format brief	XML file
Format specification ref.	[RD6]
Number of channels	N.A.
Average size	< 1 MB
Timeliness	Immediately available
Source	BIOMASS PDGS
Refresh rate	On demand (e.g., on specific events during satellite lifetime, like recalibration activities)
Remarks	None

5.2.3. FNF

See the data description table in Sec 4.2.3.

5.2.4. FP_FD__L2A

Data Description table	
Name	L2a Forest Disturbance product
ID	FP_FD__L2A
Sub-ID	N.A.
Type	Product
Content description	This is the Forest Disturbance folder-based product, representing forest change between two global cycles and forest/non-forest mask. It includes also ancillary information related to the computation of change such as average covariance matrix.

Data Description table	
Format brief	The format is a folder-based one, including GeoTIFF and NetCDF files for binary data and XML files for annotation data. The <i>proposed</i> product format is a binary GeoTIFF + XML metadata. Average covariance matrix ancillary <i>proposed</i> format is NetCDF with compression, the metadata is provided as global attributes in the NetCDF file.
Format specification ref.	[RD3]
Number of channels	Forest change between two global cycles, computed forest/non-forest mask and probability of change.
Average size	81MB (considering compression and annotations).
Timeliness	The product can be generated as soon as correspondent L1c stack is available from Stack processor and having FD L2a from previous global cycle (optional).
Source	BPS L2a processor
Refresh rate	N.A.
Remarks	None

5.2.5. FP_FH__L2A

Data Description table	
Name	L2a Forest Height product
ID	FP_FH__L2A
Sub-ID	N.A.
Type	Product
Content description	This is the forest height folder-based product, representing forest height and accuracy. It includes also ancillary information related to the computation of height.
Format brief	The format is a folder-based one, including GeoTIFF and NetCDF files for binary data and XML files for annotation data. The <i>proposed</i> product format is a binary GeoTIFF + XML metadata.
Format specification ref.	[RD4]
Number of channels	Forest height and accuracy.
Average size	6MB (considering compression and annotations).
Timeliness	The product can be generated as soon as correspondent L1c stack is available from Stack processor.
Source	BPS L2a processor
Refresh rate	N.A.
Remarks	None

5.2.6. FP_GN__L2A

Data Description table	
Name	L2a Ground Cancelled product
ID	FP_GN__L2A
Sub-ID	N.A.
Type	Product
Content description	This is the ground cancelled, radiometrically calibrated and multilooked image, three polarizations. It includes also ancillary information related to the computation.
Format brief	The format is a folder-based one, including GeoTIFF and NetCDF files for binary data and XML files for annotation data. The <i>proposed</i> product format is a binary GeoTIFF + XML metadata.
Format specification ref.	[RD5]
Number of channels	Three polarizations (HH/VH/VV)
Average size	40MB (considering compression and annotations).
Timeliness	The product can be generated as soon as correspondent L1c stack is available from Stack processor.
Source	BPS L2a processor
Refresh rate	N.A.
Remarks	None

6. L2b Processor IODD

6.1. L2b FD

6.1.1. I/O Data summary

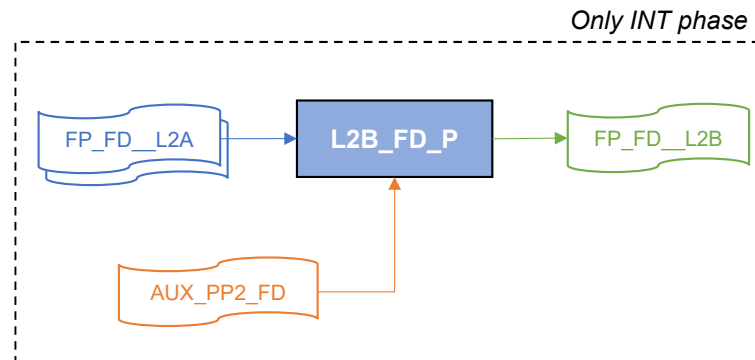


Fig.10 L2b FD Processor interfaces.

Product Type	Description	Type	I/O	Mandatory	Cardinality
FP_FD__L2A	L2a Forest Disturbance product	Product	I	Y	TD
AUX_PP2_FD	Auxiliary L2b FD Processing Parameters	Auxiliary file	I	Y	1
FP_FD__L2B	L2b Forest Disturbance product	Product	O	Y	1

Tab.5 Level-2b FD processor input/output data summary

6.1.2. Detailed I/O data description

6.1.2.1. FP_FD__L2A

See the data description table in Sec. 5.2.4.

6.1.2.2. AUX_PP2_FD

Data Description table	
Name	Auxiliary L2b FD Processing Parameters
ID	AUX_PP2_FD
Sub-ID	N.A.
Type	Auxiliary file
Content description	This is the configuration file of the L2b FD processor containing all the processing parameters for each functional block.
Format brief	XML file
Format specification ref.	[RD6]
Number of channels	N.A.
Average size	< 1 MB
Timeliness	Immediately available
Source	BIOMASS PDGS
Refresh rate	On demand (e.g., on specific events during satellite lifetime, like recalibration activities)
Remarks	None

6.1.2.3. FP_FD__L2B

Data Description table	
Name	L2b Forest Disturbance product
ID	FP_FD__L2B
Sub-ID	N.A.
Type	Product
Content description	This is the forest disturbance folder-based product, representing forest change between two global cycles and forest/non-forest mask. It includes also ancillary information related to the computation of change.
Format brief	The format is a folder-based one, including GeoTIFF and NetCDF files for binary data and XML files for annotation data. The <i>proposed</i> product format is a binary GeoTIFF + XML metadata.
Format specification ref.	[RD3]
Number of channels	Forest change between two global cycles, computed forest mask and probability of change.
Average size	21MB (considering compression and annotations).
Timeliness	Computation requires all L2a products relative to the desired L2b product to be available on the selected tile and in the selected time interval.
Source	BPS L2b FD processor
Refresh rate	N.A.

Data Description table	
Remarks	None

6.2. L2b FH

6.2.1. I/O Data summary

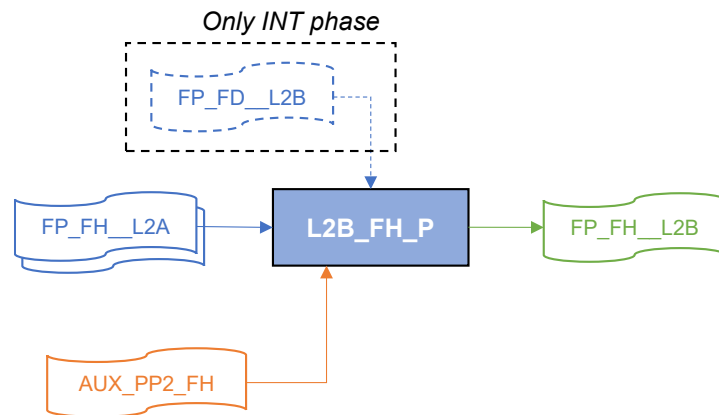


Fig.11 L2b FH Processor interfaces.

Product Type	Description	Type	I/O	Mandatory	Cardinality
FP_FH__L2A	L2a Forest Height product	Product	I	Y	TD
FP_FD__L2B	L2b Forest Disturbance product	Product	I	N	0, 1
AUX_PP2_FH	Auxiliary L2b FH Processing Parameters	Auxiliary file	I	Y	1
FP_FH__L2B	L2b Forest Height product	Product	O	Y	1

Tab.6 Level-2b FH processor input/output data summary

6.2.2. Detailed I/O data description

6.2.2.1. FP_FH__L2A

See the data description table in Sec. 5.2.5.

6.2.2.2. FP_FD__L2B

See the data description table in Sec. 6.1.2.3.

6.2.2.3. AUX_PP2_FH

Data Description table	
Name	Auxiliary L2b FH Processing Parameters
ID	AUX_PP2_FH
Sub-ID	N.A.
Type	Auxiliary file
Content description	This is the configuration file of the L2b FH processor containing all the processing parameters for each functional block.
Format brief	XML file
Format specification ref.	[RD6]
Number of channels	N.A.
Average size	< 1 MB
Timeliness	Immediately available
Source	BIOMASS PDGS
Refresh rate	On demand (e.g., on specific events during satellite lifetime, like recalibration activities)
Remarks	None

6.2.2.4. FP_FH__L2B

Data Description table	
Name	L2b Forest Height product
ID	FP_FH__L2B
Sub-ID	N.A.
Type	Product
Content description	This is the forest height folder-based product, representing forest height and accuracy. It includes also ancillary information related to the computation of height.
Format brief	The format is a folder-based one, including GeoTIFF and NetCDF files for binary data and XML files for annotation data. The <i>proposed</i> product format is a binary GeoTIFF + XML metadata.
Format specification ref.	[RD4]
Number of channels	Forest height and accuracy.
Average size	6MB (considering compression and annotations).
Timeliness	Computation requires all L2a products relative to the desired L2b product to be available on the selected tile and in the selected time

Data Description table	
	interval. It requires also L2B FD or alternatively L2A annotated forest/non-forest mask.
Source	BPS L2b FH processor
Refresh rate	N.A.
Remarks	None

6.3. L2b AGB

6.3.1. I/O Data summary

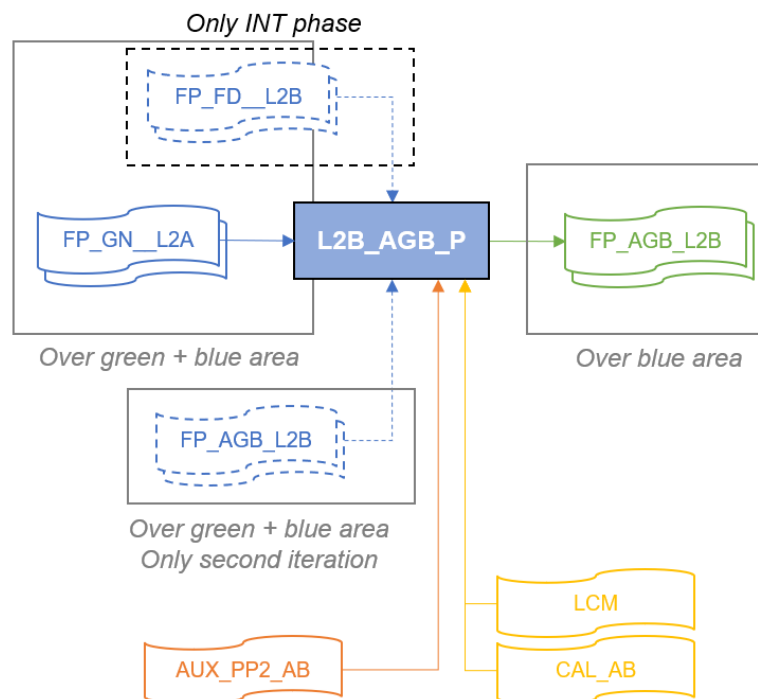




Fig.12 (top) L2b AGB Processor interfaces; (bottom) Graphical representation of DGG tiles, explaining “chromatic” input and output data selection policies.

Product Type	Description	Type	I/O	Mandatory	Cardinality
FP_GN__L2A	L2a Ground Cancelled product	Product	I	Y	TD
FP_FD__L2B	L2b Forest Disturbance product	Product	I	N	0, TT
FP_AGB_L2B	L2b Above Ground Biomass product	Product	I	N	0, TT
AUX_PP2_AB	Auxiliary L2b AB Processing Parameters	Auxiliary file	I	Y	1
CAL_AB	Reference AGB database	Internal resource (database)	I	Y	1
LCM	Land Cover Map	Internal resource (database)	I	Y	1
FP_AGB_L2B	L2b Above Ground Biomass product	Product	O	Y	TI

Tab.7 Level-2b AGB processor input/output data summary. TD denotes the number of available L2a inputs. TT denotes total number of *dgg* tiles (TT=25), while TI denotes processing block *dgg* tiles (TI=9).

6.3.2. Detailed I/O data description

6.3.2.1. FP_GN__L2A

See the data description table in Sec.5.2.6.

6.3.2.2. FP_FD__L2B

See the data description table in Sec. 6.1.2.3.

6.3.2.3. AUX_PP2_AB

Data Description table	
Name	Auxiliary L2b AGB Processing Parameters
ID	AUX_PP2_AB
Sub-ID	N.A.
Type	Auxiliary file
Content description	This is the configuration file of the L2b AGB processor containing all the processing parameters for each functional block.
Format brief	XML file
Format specification ref.	[RD6]
Number of channels	N.A.
Average size	< 1 MB
Timeliness	Immediately available
Source	BIOMASS PDGS
Refresh rate	On demand (e.g., on specific events during satellite lifetime, like recalibration activities)
Remarks	None

6.3.2.4. CAL_AB

Data Description table	
Name	Reference AGB database
ID	CAL_AB
Sub-ID	N.A.
Type	Internal resource (database)
Content description	This internal database contains the Reference AGB: a collection of AGB values (ton/hectare) and associated estimated standard deviations (ton/hectare), delivered as a collection of 1°x1° tiles. Database is built upon GEDI and ICESat2 maps. A dedicated Python tool will be provided within BPS software package to perform CAL_AB generation [RD30]
Format brief	The format is a folder-based one, with (two-layer) GeoTIFF for each 1°x1° tile, plus an additional XML file describing acquisition dates and origin of the reference data. Chosen sampling will be the same of FP_GN_L2A products. Thus, DGG sampling is adopted, that implies each layer of dimension: Longitude 0°-50° : 1201 x 1201 pixels [lat x lon] Longitude 50°-60° : 1201 x 801 pixels [lat x lon] Longitude 60°-70° : 1201 x 601 pixels [lat x lon] Only DGG tiles where AGB reference data are available and forest is present are stored (estimated 1°x1° tile number: 10000)
Format specification ref.	[RD26], [RD27], [RD31]

Data Description table	
Number of channels	2 (AGB values and associated standard deviations)
Average size	< 4Mb for each 1°x1° tile (exact dimension will be computed considering exact number of available reference values, number of forested tiles and compression).
Timeliness	Immediately available.
Source	BIOMASS PDGS (proxy) Origin: GEDI: [RD11] (Download, registration required) ICESat2 [RD27]
Refresh rate	static, can be updated on demand if deemed necessary.
Remarks	Any source of reference AGB data can be added to the database. The definition of CAL_AB allows the processing to be agnostic to data source.

6.3.2.5. LCM

Data Description table	
Name	Land Cover Map
ID	LCM
Sub-ID	N.A.
Type	Internal resource (database)
Content description	This internal database contains the C3S Landcover product classifying the type of land and forest at 0.002778° spatial resolution (approximately 300 m at the equator). The Coordinate Reference System used for the global land cover database is a geographic coordinate system (GCS) based on the World Geodetic System 84 (WGS84) reference ellipsoid. Temporal resolution is one year. Each pixel value corresponds to the label of a categorical land cover class defined using UN-LCCS classifiers [RD12] for all terrestrial zones of the Earth. The classes of interest are (corresponding integer value in brackets): mosaic_cropland (30), mosaic_natural_vegetation (40), tree_broadleaved_evergreen_closed_to_open (50), tree_broadleaved_deciduous_closed_to_open (60), tree_broadleaved_deciduous_closed (61), tree_broadleaved_deciduous_open (62), tree_needleleaved_evergreen_closed_to_open (70), tree_needleleaved_evergreen_closed (71), tree_needleleaved_evergreen_open (72), tree_needleleaved_deciduous_closed_to_open (80), tree_needleleaved_deciduous_closed (81), tree_needleleaved_deciduous_open (82), tree_mixed (90), mosaic_tree_and_shrub (100), mosaic_herbaceous (110), shrubland (120), shrubland_evergreen (121), shrubland_deciduous (122), grassland (130), lichens_and_mosses (140), sparse_vegetation (150), sparse_tree (151), sparse_shrub (152), sparse_herbaceous (153), tree_cover_flooded_fresh_or_brakish_water (160), tree_cover_flooded_saline_water (170)
Format brief	ESA CCI Landcover: NetCDF-4 format using the "classic model" of NetCDF with compression. The metadata is provided as global attributes in the NetCDF file. The NetCDF contains quality layers as well. <i>Only landcover map (no ancillary), will be used.</i> The BPS internal resource -COG- was generated using GDAL as follows, replacing Year, Band_Name and Output_Filename with the parameters of interest: <pre>gdalwarp -of Gtiff -co COMPRESS=LZW -co TILED=YES -ot Byte -te -180.0000000 -90.0000000 180.0000000 90.0000000 -tr 0.0027777777777778 0.0027777777777778 -t_srs EPSG:4326</pre>

Data Description table	
	NETCDF:C3S-LC-L4-LCCS-Map-300m-P1Y-Year-v2.1.1.nc:BandName OutputFilename.tif
Format specification ref.	[RD12]
Number of channels	1
Average size	The size of one NetCDF-4 landcover product is around 2.5 GB taking an internal LZW compression into account (330 MB w/out quality flag); after extraction of the needed data, the landcover map (no ancillary) used by the processor is a GeoTIFF of around 320MB.
Timeliness	Immediately available
Source	BIOMASS PDGS (proxy) C3S LC maps are available through the C3S Climate Data Store (CDS): [RD13] (Download, registration required)
Refresh rate	Yearly (latest product is available for one year before the year of request), replacing previous product
Remarks	The products are made available to the public by ESA and the consortium on the condition to credit the ESA Climate Change Initiative and in particular its Land Cover project as the source of the CCI-LC database.

6.3.2.6. FP_AGB_L2B

Data Description table	
Name	L2b Above Ground Biomass product
ID	FP_AGB_L2B
Sub-ID	N.A.
Type	Product
Content description	This is the Above Ground Biomass folder-based product, representing Above Ground Biomass and accuracy. It includes also ancillary information related to the computation of Above Ground Biomass.
Format brief	The format is a folder-based one, including GeoTIFF and NetCDF files for binary data and XML files for annotation data. The <i>proposed</i> product format is a binary GeoTIFF + XML metadata.
Format specification ref.	[RD5]
Number of channels	Above Ground Biomass and accuracy.
Average size	6MB (considering compression and annotations).
Timeliness	Computation requires all L2a products relative to the desired L2b product to be available on the selected group of tiles including neighbourhood and in the selected time interval. It requires also L2B FD or alternatively L2A annotated forest/non-forest mask and LCM. CAL_AB is also required for calibration when starting,

Data Description table	
	AGBL2B (neighbour tiles) can be used for propagation. FH_L2B is an optional dependence.
Source	BPS L2b AGB processor
Refresh rate	N.A.
Remarks	None

7. L3 Processor IODD

7.1. I/O Data summary

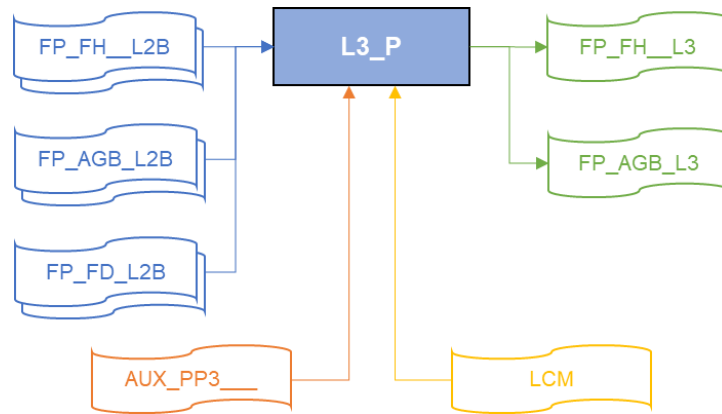


Fig.13 L3 Processor interfaces.

Product Type	Description	Type	I/O	Mandatory	Cardinality
FP_FH_L2B	L2b Forest Height product	Product	I	Y	TE
FP_AGB_L2B	L2b Above Ground Biomass product	Product	I	Y	TE
FP_FD_L2B	L2b Forest Disturbance product	Product	I	Y	TE
AUX_PP3___	Auxiliary L3 Processing Parameters	Auxiliary file	I	Y	1
LCM	Land Cover Map	Internal resource (database)	I	Y	1
FP_FH_L3T	L3 Forest Height product	Product	O	Y	1
FP_AGB_L3T	L3 Above Ground Biomass product	Product	O	Y	1

Tab.8 Level-3 processor input/output data summary

7.2. Detailed I/O data description

7.2.1. FP_FH__L2B

See the data description table in Sec. 6.2.2.4.

7.2.2. FP_AGB_L2B

See the data description table in Sec. 6.3.2.6.

7.2.3. FP_FD__L2B

See the data description table in 6.1.2.3.

7.2.4. FP_FH__L3T

Data Description table	
Name	L3 Forest Height product
ID	FP_FH__L3T
Sub-ID	N.A.
Type	Product
Content description	This is the forest height folder-based product, representing forest height and accuracy. It includes also ancillary information related to the computation of height.
Format brief	The <i>proposed</i> product format is a binary GeoTIFF + XML metadata.
Format specification ref.	[RD4]
Number of channels	Forest height and accuracy.
Average size	6MB (considering compression and annotations).
Timeliness	Computation requires all L2b products relative to the desired L3 product to be available for the selected tile.
Source	BPS L3 processor
Refresh rate	N.A.
Remarks	None

7.2.5. FP_AGB_L3T

Data Description table	
Name	L3 Above Ground Biomass product
ID	FP_AGB_L3T
Sub-ID	N.A.

Data Description table	
Type	Product
Content description	This is the Above Ground Biomass folder-based product, representing Above Ground Biomass and accuracy. It includes also ancillary information related to the computation of Above Ground Biomass.
Format brief	The <i>proposed</i> product format is a binary GeoTIFF + XML metadata.
Format specification ref.	[RD34]
Number of channels	Above Ground Biomass and accuracy.
Average size	6MB (considering compression and annotations).
Timeliness	Computation requires all L2b products relative to the desired L3 product to be available for the selected tile.
Source	BPS L3 processor
Refresh rate	N.A.
Remarks	None

7.2.6. AUX_PP3___

Data Description table	
Name	Auxiliary L3 Processing Parameters
ID	AUX_PP3___
Sub-ID	N.A.
Type	Auxiliary file
Content description	This is the configuration file of the L3 processor containing all the processing parameters for each functional block.
Format brief	XML file
Format specification ref.	[RD6]
Number of channels	N.A.
Average size	< 1 MB
Timeliness	Immediately available
Source	BIOMASS PDGS
Refresh rate	On demand (e.g., on specific events during satellite lifetime, like recalibration activities)
Remarks	None

7.2.7. LCM

See the data description table in 6.3.2.5.

8. L1 Framing Processor IODD

8.1. I/O Data summary

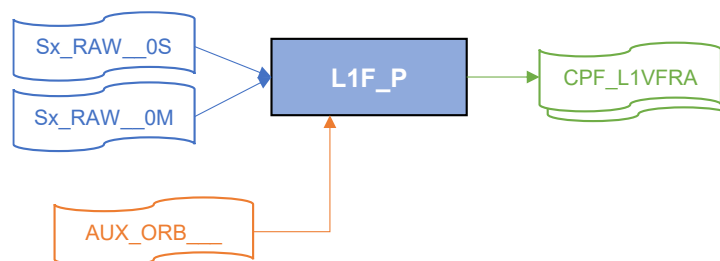


Fig.14 L1 Framing Processor interfaces.

Product Type	Description	Type	I/O	Mandatory	Cardinality
Sx_RAW__0S	Stripmap Level-0 – Standard product	Product	I	Y	1
Sx_RAW__0M	Stripmap Level-0 – Monitoring product	Product	I	Y	1
AUX_ORB__	Auxiliary Orbit	Auxiliary file	I	Y	1
CPF_L1VFRA	L1 Virtual Frame product	Product	O	Y	F

Tab.9 Level-1 Framing Processor input/output data summary

8.2. Detailed I/O data description

8.2.1. Sx_RAW__0S

See the data description table in Sec. 3.2.1.

8.2.2. Sx_RAW__0M

See the data description table in Sec. 3.2.2.

8.2.3. AUX_ORB__

See the data description table in Sec. 3.2.4.

8.2.4. CPF_L1VFRA

Data Description table	
Name	L1 Virtual Frame product
ID	CPF_L1VFRA
Sub-ID	N.A.
Type	Product
Content description	This product contains the information describing a L1 frame, in particular its identifier, its status and its start and stop times. These parameters are used by PF to trigger the L1 processor to generate that specific L1 frame, passing them via Job Order.
Format brief	XML file
Format specification ref.	[RD25]
Number of channels	N.A.

Data Description table	
Average size	Few KB
Timeliness	L1 Virtual Frame products generation is driven by the availability of new L0 product in the PDGS. L1 data are framed according to the policies defined in the BPS production model.
Source	BPS L1 Framing processor
Refresh rate	N.A.
Remarks	None