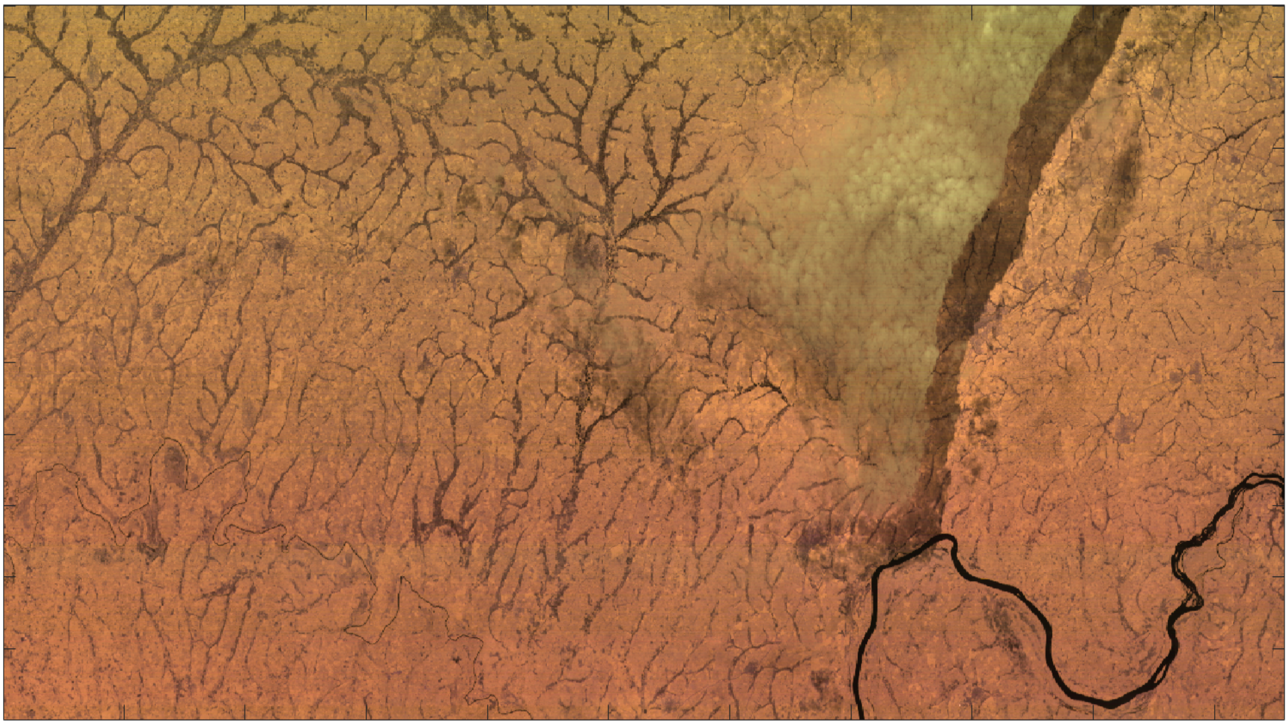


PRISMA Products Specification Document
Issue 2.3 Date 12/03/2020

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. SCOPE AND APPLICABILITY

1.1 SCOPE

This Product Specification Document contains the description of the PRISMA products based on industrial documentation PRS-SP-RTI-001 Issue 9 (revPK, rev LDO) 12/03/2020.

1.2 PURPOSE

This document is a “guide” to understand the content of the PRISMA products and to use them in all application fields.

2. APPLICABLE AND REFERENCE DOCUMENTS

2.1 APPLICABLE DOCUMENTS

[AD1] Not Used

2.2 REFERENCE DOCUMENTS

[RD-1] Payload Functional and Technical specification, PRS-SP-GAF-003
[RD-2] Sat-Ground X-band data ICD, PRS-IC-RTI-002
[RD-3] PRS-SP-GAF-028 PRODUCT SPECIFICATION OF LEVEL 0
[RD-4] PRS-SP-GAF-029 PRODUCT SPECIFICATION OF LEVEL 1
[RD-5] PRS-SP-GAF-027 L1 Processing and KDP Updating Algorithms
[RD-6] PRS-SB-GAF-005 L0 PROCESSOR ARCHITECTURAL DESIGN DOCUMENT
[RD-7] PRS-SB-GAF-002 L0 PROCESSOR ARCHITECTURAL DESIGN DOCUMENT
[RD-8] PRS-SP-CGS-043 Algorithms Specification of Level 2b-2c Products
[RD-9] pkt233-61 PRISMA Geocoding L2 Processor Algorithm Specification
[RD-10] pkt233-73 PRISMA Geocoding L2 Processor - Geocoded Product Specification
[RD-11] HDF EOS Interface Based on HDF5, Volume 1 and 2: Overview and Examples, August 2010 (175-EED-001/2)
[RD-12] PRS-TN-CGS-038 L0 QuickLook Algorithms Specification
[RD-13] The Compendium of Controlled Extensions (CE) for the National Imagery Transmission Format. Ver.2.1 NITF, 2000
[RD-14] Data Encryption Standard (DES) October 1999, FIPS PUB 46-3
[RD-15] PRISMA Gyro Unit User Manual, PRS-MA-CGS-006

3. ACRONYMS AND DEFINITIONS

3.1 ACRONYMS

Acronym	Meaning
ACD	Ancillary Data (=satellite attitude data)
AD	Applicable Document
AIT	Assembly Integration & Test
AIV	Assembly Integration and Verification
AOCS	Attitude and Orbit Control System
AR	Acceptance Review
ARD	Application Requirements Document
ASI	Agenzia Spaziale Italiana
ASIC	Application-Specific Integrated Circuit
ATG	Allegato Tecnico Gestionale
AUX	Auxiliary Data
BB	BreadBoard
BER	Bit Error Rate
Bps	Bit Per Second
BPSK	Bipolar Phase Shifting Keying
BU	Business Unit
CADM	Configuration and Data Management
CC	Cloud-Coverage
CC	Configuration Control
CCB	Configuration Control Board
CCDB	Configuration & Characterizaton DataBase
CCN	Contract Change Notice
CDF	Ciphered Data File
CDP	Characterization Data Parameters
CDR	Critical Design Review
CF	Calibration Facility
CFI	Customer Furnished Item
CGA	Capitolato generale per i contratti industriali e di servizi stipulati dall'Agenzia Spaziale Italiana
CI	Configuration Item
CIDL	Configuration Item Data List
CIDL/ABCL	Configuration Item Data List/As – Built Configuration List
CIL	Critical Item List
CN	Change Notice
CNM	Centro Nazionale Multimissione
CO	Contract Office
CO	Coregistered
CoC	Certificate of Conformance
COTS	Commercial Off-The-Shelf
CR	Change Request
CSA	Canadian Space Agency
CT	Capitolato Tecnico
DA	Documento Applicabile
DCL	Declared Components List
DCN	Document Change Notice
DDF	De-Ciphered Data File
DDF	Design Definition File
DDP	Design and Development Plan
DEL	DELiverable (documento da consegnare)
DE-OQPSK	Differential Encoded – Offset Quadrature Phase Shifting Keying
DES	Data Encryption Standard
DIN	Deutsches Institut für Normung
DIS	Direct Ingestion System
DM	Data Management

DML	Declared Materials List
DMPL	Declared Mechanical Parts List
DN	Digital Number
DPA	Destructive Physical Analysis
DPL	Declared Process List
DR	Design Review
DRB	Delivery Review Board
DRD	Document Requirement Definition
DS	Data Set
DSHA	Data Storage and Handling Assembly
DVT	Design, Verification & Testing
EAR	Export Administration Regulation
ECO	Engineering Change Order
ECOS	ESA Costing Software
ECP	Engineering Change Proposal
ECSS	European Cooperation for Space Standardisation
EEE	Electrical, Electronic and Electromechanical
EGSE	Electrical Ground Support Equipment
EIDP	End Item Data Package
EIRP	Equivalent Isotropic Radiated Power
EM	Engineering Model
EMC	Electro Magnetic Compatibility
EO	Earth Observation (=30x30km)
EOL	End Of Life
EOS	Earth Observation Special(=up to 1800x30km)
EPPL	European Preferred Parts List
ESA	European Space Agency
ESD	Electrostatic Discharge
FD	Flight Dynamics Centre
FDS	Flight Dynamics System
FGSE	Fluidic Ground Support Equipment
FKDP	In-Flight Data Parameters
FM	Flight Model
FMECA	Failure Mode Effects & Criticality Analysis
FOV	Field Of View
FPA	Focal Plane Assembly
FPGA	Field Programmable Gate Array
FPL	Free Path Loss
FQR	Flight Qualification Review
FRR	Flight Readiness Review
FS	Functional Specification
FTP	File Transfer Protocol
G/S	Ground Station
GA	Selex-Galileo
GCP	Ground Control Point
GKDP	Ground Key Data Parameters
GPS	Global Positioning System
GS	Ground Segment
GSE	Ground Support Equipment
HDS	Header Data Set
HEA	HYC Electronics Assembly
HK	HouseKeeping
HSA	Hyperspectral Sensor Assembly
HW	Hardware
HYC	HYperspectral Camera
HYP	HYPerspectral
HYP	Hyperspectral Channel
ICD	Interface Control Document
ICU	In flight calibration unit
IDHS	Image Data Handling Segment
ILS	Integrated Logistic Support

INS	Inertial Navigation System
IOV	In Orbit Validation
IP	Key Inspection Point
IRD	Interface Requirement Document
ISO	International Standardization Organization
ITAR	International Traffic in Arms Regulations
JHM	Joint Hyperspectral Mission
KDP	Key Data Parameters
KO	Kick Off
KOM	Kick-Off Meeting
L0a	Level 0 products
LAT	Lot Acceptance Test
LCC	Life Cycle Cost
LEO	Low Earth Orbit
LEOP	Launch and Early Orbit Phase
LLI	Long Lead Item
LORA	Level of repair analysis
LOS	Line Of Sight
LRR	Launch Readiness Review
LSA	Logistic Support Analysis
LSP	Launcher Service Provision
LTDN	Local Time Descending Node
MAIT	Manufacturing, Assembly, Integration & Test
MAIV	Manufacturing, Assembly, Integration, Validation
MCC	Mission Control Centre
MCS	Mission Control System
MD	Metadata Catalogue
MDS	Measurements Data Set
MGSE	Mechanical Ground Support Equipment
MIP	Mandatory Inspection Point
MLI	Multi-Layer Insulation
MOSFET	Metal Oxide Semiconductor Field Effect Transistor
MPM	Materials, Processes and Mechanical parts
MPS	Mission Planning System
MPTS	Multi-Purpose Tracking System
MRB	Material Review Board
MRD	Mission Requirement Document
MRR	Manufacturing Readiness Review
MS	Mission Statement
MTD	Catalogue Metadata File
NA	Not Applicable
NC	Non Conformance
NCO	Non Conformità o Osservazione (nonconformance or observation)
NCR	Non Conformance Report
NPSL	NASA Parts Selection List
NRB	Non Conformance Review Board
OBC	On-Board Computer
OBDH	On-Board Data Handling
OBS	Organisation Breakdown Structure
OBT	On-Board Time
OCS	Orbit Control Sub-system
OGSE	Optical Ground Support Equipment
OP	Operation
ORR	Operational Readiness Review
OVR	Operation Validation Review
OVRR	Operation Validation Readiness Review
P/F	Platform
P/L	Payload
PA	Product Assurance
PAD	Part Approval Document
PAN	PANchromatic

PAN	Panchromatic Channel
PC	Project Control
PCB	Printed Circuit Board
PCDU	Power Control and Distribution Unit
PCONF	Processing Configuration Parameters File
PD	Project Directive
PDHT	Payload Data Handling and Transmission
PDR	Preliminary Design Review
PEB	Power Electronic Box
PERT	Program Evaluation and Review Technique
PFD	Power Flux Density
PFM	Proto-Flight Model
PGSE	Propulsion Ground Support Equipment
PHST	Packaging, Handling, Storage, Transport
PM	Project/Program Manager
PM/PSK	Pulse Modulation / Phase Shifting Keying
PMI	Piccola e Media Impresa
PMP	Program Management Plan
PN	Part Number
PO	Project Office
PSLV	Polar Satellite Launch Vehicle
PT	Product Tree
PVA	PhotoVoltaic Array
PVS	Procedure Variation Sheet
PY	Preliminary
QA	Quality Assurance
QC	Quality Control
QCI	Quality Conformance Inspection
QL	QuickLook
QR	Qualification Review
RAM	Reliability, Availability, Maintenance
RAMS	Reliability Availability Maintainability Safety
RC	Radiometrycally Calibrated
RD	Reference Document
RdO	Richiesta d’Offerta
RF	Radio Frequency
RFA	Request For Approval
RFD	Request For Deviation
RFDU	Radio Frequency Distribution Unit
RFW	Request For Waiver
RHCP	Right Handed Circular Polarization
RID	Review Item Discrepancy
RMP	Risk Management Plan
RPT	Screening Report
RR	Requirement Review
RTC	Real Time Clock
RTI	Raggruppamento Temporaneo d’Impresa
RVT	Radiation Verification Testing
RX	Receiver
S/C	SpaceCraft
S/L	Satellite
S/S	SubSystem
SA	Solar Array
SCC	Satellite Control Centre
SCS	Satellite Control System
SE	System Engineering
SEMP	System Engineering Management Plan
SM	Structural Model
SOC	Statement Of Compliance
SOI	Scene of Interest
SOVT	System Operation Validation Test

SOW	Statement Of Work
SP	Source Packet
SPF	Single Point Failure
SPR	Software Problem Report
SRF	Spectral Response Function
SRR	System Requirements Review
SSO	Sun Synchronous Orbit
SSPA	Solid State Power Amplify
STK	Satellite ToolKit
STR	Star TRacker
STT	STT-SystemTechnik
SVT	System Validation Test
SW	Software
SWIR	Short Wavelength Infra-Red
SZA	Solar Zenith Angle
TAS-I	Thales-Alenia Space Italia
TBC	To Be Confirmed
TBD	To Be Defined
TBV	To Be Verified
TC	TeleCommand
TM	TeleMetry
TMA	Three Mirror Anastigmatic
TNA	Training Needs Analysis
TPM	Technical Performance Measurement
TRR	Test Readiness Review
TRRB	Test Readiness Review Board
TSD	Technosystem Developments
TWTA	Traveling Wave Tube Amplifiers
TX	Transmitter
TXA	X-Band Transmission Assembly
UPD	User Programmable Devices
UTC	Coordinated Universal Time
VCD	Verification Control Document
VNIR	Visible and Near Infra-Red
WBS	Work Breakdown Structure
WCA	Worst Case Analysis
WP	Work Package
WPD	Work Package Description
WV	Waiver
XBAA	X-Band Antenna Assembly

3.2 DEFINITIONS

SAMPLE = up to 1000 pixel in the direction of FOV (ACROSS TRACK).

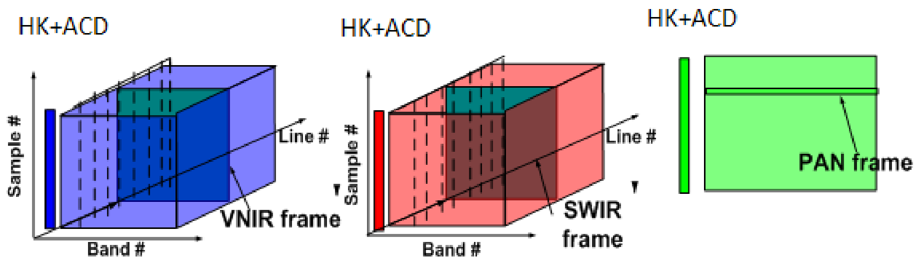
FRAME = MADE BY UP TO 1000SAMPLES AND 66 BANDS VNIR
1000SAMPLES AND 173 BANDS SWIR
6000SAMPLES

CALIBRATION-FRAME = MADE BY UP TO 1000SAMPLES AND 76 BANDS VNIR
1000SAMPLES AND 181 BANDS SWIR
6000SAMPLES

PIXEL= a single detector element. It is individuated by 1 SAMPLE e 1 BAND.

LINE= it represent the time evolution in the CUBE of acquired data (ALONG TRACK DIRECTION)

CUBE = A set of FRAME acquired at different lines, as in the figure:



CATALOGUE METADATA = Data necessary to indicize files inside the CNM Archive. Each file stored into CNM has its relevant CATALOGUE METADATA.

ANCILLARY DATA = List of satellite attitude data produced with frequency of 8Hz e 1Hz by GPS and star-tracker. They are reported internally to the L1-HDF5 or L2-HDF5 files.

PRODUCT ATTRIBUTE = Attribute associated to each L1 or L2 product: they are reported internally to L1-HDF5 or L2-HDF5 file. They can be Global Attribute, that is referred to the entire CUBE, or Frame Attribute that is the Housekeeping and Ancillary Data referred frame per frame.

AUXILIARY DATA (FILE) = Files saved in CNM and used as auxiliary for the processing. For example ExtraAtmospheric Sun Irradiance spectrum, DEM Maps and so on. Each Auxiliary Data has its associated CATALOGUE METADATA.

GKDP = Ground Key Data Parameters (NETCDF4 file) = Parameters that characterize the entire instrument. They are measured only during Ground Calibration Campaign. All GKDP can be useful in order to transform DN to Radiance.

FKDP = Flight Key Data Parameters (NETCDF4 file) = Parameters that characterize the entire instrument. They are measured the first time during Ground Calibration Campaign and successively they are measurable during flight. Not all the FKDP can be useful in the transformation from DN to Radiance (see for example Defocusin), but they have been classiefied in this section since they are paramters that characterize the instrument and are updatable during flight.

ICU_CDP= In-flight Calibration Unit Characterization Data Parameters (NETCDF4 file) = Parameters that characterize onlyt the on board ICU. They are needed in input to processors L0 and L1 in order produce the output product. For example Lamp Spectral Features, NIST file spectral features, lamp nominal current.

CDP = Characterization Data Parameters (NETCDF4 file) = Parameters measured during Ground Calibration that characterize the

ConfigFile = XML file passed in input to L0 and L1 processor. It reports those parameters triggerable by an expert user and necessary to perform the processing (for example number of bands to be used, thresholds for KDP and so on).

EO = Earth Observation Typical Acquisition = 30km x 30km.

EOS = Earth Observation Acquisition, commanded for special reasons (for example Vicarious Validation). It can be wide at maximum 1800km along track x 30km across.

SOI = Scene of Interesets. List of L0a files that shall be passed in input to the L1 PROCESSOR in order to produce the opportune L1 EO Product or the opportune FKDP updating.

JOB-ORDER= order produced by CNM to be passed in input to the processor in order to generate an opportune product.

THIN-LAYER = Each processor mounts a low-level layer named “Thin-Layer” that manages interfaces with CNM-ARCHIVE.

T_exp = detector exposition time.

MD Quality Info = Metadata Quality Flag. Flags that notifies if problems has occurred during processing. They are saved into CATALOGUE METADATA. A copy of Quality Info is saved also inside L1 HDF5 product file.

4. INSTRUMENT OVERVIEW

The PRISMA Satellite is a single satellite placed in suitable LEO SSO orbit characterized by a repeat cycle of approximately 29 days. It is in the small size class, with an operational lifetime of 5 years.
The Satellite is mainly composed by the Platform, the electro-optical Payload and the Payload Data Handling and Transmission subsystem (PDHT).
The PRISMA Payload is composed by an Imaging Spectrometer (or Hyperspectral Imager), able to take images in a continuum of spectral bands ranging from 400 to 2500 nm, and a medium resolution Panchromatic Camera.
The PRISMA Payload is in charge of the image data acquisition. All the data generated by the Payload are transmitted by a dedicated link to the PDHT. This unit will provides the memory for the temporary storage of the images and ancillary data, thanks to its internal memory. Besides the storage functionality the PDHT will be in charge of the data transmission, thanks to its X-band transmitter, to the dedicated ground station.
The Payload does not include any pointing device, therefore any off-nadir (across-track or along track) acquisition has to be performed through platform rotation. Nadir is when the satellite is looking straight down. High off-nadir angles can mean lower quality in terms of geolocation accuracy and resolution, while tall objects can conceal targets.
There is not any design limitation for the instrument to acquire off-nadir images for Satellite roll maneuvers.

The PRISMA Hyperspectral sensor utilizes prisms to obtain the dispersion of incoming radiation on a 2-D matrix detector so to acquire several spectral bands of the same strip on ground. The “instantaneous” spectral and spatial dimensions (across track) of the spectral cube are given directly by the 2-D detector, while the “temporal” dimension (along track) is given by the satellite motion. This image scanning concept is defined as “Pushbroom”.

The function of the PRISMA Payload is to acquire images of the Earth simultaneously in contiguous spectral bands, spanning the wavelength range 400 to 2500 nm using a push broom mode of operation. The image data is to be collected, formatted to CCSDS standards and sent Satellite on-board mass memory and downlink units.

The key Payload technical features can be summarized as follows:

Orbit Altitude Reference	615 km
Swath / FOV	30 km / 2.77°
GSD	Hyperspectral: 30 m PAN: 5 m
Spatial Pixels	Hyperspectral: 1000 PAN: 6000
Pixel Size	Hyperspectral: 30x30 μm PAN: 6.5x6.5 μm
Spectral Range	VNIR: 400 – 1010 nm (66 bands) SWIR: 920 – 2500 nm (173 bands) PAN: 400 – 700 nm
Spectral Sampling Interval (SSI)	≤ 12 nm
Spectral Width	≤ 12 nm
Cross-Track Variation of Centre Wavelength (Smile)	< +/- 0.1 SSI
Spatial registration of spectral sampling (incl. Keystone)	≤ 0.1 pixel
Spectral Calibration Accuracy	+/-0.1 nm
Radiometric Quantization	12 bit
VNIR SNR	>200:1
SWIR SNR	>100:1
PAN SNR	> 240:1
Absolute Radiometric Accuracy	Better than 5%

Aperture Diameter	210 mm
MTF@ Nyquist Frequency	VNIR/SWIR along track >0.18 VNIR/SWIR across track > 0.34 PAN along track >0.1 PAN across track >0.2
Cooling System	Passive Radiator
Lifetime	5 years

4.1 ACQUISITION METHOD

The PRISMA Hyperspectral sensor utilizes prisms to obtain the dispersion of incoming radiation on a 2-D matrix detector so to acquire several spectral bands of the same strip on ground. The “instantaneous” spectral and spatial (across track) dimensions of the spectral cube are given directly by the 2-D detector, while the “temporal” dimension (along track) is given by the satellite motion. This image scanning concept is defined as “Pushbroom”. The concept is shown in Figure 4-1.

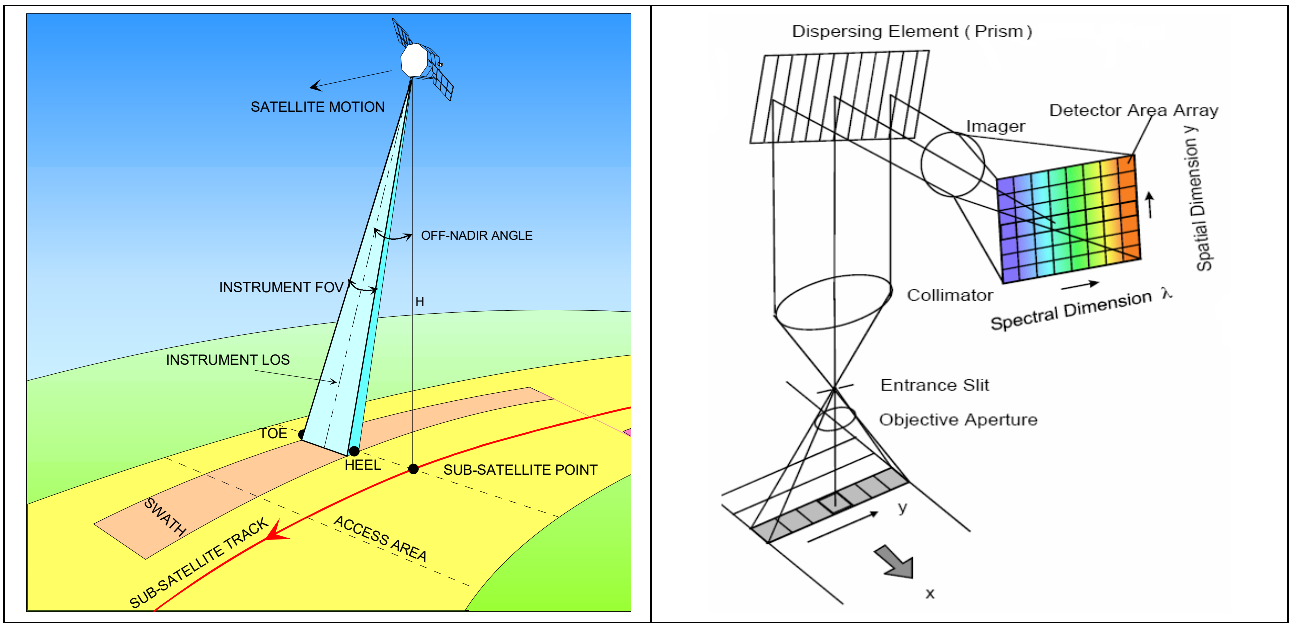


Figure 4-1: Pushbroom operating concept

Pushbroom imaging spectrometers offer the signal-to-noise ratio performance that is required for orbiting platforms, with respect to whiskbroom scanning. This means that the recovered spectrum of any ground feature from a pushbroom sensor potentially can contain substantial artefacts that compromise identification of the feature’s composition. In fact, while whiskbroom sensors can achieve the highest spectral and spatial uniformity, they are more appropriate for airborne rather than orbiting platforms, as they cannot easily provide adequate signal-to-noise ratio performance from orbit owing to the limited integration time.
In a pushbroom sensor, the slit is dispersed and imaged onto the 2D detector array, so that each row is effectively an independent spectrometer. Thus, if a pushbroom sensor is to produce data of the same quality as a whiskbroom sensor, the SRF of every pixel must be calibrated to the same accuracy (concerning the error in the centre location of the response and the error in the half-width of the response[1]).
Moreover, there are additional problems with pushbroom systems that relate to the spatial direction. These have mostly to do with spatial uniformity and cross contamination of the spectra between adjacent spatial pixels.
In order to avoid this problem, the instrument design requirements have been specified in order to greatly reduce the distortion in both the spectral and the spatial directions (i.e. co-registration requirements, smile,

[1] R. O. Green, “Spectral calibration requirement for Earthlooking imaging spectrometers in the solar-reflected spectrum,” Appl. Opt. 37, 683–690 (1998).

keystone)

4.2 PAYLOAD ARCHITECTURE

The general Payload architecture is shown in the following diagram.

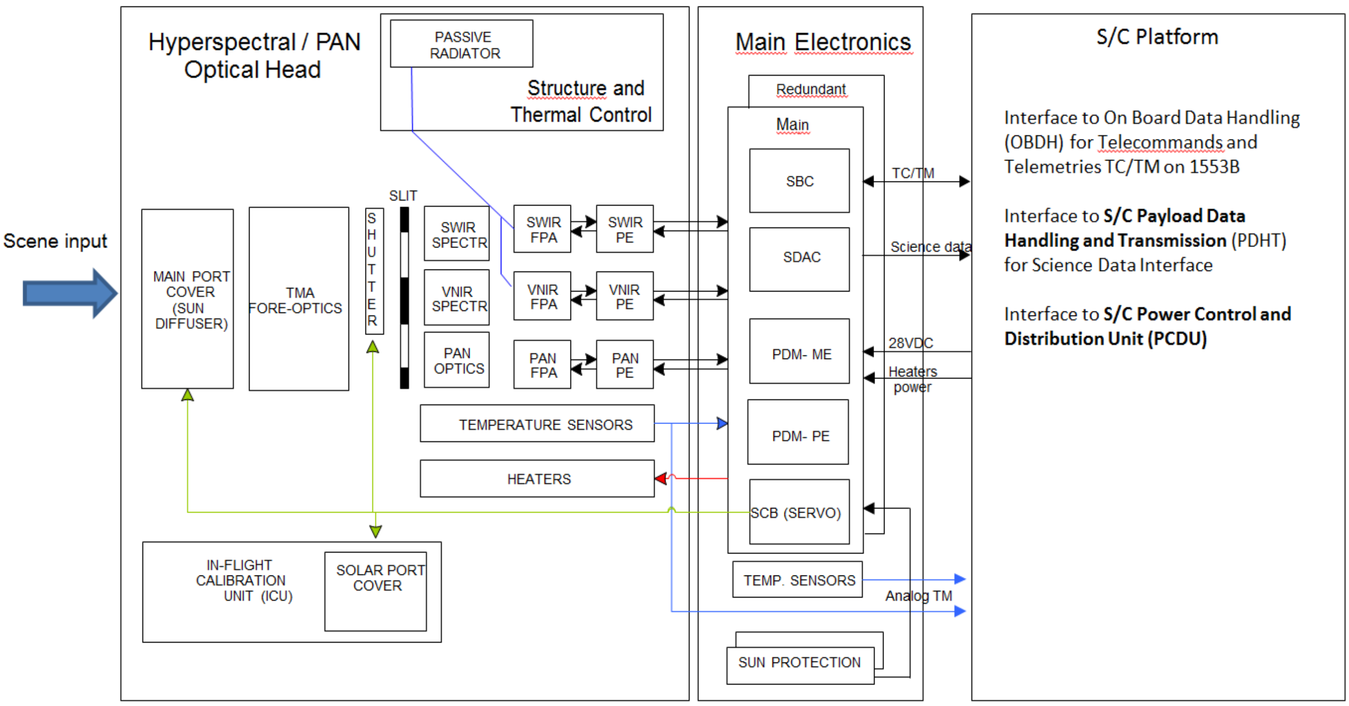


Figure 4-2: Payload functional block diagram

The architecture is composed of the following three separate subsystems:

- Hyperspectral/PAN Optical Head (OH)
- Main Electronics (ME)
- Sun Protection System (SPS)

The Payload Main Electronics is the electronix box that control all instrument and is electrically interfaced with the following platform units:

- On Board Data Handling (OBDH) – communication of Telecommands (TC) and Telemetries (TM)
- Power Control Distribution Unit (PCDU) – power lines
- Payload Data Handling & Transmission (PDHT) – transmission of acquired science data

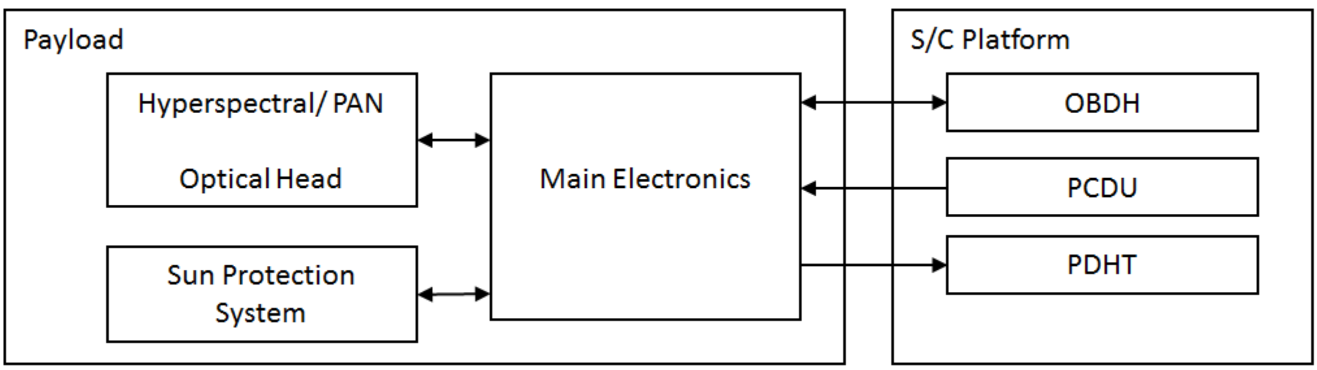


Figure 4-3: Payload main units and interfaces

The Hyperspectral/PAN Optical Head has the functions to collect the radiation by a telescope, to disperse the radiation by two spectrometers, to convert photons to electrons by means of appropriate detectors, to amplify the electrical signal and to convert it into bits. It has mechanical and thermal interfaces with the S/C.

The Main Electronics (ME), based on a redundant sub-assembly architecture, is devoted to the control of the instrument and to handle, according to the agreed protocols, the bit stream representing the spectral images up to the interface with the S/C transmitter.

Payload Sun Protection System (SPS) is an autonomous system, directly connected to the PL ME and independent from the S/C, that is meant to activate a recovery reaction in case of failure of AOCS so to prevent direct sun flux entering inside PL main optical channel.

4.3 PAYLOAD SCIENTIFIC DATA MANAGEMENT

Every 4.31 msec a VNIR, SWIR and PAN FRAME are acquired by Payload sensors and transmitted to PDHT.

VNIR/SWIR FRAME

- Along Track Spatial resolution: 30 m
- Spatial axis cover up to 1000 useful pixels corresponds to projection of 30 Km swath (Across Track)
- Spectral axis cover up to 256 spectral bands, corresponding to the maximum spectral dispersion achieved by the prism.

Note: the actual number of meaningful bands is 66 for VNIR and 173 for SWIR

PAN FRAME

- PAN-Subframe
- Along Track Spatial resolution: 5 m
- Spatial axis cover 6000 useful pixels, corresponding to the projection of 30 Km swath (Across Track)
- To cover an along track spatial resolution of 30m, the PAN FRAME shall be composed by 6 sub-frames.

4.4 SCIENCE PACKETS FORMAT

Each Science Data Frame is sent to Ground Segment through several data packets in a CCSDS format. There are four different types of Source Packets:
-Header Packets
-Data Packets:
-VNIR source packets,
-SWIR source packets,
-PAN source packets,

Packets are then encoded with a Reed Solomon (255,239) algorithm with Interleaving factor 8.

Each source packet (encapsulated according to the CCSDS format) is composed of up to 3824 bytes (4088 after Reed Solomon encoding).

When the data to encode is not a multiple of 3824 bytes, virtual fills are added to make up the difference between the shortened block and the maximum codeblock length. Virtual filling are needed to undergo Reed Solomon encoding but is not actually transmitted.

16 to 3824 bytes total length (multiple of 4 bytes)									
PACKET PRIMARY HEADER							PACKET DATA FIELD		
Version Number	Packet Identification			Packet Sequence Control		Packet Data Length	Packet Control	Source Data	Checksum
	Type indicator	Secondary Header Flag	Application Process ID	Grouping Flag	Source Sequence Number				
3 bit	1 bit	1 bit	11 bit	2 bit	14 bit	16 bit	8 bytes	0 to 3808 bytes	2 bytes
6 bytes							10 to 3818 bytes		

Figure 4-4: Source Packet format

Every packet is composed by two codeblocks of 2040 bytes each, preceded by a Code Block Marker (CBM).

Encoded CCSDS Complete Packet with CBM - 4088 bytes							
	Codeblock #1 2040 bytes				Codeblock #2 2040 bytes		
CBM	CCSDS Header	CCSSDS data (1 of 2)	RS chech data	CBM	CCSSDS data (2 of 2)	CCSDS CRC	RS chech data
4 bytes	14 bytes	1898 bytes	128 bytes	4 bytes	1910 bytes	2 bytes	128 bytes

Figure 4-5: P/L RS Encoded Source Packet Structure

The CBM is also replicated after the last Code Block of the acquisition,

START	CBM	Codeblock1	CBM	Codeblock2	STOP	START	CBM	Codeblock1	CBM	Codeblock2	CBM	STOP	...

The Header Packets carries information about Ancillary data, Housekeeping data, and other data rising the specific frame.

The VNIR, SWIR, PAN packets carry the pixel data, each pixel being represented by 12 bits.

5. GROUND SEGMENT PROCESSING CHAIN- OVERVIEW

This section describes the processing chain inside to the CNM IDHS system.
The data processing function is devoted to generate Level 0, Level 1 and Level 2 products.
After the downstream data received from the Antenna are saved into the Ciphered Data File (CDF) into the CNM Archive. When the Archive receives the CDF, it provides automatically activating the DECRIPITON PROCESSOR, by passing it the CDF file and the relevant Decryption Key Files.

The Decryption Processor will decrypt the incoming CDF, if encrypted, and will remove the protocol layers introduced by the PDHT, in order to produce, as exit, the Deciphered Data File (DDF), a Decryption Report and a Metadata file. The DDF contains the stream of all the correctly deciphered Payload Source Packets (HEADER, VNIR, SWIR and PAN packets), related to a single acquisition and encoded with the Reed Solomon 239/255 Interleaving 8 algorithm.

The DDF file is sent back to the CNM Archive. The Archive shall activate automatically the processing L0 when a new DDF file reaches the Archive.
The L0-PROCESSOR receives in input the DDF data file, coming from IDHS archive, the Acquisition Plan and the Auxiliary Data files.
As a first step the L0 processor shall remove the Reed Solomon encoding; then it is in charge of generating several L0files from the incoming Payload Raw Packets, according to the rules described in current document.
For each new generated L0a files, the processor shall produce also the relevant CATALOGUE-METADATA
The processor shall also produce the Screening Report file, where the correct execution of the L0 processing is described, and where a feedback to the Acquisition Plan is provided.
When each L0afiles Earth Observation type (EO) or Earth Observation Special type (EOS) reaches the archive, the CNM shall provide to activate automatically the QL function, by passing the L0a files to the QL processor. The QL processor will provide to produce as output the L0aQL file with its relevant CATALOGUE METADATA.
So, L0a files, QL files and L0ScreeningReport files will be archived automatically in the CNM Archive after the download processing has been completed.
Each L0a file is made up of a list of Raw Data Packets, that are exactly the Packets produced by the Instrument (they are in fact decrypted and lack the CCSDS header inserted by the PDHT). Each L0a files contain packets related to the same Acquisition Type.

In case of an L0a file containing compressed VNIR and SWIR data, the L0 processor is also in charge for the decompression process and generates a new L0a file with decompressed content.
After the generation of the L0a products, the CNM will automatically remove of the relevant CDF and DDF file from the archive.
In case of L0afiles marked as Special Product for Calibration/Validation, the CNM will automatically activate the L1 processing when the complete list of L0a files necessary for the computation of new KDPs are collected from the Archive.
In case of L0afiles marked as Not Special Product, the processing L1 and L2 will occur only in case of user demand: the CNM User can browse the catalogue and for all L0a files the relevant L1 product can be requested (if not already present in the catalogue). In case the L2 product is requested and the L1 is not present, the CNM also automatically activate the L1 processing.
L1 product will be generated by the L1 processor, together with its relevant CATALOGUE-METADATA.
Any time the L1 processor run, it can produce as output a new FKDP file (with its relevant CATALOGUE METADATA). The new generated FKDP file shall be archived and marked with a validation flag as “to be validated”. The file shall be also forwarded to the Calibration Facility, where the Calibration Working Group shall be able to validate the file and to return it back to the CNM Archive with the validation flag as “validated”.
<u>NOTE: L1 processor receives as input only validate d FKDP.</u>
GKDP FKDP and CDP files (and CATALOGUE METADATA) can be also inserted into the CNM Archive directly from the CALIBRATION FACILITY.
L1-PROCESSOR receives in input the list of L0a data files associated to the current SOI, one FKDP file, one GKDP file, one CDP file, and a set of Auxiliary File, coming from IDHS archive, and will produce the L1 product with its PRODUCT ATTRIBUTE reported inside the HDF5 file; L1 shall also produce a new set of FKDP updated file, to be sent to the IDHS Archive. Both L1-HDF5 file and FKDP file produced by L1 processer shall be accompanied by its relevant CATALOGUE-METADATA.
L2 product will be generated by the L2 processor, together with its relevant CATALOGUE-METADATA.
After the delivery of the L1 and L2 products, the CNM will provide with an opportune policy to remove the products from the Archive.
The following figure shows the logic IDHS top level architecture:

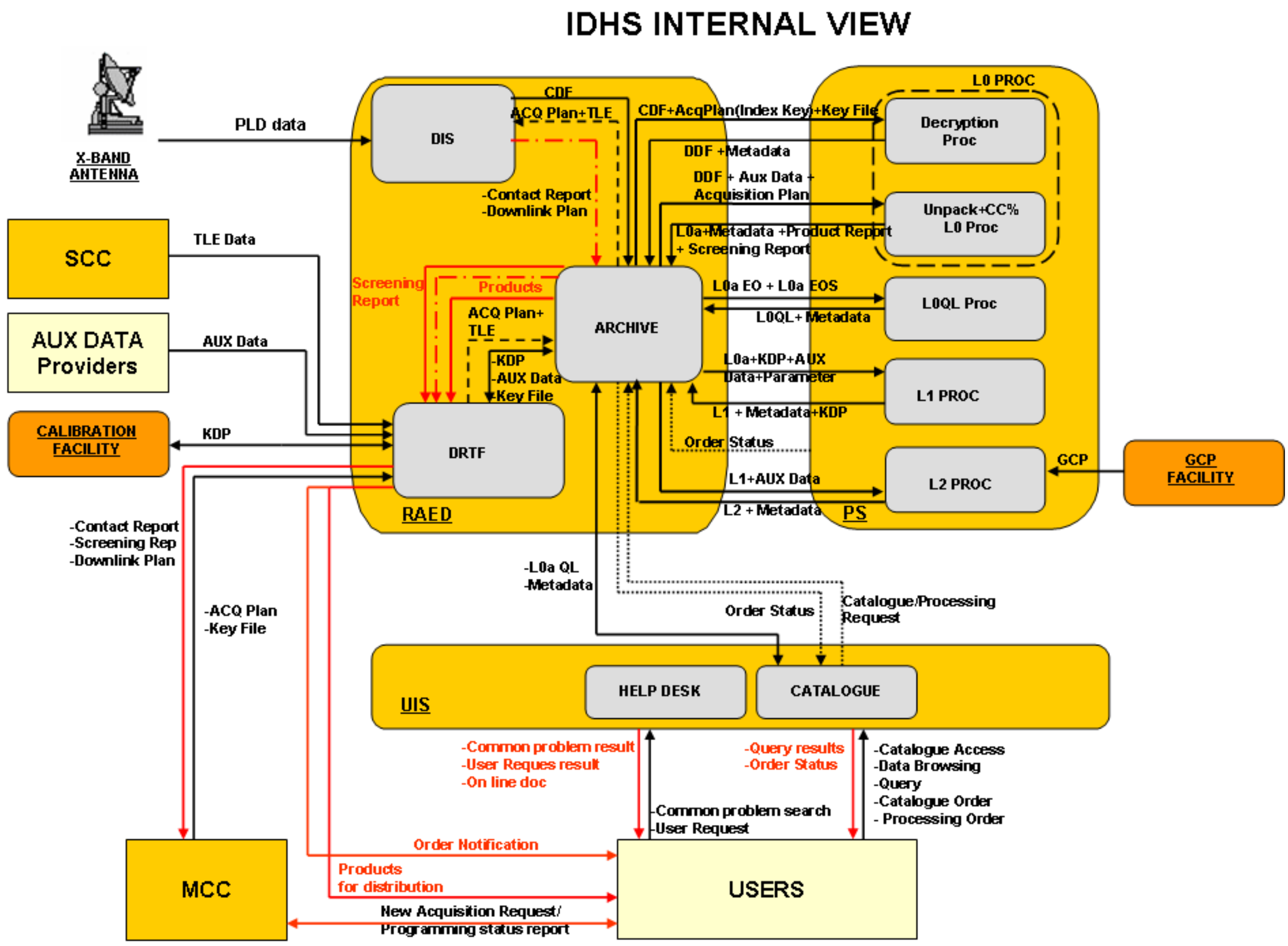


Figure 5-1: PRISMA IDHS functionalities and data flow

The Archive is so able to collect following types of file:

-L0a files*

-QL files*

-L0ScreeningReport

-L1 files

-L2 files

-DDF files

-CDF files

-KDP files*

-Aux Data files*

Files identified with a star * are never removed from the Archive.

Each file in the archive shall be accompanied by its relevant catalogue metadata.

Aux Data Files, will be inserted into the Archive together with their relevant Catalogue Metadata at the beginning. Successively, updated Aux Data Files will be inserted into the Archive by means of the Calibration Facility System.

Each processor mounts a low-level layer named “Thin-Layer” that manages interfaces with CNM-ARCHIVE.

Each processor is activated by means of a JOB-ORDER produced by CNM: the JOB-ORDER reports the description of the processing that has been commanded.

5.1 L0A FILE TYPE: OUTPUT FROM L0 PROCESSOR

Following tale reports the list of L0a File Type produced by L0 Processor as consequence of an opportune ACQUISITION/CALIBRATON telecommand=>

ACQUISITON/CALIBRATON TELECOMMAND			L0A FILE TYPE
Acquisition Type	**Acquisition Purpose**	**Flag Prev Dark/ Flag Post Dark**	
SURFACE-OBSERVATION	0 or 1	Flag Prev Dark = 1	Dark_Calibration_file <PRS_L0__DC>
	0->NOT SPECIAL PRODUCT	na	**Earth_Observation_file** <PRS_L0__EO>
	1->SPECIAL PRODUCT FOR VALIDATON		**Earth_Observation_Special_file**<PRS_L0S__EO>
	0 or 1	Flag Post Dark = 1	Dark_Calibration_file <PRS_L0__DC>
DARK CALIBRATION	NOT SPECIAL PRODUCT	na	**Dark_Calibration_file** <PRS_L0__DC>
INTERNAL-CALIBRATION	NOT SPECIAL PRODUCT	na	**Internal_Calibration_file** <PRS_L0__IC>
	SPECIAL PRODUCT FOR CALIBRATION	na	**Internal_Calibration_Special_file** <PRS_L0S__IC>
SUN CALIBRATION	SPECIAL PRODUCT FOR CALIBRATION.	na	**Sun_Calibration_file** <PRS_L0S__SC>
SUN CALIBRATION-FLUX	SPECIAL PRODUCT FOR CALIBRATION.	na	**Sun_Flux_Calibration_file** <PRS_L0S__SX>
MOON CALIBRATION	SPECIAL PRODUCT FOR CALIBRATION.	na	**Moon_Calibration_file** <PRS_L0S__MC>
FLAT-FIELD SPECIAL	SPECIAL PRODUCT FOR CALIBRATION.	na	**Flat_Field_Special_file** <PRS_L0S__FCV> or <PRS_L0S__FCS> or <PRS_L0S__FCP>
AUTOTEST	SPECIAL PRODUCT FOR CALIBRATION	na	**Autotest file** <PRS_L0S_AU>

Table 5-1 Association Acquisition/Calibration Telecommand to L0a file.

5.2 L0 SOI TYPE: INPUT TO L1 PROCESSOR

The Thinlayer of L1 processor shall process the Job Order and creates the work directory that contains all the input files related to the current Scene of Interest (SOI) to be processed.

Input files of the SOI (science files) are composed by L0a files and contain both science raw packets and housekeeping + attitude data packets. Also the input KDP file is part of the input files.

The lisf of file associated to each SOI depends on the particular Acquisition/Calibration that has been commanded: each L0A file in bold in the Table 5-1 is associated to the generation of a SOI.

Following table reports the list of SOI produced by L1 ThinLayer.

SOI-Type	List of Files	Note
SOI A-1	Dark_Calibration_file **Earth_Observation_file** Dark_Calibration_file Kdp input file Aux input file (Sun_Earth_Distance, Extra_Atmospheric_Sun_Irr)	Standard earth observation. Processed by L1 processor for radiance calculation.
SOI A-2	Internal_Calibration_file Dark_Calibration_file **Earth_Observation_Special_file** Dark_Calibration_file Internal_Calibration_file Kdp input file Aux input file (Sun_Earth_Distance, Extra_Atmospheric_Sun_Irr)	Processed by L1 processor for radiance calculation. **CNM has to make this SOI available for possible off-line calibration analysis during on flight operations.** It can be retrievable by CNM Operator.
SOI B-1	Internal_Calibration_file **Internal_Calibration_Special_file** Internal_Calibration_file Kdp input file	Core calibration. Processed by L1 processor for calibration purposes. KDPs are regenerated when relevant. When new KDPs are generated, a warning flag is raised and a decision about their actual application can subsequently be made through the Calibration Facility.
SOI B-2	Internal_Calibration_file **Sun_Calibration_file** Internal_Calibration_file Kdp input file Aux input file (Extra_Atmospheric_Sun_Irr)	Core calibration. Processed by L1 processor for calibration purposes. KDPs are regenerated when relevant. When new KDPs are generated, a warning flag is raised and a decision about their actual application can subsequently be made through the Calibration Facility.
SOI B-3	Internal_Calibration_file **Moon_Calibration_file** Internal_Calibration_file Kdp input file Aux input file (Moon_Irr)	Auxiiary calibration. Processed by L1 processor. KDPs are recalculated when relevant for auxiliary purposes.
SOI B-4	Internal_Calibration_file **Flat_Field_Special_file** Internal_Calibration_file Kdp input file	Auxiiary calibration. Processed by L1 processor. KDPs are recalculated when relevant for auxiliary purposes.
SOI B-5	Internal_Calibration_file **Sun_Flux_Calibration_file** Internal_Calibration_file Kdp input file Aux input file (Extra_Atmospheric_Sun_Irr)	Not processed by the L1 processor. **CNM has to make this SOI available for possible off-line calibration analysis during on flight operations.** It can be retrievable by CNM Operator.

Table 5-2: SOI Type and content.

Each SOI is made by a set of files collected by CNM. Any time the CNM collects the entire list of file necessary to invoke a SOI, it provide to invoke the relevant run of L1 by means of the opportune JobOrder.

In order to collect the list of files, it is necessary that a list of acquisition/caliblraton telecommands shall be sent to Payload. Following table report the sequence of telecommads necessary in order to acquire each SOI.

It is important to remark that during the operating life, there wil be not telecommand sequences finalized to the acquisition of the SOI: each calibration telecommand will be allocated in the time line according to the calibration system scheduler: it is then up to CNM to wait in calling L1 processing until the entire set of L0a files associated to a SOI have been collected.

SOI-Type	TELECOMMAND SEQUENCES	
SOI A-1	PRS_TC-ACQUISITON with: -ACQ_PURPORSE=0 -PREV_DARK =0 or 1 -SUCC_DARK =0 or 1	Any time an Earth Observation is commanded, the SOI-A-1 is called. If the EO last more than 30km, several SOI-A-1 are called, per each 30kmx30km file.
SOI A-2	PRS_TC_CALIBRATION with: -SEQUENCE_ID =1 PRS_TC-ACQUISITON with: -ACQ_PURPORSE=1 -PREV_DARK =0 or 1 -SUCC_DARK =0 or 1 PRS_TC_CALIBRATION with: -SEQUENCE_ID =1	The SOI-A-2 processing needs that an Earth Observation Special is commanded, It is invoked any time INTERNAL_CALIBRATION successive to the Earth Observation Special is acquired. The CNM provides to collect the two INTERNAL_CALIBRATION files that preceded and succeed the Earth Observation Special, and to invoke the SOI processing.
SOI B-1	PRS_TC_CALIBRATION with: -SEQUENCE_ID =1 (=INT_CALIB) PRS_TC_CALIBRATION with: -SEQUENCE_ID =2 (=INTERNAL_CALIB_SPECIAL) PRS_TC_CALIBRATION with: -SEQUENCE_ID =1 (=INT_CALIB)	The SOI-B-1 processing needs that an INTERNAL_CALIBRATION_SPECIAL is commanded, It is invoked any time INTERNAL_CALIBRATION successive to the INTERNAL_CALIBRATION_SPECIAL is acquired. The CNM provides to collect the two INTERNAL_CALIBRATION files that preceded and succeed the INTERNAL_CALIBRATION_SPECIAL, and to invoke the SOI processing.
SOI B-2	PRS_TC_CALIBRATION with: -SEQUENCE_ID =1 (=INT_CALIB) PRS_TC_CALIBRATION with: -SEQUENCE_ID =3 (SUN_CALIBRATION) PRS_TC_CALIBRATION with: -SEQUENCE_ID =1 (=INT_CALIB)	The SOI-B-2 processing needs that an SUN_CALIBRATION is commanded, It is invoked any time INTERNAL_CALIBRATION successive to the SUN_CALIBRATION is acquired. The CNM provides to collect the two INTERNAL_CALIBRATION files that

		preceded and succeed the SUN_CALIBRATION, and to invoke the SOI processing.
SOI B-3	PRS_TC_CALIBRATION with: -SEQUENCE_ID =1 (=INT_CALIB) PRS_TC_CALIBRATION with: -SEQUENCE_ID =4 (MOON_CALIBRATION) PRS_TC_CALIBRATION with: -SEQUENCE_ID =1 (=INT_CALIB)	The SOI-B-3 processing needs that an MOON_CALIBRATION is commanded, It is invoked any time INTERNAL_CALIBRATION successive to the MOON_CALIBRATION is acquired. The CNM provides to collect the two INTERNAL_CALIBRATION files that preceded and succeed the MOON_CALIBRATION, and to invoke the SOI processing.
SOI B-4	PRS_TC_CALIBRATION with: -SEQUENCE_ID =1 (=INT_CALIB) PRS_TC_CALIBRATION with: -SEQUENCE_ID =5 (=EXTERNAL_FF) PRS_TC_CALIBRATION with: -SEQUENCE_ID =1 (=INT_CALIB)	The SOI-B-4 processing needs that an EXTERNAL_FF_CALIBRATION is commanded, It is invoked any time INTERNAL_CALIBRATION successive to the EXTERNAL_FF_CALIBRATION is acquired. The CNM provides to collect the two INTERNAL_CALIBRATION files that preceded and succeed the EXTERNAL_FF_CALIBRATION, and to invoke the SOI processing.
SOI B-5	PRS_TC_CALIBRATION with: -SEQUENCE_ID =1 (=INT_CALIB) PRS_TC_CALIBRATION with: -SEQUENCE_ID =7(=SUN_FLUX) PRS_TC_CALIBRATION with: -SEQUENCE_ID =1 (=INT_CALIB)	The SOI-B-5 processing needs that a SUN_FLUX_CALIBRATION is commanded, It is invoked any time INTERNAL_CALIBRATION successive to the SUN_FLUX_CALIBRATION is acquired. The CNM provides to collect the two INTERNAL_CALIBRATION files that preceded and succeed the SUN_FLUX_CALIBRATION, and to invoke the SOI processing.

Table 5-3: SOI Commanding

6. LEVEL 0 PRODUCT

6.1 LEVEL 0 PROCESSING OVERVIEW

The L0 processor is in charge of generating several L0a files according to the content of input Decyphered Data File. The Cloud-Coverage percentage is computed for L0a Earth-Observation files and written into the Catalogue Metadata file of the relevant L0a file.
Besides the L0a products, the L0 processor shall generate a LIST file and a Screening Report file and, for each file to be archived, a specific Catalogue Metadata.
In this section, an overview of the generated products is reported.
The following picture shows a block diagram of the L0 Processing scheme:

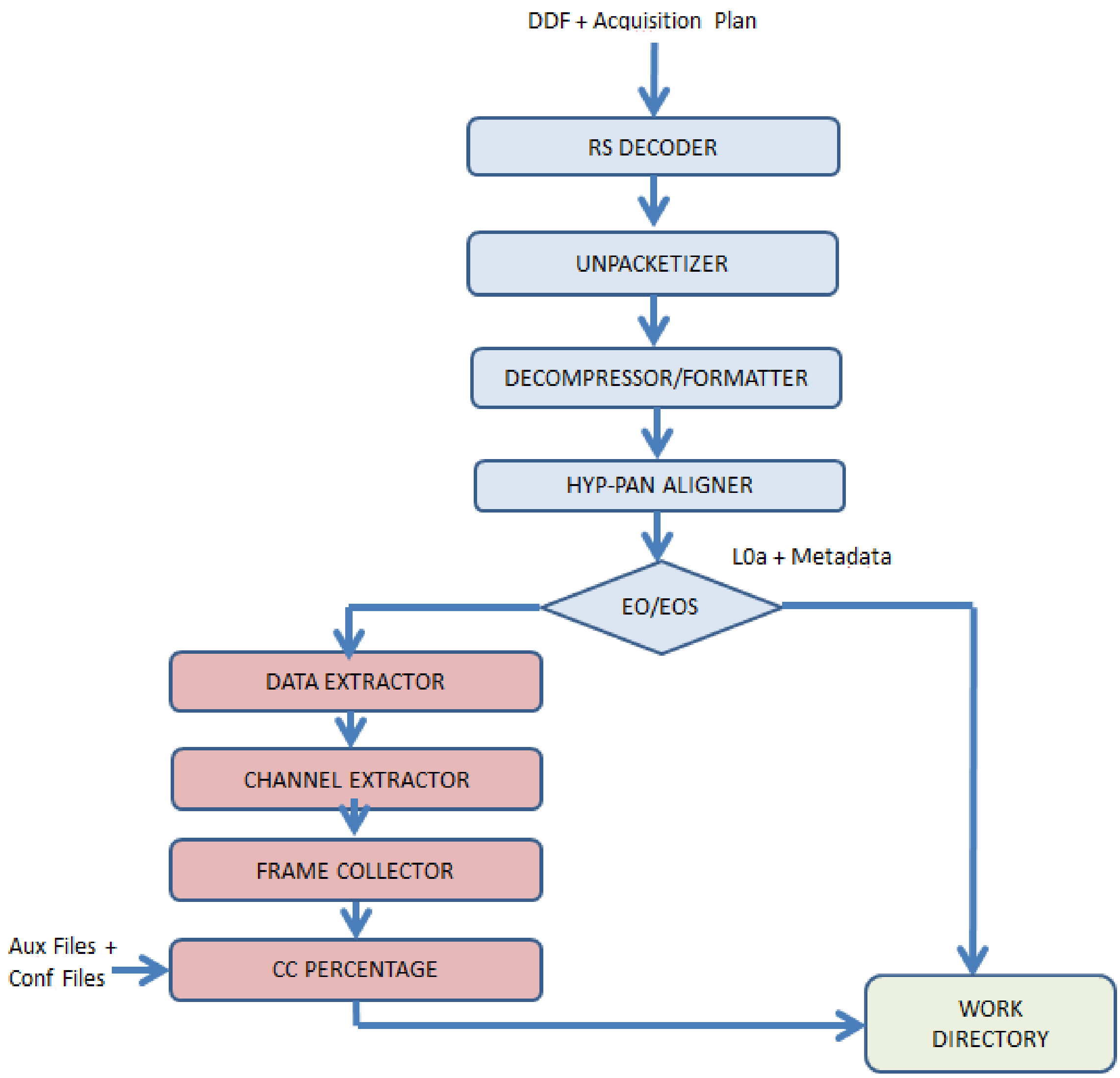


Figure 6-1: L0 processing flow

6.2 L0 PROCESSORS INTERFACES

The input data are all coming from the IDHS Archive. Output data flow is created in the Working Directory and then pushed into the IDHS archive. The L0 processor interfaces only the IDHS through the “THIN LAYER” component.

One intermediate file is foreseen to be created into the working dir for troubleshooting activity and to provide interfaces between the tasks.

The L0 processor has as **input** the following data:

- **DDF (Deciphered Data File)**, from the IDHS Archive, a binary file containing the Raw Data Stream (source packets)

- **Static Auxiliary Data Files:**
  - Sun-Earth Distance file, in XML format
  - Sun Irradiance at the top atmosphere, in XML format
  - Processing Configuration Parameters (PCONF):Config file is an XML file, and brings following information:
    -Link to the file name of the Static GKDP,FKDP,CDP files
    -List of the wavelengths to be used for the CC% processing
    -L0A File Format table
  - Static In-Flight Key Data Parameters for L0 processing, the file containing the FKDP parameters. Such a file has the same layout and content as the FKDP file used in L1 chain, even if his life-cycle may be different, as it is intended to contain default parameters to be used only for the level0 processing. For this reason, it may be considered as a static file (update is infrequent). This file is not retrieved from the IDHS archive, but included in the SW distribution as an internal configuration file.
  - Static On-Ground Data Parameters Key Data Parameters for L0 processing, the file containing the GKDP parameters. Such a file has the same layout and content as the GKDP file used in L1 chain, even if his life-cycle may be different, as it is intended to contain default parameters to be used only for the level0 processing. For this reason, it may be considered as a static file (update is infrequent). This file is not retrieved from the IDHS archive, but included in the SW distribution as an internal configuration file.

- **Dynamic Auxiliary Data Files**
  - Acquisition Plan file, XML file, content described in [RD-5]
  - JobOrder file, generated according to the Processing Order file, XML file, format described in [L0-ICD]

- **L0a File**

  The L0 processor has as **output** the following L0a data, all pushed to the IDHS archive: they are binary file made by a list of Raw CCSDS Packets uncompressed and RS corrected, where each raw pixel data is transformed from 12 to16 bit. Each packet bring information for one band. For each L0a file type it is reported also the list of raw frames saved internally.

L0a file type	Frame Type
Earth-Observation file (L0A_EO)	DARK-OBS, SURFACE-OBS
Earth-Observation Special file (L0A_EOS)	DARK-OBS, SURFACE-OBS-special
Dark_Calibration_file (DARK)	DARK-INT
Internal_Calibration_file (IC)	DARK-INT, BACKGROUND, LAMP, LED
Internal_Calibration_Special_file (ICS)	DARK-INT, BACKGROUND, LAMP at several t_exp, LED at sevrat t_exp
Sun_Calibration_file (SUN)	DARK-INT, SUN-OBS
Sun_Flux_Calibration_file (SUN_FLUX)	DARK-INT, SUN-FLUX
Moon_Calibration_file (MOON)	DARK-OBS, MOON-OBS
Flat_Field_Special_file (FF)	DARK-OBS, EXTERNAL-FF-HYP, EXTERNAL-FF-PAN

- **Screening Report File**, XML file, format and content described in [RD-3]

- **Catalogue Metadata,** XML file, format described in [RD-3]: for each output file to be archived, a catalogue metadata is generated to allow the product archiving. Following fields are filled in the MD:

    - L0A file Name
    - file Generation Time
    - Utc time of the first and of the last frame contained in the file
    - lat & lon of the 4 corners of the EO image (if L0aEO or L0aEOs)
    - list of compressed bands
    - MD quality info = quality flags associated to L0 product.
    - CC%

LIST file (ASCII file) it is meant to contain the list of files to be archived. It reports the list of files that the L0 processor has generated (one line per filename). This file does not reach the Archive, it is only used by the Thinlayer in order to copy into the Archive all the files generated by the processor.

The L0 processor produces also the following intermediate data, used to save partial results for troubleshooting activity:

- **BreakPoint file (troubleshooting):**

  The filenames of the BreakPoint files, as well as an enabling/disabling flag for each of them, are reported in the JobOrder. The following breakpoint file is foreseen:

  - PRS_BK_CCM: contains the Cloud Coverage Mask

The position of the breakpoint file generation in the overall work-flow is depicted in the next figure.

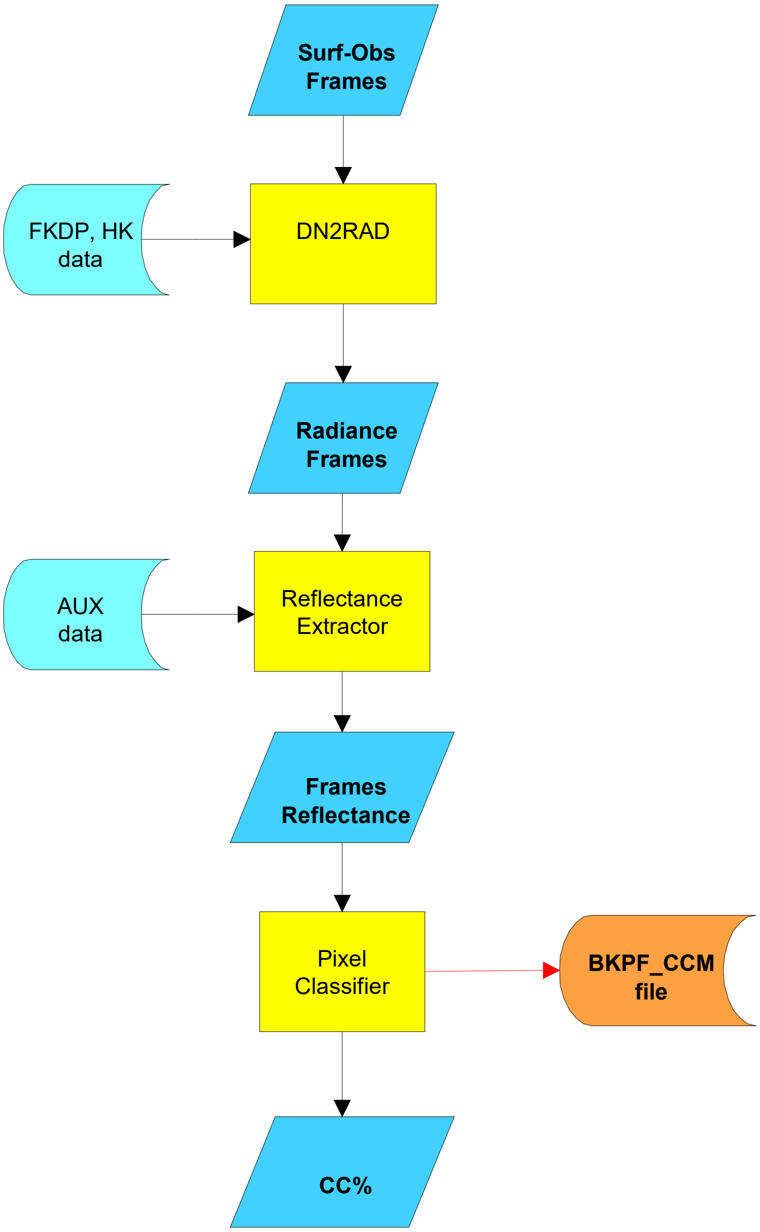


Figure 6-2: Generation of the Breakpoint file in the Cloud Coverage chain

In the next tables, the interfaces of the L0 processing tasks are summarized.

File Description	Filetype	Format	Class
Input			
Job Order File	JobOrder	XML	Mandatory
Processor Configuration	PCONF	XML	Mandatory
Acquisition Plan	AUX_ACQPLN	XML	Mandatory
Decyphered Data File (TM stream)	PRS_DDF	Binary	Mandatory
Output			
Earth-Observation	PRS_L0__EO	binary	Optional
Earth-Observation Special	PRS_L0S_EO	binary	Optional
Dark Calibration	PRS_L0__DC	binary	Optional

Internal Calibration	PRS_L0__IC	binary	Optional
Internal Calibration Special	PRS_L0S_IC	binary	Optional
Sun Calibration	PRS_L0S_SC	binary	Optional
Sun Calibration Flux	PRS_L0S_SX	binary	Optional
Moon Calibration	PRS_L0S_MC	binary	Optional
Flat Field Calibration	PRS_L0S_FC(V/S/or P)	binary	Optional
A catalogue metadata for each L0a different form Earth Observation (both Special or not)	----	XML	Optional
LIST File	PRS_L0_LST	ASCII	Mandatory
Screening Report File	PRS_L0_RPT	XML	Mandatory

Table 6-1: Unpacketizer task (DDF_UNPACK) I/O interfaces

File Description	**Filetype**	**Format**	**Class**
	Input		
Job Order File	JobOrder	XML	Mandatory
Processor Configuration	PCONF	XML	Mandatory
Sun-Earth Distance file	PRS_AUX_D_SUN	XML	Mandatory
Sun Irradiance at the top atmosphere	PRS_AUX_S_IRR	XML	Mandatory
FKDP file for L0 processing	PRS_AX_FDP	NETCDF4	Configuration file
GKDP file for L0 processing	PRS_AX_GDP	NETCDF4	Configuration file
CDP file for L0 proessing	PRS_AX_CDP	NETCDF4	Configuration file
L0a Earth -Observation	PRS_L0__EO	binary	Optional
L0a Earth -Observation Special	PRS_L0S_EO	binary	Optional
LIST file	PRS_L0_LST	XML	Mandatory
	Output		
A catalogue metadata for each processed Earth Observation L0a (both Special or not)	----	XML	Mandatory
Breakpoint	PRS_BK_CCM	binary	Optional

Table 6-2: Cloud Coverage task (CLOUD_COVERAGE) I/O interfaces

6.3 LEVEL 0 OUTPUT FORMAT DESCRIPTION

The format and content of files generated by the Level0 processing chain is reported in this section.

6.3.1 L0A PRODUCT FORMAT DESCRIPTION

The L0a files produced by the L0 processing chain are binary files. They are composed by a sequence of Payload Source Packets belonging to a specific Acquisition Type and, for Earth-Observation data, to a specific Sub-Acquisition. A binary data set, hereinafter Header Data Set (HDS), is inserted at the beginning of the file, before the first packet.
The HDS is meant to contain general information (filename, start and stop time, quality flags, number of packets, size, etc.) as well as parameters retrieved during the L0 processing and needed to the L1 processor, which aren’t available in the other processor interfaces.

The high level structure of the L0a product is depicted in the next figure:

DS NAME	**DS CONTENT**

HDS	Binary records containing useful annotations concerning the acquired image
MDS	Stream of binary Source Packets
frame 1	1 header packet up to 76 VNIR packets up to181 SWIR packets up to 36 PAN packets
A new frame ***(every Tsync – nominal Tsync 4.31 ms)***	
frame N	1 header packet up to 76 VNIR packets up to 181SWIR packets up to36 PAN packets

Figure 6-3: L0a Nominal Product Structure

The MDS shall nominally include a well defined sequence of VNIR, SWIR and PAN frames, repeated every 4.31 ms. Each Payload Source Packet (encapsulated according to the CCSDS format) is 2016 bytes long and thus includes 1000 samples, coded in DN at 16 bits. The spatial coverage of each packet depends on the selected grouping from the PRS_TC_ACQUISITON telecommand.

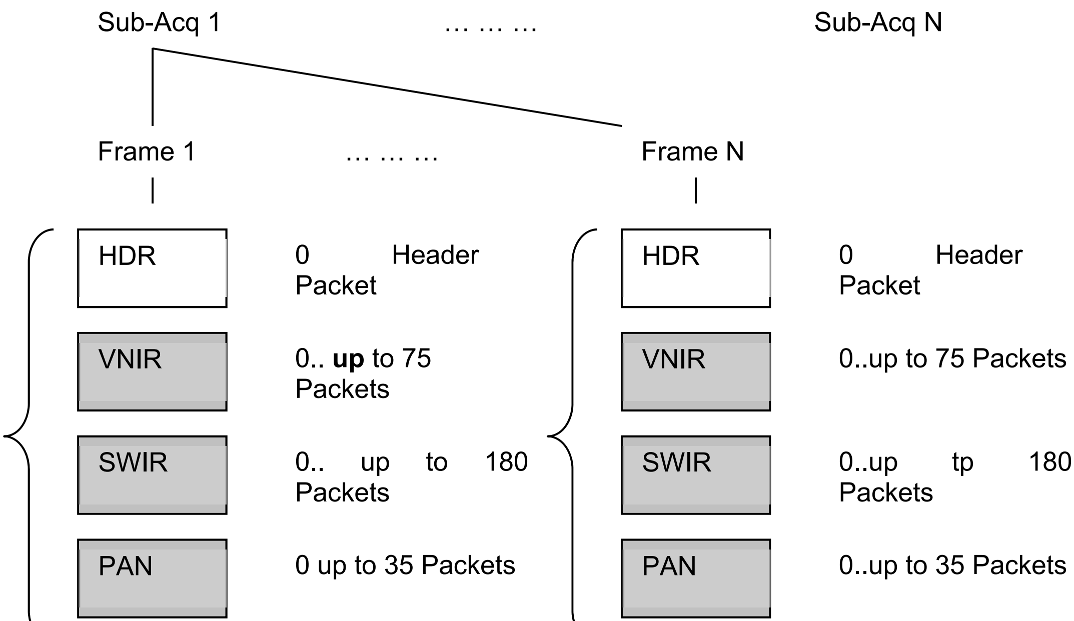


Figure 6-4: Sequence of frames for each Sub-Acquisition in the DDF and L0a products

*Packet Number is a progressive number, it is increased for any new packet sent (no kind of control on the number of band skipped is performed)

The nominal EO (Earth Observation) L0a product refers to 1000x1000 pixel image, corresponding to a 30kmx30km area at ground.

6.3.1.1 L0A_EO FILE FORMAT

In case of L0A_EO files, each file brings [1000] HYP frames, [1000+NExtended] PAN frames, [1000+NExtended] Header Packets: these ones overlapping the beginning of each L0a file which follows.

L0a_EO products relative to the last part of the acquisition always contain less than 1000 HYP frames, and for this reason are discarded: no L0a product is provided.

Extended frames will be marked by setting a flag into word n. 256 of the Header Packet.

(Note: the Extended frames overlap the beginning of the successive L0A_EO file).

The number of frames PAN to be added is obtained by following formula:
Frames-to_add = PAN_HYP_DELAY + max(ATT_DELAY, GPS_DELAY)

Where PAN_HYP_DELAY is extracted from the L0 Configuration File. It is set at 120 frames as default.

ATT_DELAY is the maximum delay for the ATTITUDE, retrieved from L0 Configuration file. It is set a 0 frames as default.

GPS_DELAY is the maximum delay for GPS, retrieved from L0 Configuration file. It is set at 0 frames as default.

L0aCorners produce as output the parameters PAN_HYP_START_SYNC_FRAME and PAN_HYP_START_SYNC_SUBFRAME.

Then it is up to L1 to realingn PAN to HYP cubes using the PAN_HYP_START_SYNC_FRAME, PAN_HYP_START_SYNC_SUBFRAME, in order to produce as output a 1000 frames image.

6.3.2 L0A HEADER DATA SET DESCRIPTION

The HDS section of the L0a product has a fixed size. The structure and content of the HDS is detailed in the next table (Table 6-3).

#	Header Data Set records	Units	Byte	Format
1	UTC Time stamp of the first frame (1)	(1)	8	mjd2000 2000
2	UTC Time stamp of the last frame (1)	(1)	8	mjd 2000
3	Latitude of the first pixel in the first frame (positive N negative S) It has been obtained by means of the L0ACorners function applied to VNIR cube.	deg	4	sl
4	Longitude of the first pixel in the first frame (positive E 0=Greenwich negative W) It has been obtained by means of the L0ACorners function applied to VNIR cube.	deg	4	sl
5	Latitude of the last pixel in the first frame (positive N negative S) It has been obtained by means of the L0ACorners function applied to VNIR cube.	deg	4	sl
6	Longitude of the last pixel in the first frame (positive E 0=Greenwich negative W) It has been obtained by means of the L0ACorners function applied to VNIR cube.	deg	4	float
7	Latitude of the first pixel in the last frame (positive N negative S) Note: the last frame is intended as the last of not extended frames: the corners are always referred to a set of not extended frames.	deg	4	float
8	Longitude of the first pixel in the last frame (positive E 0=Greenwich negative W) It has been obtained by means of the L0ACorners function applied to VNIR cube. Note: the last frame is intended as the last of not extended frames: the corners are always referred to a set of not extended frames.	deg	4	float
9	Latitude of the last pixel in the last frame (positive N negative S) It has been obtained by means of the L0ACorners function applied to VNIR cube. Note: the last frame is intended as the last of not extended frames: the corners are always referred to a set of not extended frames.	deg	4	float
10	Longitude of the last pixel in the last frame (positive E 0=Greenwich negative W) It has been obtained by means of the L0ACorners function applied to VNIR cube. Note: the last frame is intended as the last of not extended frames: the corners are always referred to a set of not	deg	4	float

#	Header Data Set records	Units	Byte	Format
	extended frames.			
11	Acquisition Type (2)	enumerator	2	integer
12	Acquisition Purpose	enumerator	2	integer
13	List of Frame Types (3)	enumerator	2 *30	integer
14	Incomplete at the beginning L0a file flag (4)	flag	1	integer
15	Incomplete at the end L0a file flag (5)	Flag	1	integer
16	Filename of the Input DDF file (6)	-	54	sting
17	Filename of the Input PCONF file (6)	-	54	sting
18	Filename of the Input Acquisition Plan file (6)	-	54	sting
19	Filename of the Input FKDP file (6)	-	54	sting
20	Filename of the Input GKDP file (6)	-	54	sting
21	Filename of the Input CDP file (6)	-	54	sting
22	Filename of the Input ICU_CDP file (6)	-	54	sting
23	CC Percentage (set only for EO or EOS files).	percentage	2	integer
24	PAN_HYP_START_SYNC_FRAME (7)	Number of frames	2	integer
25	PAN_HYP_START_SYNC_SUBFRAME (7)	Number of sub frames	2	integer
26	PAN_HYP_STOP_SYNC_FRAME (7)	Number of frames	2	integer
27	PAN_HYP_STOP_SYNC_SUBFRAME(7)	Number of sub frames	2	integer
28	PAN_HYP_ACT_RESIDUAL_m (7)	m	4	float
29	PAN_HYP_ALT_RESIDUAL_m(7)	m	4	float
30	Spare		16	
	HDS size =		**528**	

Table 6-3: Format and content of the HDS records

(1) UTC stamp is the UTC time in format MJD2000;

(2) An unsigned short value is associated to each Acquisition Type according to the following mapping:

0 = EARTH-OBSERVATION
6 = DARK CALIBRATION
1 = INTERNAL-CALIBRATION
3 = SUN CALIBRATION
4 = MOON CALIBRATION
5 = FLAT-FIELD SPECIAL
7 = SUN CALIBRATION FLUX

(3) Frame Types actually stored in the L0a file – array of up to 30 elements: an unsigned short value is associated to each Frame Type according to the following mapping:

1 = SURFACE-OBS (shutter open, main port open, lamp off, solar port closed)
2 = DARK-OBS (shutter closed, main port open, lamp off, solar port closed)
3 = BACKGROUND (shutter open main port closed lamp off, solar port closed)
4 = DARK-INT (shutter closed, main port closed, lamp off, solar port closed)
5 = LAMP (shutter open, main port closed, lamp on, solar port closed)
6 = SUN-OBS (shutter open, main port closed, lamp off, solar port open)
7 = MOON-OBS (shutter open, main port open, lamp off, solar port closed)
8 = EXTERNAL-FF-HYP (shutter open, main port open, lamp off, solar port closed)
9= SUN-FLUX (shutter open, main port closed, lamp off, solar port moving)

10= LED (shutter open, main port closed, led on, solar port closed)
11 =EXTERNAL-FF-PAN (shutter open, main port open, lamp off, solar port closed)
12 = AUTOTEST (not managed by processors L0 and L1)

(4) this flag is set if the L0a file is incomplete at the beginning (sub-acquisition phase is missing at the beginning= in fact the L0config file report the list of frame_types that shall be present consecutively into an L0a file. If these frames has not been received or have been flagged as corrupted frames (for calib) – they are marked as missing frames)

(5) this flag is set if the L0a file is incomplete at the end (sub-acquisition phase is missing at the end) *= in fact the L0config file report the list of frame_types that shall be present consecutively into an L0a file. If these frames has not been received or have been flagged as corrupted frames (for calib) – they are marked as missing frames)*

(6) **it is assumed that the filename of all the AUX files will follow the same naming convention of the** *L0a product*

(7)These fields are produced by L0a corners*: in particular the field* PAN_HYP_START_SYNC_FRAME reports the number of PAN-HYP delay frames in the Along track direction to synch first HYP cube's line with first PAN cube's line. It's computed on the first frame of the 30km x 30km image . It is Applied in PAN-HYP coarse coregistration al Level L1.
The field PAN_HYP_START_SYNC_SUBFRAME (7) reports the number of PAN-HYP delay SUB-frames (0 5) in the Along track direction to synch first HYP cube's line with first PAN cube's line.It's computed on the first frame of the 30km x 30km image. It is applied in PAN-HYP coarse coregistration at LevelL1.

6.3.3 L0A MEASUREMENT DATA SET DESCRIPTION

The size of the MDS is not fixed as it depends on the number of acquired frames as well as on on-board selected spatial grouping, spectral binning and on the spectral selection masks. Moreover, as stated in [L0-SRS], the Unpacketizer task doesn't take any action to correct for missing packets, neither header nor data. For this reason, the first packets in the file could be a data packet instead of a header packet.

The structure and content of a generic source packet is reported herein.

Packet Primary Header				Packet Data Field		
Version number	Packet Identification	Packet Sequence Control	Packet Data Length	Packet Control	Source Data Field	Packet Error Control
6 bytes				8 bytes	2000 bytes	2 bytes

Figure 6-5: Source Packet Structure

The section "Source Data Field" is detailed in two different sections as its content depends on the type of packet (header packet or VNIR/SWIR/PAN packet). In the case of Header Packet, the Source Data Field contains Ancillary+HK data, while in case of VNIR, SWIR and PAN packets the Source Data Field reports the list of pixels coded as DN 12 bit.

The content of Packet Primary Header and Packet Data Field are detailed herein.

ENDIANESS
CCSDS packet are all written according to a big endian notation.

Description	Field Name	Type	Remarks	Byte#	Description
Packet Primary Header	Packet Identification	Version (3 Bit)	Bit		1,2
		Type (1 Bit)			
		Sec_Header_Flag (1 Bit)			
		APID (11 Bit)			
	Packet Sequence	Grouping_Flags (2 Bit)	Bit	It will be increased, modulo 16384, for each	3,4
		Source_Sequence_Number			

	Control	(14 Bit)		packet produced by the payload	
	Packet Data Length		UINT-16	Indicates the number of bytes in the packet data field minus 1	5,6
Packet Data Field					
	Packet Control	Packet_Type	Byte	Type of Packet: 0: HEADER Packet 1: uncompressed SWIR_A data packet (high side) 2: uncompressed SWIR_B data packet (low side) 3: uncompressed VNIR data packet 4: uncompressed PAN data packet 5: compressed SWIR data packet – Compressor A 6: compressed SWIR data packet – Compressor B 7: compressed VNIR data packet (1) 8...255: not used	7
		Packet_Number (2)	Byte	Packet Number within the frame. Each packet type has its own packet number. 0: Header Range in [0,75]: VNIR Range in [0,180]: SWIR Range in [0,35]: PAN	8
		Frame_Number	UINT-32	Counts the number of synchronism=frames at 4.31msec. It is restarted any time a new sub-acquisition or frame part file is generated?	9,10,11,12
		HGRP	Byte	Grouping factor (meaningful only for packets PAN, SWIR and VNIR. Allowed values: 1, 2 or 4)	13
		NB	Byte	Number of the spectral line carried by the current packet: it can be a value from 0…255. ***Note:*** *in the DDF (input to the L0 processor) this same fieled has a different meaning: total number of bands (meaningful only for SWIR and VNIR. for example 87 for SWIR_A, 86 for SWIR_B, 66 for VNIR) The L0 processor is in charge of the appriopate conversion.*	14
	Source Data Field			Detailed in par. 6.3.4	From 15 to 1514

	Packet Error Control		UINT-16		1515,1516

Table 6-4: Content of the fixed part of the source packet

(1) L0a Packet are not compressed, but this fields indicates if originally data was compressed or not.

(2) One PacketNumber for each band (or for each set of 1000 pixel PAN)

6.3.4 SOURCE DATA FIELD CONTENT

The source data field content depends on the type of packets and can be distinguished in “Source Data Field for Header Packets” and “Source Data Field for VNIR/SWIR/PAN Packets” hereafter detailed.

6.3.4.1 SOURCE DATA FIELD FOR HEADER PACKETS

The Header Packet is divided into two parts:

– the fixed part, whose size is 1152bytes, used for those information that does not vary during the current sub-acquisition: in particular they have the purpose to describe the features of the current frame. It is updated at the beginning of a new sub-acquisition or at the beginning of a new frame part for calibration sub-acquisitions DARK-INT, DARK-OBS, LAMP, LED, SUN-FLUX , BACKGROUND, SUN-OBS, MOON-OBS, EXTERNAL_FF_HYP, EXTENRAL_FF_PAN;

– the variable part, whose size is 348 bytes, used for Housekeeping and Ancillary that varies during the current sub-acquisition. These data are written at the beginning of each sub-acquisition and successively updated every 125ms.

		HEADER PACKET			
	16 Bits Word No	**Field**	**Size (bits)**	**Values**	**Description**
FIXED PART (written by PL SW at each start of sub-acquisition phase or frame_part)	8 9	Synchro word	32	0xB38F0F83 (=big endian)	
	10	Image ID	16	0x0.. 0xFFFF	This value reports the imageID/or CalibrationID associated to the current Acquisition or to the current Calibration Sequence. It is the same ImageID or CalibrationID that has been sent to payload by means of PRS_TC_ACQUISITION or Calibration ID of PRS_TC_CALIBRATION/ PRS_TC_DARK_ACQUISITION

	11 12	ISF_ID_Start	32	0x0.. 0xFFFFFFFF	This value reports the ISF ID associated to the current Acquisition or to the current Calibration Sequence It is the same field that has been sent to payload by means of PRS_TC_ACQUISITION, PRS_TC_CALIBRATION or PRS_TC_DARK_ACQUISTION Word n.11 is MSW word n.12 is LSW
	13	Number of ISF	16	0x0 0xFFFF Default= 1	A single acquisition or a single calibration sequence is stored in a single ISF file It is the same field that has been sent to payload by means of PRS_TC_ACQUISITION, PRS_TC_CALIBRATION or PRS_TC_DARK_ACQUISTION
	14 15 16 17	UTC_Time	64	TTAG	Time (UTC format-Greenwhich time) of the 1st sub-acquisition frame. NOTE: this is written by PL SW just before to start the data acquisition. Word n.14 is MSW word n.17 is LSW
	18 Bit 15-8	Frame type	8	1/2/3/4/5/6/7/8/9/10/11/12/13	It is related to the current sub-acquisition phase: 1= SURFACE-OBS 2= DARK-OBS 3= BACKGROUND 4= DARK-INT 5= LAMP 6= SUN-OBS 7= MOON-OBS 8= EXTERNAL-FF-VNIR 9=SUN-FLUX 10= LED 11=EXTERNAL-FF-PAN 12=AUTOTEST 13=EXTERNAL-FF-SWIR 14=FREE RUN

	18 Bit 7-0	Frame Part	8	0/1/2/3	**For calibrations:** 3= Full Part it is associated to frames of MOON-OBS, EXTERNAL-FF-VNIR, EXTERANL-FF-SWIR, EXTERNAL-FF-PAN 2= Frame Part2 1= FramePart1 They are associated to frames of : DARK-INT DARK-OBS (except dark associated to EO compressed) LAMP LED SUN-OBS SUN-FLUX AUTOTEST **For EarthObservation:** 0 = Full Part EO associated to frames of: SURFACE-OBS DARK-OBS (only if part of compression)
	19 Bit 15-8	Acquisition Type	8	0/1/3/4/5/6 /7/8/9	It is related to the current scheduled activity: 0= EARTH-OBSERVATION 6= DARK CALIBRATION (=Only Dark Observation during AOI) 1= INTERNAL-CALIBRATION 3= SUN CALIBRATION 4= MOON CALIBRATION 5= FLAT-FIELD SPECIAL 7= SUN CALIBRATION FLUX 8 = Autotest
	19 Bit 7-0	Acquisition Purpose	8	0/1	ACQUISITION: it is taken from the PRS_TC_ACQUISITION devoted field. CALIBRATION: For PRS_TC_DARK_ACQUISITIO N or Calibration Seq. n.1 = 0 (Not special product) . For Calibration Sequence n. 2/3/4/5/6/7 =1 (Special product). It is marked as 1 also for Calibration Seq.n.1 when Internal Calibration Special is commanded.

	20 21	Integration time	32	0x0.. 0xFFFFFFFF	This field a copy of the integration time Settable Parameter internal to payload sw, depending on the Acquisition/Calibration Type INTEGRATION TIME is the integration time set. It is expressed in multiples of 10μs. Tint (s)= IntegrationTime * 10^-5 Default Integration Time =411 Word n.20 is MSW word n.21 is LSW
	22 23	Synch Time	32	0x0.. 0xFFFFFFFF	Calculated TSynch necessary to perform the current acquisition SYNC is the sync period sent. It is expressed in multiples of 10μs. Tsync(s) = SYNC_TIME * 10^-5 Default SYNC_TIME =431 Word n.22 is MSW word n.23 is LSW
	24 25	Pan Tint	32	0x0.. 0xFFFFFFFF	PAN INT is the Integration time: PAN Tint(us) = PAN Tint *10 Default value= Nominally it is 1/6 of Tsync =718usec Word n.24 is MSW word n.25 is LSW
	26	Number of frames to be acquired in current sub-acquisition	16	0x0.. 0xFFFF	Number of frames to be acquired in current sub-acquisition=> **ACQUISITION:** It is computed using the Start/Stop time commanded with PRS_TC_ACQUISITION: Nframes = *[Stop Time-Start Time)]/Synch Time* **CALIBRATION:** It is taken from the current sub-phase Settable Parameter reporting the number of frames

	27	Number of frames to be acquired in current Image Id/Calibration ID	16	0x0.. 0xFFFF	Number of frames to be acquired in current Image Id/Calibration ID=> **CALIBRATION:** This field is taken from the devoted Settable Parameter for the entire Calibration sequence **ACQUISITION:** It is equal to the number of Surface frames to be acquired (field.26) + the number of frames for PrevDark (if commanded) + the number of frames for Post Dark (if commanded)
	28 Bit 15-14	SWIR_HGRP	2	0b01 0b10 0b11	Legenda: 0b01=no grouping 0b10=grouping factor 2 0b11=grouping factor 4 This information is retrieved from the PRS_TC_ACQUISITION devoted field. In case of CALIBRATION, the value is always set to 01=no grouping.
	28 Bit 13-12	VNIR_HGRP	2	0b01 0b10 0b11	Legenda: 0b01=no grouping 0b10=grouping factor 2 0b11=grouping factor 4 This information is retrieved from the PRS_TC_ACQUISITION devoted field. In case of CALIBRATION, the value is always set to 01=no grouping.
	28 Bit 11-10	PAN_HGRP	2	0b01 0b10 0b11	Legenda: 0b01=no grouping 0b10=grouping factor 2 0b11=grouping factor 4 This information is retrieved from the PRS_TC_ACQUISITION devoted field. In case of CALIBRATION, the value is always set to 01=no grouping.

	28 Bit 9-8	PAN_ACQ	2	0/1/2/3	bit n.8= Equivalent to the _X register for VNIR and SWIR but applied to the PAN channel. This bit signals if the PE shall trasmit (1) or not (0) the PANchromatic data. bit n.9 =Equivalent to the _P register for VNIR and SWIR but applied to the PAN channel. This bit signals if the SDAB shall trasmit to PDHT (1) or not (0) the PANchromatic data. 00=NO PAN Acq Data. 11= PAN Acq Data. 01= not correct register programming 10= not correct register programming **In case of ACQUISITION:** it is retrieved from the PRS_TC_ACQUISITION devoted field. **In case of CALIBRATION:** It is retrieved from the devoted SP, depending on the Frame Part field.
	28 Bit 7-0	SWIR_BNSTART	8	0x0.. 0xFF	Binning start band index for SWIR. **In case of Acquisition,** it is retrieved from the PRS_TC_ACQUISITION devoted field. **In case of Calibration** it is set 255=binning not applied
	29 Bit 15-8	SWIR_BNSTOP	8	0x0.. 0xFF	Binning stop band index for SWIR. **In case of Acquisition,** it is retrieved from the PRS_TC_ACQUISITION devoted field. **In case of Calibration** it is set to 0=binning not applied

	29 Bit 7-0	VNIR_BNSTART	8	0x0.. 0xFF	Binning start band index for VNIR. **In case of Acquisition,** it is retrieved from the PRS_TC_ACQUISITION devoted field. **In case of Calibration i**t is set 255=binning not applied
	30 Bit 15-8	VNIR_BNSTOP	8	0x0.. 0xFF	Binning stop band index for VNIR. **In case of Acquisition,** it is retrieved from the PRS_TC_ACQUISITION devoted field. **In case of Calibration i**t is set to 0=binning not applied
	30 Bit 7	MainElectornic_Main_Red_Flag	1		0 = Main Electronic Main 1 = Main Electronic Red
	30 Bit 6-0	Pan_N_Int	7		Default = 6
	31 […] 46	SDAB_SWIR	256	Bit field matrix	SWIR Band selection at SDAC level=> One bit flag for each SWIR row. If the flag is 0 the row shall not be read, if 1 the row shall be read. The mapping of the rows is the following: SDAB_SWIR[0][15] – Row 0 SDAB_SWIR[0][14] – Row 1 … SDAB_SWIR[15][0] – Row 255 **In case of uncompressed ACQUISITION:** This field is retrieved from the devoted TC field. **In case of compressed Acquisiotion or CALIBRATION:** This is retrieved from the devoted SPs, depending on the current Frame Part (see SRD devoted requirement)

	47 […] 62	SDAB_VNIR	256	Bit field matrix	VNIR Band selection at SDAC level=> One bit flag for each VNIR row. If the flag is 0 the row shall not be read, if 1 the row shall be read. The mapping of the rows is the following: SDAB_VNIR[0][15] – Row 0 SDAB_VNIR[0][14] – Row 1 … SDAB_VNIR[15][0] – Row 255 **In case of uncompressed ACQUISITION:** This field is retrieved from the devoted TC field. **In case of compressed Acquisiotion or CALIBRATION:** This is retrieved from the devoted SPs, depending on the current Frame Part (see SRD devoted requirement)
	63 […] 78	PE_SWIR	256	**Bit field matrix**	SWIR Band selection at PE level=> One bit flag for each SWIR row. If the flag is 0 the row shall not be read, if 1 the row shall be read. The mapping of the rows is the following: PE_SWIR[0][15] – Row 0 PE_SWIR[0][14] – Row 1 … PE_SWIR[15][0] – Row 255 **In case of uncompressed ACQUISITION:** This field is retrieved from the devoted TC field. **In case of compressed Acquisiotion or CALIBRATION:** This is retrieved from the devoted SPs, depending on the current Frame Part (see SRD devoted requirement)

	79 […] 94	PE_VNIR	256	Bit field matrix	VNIR Band selection at PE level=> One bit flag for each VNIR row. If the flag is 0 the row shall not be read, if 1 the row shall be read. The mapping of the rows is the following: PE_VNIR[0][15] – Row 0 PE_VNIR[0][14] – Row 1 … PE_VNIR[15][0] – Row 255 **In case of uncompressed ACQUISITION:** This field is retrieved from the devoted TC field. **In case of compressed Acquisition or CALIBRATION:** This is retrieved from the devoted SPs, depending on the current Frame Part (see SRD devoted requirement)
	95 […] 110	PE_GAIN_SWIR	256	Bit field matrix	Gain Selection for each SWIR band. One bit flag for each SWIR row. 0 = Gain30fF (=High gain); 1 = Gain 128fF (=Low Gain). The mapping of the rows is the following: PE_GAIN_SWIR[0][15] – Row 0 PE_GAIN_SWIR[0][14] – Row 1 … PE_GAIN_SWIR[15][0] – Row 255 This field is retrieved from the devoted SPs.
	111 […] 126	PE_GAIN_VNIR	256	Bit field matrix	Gain Selection for each VNIR band. One bit flag for each VNIR row. 0 = Gain30fF (=High gain); 1 = Gain 128fF (=Low Gain). The mapping of the rows is the following: PE_GAIN_VNIR[0][15] – Row 0 PE_GAIN_VNIR[0][14] – Row 1 … PE_GAIN_VNIR[15][0] – Row 255 This field is retrieved from the devoted SPs.

	127 Bit 15	Flag PREV Dark	1	0/1	Flag that notify if prev dark has been selected in case of Earth Observation. **In case of ACQUISITION:** 1=if is programmed a PREV Dark in the current TC 0= if is not programmed a PREV Dark in the current TC **In case of CALIBRATION:** Set to 0
	127 Bit 14	Flag Post Dark	1	0/1	Flag that notify if post dark has been selected in case of Earth Observation. **In case of ACQUISITION:** 1= if is programmed a SUCC Dark in the current TC 0= if is not programmed a SUCC Dark in the current TC **In case of CALIBRATION:** Set to 0
	127 Bit 13	Enable Compression	1	0/1	Flag that notify if the compression is active or not. It is valid only in case of **ACQUISITION:** 1 = Acquisition with compression 0 = Acquisition without compression If compression is disabled a band reduction strategy shall be applied to not exceed 600Mbps data rate versus PDHT
	127 Bit 12-11	Quantization Factor	2	0..3	It reports the quantization factor (QF) used for the compression 0= Lossless 1= near Lossless with QF egual 1 2= near Lossless with QF egual 2 3= near Lossless with QF egual 3
	127 Bit 10-8	Spare	3		
	127 Bit 7-0	Number of Lamp Groups	8	1..20	It is used only for internal calibration: it reports the the number of the lamp phase during Internal Calibration (Special product). =17 for Internal Calib Special = 3 for internal Calib For all other calibration and acquisition it is always set to 0.
	128	Solar Port open /close time (msec)	16 (uint)	0x0.. 0xFFFF	Time necessary to open / close solar port

	129	Delta Solar Port Open Time (msec)	16 (uint)	0x0.. 0xFFFF	Time when Solar Port Open (only used in Sun-Flux calibration) is commanded. Delay time from UTC_Time.
	130	Delta Solar Port Close Time (msec)	16 (uint)	0x0.. 0xFFFF	Time when Solar Port Close (only used in Sun-Flux calibration) is commanded. Delay time from UTC_Time.
	131	SYNC_CNTL	16 (uint)	0x0.. 0xFFFF	Copy of SDAC register SYNC_CNTL= Number of frames in the current acquisition or calibration sequence (LSW) Reset with zero (disabled) Reset with 0x"0000".
	132	SYNC_CNTH	16 (uint)	0x0.. 0xFFFF	SDAC register SYNC_CNTH Number of frames in the current acquisition/calibration sequence (MSW) Reset with 0x"0000". Note: in order to retrieve the number of frames of current acquisition, the SYNC_COUNTER shall be re composed as in the following: [SYNC_CNTH SYNC_CNTL]
	133	ACQ_DELAY	16 (uint)	0x0.. 0xFFFF	Copy of SDAC register ACQ_DELAY: Register for the management of the PAN delay: *bit [15:8]: ACQ_STOP_DELAY This register sets the number of synch impulse remaining to the end of acquisition after which the SWIR and VNIR data have not to be sent to the PDHT. Reset with x"00".* Not used:it is always fixed to 0. *bit [7:0]: ACQ_START_DELAY This register sets the number of synch impulse to wait before the transmission of PAN data to the PDHT. Reset with x"00".* Not used:it is always fixed to 0.

	134	HGRP_PAN_PX	16 (uint)	0x0… 0xFFFF	Copy of SDAC register HGRP_PAN_PX= PAN_ACQ and Grouping (column) for SWIR, VNIR and PAN channels *bit [15:14]:* Not Used bit[13]: PAN_P This bit signals if the SDAC shall trasmit to PDHT (1) or not (0) the PANchromatic data. Reset with zero. bit[12]: PAN_X This bit signals if the PE shall trasmit (1) or not (0) the PANchromatic data. Reset with zero. bit [11:8] PN_HGRP: Value 0x1 means PAN Grouping 1 Value 0x2 means PAN Grouping 2 Value 0x4 means PAN Grouping 4 Reset with 0x1. bit [7:4] VN_HGRP: Value 0x1 means VNIR Grouping 1 Value 0x2 means VNIR Grouping 2 Value 0x4 means VNIR Grouping 4 Reset with 0x1. bit [3:0] SW_HGRP: Value 0x1 means SWIR Grouping 1 Value 0x2 means SWIR Grouping 2 Value 0x4 means SWIR Grouping 4 Reset with 0x1.

	135	PDHT_RATE	16 (uint)	0x0… 0xFFFF	Copy of SDAC register PDHT_RATE This register sets the data rate for PDHT data communication by inserting wait states (i.e. transmission of COMMA character) between each data burst transmission. bit [15:8]: WAIT_LENGTH bit [7:0]: BURST_LENGTH Reset with x"0108". PDHT rate(Mb/s) = 750*(BURST_LENGTH/(BURST_LENGTH+WAIT_LENGTH +1))
	136 137	LAMP_NOMINAL_CURRENT	32 (uint)	0x0… 0xFFFF	Echo of the SP SP_LAMP_NOMINAL_CURRENT used during internal calibration (not special product) It is a value in DN with the following conversion rule DN /4096*550mA Word n.136 is MSW, word n. 137 is LSW
	138 139	LED_NOMINAL_CURRENT	32 (uint)	0x0… 0xFFFF	Echo of the SP SP_LED_NOMINAL_CURRENT used during internal calibration (not special product) It is a value in DN with the following conversion rule DN /4096*400mA Word n.138 is MSW, word n. 139 is LSW
	140 141	PreviousAcquiredFrames	32 (uint)	0x0… 0xFFFF	Number of frames acquired up to previous sub-acquisition of current Acquisition or Calibration Sequence. For the first subacquisition it is set to 0. Word n.140 is MSW, word n. 141 is LSW It is necessary in order to compute the frame time. In fact the frame time is Frame UTC_TIME = Header.Utc_time + Header.Sync_time *(PacketControlField.FrameNumber - Header.PreviousAcquiredFrames-1)

	142 […] 255	Spare	16*114		
	256 bit 15	Extended_Frame_flag	1	0,1	0= nominal frame: HEADER, PAN frame, VNIR frame, SWIR frame. 1= extetended frame: it reports only header packet and PAN frame.
	256 bit 14 to 0	Spare	15		
	257 […] 583	Spare	16*327		
VARIABLE PART (Anc8Hz, Anc1Hz, HK subset) *From here there is the part containing Anc8Hz and Anc1HZ*	584	NAV_APROP_EKF_values	16 (uint)	0x0.. 0xFFFF	Bit15..12: EKF_rate Bit11..8: EKF_attitude Bit7..4: APROP_rate Bit3..0: APROP_attitude Range value for each nibble = [0..6] (see figure in 7.6.4.1)
	585 586	Navigation_time	32 (uint)	> 600825600	Navigation Time: number of seconds since 01/01/2000 00:00:00 Expected value: > 600825600 (15/01/2019)
	587 Bit 15-8	NAV_ENA_values	8 (uint)	0x0.. 0xFF	Bit_14_15= Enable Bias_ EKF Bit_12_13= Enable Bias_APROP Bit_10_11 = Enable EKF Bit_8_9 = Enable APROP Range value for each one = 0 (disable) or 1 (enable) (see figure in 7.6.4.1)
	587 Bit 7-0	NAV_ALG_values	8 (uint)	0x0.. 0xFF	bit3..0: ALG_attitude [1,2] bit7..4: ALG_rate [1,2] Range value for each nibble 1 (APROP) or 2 (EKF) . (see figure in 7.6.4.1)

	588 589	q_ECI_2_Body_1	32 (float)	IEEE	q_ECI_2_Body_1 Output of AOCS Navigation (available in each AOCS state). 1st component of the vectorial part of the quaternion representing a rotation from J2000 ECI reference frame to S/C body reference frame. Quaternion: Range [-1.0; +1.0] float 32 standard Bit [31]=sign Bit[30:23]=exp Bit[22:0] =mantissa
	590 591	q_ECI_2_Body_2	32 (float)	IEEE	q_ECI_2_Body_2 Output of AOCS Navigation (available in each AOCS state). 2nd component of the vectorial part of the quaternion representing a rotation from J2000 ECI reference frame to S/C body reference frame. Quaternion: Range [-1.0; +1.0] IEEE float 32 standard Bit [31]=sign Bit[30:23]=exp Bit[22:0] =mantissa
	592 593	q_ECI_2_Body_3	32 (float)	IEEE	q_ECI_2_Body_3 Output of AOCS Navigation (available in each AOCS state). 3rd component of the vectorial part of the quaternion representing a rotation from J2000 ECI reference frame to S/C body reference frame. Quaternion: Range [-1.0; +1.0] IEEE float 32 standard Bit [31]=sign Bit[30:23]=exp Bit[22:0] =mantissa

	594
	595
		q_ECI_2_Body_4	32 (float)	IEEE	q_ECI_2_Body_4
					Output of AOCS Navigation (available in each AOCS state).
					
					Scalar component of the quaternion representing a rotation from J2000 ECI reference frame to S/C body reference frame.
					
					Quaternion: Range [-1.0; +1.0]
					
					IEEE float 32 standard
					`Bit [31]=sign`
					`Bit[30:23]=exp`
					`Bit[22:0] =mantissa`

	596
	597
		w_body_1	32 (float)	IEEE	w_body_1
					Output of AOCS Navigation (available in each AOCS state)
					
					x-component of angular velocity expressed in the S/C body reference frame.
					
					Rad/s: range:-0.5:0.5
					
					IEEE float 32 standard
					`Bit [31]=sign`
					`Bit[30:23]=exp`
					`Bit[22:0] =mantissa`

	598
	599
		w_body_2	32 (float)	IEEE	w_body_2
					Output of AOCS Navigation (available in each AOCS state)
					
					y-component of angular velocity expressed in the S/C body reference frame.
					
					Rad/s: range:-0.5:0.5
					
					IEEE float 32 standard
					`Bit [31]=sign`
					`Bit[30:23]=exp`
					`Bit[22:0] =mantissa`

	600
	601
		w_body_3	32 (float)	IEEE	w_body_3
					Output of AOCS Navigation (available in each AOCS state)
					
					z-component of angular velocity expressed in the S/C body reference frame.
					
					Rad/s: range:-0.5:0.5
					
					IEEE float 32 standard
					`Bit [31]=sign`
					`Bit[30:23]=exp`
					`Bit[22:0] =mantissa`

	602	Time_day_ss	16 (uint)	0x0.. 0xFFFF	Start sensor data, taken from Anc8Hz message Number of days since 1st Jan 1958
	603 604	Time_msec_ss	32 (uint)	0x0.. 0xFFFFFFFF	Milliseconds of day. Range: 0:86400000
	605 Bit 15-8	Data_valid_ss	8 (uint)	0x0.. 0xFF	Binary coded attitude validity flags 00 = NEAT/HEAT with quaternion 01 = NEAT/HEAT without quaternion 10 = NEAT/HEAT error Bit 7: set if quaternion is not valid Bit 6: set if angular rate is not valid Bit 5-2: spare set to 0 Bit 1-0: cycle status (for NEAT/HEAT)
	605 Bit 7-0	Attitude_status_ss	8 (uint)	0x0.. 0xFF	Status of attitude, it can assume following values: 0 = no error 1 = not enough (<2) matched stars in AAD 2 = not enough (<1) pre-processed segments in AAD search 3 = not enough (< 1) objects after clustering in AAD search 4 = number of predicted stars is lower than number of tracked stars in AAD_P confirmation 5 = only zero or one tracking window has been prepared for the next NEAT/HEAT/AAD_V cycle 6 = spare 7 = not enough linked stars (if AAD_P, AAD_V, NEAT, HEAT) 8 = angular rate higher than ω max (settable parameter mode depending) 9 = quaternion not convergent
	606 607	Quaternion_1_ss	32 (int)	0xfff0bdc0 0x000f4240	Quaternion*10^6: Range -10^6:10^6 1st component of the vectorial part of the quaternion representing a rotation between the J2000 ECI reference frame and the Star Sensor reference frame [RD-15]
	608 609	Quaternion_2_ss	32 (int)	0xfff0bdc0 0x000f4240	Quaternion*10^6: Range -10^6:10^6 2nd component of the vectorial part of the quaternion representing a rotation between the J2000 ECI reference frame and the Star Sensor reference frame [RD-15]

	610 611	Quaternion_3_ss	32 (int)	0xfff0bdc0 0x000f424 0	Quaternion*10^6: Range -10^6:10^6 3rd component of the vectorial part of the quaternion representing a rotation between the J2000 ECI reference frame and the Star Sensor reference frame [RD-15]
	612 613	Quaternion_4_ss	32 (int)	0xfff0bdc0 0x000f424 0	Quaternion*10^6: Range -10^6:10^6 Scalar component of the quaternion representing a rotation between the J2000 ECI reference frame and the Star Sensor reference frame. [RD-15]
	614 615	Omega_x_ss	32 (int)	0x0007a12 0 0xfff85ee0	Rad/s*10^6: range:-0.5e+6:0.5e+6 x-component of angular velocity expressed in the J2000 ECI reference frame.
	616 617	Omega_y_ss	32 (int)	0x0007a12 0 0xfff85ee0	Rad/s*10^6: range:-0.5e+6:0.5e+6 y-component of angular velocity expressed in the J2000 ECI reference frame.
	618 619	Omega_z_ss	32 (int)	0x0007a12 0 0xfff85ee0	Rad/s*10^6: range:-0.5e+6:0.5e+6 z-component of angular velocity expressed in the J2000 ECI reference frame.
	620 621 Bit 15-8	Gyro_1_data_ angle	24 (24 bit of an int 32)	0x800000 0x7FFFFF	Gyro 1 data, taken from Anc8Hz message It is a 24-bit integer data type. Range [-8388608 ; +8388607]. To properly use this datum a specific conversion is needed. According to [RD-14] for Incremental Angle Mode: LSB value: 2.384 * 10-7°; Range of Incremental Angle +-2°. See [RD-15] for the definition of Gyro reference frame.

	621 Bit 7-0	Gyro_1_data_byte	8 (uint)	0x0.. 0xFF	8bit Gyro_1 Status Byte Range [0-0xFF]. Bitwise of: Bit0 = NOGO (0x1) Bit1 = Reset acknowledge (0x2) Bit2 = Not Used Bit3 = Temp. warning (0x8) Bit4 = Auxiliary Control Loop Error (0x10) Bit5 = HW Bit Error (0x20) Bit6 = Measurement Range Exceeded (0x40) Bit7 = Unknown command (0x80)
	622 623 Bit 15-8	Gyro_2_data_ angle	24 (24 bit of an int 32)	0x800000 0x7FFFFF	Gyro 2 data, taken from Anc8Hz message For range and values see description of word 620 and 621 Bit 15-8 1° bit is the sign
	623 Bit 7-0	Gyro_2_data_byte	8 (uint)	0x0.. 0xFF	8bit Gyro_2 Status Byte For range and values see description of word 621 Bit 7-0
	624 625 Bit 15-8	Gyro_3_data_angle	24 (24 bit of an int 32)	0x800000 0x7FFFFF 1° bit is the sign	Gyro 3 data, taken from Anc8Hz message For range and values see description of word 620 and 621 Bit 15-8
	625 Bit 7-0	Gyro_3_data_byte	8 (uint)	0x0.. 0xFF	8bit Gyro_3 Status Byte For range and values see description of word 621 Bit 7-0
	626 627 Bit 15-8	Gyro_4_data_ angle	24 (24 bit of an int 32)	0x800000 0x7FFFFF	Gyro 4 data, taken from Anc8Hz message For range and values see description of word 620 and 621 Bit 15-8 1° bit is the sign
	627 Bit 7-0	Gyro_4_data_byte	8 (uint)	0x0.. 0xFF	8bit Gyro_4 Status Byte For range and values see description of word 621 Bit 7-0
	628 629 Bit 15-8	Gyro_5_data_angle	24 (24 bit of an int 32)	0x800000 0x7FFFFF	Gyro 5 data, taken from Anc8Hz message For range and values see description of word 620 and 621 Bit 15-8 1° bit is the sign
	629 Bit 7-0	Gyro_5_data_byte	8 (uint)	0x0.. 0xFF	8bit Gyro_5 Status Byte For range and values see description of word 621 Bit 7-0

	630 631 Bit 15-8	Gyro_6_data_ angle	24 (24 bit of an int 32)	0x800000 0x7FFFFF	Gyro 6 data, taken from Anc8Hz message For range and values see description of word 620 and 621 Bit 15-8 1° bit is the sign
	631 Bit 7-0	Gyro_6_data_byte	8 (uint)	0x0.. 0xFF	8bit Gyro_6 Status Byte For range and values see description of word 621 Bit 7-0
	632 Bit 15-8	Star_sensors_&_Gyros_Data_validity	8 (uint)	0x0.. 0xFF	Validity flags: 1 means available, 0 not available. Bit 8: Star Sensor1 (1 means SS1 copied in TC) Bit 9: Star Sensor2 (1 means SS2 copied in TC) The value bit8=1 and bit9=1 at the same time is not allowed. Bit 15..10: gyro flags Bit_10 = gyro_1A validity flag (1=valid, 0 = not valid) Bit_11 = gyro_2A validity flag (1=valid, 0 = not valid) Bit_12 = gyro_3A validity flag (1=valid, 0 = not valid) Bit_13 = gyro_1B validity flag (1=valid, 0 = not valid) Bit_14 = gyro_2B validity flag (1=valid, 0 = not valid) Bit_15 = gyro_3B validity flag (1=valid, 0 = not valid)
	632 Bit 7-0	AOCS_Stat	8 (uint)	0x0.. 0xFF	AOCS Status, taken from Anc8Hz message AOCS Current SW State: 1=Damping, 2 =Coarse, 3=StandBy, 4=Fine, 5=Orbit, 6=Safe, 7=Initial Test
	633 634	Wgs84_pos_x	32 (float)	IEEE	GPS Data, taken from Anc1Hz message Float. GPS Position [m] x-component of the S/C position expressed in the WGS84 ECEF reference frame. Range:-10^7+10^7 IEEE float 32 standard Bit [31]=sign Bit[30:23]=exp Bit[22:0] =mantissa

	635 636	Wgs84_pos_y	32 (float)	IEEE	Float. GPS Position [m] y-component of the S/C position expressed in the WGS84 ECEF reference frame. Range:-10^7+10^7 IEEE float 32 standard Bit [31]=sign Bit[30:23]=exp Bit[22:0] =mantissa
	637 638	Wgs_84_pos_z	32 (float)	IEEE	Float. GPS Position [m] z-component of the S/C position expressed in the WGS84 ECEF reference frame. Range:-10^7+10^7 IEEE float 32 standard Bit [31]=sign Bit[30:23]=exp Bit[22:0] =mantissa
	639 640	Wgs84_vel_x	32 (float)	IEEE	Float. GPS Velocity [m/s] x-component of the S/C velocity expressed in the WGS84 ECEF reference frame. Range. -10^4+10^4 IEEE float 32 standard Bit [31]=sign Bit[30:23]=exp Bit[22:0] =mantissa
	641 642	Wgs84_vel_y	32 (float)	IEEE	Float. GPS Velocity [m/s] y-component of the S/C velocity expressed in the WGS84 ECEF reference frame. Range. -10^4+10^4 IEEE float 32 standard Bit [31]=sign Bit[30:23]=exp Bit[22:0] =mantissa
	643 644	Wgs84_vel_z	32 (float)	IEEE	Float. GPS Velocity [m/s] z-component of the S/C velocity expressed in the WGS84 ECEF reference frame. Range. -10^4+10^4 IEEE float 32 standard Bit [31]=sign Bit[30:23]=exp Bit[22:0] =mantissa
	645	Week_Number	16 (short)	0x0.. 0xFFFF	Weeks since 6/1/1980 Range: 1900-2500

	646 647 648 649	GPS_Time_of_Last _Position	64 (double)	IEEE	Seconds in week Range: 0- 604800 The UTC shall be derived subtracting the leap seconds (according to IERS Bulletin C). IEEE double 64 standard Bit [63]=sign Bit[62:52]=exp Bit[51:0] =mantissa
	650 651	Clock Bias (* speed of light c)	32 (float)	IEEE	Float GPS Clock Bias [m] Range: -1000:+1000 IEEE float 32 standard Bit [31]=sign Bit[30:23]=exp Bit[22:0] =mantissa
	652 653	Clock Bias Rate (* speed of light c)	32 (float)	IEEE	Float GPS Clock Bias Rate [m/s] Range: -1000:+1000 IEEE float 32 standard Bit [31]=sign Bit[30:23]=exp Bit[22:0] =mantissa
	654 Bit 15-8	Number of Satellites	8 (uint)	0x0.. 0xFF	Number of Satellites used in position fix. Range: 0:50
	654 Bit 7-0	Gdop	8 (uint)	0x0.. 0xFF	Uint 8 Geometric Dilution of Precision GDOP*10 Range: 0:100
	655 Bit 15-8	Position Fix Validity	8 (uint)	0x0.. 0xFF	Uint8 Position Fix Validty 0 = No Navigation 1 = 2D Fix 2 = 3D Fix
	655 Bit 7-0	GPS-OBDH Synch Status	8 (uint)	0x0.. 0xFF	Flag 0/1: 1 means OBDH is synchronized with GPS
From here there is the part containing PL HKs	656 657 658 659	HK_UTC_TIME	64	TTAG See par 6.3.8	ME time at the moment of HK collecting Word n. 656 is the MSW , word n. 659 is the LSW.
	660 Bit 15-8	SW_MODE	8	0x01...0x06 0x11 0x12	PL SW Actual mode 0x01=INI 0x03=IDLE, 0x02=SURV 0x04=SW_MAINT, 0x05= DEIC_MAINT 0x06=SW_UPD 0x11= ACQ 0x12=CAL

	660 Bit 7-0	SW_PREMODE	8	0x01...0x06 0x11 0x12	PL SW previous mode 0x01=INI 0x03=IDLE, 0x02=SURV 0x04=SW_MAINT, 0x05= DEIC_MAINT 0x06=SW_UPD 0x11= ACQ 0x12=CAL
	661 Bit 15-2	SYNCHRO_STATUS	14	0..2	Info about the synchro mode code reception. 0=Received 1=Not received 2=Received with wrong period (outside the PL "locking slot")
	661 Bit 1-0	TOD_STATUS	2	0b01 0b10 0b11	Contains the info about the last TOD reception. 0b01=synchronization with TOD not executed due to running acquisition 0b10=TOD message not received for a time >600 sec (TBC) 0b11=Synchronization with TOD OK
	662 Bit 15-8	Spare	8		
	662 Bit 7-6	SEC_COM	2	0x0..0x3	SDAC Secondary Communication Register, as reported by SDAC Technical Note on FPGA registers space. The used fields are the following: 1: BUF_ERR: The amount of data to send to the PDHT is greater than the maximum allowable by PDHT link rate 0: SEC_IF_ERR: Error condition on the TM/TC I/F, the source of error are in write or read transactions.
	662 Bit 5-0	Spare	6		
	663	PS_VOLT_5V	16	0x0.. 0x0FFF	Power Supply 5V value Unit: V Conversion: $2.004 * \frac{5 * DN}{4096}$
	664	PS_VOLT_28V	16	0x0.. 0x0FFF	Power Supply 28V value Unit: V Conversion: $11.722 * \frac{5 * DN}{4096}$

	665	PSR_VOLT_28V	16	0x0.. 0x0FFF	Regulated Power Supply 28V value Unit: V Conversion: $$11.494 * \frac{5 * DN}{4096}$$
	666	PS_VOLT_3_3V	16	0x0.. 0x0FFF	Power Supply 3.3V value Unit: V Conversion: $$\frac{5 * DN}{4096}$$
	667	V_LAMP	16	0x0.. 0x0FFF	Lamp voltage Unit: V Conversion: $$\frac{Ro}{R1} * \frac{5 * DN}{4096}$$ where Ro = 10 kΩ, R1 = 7.87 kΩ
	668	PS_VOLT_6V	16	0x0.. 0x0FFF	Power Supply 6V value Unit: V Conversion: $$2.427 * \frac{5 * DN}{4096}$$
	669	V_LED	16	0x0.. 0x0FFF	Led voltage Unit: V Conversion: $$\frac{Ro}{R1} * \frac{5 * DN}{4096}$$ where Ro = 10 kΩ, R1 = 7.87 kΩ
	670	PS_VOLT_MINUS_15V	16	0x0.. 0x0FFF	Power Supply -15V value Unit: V Conversion: $$-6.0437 * \frac{5 * DN}{4096}$$

	671	PS_VOLT_PLUS_15V	16	0x0.. 0x0FFF	Power Supply +15V value Unit: V Conversion: $6.0437 * \frac{5 * DN}{4096}$
	672	I_PHOTODIODE_SIGNAL	16	0x0.. 0x0FFF	Photodiode current (signal) Unit: A Conversion: (DN * 5 / 4096 – 0.65) / (2000 * 1.3)
	673	I_PHOTODIODE_SAFETY	16	0x0.. 0x0FFF	Photodiode current (safety) Unit: A Conversion: (DN * 5 / 4096 – 0.65) / (2000 * 0.65)

	674	POSITON_SOLAR_PORT_MAIN_COVER_HES	16	0x0.. 0xFFFF	Position for Main Cover and Solar Port HES Four least significant bits as follows: D3 = SP_CP = Status of the HES placed at close position of the Solar Port. D2 = SP_OP = Status of the HES placed at open position of the Solar Port. 0 it means HES is activated; 1 it means HES is not activated nom values: 0x4 (SolarPort CLOSED) 0x8 (SolarPort OPEN) during movement, the value can be 0xC (Solar Port is not Open nor Closed, indeed it is in intermediate position) D1 = MP_CP = Status of the HES placed at close position of the Main Port. D0 = MP_OP = Status of the HES placed at open position of the Main Port. 0 it means HES is activated; 1 it means HES is not activated nom values: 0x1 (MPM door CLOSED) 0x2 (MPM door OPEN) during movement, the value can be 0x3 (MPM Door is not Open nor Closed, indeed it is in intermediate position) D15 = Main port motor overload status (0=Nominal ; 1= Overload)
	675	SPS_STATUS	16	0x0.. 0xFFFF	Sun Protection System Status (Enable/Disable) 0 = disable 1 = enable
	676	RTC_C_4W_1	16	0x0.. 0x0FFF	DN corresponding to the Calibration resistance 4W RTD 1 to be used in the Rt calculation in the conversion of the Temperature (for example refer to the formula reported into TMA_T1)

	677	RTC_C_4W_2	16	0x0.. 0x0FFF	DN corresponding to the Calibration resistance 4W RTD 2 to be used in the Rt calculation in the conversion of the Temperature (for example refer to the formula reported into TMA_T1)
	678	RTC_C_2W_1	16	0x0.. 0x0FFF	DN corresponding to the Calibration resistance 2W RTD 1 to be used in the Rt calculation in the conversion of the Temperature (for example refer to the formula reported into TMA_T1)
	679	RTC_C_2W_2	16	0x0.. 0x0FFF	DN corresponding to the Calibration resistance 2W RTD 2 to be used in the Rt calculation in the conversion of the Temperature (for example refer to the formula reported into TMA_T1)
	680	POS_POT	16	0x0.. 0x0FFF	Potentiometer angle Unit: Degrees Conversion: $\frac{90}{4} * (\frac{5 * DN}{4096} - 0.5)$
	681 Bit 15-14	Spare	2		
	681 Bit 13-12	Spare	2		
	681 Bit 11-10	Spare	2		
	681 Bit 9-8	Spare	2		
	681 Bit 7-6	MAIN_PORT_LOCK_EN	2	0/1	Main Cover Lock 1=ENABLED 0=DISABLED
	681 Bit 5-4	Spare	2		
	681 Bit 3-2	MAIN_PORT_EMERGENCY_EN	2	0/1	Main Cover Emergency mechanism 1=ENABLED 0=DISABLED
	681 Bit 1-0	SOLAR_PORT_EMERGENCY_EN	2	0/1	Solar Port emergency mechanism 1=ENABLED 0=DISABLED
	682	SWIR_PE_ERR	16	0x0.. 0xFFFF	SWIR PE Error Status bit [15:1]=spare, bit 0 = IF_ERR: TC/TM interface error flag PE proper document).

	683	SWIR_PE_ STATUS1	16	0x0.. 0xFFFF	SWIR PE Status Bit15:8=SPARE Bit7:5=SWIR Detector Status: * 000 = READY * 001 = OPERATING * 010 = TEST PATTERN * 011 = PRE OPERATING * 100 = WAIT (POST-LU) * 101 = TRANSIENT Bit4=LUR it is Latch Up Recovery, where: * 0 INACTIVE bias * 1 ACTIVE bias Bit 3:1=LUS it is Latch Up Status: bit 3= +5VDD_Latch_in bit 2=+5VDDA_Latch_in bit 1=+5VDDO_Latch_in where: * 1 is Latch-Up event * 0 not Latch-Up event Bit0=STATUS_DET_SWIR displays the status of detector SWIR (1 on, 0 off)
	684	SWIR_PE_ STATUS2	16	0x0.. 0xFFFF	SWIR PE Status bit [15:2] = spare bit [1:0] =PDS that is Serializers’ Power Down Status (0 is Power Down)
	685	SWIR_PE_VDET	16	0x0.. 0x0FFF	SWIR PE VDET voltage Unit: V V=4,997*DN/4096
	686	SWIR_PE_VDDA	16	0x0.. 0x0FFF	SWIR PE VDDA voltage Unit: V V=4,997*2*DN/4096
	687	SWIR_PE_VDD	16	0x0.. 0x0FFF	SWIR PE VDD voltage Unit: V V=4,997*2*DN/4096
	688	SWIR_PE_VDDO	16	0x0.. 0x0FFF	SWIR PE VDDO voltage Unit: V V=4,997*2*DN/4096

	689	SWIR_PE_6.5PWR	16	0x0.. 0x0FFF	SWIR PE 6.5 PWR Unit: V V=4,997*5,008*DN/4096
	690	VNIR_PE_ERR	16	0x0.. 0xFFFF	VNIR PE error status bit [15:1]=spare, bit 0 = IF_ERR: TC/TM interface error flag PE proper document).
	691	VNIR_PE_ STATUS1	16	0x0.. 0xFFFF	VNIR PE Status Bit15:8=SPARE Bit7:5= VNIR Detector Status: * 000 = READY * 001 = OPERATING * 010 = TEST PATTERN * 011 = PRE OPERATING * 100 = WAIT (POST-LU) * 101 = TRANSIENT Bit4=LUR it is Latch Up Recovery, where: * 0 INACTIVE bias * 1 ACTIVE bias Bit 3:1=LUS it is Latch Up Status: bit 3= +5VDD_Latch_in bit 2=+5VDDA_Latch_in bit 1=+5VDDO_Latch_in where: * 1 is Latch-Up event * 0 not Latch-Up event Bit0=STATUS_DET_ VNIR displays the status of detector VNIR (1 on, 0 off)
	692	VNIR_PE_ STATUS2	16	0x0.. 0xFFFF	VNIR PE Status bit [15:2] = spare bit [1:0] =PDS that is Serializers' Power Down Status (0 is Power Down)
	693	VNIR_PE_VDET	16	0x0.. 0x0FFF	VNIR PE VDET voltage Unit: V V=4,942*DN/4096
	694	VNIR_PE_VDDA	16	0x0.. 0x0FFF	VNIR PE VDDA voltage Unit: V V=4,942*2*DN/4096

	695	VNIR_PE_VDD	16	0x0.. 0x0FFF	VNIR PE VDD voltage Unit: V V=4,942*2*DN/4096
	696	VNIR_PE_VDDO	16	0x0.. 0x0FFF	VNIR PE VDDO voltage Unit: V V=4,942*2*DN/4096
	697	VNIR_PE_6.5PWR	16	0x0.. 0x0FFF	VNIR PE 6.5 PWR Unit: V V=4,942*5,008*DN/4096
	698	PAN_PE_ERR	16	0x0.. 0xFFFF	PAN PE Error status bit [15:1]=spare, bit 0 = IF_ERR: TC/TM interface error flag PE proper document).
	699	PAN_PEV3.3	16	0x0.. 0x0FFF	PAN PE 3.3V voltage Unit: V V=5,0002*DN/4096
	700	PAN_PE_V6.5	16	0x0.. 0x0FFF	PAN PE 6.5V voltage Unit: V V=5,0002*DN*2/4096
	701	PAN_PE_V13DR	16	0x0.. 0x0FFF	PAN PE 13V DR voltage Unit: V V=5,0002*DN*5/4096
	702	PAN_PE_V-6.5	16	0x0.. 0x0FFF	PAN PE -6.5V voltage Unit: V V=-5,0002*DN*2/4096
	703	PAN_PE_V18.5	16	0x0.. 0x0FFF	PAN PE 18.5V voltage Unit: V V=5,0002*DN*5,03/4096

	704	PAN_PE_STATUS1	16	0x0.. 0xFFFF	PAN PE status Bit[15:4] = spare Bit[3:1] = PAN_STS it is PAN status: * 000 = READY * 001 = OPERATING * 010 = TEST PATTERN * 011 = PRE-OPERATIVE * 100 = TRANSIENT Bit 0 = STATUS_DET_PAN displays the status of detector PAN (1 on, 0 off)
	705	PAN_PE_STATUS2	16	0x0.. 0xFFFF	PAN PE status bit [15:1] = spare bit [0] =PDS that is Serializers' Power Down Status (0 is Power Down)
	706	FPA_SWIR_T1	16	0x0.. 0x0FFF	SWIR FPA Temperature 1 Unit: K Conversion: $T = -460.6631Vd^4 + 1052.8133Vd^3 - 812.6656Vd^2 - 227.7627Vd + 539.6459$ Vd = 4.997 / 4096 * 2.49 / 12.49 * DN
	707	FPA_SWIR_T2	16	0x0.. 0x0FFF	SWIR FPA Temperature 2 Unit: K Conversion: $T = -460.6631Vd^4 + 1052.8133Vd^3 - 812.6656Vd^2 - 227.7627Vd + 539.6459$ Vd = 4.997 / 4096 * 2.49 / 12.49 * DN
	708	FPA_VNIR_T1	16	0x0.. 0x0FFF	VNIR FPA Temperature 1 Unit: K Conversion: $T = -460.6631Vd^4 + 1052.8133Vd^3 - 812.6656Vd^2 - 227.7627Vd + 539.6459$ Vd = 4.942 / 4096 * 2.49 / 12.49 * DN

	709	FPA_VNIR_T2	16	0x0.. 0x0FFF	VNIR FPA Temperature 2 Unit: K Conversion: T = $-460.6631Vd^4 + 1052.8133Vd^3 - 812.6656Vd^2 - 227.7627Vd + 539.6459$ Vd =4.942 / 4096 * 2.49 / 12.49 * DN
	710	FPA_PAN_T1	16	0x0.. 0x0FFF	PAN FPA Temperature 1 Unit: K Conversion: DN * (5 / 4096) * 100 (=10mv/K)
	711	FPA_PAN_T2	16	0x0.. 0x0FFF	PAN FPA Temperature 2 Unit: K Conversion: DN * (5 / 4096) * 100 (=10mv/K)
	712	PE_SWIR_T	16	0x0.. 0x0FFF	SWIR PE temperature Unit: K Conversion: DN * (5 / 4096) * 500 (=2mv/K)
	713	PE_VNIR_T	16	0x0.. 0x0FFF	VNIR PE temperature Unit: K Conversion: DN * (5 / 4096) * 500 (=2mv/K)
	714	PE_PAN_T	16	0x0.. 0x0FFF	PAN PE temperature Unit: K Conversion: DN * (5 / 4096)* 100 (=10mv/K)

<table>
<tr><td></td><td>715</td><td>TMA_T1</td><td>16</td><td>0x0..
0x0FFF</td><td>TMA temperature 1
Unit: K

Conversion: DN->Ω

Rt fine calibration formula:
$RT = \frac{(DN - DN1\_4W)) * (R2\_4W - R1\_4W)}{(DN2\_4W - DN1\_4W)} + R1\_4W$

Where
DN1_2w = HK RTC_C_2W_1 word 678
DN2_2w = HK RTC_C_2W_2 word 679
DN1_4w = HK RTC_C_4W_1 word 676
DN2_4w = HK RTC_C_4W_2 word 677
R1_2W=357 Ω
R2_2W=1270 Ω
R1_4W=357 Ω
R2_4W=1270 Ω

Rt Coarse Calibration Formula(*):

Note: the Rt coarse calibration formula approximates the RT fine calibration formula; for RT conversion considering DN1/2_2w and DN1/2_4w that may change in time. It is recommended to use the Rt fine calibration formula instead of the coarse one.

RT= DN*0,32960289+192,1986

(*) Coarse formula uses following DN values for the calibration resistances:
RTC C 2W 1 501
RTC C 2W 2 3266
RTC C 4W 1 500
RTC C 4W 2 3270

CONVERTION Ω->K
<table><tr><td>R0</td><td>A</td><td>B</td></tr><tr><td>1,00E+03</td><td>3,94E-03</td><td>-5,39E-07</td></tr></table>
$T(K) = \frac{-R_0A + \sqrt{(R_0A)^2 - 4R_0B(R_0 - R_t)}}{2R_0B} + 273,15$</td></tr>
<tr><td></td><td>716</td><td>TMA_T2</td><td>16</td><td>0x0..
0x0FFF</td><td>TMA temperature 2
Unit: K

Conversion DN->see TMA_T1</td></tr>
<tr><td></td><td>717</td><td>TMA_T3</td><td>16</td><td>0x0..
0x0FFF</td><td>TMA temperature 3
Unit: K

Conversion DN->see TMA_T1</td></tr>
</table>

<table>
<tr><td></td><td>718</td><td>UP_CARTER_T</td><td>16</td><td>0x0..
0x0FFF</td><td>Temperature of UP carter
Unit: K

Conversion: DN->Ω

Rt fine calibration formula:

$RT = \frac{(DN - DN1\_2W)) * (R2\_2W - R1\_2W)}{(DN2\_2W - DN1\_2W)} + R1\_2W$

Where
DN1_2w = HK RTC_C_2W_1 word 678
DN2_2w = HK RTC_C_2W_2 word 679
DN1_4w = HK RTC_C_4W_1 word 676
DN2_4w = HK RTC_C_4W_2 word 677
R1_2W=357 Ω
R2_2W=1270 Ω
R1_4W=357 Ω
R2_4W=1270 Ω

Rt Coarse Calibration Formula(*):

Note: the Rt coarse calibration formula approximates the RT fine calibration formula; for RT conversion considering DN1/2_2w and DN1/2_4w that may change in time. It is recommended to use the Rt fine calibration formula instead of the coarse one.

RT= DN*0,33019892+191,5703

(*) Coarse formula uses following DN values for the calibration resistances:
RTC C 2W 1 501
RTC C 2W 2 3266
RTC C 4W 1 500
RTC C 4W 2 3270

Conversion Ω->K

<table><tr><td>R0</td><td>A</td><td>B</td></tr><tr><td>1,00E+03</td><td>3,94E-03</td><td>-5,39E-07</td></tr></table>
$T(K) = \frac{-R_0A + \sqrt{(R_0A)^2 - 4R_0B(R_0 - R_t)}}{2R_0B} + 273{,}15$</td></tr>
<tr><td></td><td>719</td><td>LOW_CARTER_T</td><td>16</td><td>0x0..
0x0FFF</td><td>Temperature of LOW carter
Unit: K

Conversion DN->K see UP_CARTER_T</td></tr>
</table>

<table>
<tr><td></td><td>720</td><td>SPECT_T1</td><td>16</td><td>0x0..
0x0FFF</td><td>Spectrometer temperature 1
Unit: K

Conversion DN->K see TMA_T1

Using following parameters:

Nominal ME:
<table><tr><td>R0</td><td>A</td><td>B</td></tr><tr><td>1000,572</td><td>0,003935</td><td>-5,94E-07</td></tr></table>Redundant ME:
<table><tr><td>R0</td><td>A</td><td>B</td></tr><tr><td>1000,601</td><td>0,003936</td><td>-6,06E-07</td></tr></table></td></tr>
<tr><td></td><td>721</td><td>SPECT_T2</td><td>16</td><td>0x0..
0x0FFF</td><td>Spectrometer temperature 2
Unit: K

Conversion DN->K see TMA_T1

Using following parameters:

Nominal ME:
<table><tr><td>R0</td><td>A</td><td>B</td></tr><tr><td>1000,533</td><td>0,003936</td><td>-6,06E-07</td></tr></table>Redundant ME:
<table><tr><td>R0</td><td>A</td><td>B</td></tr><tr><td>1000,460</td><td>0,003936</td><td>-6,06E-07</td></tr></table></td></tr>
<tr><td></td><td>722</td><td>SPECT_T3</td><td>16</td><td>0x0..
0x0FFF</td><td>Spectrometer temperature 3
Unit: K
Conversion DN->K see TMA_T1

Using following parameters:

Nominal ME:
<table><tr><td>R0</td><td>A</td><td>B</td></tr><tr><td>1000,473</td><td>0,003934</td><td>-6,06E-07</td></tr></table>Redundant ME:
<table><tr><td>R0</td><td>A</td><td>B</td></tr><tr><td>1000,464</td><td>0,003937</td><td>-6,07E-07</td></tr></table></td></tr>
</table>

	723	TMA_M1_T	16	0x0.. 0x0FFF	TMA M1 temperature Unit: K Conversion DN->K see TMA_T1
	724	TMA_M2_T	16	0x0.. 0x0FFF	TMA M2 temperature Unit: K Conversion DN->K see TMA_T1
	725	TMA_M3_T	16	0x0.. 0x0FFF	TMA M3 temperature Unit: K Conversion DN->K see TMA_T1
	726	PRISM_VNIR_T1	16	0x0.. 0x0FFF	VNIR Prism temperature Unit: K Conversion DN->K see TMA_T1
	727	FPA_PT1000_VNIR_T	16	0x0.. 0x0FFF	Temperature of PT1000 on COLD STRAP close to VNIR FPA t Conversion:DN->Ω **Rt fine calibration formula:** $RT = \frac{(DN - DN1\_4W)) * (R2\_4W - R1\_4W)}{(DN2\_4W - DN1\_4W)} + R1_{4W} - DeltaOmega$ where ΔΩ=0.66 for MainElectronicMain ΔΩ=0.66 for MainElectronicRed Where DN1_2w = HK RTC_C_2W_1 word 678 DN2_2w = HK RTC_C_2W_2 word 679 DN1_4w = HK RTC_C_4W_1 word 676 DN2_4w = HK RTC_C_4W_2 word 677 R1_2W=357 Ω R2_2W=1270 Ω R1_4W=357 Ω R2_4W=1270 Ω **Rt Coarse Calibration Formula(*):** Note: the Rt coarse calibration formula approximates the RT fine calibration formula; for RT conversion considering DN1/2_2w and DN1/2_4w that may change in time. It is recommended to use the Rt fine calibration formula instead of the coarse one. RT= DN*0,329603+192,1986-ΔΩ (*) Coarse formula uses following DN values for the calibration resistances: RTC C 2W 1 501 RTC C 2W 2 3266 RTC C 4W 1 500 RTC C 4W 2 3270 Conversion Ω->K T = 0.241495582*Rt-242,328078 +273,15

	728	FPA_PT1000_SWIR_T	16	0x0.. 0x0FFF	Temperature of PT1000 on COLD STRAP close to SWIR FPA temperature Conversion:DN->Ω As FPA_PT1000_VNIR_T **Rt fine calibration formula:** $RT = \frac{(DN - DN1\_4W)) * (R2\_4W - R1\_4W)}{(DN2\_4W - DN1\_4W)} + R1_{4W} - DeltaOmega$ where ΔΩ=0.66 for MainElectronicMain ΔΩ=0.66 for MainElectronicRed Where DN1_2w = HK RTC_C_2W_1 word 678 DN2_2w = HK RTC_C_2W_2 word 679 DN1_4w = HK RTC_C_4W_1 word 676 DN2_4w = HK RTC_C_4W_2 word 677 R1_2W=357 Ω R2_2W=1270 Ω R1_4W=357 Ω R2_4W=1270 Ω **Rt Coarse Calibration Formula(*):** Note: the Rt coarse calibration formula approximates the RT fine calibration formula; for RT conversion considering DN1/2_2w and DN1/2_4w that may change in time. It is recommended to use the Rt fine calibration formula instead of the coarse one. RT= DN*0,329603+192,1986-ΔΩ (*) Coarse formula uses following DN values for the calibration resistances: RTC C 2W 1 501 RTC C 2W 2 3266 RTC C 4W 1 500 RTC C 4W 2 3270 Conversion Ω->K T = 0.241495582*Rt-242,328078 +273,15
	729	PRISM_SWIR_T2	16	0x0.. 0x0FFF	SWIR Prism temperature Unit: K Conversion DN->K see TMA_T1

	730	HEAT_PIPE_VNIR_T	16	0x0.. 0x0FFF	VNIR heat pipe temperature Unit: K Conversion: DN->Ω **Rt fine calibration formula:** $RT = \frac{(DN - DN1\_2W)) * (R2\_2W - R1\_2W)}{(DN2\_2W - DN1\_2W)} + R1_{2W} - DeltaOmega$ where : ΔΩ=6,4for MainElectronicMain ΔΩ=6,4for MainElectronicRed Where DN1_2w = HK RTC_C_2W_1 word 678 DN2_2w = HK RTC_C_2W_2 word 679 DN1_4w = HK RTC_C_4W_1 word 676 DN2_4w = HK RTC_C_4W_2 word 677 R1_2W=357 Ω R2_2W=1270 Ω R1_4W=357 Ω R2_4W=1270 Ω **Rt Coarse Calibration Formula(*):** Note: the Rt coarse calibration formula approximates the RT fine calibration formula; for RT conversion considering DN1/2_2w and DN1/2_4w that may change in time. It is recommended to use the Rt fine calibration formula instead of the coarse one. RT= DN*0,330199+191,5703-ΔΩ (*) Coarse formula uses following DN values for the calibration resistances: RTC C 2W 1 501 RTC C 2W 2 3266 RTC C 4W 1 500 RTC C 4W 2 3270 Conversion Ω->K T = 0.241495582*Rt-242,328078 +273,15

	731	HEAT_PIPE_SWIR_T	16	0x0.. 0x0FFF	SWIR heat pipe temperature Unit: K Conversion: DN->Ω As HEAT_PIPE_VNIR_T except than for DeltaOmega **Rt fine calibration formula:** $RT = \frac{(DN - DN1\_2W)) * (R2\_2W - R1\_2W)}{(DN2\_2W - DN1\_2W)} + R1_{2W} - DeltaOmega =$ where : ΔΩ=7,22for MainElectronicMain ΔΩ=7,22for MainElectronicRed Where DN1_2w = HK RTC_C_2W_1 word 678 DN2_2w = HK RTC_C_2W_2 word 679 DN1_4w = HK RTC_C_4W_1 word 676 DN2_4w = HK RTC_C_4W_2 word 677 R1_2W=357 Ω R2_2W=1270 Ω R1_4W=357 Ω R2_4W=1270 Ω **Rt Coarse Calibration Formula(*):** Note: the Rt coarse calibration formula approximates the RT fine calibration formula; for RT conversion considering DN1/2_2w and DN1/2_4w that may change in time. It is recommended to use the Rt fine calibration formula instead of the coarse one. RT= DN*0,330199+191,5703-ΔΩ (*) Coarse formula uses following DN values for the calibration resistances: RTC C 2W 1 501 RTC C 2W 2 3266 RTC C 4W 1 500 RTC C 4W 2 3270 Conversion Ω->K T = 0.241495582*Rt-242,328078 +273,15

	732	RADIATOR_SWIR	16	0x0.. 0x0FFF	Radiator SWIR Temperature Unit: K Conversion: DN->Ω As HEAT_PIPE_VNIR_T except than for DeltaOmega **Rt fine calibration formula:** $RT = \frac{(DN - DN1\_2W)) * (R2\_2W - R1\_2W)}{(DN2\_2W - DN1\_2W)} + R1_{2W} - DeltaOmega$ where : ΔΩ=8for MainElectronicMain ΔΩ=8,5for MainElectronicRed Where DN1_2w = HK RTC_C_2W_1 word 678 DN2_2w = HK RTC_C_2W_2 word 679 DN1_4w = HK RTC_C_4W_1 word 676 DN2_4w = HK RTC_C_4W_2 word 677 R1_2W=357 Ω R2_2W=1270 Ω R1_4W=357 Ω R2_4W=1270 Ω **Rt Coarse Calibration Formula(*):** Note: the Rt coarse calibration formula approximates the RT fine calibration formula; for RT conversion considering DN1/2_2w and DN1/2_4w that may change in time. It is recommended to use the Rt fine calibration formula instead of the coarse one. RT= DN*0,330199+191,5703-ΔΩ (*) Coarse formula uses following DN values for the calibration resistances: RTC C 2W 1 501 RTC C 2W 2 3266 RTC C 4W 1 500 RTC C 4W 2 3270 Conversion Ω->K T = 0.241495582*Rt-242,328078 +273,15
	733	ICU_T	16	0x0.. 0x0FFF	ICU temperature Unit: K Conversion DN->K see UP_CARTER_T
	734	LAMPS_T	16	0x0.. 0x0FFF	Lamps temperature Unit: K Conversion DN->K see UP_CARTER_T

	735	LEDS_T	16	0x0.. 0x0FFF	Leds temperature Unit: K Conversion DN->K see UP_CARTER_T
	736	TM_ES_OPPOSITE_SIDE_SA_BA	16	0x0.. 0x0FFF	Earth Shield Temperature Unit: K Conversion DN->K see UP_CARTER_T In case of MainElectornic Nominal, it is the thermistor on the ES Panel opposite to the Solar Array In case of Main Electronic Redundant, it is the thermistor on the ES Panel opposite to the Baffle

	737	RADIATOR_VNIR	16	0x0.. 0x0FFF	Radiator VNIR temperature Unit: K Conversion: DN->Ω As HEAT_PIPE_VNIR_T except than for DeltaOmega **Rt fine calibration formula:** $RT = \frac{(DN - DN1\_2W)) * (R2\_2W - R1\_2W)}{(DN2\_2W - DN1\_2W)} + R1_{2W} - DeltaOmega$ where : ΔΩ=8 for MainElectronicMain ΔΩ=6,7 for MainElectronicRed Where DN1_2w = HK RTC_C_2W_1 word 678 DN2_2w = HK RTC_C_2W_2 word 679 DN1_4w = HK RTC_C_4W_1 word 676 DN2_4w = HK RTC_C_4W_2 word 677 R1_2W=357 Ω R2_2W=1270 Ω R1_4W=357 Ω R2_4W=1270 Ω **Rt Coarse Calibration Formula(*):** Note: the Rt coarse calibration formula approximates the RT fine calibration formula; for RT conversion considering DN1/2_2w and DN1/2_4w that may change in time. It is recommended to use the Rt fine calibration formula instead of the coarse one. RT= DN*0,330199+191,5703-ΔΩ (*) Coarse formula uses following DN values for the calibration resistances: RTC C 2W 1 501 RTC C 2W 2 3266 RTC C 4W 1 500 RTC C 4W 2 3270 Conversion Ω->K T = 0.241495582*Rt-242,328078 +273,15
	738	TM_ES_SIDE_SA_BA	16	0x0.. 0x0FFF	Earth Shield Temperature Unit: K Conversion DN->K see UP_CARTER_T In case of MainElectornic Nominal, it is the thermistor on the ES Panel on the Solar Array side. In case of Main Electronic Redundant, it is the thermistor on the ES Panel on the Baffle side.
	739 bit 15-3	Spare	13		

	739 bit 2-0	PhotoDiode_High_Rate_Section	3	0…4	0 = register from 744..755 are not significant 1= register from 744…755 are significant.=> first group of the 48 samples is written. 2 = register from 744…755 are significant.=> second group of the 48 samples is written. 3 = register from 744…755 are significant.=> third group of the 48 samples is written. 4 = register from 744 to 755 are significant => fourth group of 48 samples is written. Unit: V Conversion: $0.522 * (\frac{5 * DN}{4096} - 0.45438)$

	740	SDAC_PRI-COM	16	0x0.. 0xFFFF	It is a copy of the SDAC Primary Communication register: **bit [15] FRAME_ERR**: high when the number of frames acquired is not equal to the programmed one after the reception of the END character. The bit is reset after the reception of the BEGIN character. **bit [14] PAN_PLOST**: high when the number of lines received from the PAN is not equal to the expected one (by setting the PAN_ACQ register bit 0). **bit [13] VNIR_PLOST**: high when the number of lines received from the VNIR is not equal to the expected one (by setting the VNIR_X[0..15] registers). . **bit [12] SWIR_PLOST**: high when the number of lines received from the SWIR is not equal to the expected one (by setting the SWIR_X[0..15] registers). The bit is reset after the reception of the BEGIN character. **bit [11] PAN_OVERR:** high when overrun condition occur on the PAN input Fifo. The bit is reset after the register is read. **bit [10] VNIR_OVERR**: high when overrun occur on the VNIR input Fifo. **bit [9] SWIR_OVERR**: This bit is high when overrun condition occur on the SWIR input Fifo. The bit is reset after the register is read. **bit [8]: PRI_IF_ERR** This bit is high when an error occurs on the TM/TC I/F. The bit is reset after the register is read. **bit[7:6]:NC** Not Used **bit [5]: FILL_STATUS** When the Autotest enable bit is set, it goeshigh when the memory banks have been filled **bit [4]: AUTOTEST_ENABLE** When the bit is set the SDAC FPGA fills the memories with a fixed pattern. Each location is written with five 12-bit pixels. Each pixel value is the previous one plus 1. **bit[3]: END_CMD** When issued the END character is sent on the PDHT I/F. The bit is auto cleared after it is written with 1. **bit[2]: BEGIN_CMD** When issued the BEGIN character is sent on the PDHT I/F. The bit is auto cleared after it is written with 1. **bit[1]: BANK_SWITCH_CMD** Switch of the variable part of the Header Packet. The bit is auto cleared after it is written with 1. The switch of the bank is performed on the reception of the Sync signal after the command is received. **bit[0]:** CCSDS_FRAME_RESET_CMD Reset command for the Frame counter inside the CCSDS packet. The bit is auto cleared after it is written with 1.

	741	SDAC_HEALTH	16	0x0.. 0xFFFF	The complete SDAC HEALTH register dump. **bit [11] PG_1V8:** Status of the POWER_GOOD signal of the 1.8V POL. Power is good when bit is high. **bit [10] PG_1V0:** Status of the POWER_GOOD signal of the 1.0V POL. Power is good when bit is high. **bit [9] PG_2V5:** Status of the POWER_GOOD signal of the 2.5V POL. Power is good when bit is high. **bit [8] PG_3V3:** Status of the POWER_GOOD signal of the 3.3V POL. Power is good when bit is high. **bit [7] PROG_ERR:** It goes high in case of failure of the Primary FPGA programming. **bit [6] PROG_END:** It goes high at the end of the Primary FPGA programming. **bit [5] FLASH_CFG_CMD:** Command that starts the loading of the bitstream located in the Flash memory into the Primary FPGA. The bit is auto cleared after it is written with 1. **bit [4] OTP_CFG_CMD:** Command that starts the loading of the bitstream located in the OTP memory into the Primary FPGA. The bit is auto cleared after it is written with 1. The command is executed automatically after power up. **bit [3:2]:** NC Not Used **bit [1] PROT_EN:** When high, enables the powering off the Primary FPGA when a POL voltage is not good. High at reset. **bit [0] PWR ON_OFF:** When high, Primary FPGA is powered ON. When low, Primary FPGA is powered OFF. High at reset.

	742	SDAC_COMP	16	0x0.. 0xFFFF	SWIR and VNIR Compressors setting and status. **bit [15:12]: N.C.** Not used **bit [11:8] FRAME_RESET:** Number of frames before prediction reset. Number of frames is: 16*FRAME_RESET Reset value is "001" (16 frames) **bit [7:4] Quantization:** Permitted values: 0x0; 0x1, 0x2, 0x3 Reset value is zero. **bit [3] VNIR_COMP_OVF:** This bit is high when the VNIR compressor internal buffer overflows. **bit [2] SWIR_B_COMP_OVF:** This bit is high when the SWIR_B compressor internal buffer overflows. **bit [1] SWIR_A_COMP_OVF:** This bit is high when the SWIR_A compressor internal buffer overflows. **bit [0]: COMP_EN** When this bit is set the SWIR and VNIR compressors are enabled. Reset value is zero.
	743	Spare	16		
	744[…] 755	I_PhotoDiode_High_Rate_Samples	12 words of 16 bit each	0x0.. 0x0FFF	Value samples (they represent a section of 12 samples) of photodiode current sampled during the opening/closing of the solar port (the total is made by 48 samples reported in 4 different sections of 12).
	756	SPARE	16		
	757	SPARE	16		
CHECKSUM (written automatically by FPGA)	758	Packet Error Control	16	0x0.. 0xFFFF	This field is calculated as reported in [RD1]

Table 6-5: Format of the Source Data Field for header packet type

Notes on the usage of header packet information:

(1) FRAME_NUM: this is the frame counter;

(2) Image_id, used to give a feedback to the Acquisition Plan AUX file;

(3) UTC time: this is the time of the first frame of the current sub-acquisition. It is used together with the FRAME_NUM to assign the time of acquisition to each frame packet:

*Frame UTC_TIME = Header.Utc_time + Header.Sync_time *(PacketControlField.FrameNumber-Header.PreviousAcquiredFrames-1)*

where Tsync is the along-track sampling time extracted from the header.

Acquisition_Type, Acquisition_Purpose, Frame_Type (sub-acquisition phase): used to identify the L0a file type to which the frames have to be dispatched. The next table summarize the available choices.

Acquisition Type	**Acquisition Purpose**	**Frame_Type**
EARTH-OBSERVATION ()	NOT SPECIAL PRODUCT ()	DARK-OBS ()
		SURFACE-OBS ()
		DARK-OBS ()
	SPECIAL PRODUCT FOR VALIDATON ()	DARK-OBS ()
		SURFACE-OBS ()
		DARK-OBS ()
DARK CALIBRATION ()	NOT SPECIAL PRODUCT ()	DARK-OBS ()
INTERNAL-CALIBRATION ()	NOT SPECIAL PRODUCT ()	BACKGROUND ()X 4 Tint
		DARK-INT ()X 4 Tint
		LED()X 1Tint
		LAMP ()X3 Tint
		DARK-INT ()X 4 Tint
		BACKGROUND ()X 4 Tint
	SPECIAL PRODUCT FOR CALIBRATION ()	BACKGROUND () X 20 Tint
		DARK-INT () x 20 Tint
		LED () X 3 Tint
		LAMP () X 17 Tint
		DARK-INT () x 20 Tint
		BACKGROUND () x 20 Tint
SUN CALIBRATION ()	SPECIAL PRODUCT FOR CALIBRATION ()	DARK-INT () x 20 Tint
		SUN-OBS () X 20 Tint
		DARK_INT () x 20 Tint
MOON CALIBRATION ()	SPECIAL PRODUCT FOR CALIBRATION ()	DARK-OBS ()
		MOON-OBS ()
		DARK-OBS ()
FLAT-FIELD SPECIAL ()	SPECIAL PRODUCT FOR CALIBRATION ()	DARK-OBS ()
		EXTERNAL-FF ()
		DARK-OBS ()
SUN FLUX CALIBRATION ()	SPECIAL PRODUCT FOR CALIBRATION ()	DARK-INT ()
		SUN-FLUX ()
		DARK_INT ()
AUTOTEST()	SPECIAL PRODUCT FOR CALIBRATION ()	AUTOTEST()

Table 6-6: Schema of Acquisition Purposes and Frame Types for each Acquisition Types

6.3.4.2 SOURCE DATA FIELD FOR VNIR/SWIR/PAN PACKETS

For packets containing the data collected from a scene or coming from calibration, the source data field contains a sequence of 1000 Digital Numbers (DN) 16 bits coded. The retrieval of the spectral information shall take into account the information concerning grouping, binning and spectral selection extracted from the header packet. Grouping, binning and spectral selection at this level are those fixed by PRS_TC_ACQUISITON telecommand.

Field Name	Type	Remarks	Byte#

Source Data Field	Bit	List of Pixel coded as Digital Number 16 bit each (For each packets 1000 pixel)	From 15 to 2014

Table 6-7: Format of the Source Data Field for image packet type

If no grouping is applied, the Source Data Field of each VNIR and SWIR packet brings information for an entire band in the frame, i.e. 1000 pixels swath. If grouping 2 is applied, the spatial resolution in the across track direction is reduced from 1000 to 500 pixels: in this case one packet gathers the information of two bands in the frame, being each one formed by 500 pixels. If grouping 4 is applied, the spatial resolution in the across track direction is further reduced and each SWIR/VNIR packet contains information for four bands.

The following picture shows that in case of GRP=2 one packet brings two bands on a total of 1000pixel. In case of GRP=4 one packet brings four bands on a total of 1000 pixel.

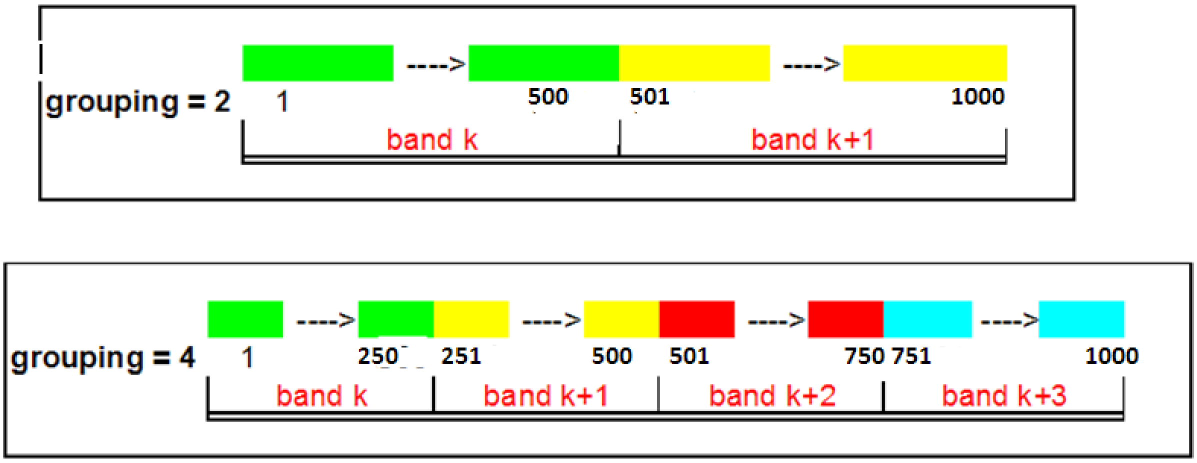
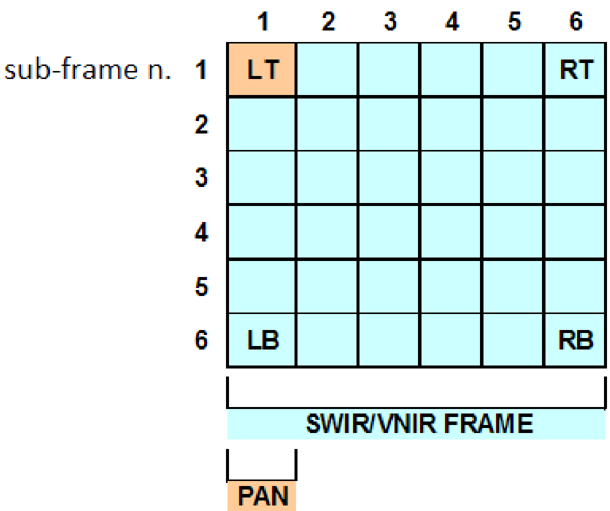


Figure 6-6: Source Data Field content

Each PAN packet brings information on 1000 Panchromatic pixels. A complete PAN sub-frame (30 km of coverage across-track) is made of 6 PAN packets. Thus, to achieve the same spatial coverage of a SWIR/VNIR frame (30km across-track x 30m along-track), 36 PAN packets shall be collected and properly reassembled. The way to properly handle the 36 PAN packets is depicted in the next picture.



Line (along track)	Sample (across-track)					
Sub-Frame 1	Left Top Pckt 1:					Right Top Pckt 6

	sample 1:1000					Sample 5001:6000
Sub-Frame 2	Pckt 7					Pckt 12
Sub-Frame 3						
Sub-Frame 4						
Sub-Frame 5	Pckt 24					Pckt 29
Sub-Frame 6	Left Bottom Pckt 30					Right Bottom Pckt 36

Figure 6-7: PAN 30 kmx30m frame recovery

6.3.5 L0A PRODUCT FILE TYPES

In sec. 6 it has been stated that different types of Level 0a files are produced by Level 0 Processor according to the Acquisition Type, the Acquisition Purpose and the Frame Type extracted from the header packets of the DDF stream. The different types of L0a files are summarised in the next table (Table 6-8).

ACQUISITION TYPE	ACQUISITION PURPOSE	FRAME_TYPES	L0A FILETYPE
EARTH-OBSERVATION	NOT SPECIAL PRODUCT	DARK-OBS	PRS_L0__DC
		SURFACE-OBS	PRS_L0__EO
		DARK-OBS	PRS_L0__DC
	SPECIAL PRODUCT FOR VALIDATON	DARK-OBS	PRS_L0__DC
		SURFACE-OBS	PRS_L0S_EO
		DARK-OBS	PRS_L0__DC
DARK CALIBRATION	NOT SPECIAL PRODUCT	DARK-OBS	PRS_L0__DC
INTERNAL-CALIBRATION	NOT SPECIAL PRODUCT	All frame types	PRS_L0__IC
	SPECIAL PRODUCT FOR CALIBRATION	All frame types	PRS_L0S_IC
SUN CALIBRATION	SPECIAL PRODUCT FOR CALIBRATION	All frame types	PRS_L0S_SC
SUN FLUX CALIBRATION	SPECIAL PRODUCT FOR CALIBRATION	All frame types	PRS_L0S_SX
MOON CALIBRATION	SPECIAL PRODUCT FOR CALIBRATION	All frame types	PRS_L0S_MC
FLAT-FIELD SPECIAL	SPECIAL PRODUCT FOR CALIBRATION	All VNIR frames All SWIR frames ALL PAN frames	PRS_L0S_FV PRS_L0S_FS PRS_L0S_FP
AUTOTEST	SPECIAL PRODUCT FOR CALIBRATION	All frame types	PRS_L0S_AU

Table 6-8: Mapping between L0a filetypes and header packet content

6.3.6 L0A PRODUCT NAMING CONVENTION

The following naming convention will be used for the identification of the PRISMA L0a Products files:

```
<MID>_L<P><M>_<AT>_<ORDT>_<YYYYMMDDhhmmss>_<YYYYMMDDhhmmss>_<XXXX>.DBL (54 chars)
```

The semantic of the variable sub-strings is reported in the following table:

Sub-string code	Meaning	Allowed values
<MID>	Prisma Mission Identifier (3 char)	PRS
<MID>_L<P><M>_<AT> is the file type (10 chars), defined in [L0-ICD] and reported in sec.6.3.5 Table 6-8. The meaning of the filetype fields is summarized herein:		
<P>	Processing level (1 char)	0
<M>	Product Mode (1 char)	S = Special Product _ = Not Special Product
<AT>	Acquisition Type (2 chars)	EO = Earth Observation DC = Dark Calibration IC = Internal Calibration SC = Sun Calibration SX = Sun Flux Calibration MC = Moon Calibration FV = Flat-field Vnir Calib FS = Flat-field Swir Calib FP = Flat-field Pan Calib AU = Autotest Calibration
<ORDT>	Order Type.	**For L0a files it is always set to OFFL.** "NRT" =on request processing "OFFL" = "SYSTEMATIC processing"; "RPRO" = if it is necessary to make a "REPROCESSING" in future (for example in some missions – non PRISMA- the attitude data are not good at the beginning but data can be processed. They are marked RPRO and then successively reprocessed with good attitude data.
<YYYYMMDDhhmmss>	UTC Sensing Start Time truncated to the closest integer second. This is the UTC datation of the first frame stored in the product (14 chars)	YYYY = year MM = month DD = day of the month hh = hour mm = minute ss = second
<YYYYMMDDhhmmss>	UTC Sensing Stop Time truncated to the closest integer second. This is the UTC datation of the last frame stored in the product. (14 chars)	As for sensing start time
<XXXX>	Product Version (4 chars) –used in case of reprocessing	e.g. 0001

Table 6-9: L0a Product File naming convention

The following naming convention will be used for the identification of the PRISMA L0a Products files:

```
PRS_L0<M>_<AT>_OFFL_<YYYYMMDDhhmmss>_<YYYYMMDDhhmmss>_0001.DBL (54 chars)
```

-where

- `YYYYMMDDhhmmss` provides UTC time of sensing start/stop.

-<M> provides Product Mode (1 char):

- `S = Special Product`
- `_ = Not Special Product`

-<AT> provides Acquisiton Type (2 chars):

- `EO = Earth Observation (PRS_L0S_EO_OFFL or PRS_L0__EO_OFFL)`
- `DC = Dark Calibration  (PRS_L0__DC_OFFL)`
- `IC = Internal Calibration (PRS_L0S_IC_OFFL or PRS_L0__IC_OFFL)`
- `SC = Sun Calibration (PRS_L0S_SC_OFFL)`
- `SX = Sun Flux Calibration (PRS_L0S_SX_OFFL)`
- `MC = Moon Calibration (PRS_L0S_MC_OFFL)`
- `FV = Flat-field Vnir Calib (PRS_L0S_FV_OFFL)`
- `FS = Flat-field Swir Calib (PRS_L0S_FS_OFFL)`
- `FP = Flat-field Pan Calib  (PRS_L0S_FP_OFFL)`
- `AU = Autotest Calibration  (PRS_L0__AU_OFFL)`

6.3.7 L0A MD QUALITY INFO

Following sections reports the quality info for the L0 product.

It is a STRING of 65 characters reported into the Catalogue Metadata file.

Each position of the character in the string has an opportune meaning, following reported:

Position in the string	Meaning of the flag
0,1	-00 ok -01 Warning : L0a files associated to the Image can be used by CNM=> if any of the successvie flags is eet to 1, the L0 exit code is marked at warning. -10 Error: L0a files associated to the Image shall not be used by CNM, since they are corrupted.
2	**Image Size** **0= OK** if the sum of the size of the all the frames associated to current ImageId corresponds to the ImageSize declared into the acquisition plan **1= Not OK** [It generates a **Warning**]
3	**Image Complete** **0= OK:** an Image is complete if it contains the entire set of sub-acquisitions commanded with the PRS_TC_ACQUISITION or with the PRS_TC_CALIBRATION, and if, for each sub-acquisition, the entire set of frames has been acquired. In order to be complete, an Image shall respect following constraints: • No missing frames or corrupted frames shall be detected. The sequence of frames type identified with [**Header.FrameType+Header.FramePart**] with the same Image_Id (**Header.Image_id**) shall respect the sequence indicated into the L0a Format Table (from the Config File) indicated by the entry **Header.AcquisitionType + Header.AcqusitionPurpose** The number of frames associated to each frame type [**Header.FrameType+Header.FramePart]** shall correspond to the number indicated into the field **Header.Number_frames_acquired_current sub-acquisition**

<table>
<tr><td></td><td>The number of frame associated to each Image shall correspond to the field reported into Header.Number_Frames_Acquired_Current_Image

1 = NOT OK:
[It generates Warning for Image for AcquistionPlan.PrType = EO]
[it generates Error for Image related to AcquisitionPlan.PrType = Calib]</td></tr>
<tr><td>4</td><td>If the image is not complete(MD.QualityInfo[3] = 1), it values:
1 = Flag Number of Missing Frames overcome 20% (see missing frames definition)</td></tr>
<tr><td>5</td><td>If the image is not complete(MD.QualityInfo[3] = 1), it values:
1 = Flag Number of Corrupted Frames overcome 20% (see corrupted frames definition for unpacektizer)</td></tr>
<tr><td>6</td><td>If the image is not complete(MD.QualityInfo[3] = 1), it values:
=1 Flag if Prev Dark is commanded (Header.FlagPrevDark=1 with Header.AcquistionType = E0 if more than 20% of prev-dark frames are missing or corrupted.</td></tr>
<tr><td>7</td><td>If the image is not complete(MD.QualityInfo[3] = 1), it values:
lag if Post Dark is commanded (Header.FlagPostDark=1 with Header.AcquistionType = E0): if more than 20% of post dark frames not acquired or corrupted.</td></tr>
<tr><td>8</td><td>0 = Ok, the time is matched
1 = Not OK, the time is not matched [Warning]

The unpacketizer shall check if the UTC time of each frame associated to the current ImageID (Header.Image_id) is contained into the values Sensing Start Time and Sensing Stop Time from the Acquisition Plan of the current Image.
<table><tr><td><SensingStartTime></td><td>DateTime</td><td>Starting epoch of the current I</td></tr><tr><td><SensingStopTime></td><td>DateTime</td><td>Ending epoch of the current D</td></tr></table>
The UTC time of each frame is given by:
Header.UTC_Time +Header.Sync_Time*Packet.Control_Byte.FrameNumber</td></tr>
<tr><td>9</td><td>If MD.QualityInfo[9] = 1
1 = Image start time not matched</td></tr>
<tr><td>10</td><td>If MD.QualityInfo[9] = 1
1=Image stop time not matched.</td></tr>
<tr><td>11</td><td>1= The cloud coverage processing has not been executed since the number of corrupted frame for the input L0a file , overcome more than 20% of the total input frame number.</td></tr>
<tr><td>12</td><td>1= The cloud coverage processing has not been executed since it is missing the data for at least a band necessary for CC.</td></tr>
<tr><td>13..65</td><td>Not used</td></tr>
</table>

<table>
<tr><td colspan="2">LIST OF ERRORS to be marked inside the LOG FILE and into the exit code:</td></tr>
<tr><td>Error Code 56
(see screening report Quality Description)</td><td><u>Image Not Found</u>
0 = 0k image found
1 = image not found [it generate an Error]
At the beginning the Unpacketizer shall set all the Image from the current Pass of the Acquisition Plan at the value of “file not found”. In case of file found (this means that at least a packet with Header.Image_id has been found), the flag is then varied.</td></tr>
<tr><td>Error Code 57</td><td>1 Error : Input DDF not valid *
* Input files are not valid if they don’t respect the format or if there are problems in file opening.</td></tr>
<tr><td>Error Code 58</td><td>1 Error: Config file not valid *</td></tr>
<tr><td>Error Code 59</td><td>1 Error :Job Order not valid *</td></tr>
<tr><td>Error Code 60</td><td>1 Error :Param File not valid *</td></tr>
<tr><td>Error Code 61</td><td>1 Error: Acq Plan Not Vaild *</td></tr>
</table>

Error Code 62	1 Error Aux file not valid *
Error Code 63,64	Not used

6.3.8 L0 TTAG FORMAT

The format used in the Header Packet in order to represent the UTC Start Time of the current sub-acquisition is reported in the following:

	MSb (bits 0 1 2 3 4 5 6 7)	(bits 8 9 10 11 12 13 14 15) LSb
Byte 1/2	Year (0 … 99)	Month (1 … 12)
3/6	Day of Month (1 … 31)	Hour (0 … 23)
5/6	Minute (0 … 59)	Second (0 … 59)
7/8	10^{-2} Seconds (0…99)	10^{-4} Seconds (valid only 00, 10, 20 … 90)

For example in order to command 28-12-2018 at 10:55:39.4567'' the table will be filled as in the following:

60	12
28	10
55	39
45	60

<u>Note that the Year field reports the delta-years between the 1958 (which is the year of times base for the PL) and the current year. That is, if the Year field reports 60, the real year is 1958+60=2018</u>

7. LEVEL 1 PRODUCT

7.1 LEVEL 1 PROCESSING OVERVIEW

In case of L0afiles marked as Special Product for Calibration/Validation, the CNM will automatically activate the L1 processing when the complete list of L0a files necessary for the computation of new KDPs are collected from the Archive.

In case of L0afiles marked as Not Special Product, the processing L1 only in case of user demand.

Depending on the L0a file type, a different set of files (SOI) shall be passed in input to L1 processor: see Table 5.2 of current document.

The CNM activate the L1 processing by passing in input to the L1 proessor the entire set of files that characterized the SOI, by reporting the list of L0a data file into the L1 JobOrder.

L1 Processor receives in input the list of L0a data files for a specific type of SOI, five files containing the KDP parameters (FKDP, GKDP, CDP, ICU-KDP files see par 7.6 for KDP format and content) and a set of Auxiliary Data Files coming from the IDHS archive.

There are up to 6 different types of SOI, two owing to the class SOI-A and five owning to the class SOI-B, (see Table 5.2 for SOI file content).

- SOI-A-1: Earth Observation;
- SOI-A-2: Earth Observation Calval;
- SOI-B-1: Internal Calibration Calval;
- SOI-B-2: Sun Calibration;
- SOI-B-3: Moon Calibration;
- SOI-B-4: Flat Field Calibration.

Each type of SOI is always associated to the updating of a sub-set of FKDP parameters typical of the current instance: if the updated FKDP parameters are noticeably different with respect to the input ones, L1 processing can produce a new FKDP updated file, to be sent to the IDHS archive.

SOI-A classes are also associated to the generation of the L1 Earth Observation radiance file. The L1 **Earth Observation Product** contains **four layers of data**, each referring to a specific type of data, and a **fifth layer** collecting the **information** extracted from the Header Packets of the L0a files (see sec. 7.4 for details).

An overview of the main processing steps can be summarized as follows.

FrameBuilder: it is the first algorithm of the processor according to which the incoming SOI L0a files are transformed into two lists of Cubes: one for SWIR+VNIR channel, the other one for the PAN channel. Each cube contains a list of frames, ordered according to UTC Time, of the same Sub-Acquisition Type.

In the case of HYPER (VNIR+SWIR) channel the cube has the following axis-meaning:

- the x axis is aligned with the spectral direction (Band);
- the y axis is the across track direction (Sample);
- the z axis is the along track direction (Line/Frames).

Each (y,z) plane represents a monochromatic image, while each (x,y) plane represents a Frame.

In the case of PAN channel, the image (the spectral direction is absent) has the following axis-meaning:

- the x axis is the across track direction (Sample);
- the y axis is aligned with the along track direction (Line).

KDP Updating: any time a L1 processing is activated, a new set of FKDP parameters is automatically generated with the in-flight acquisition data: if the difference with respect to the input FKDP files exceed the threshold defined into the input ConfigFile, the new FKDP files containing the updated values shall be sent to archive. The new FKDP file has the validation flag set raised to indicate that the product has not yet been validated by the CVWG.

The CVWG should in a successive time to analize the new FKDP in order to validate them= in order to confirm if the automatic updating made by L1 processor effectively is associated to a changed of the KDP. In affirmative case, the validation flag is set to 0 and the validated FKDP file is saved into CNM for being used for successive run of L1 processor.

This KDP Updating basically consists of the following algorithms:

- Dark Updating (performed for each type of SOI);
- Background Updating (performed for each type of SOI);
- Lamp Updating (performed for each type of SOI);
- Lamp Linearity Updating (performed only in case of SOI-B-1);
- Sun Updating (performed only in case of SOI-B-2);
- Moon Updating (performed only in case of SOI-B-3);
- Flat Field Special Updating (performed only in case of SOI-B-4).

Earth Observation Processing (only in case of SOI-A): this is the collection of the algorithms devoted to process the Earth-Observation frames. It consists of the following main steps:

- **Radiance Generation**: this step processes the cubes created by the FrameBuilder of Surface_Obs sub-acquisition type (with use of the KDP parameters) in order to convert the Digital Numbers of L0a Packets into Spectral Radiances.
- **Coregistration**: this algorithm ingests as input the Radiance HYPER (VNIR+SWIR) and PAN cubes (output of the previous steps) and produces two new HYPER and PAN Surface_Obs cubes, in which the previous ones have been coregistered.
- **Mask Generation**: has the purpose to generate the Cloud Coverage, Sun Glint and Generic Land Cover masks.
- **End User Binning**: this step is performed only in case of SOI-A-1, whose processing is required by the user (whereas SOI-A-2 processing is automatic); it is in charge of binning data in the spatial and/or spectral dimensions according to some input parameters which are set by the user.

The L1 Earth Observation Product basically contains four kinds of data organized in the above mentioned four layers: two Radiometrically Calibrated HYPER and PAN Surface_Obs cubes (produced by the Radiance Generation step) and two Coregistered HYPER and PAN Surface_Obs cubes (output of the Coregistration algorithm). It contains also the Cloud Coverage, Sun Glint and Generic Land Cover masks. Coregistered cubes correspond to the Radimetric Cubes where also spatial coregistration of SWIR and PAN with respect to VNIR channel is performed. It has been dediced to send both not-coregisterd and coregisterd data, since coergistraton is founded on interpolation so coregisterd data represent manipuled data. Not coregistered data instead is directly associable to L0a Raw Data, simply the Radiance transformation is applied.

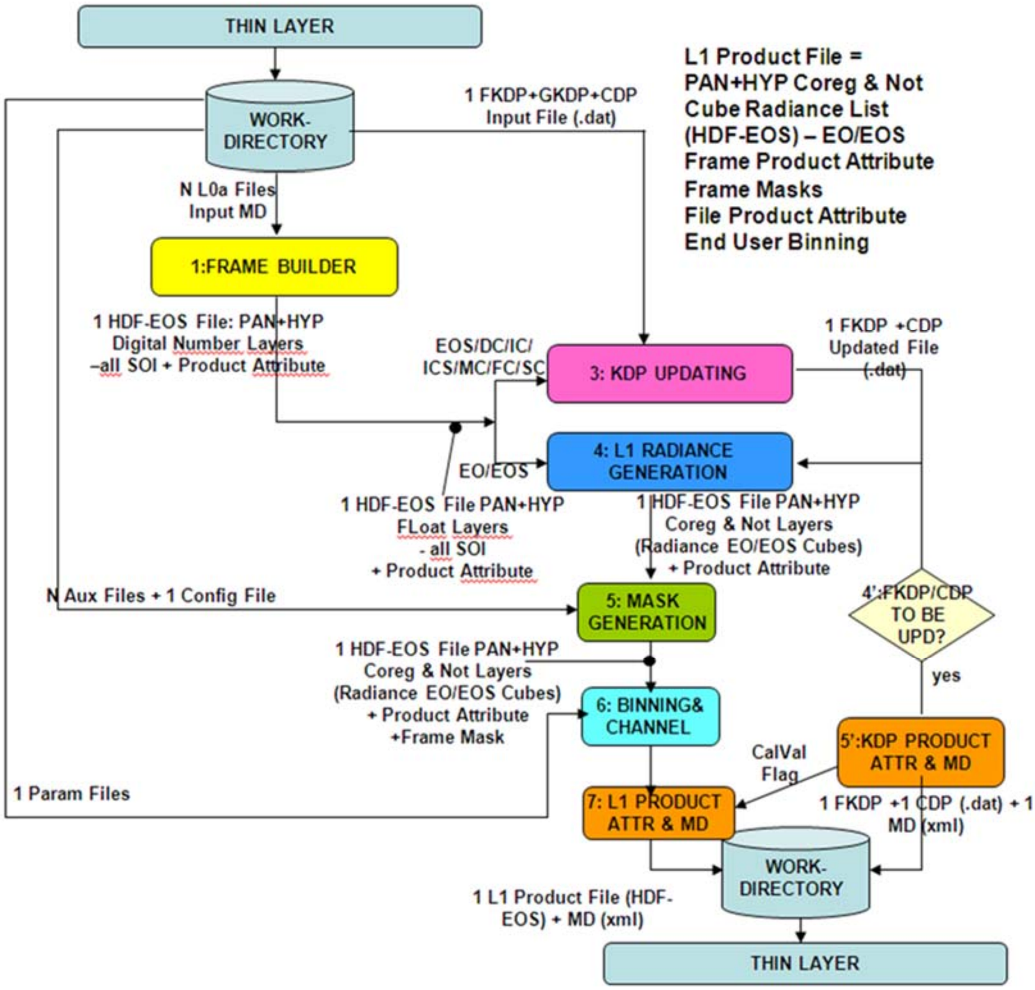
The following table summarizes the feature of the L1 Earth Observation Product listing the ID associated to each layer (see sec. 7.4 for details). The amount of the four layers plus a layer of info data composes the L1 Earth Observation PRISMA product:

LAYER ID	PIXEL INFORMATION	ATTRIBUTE

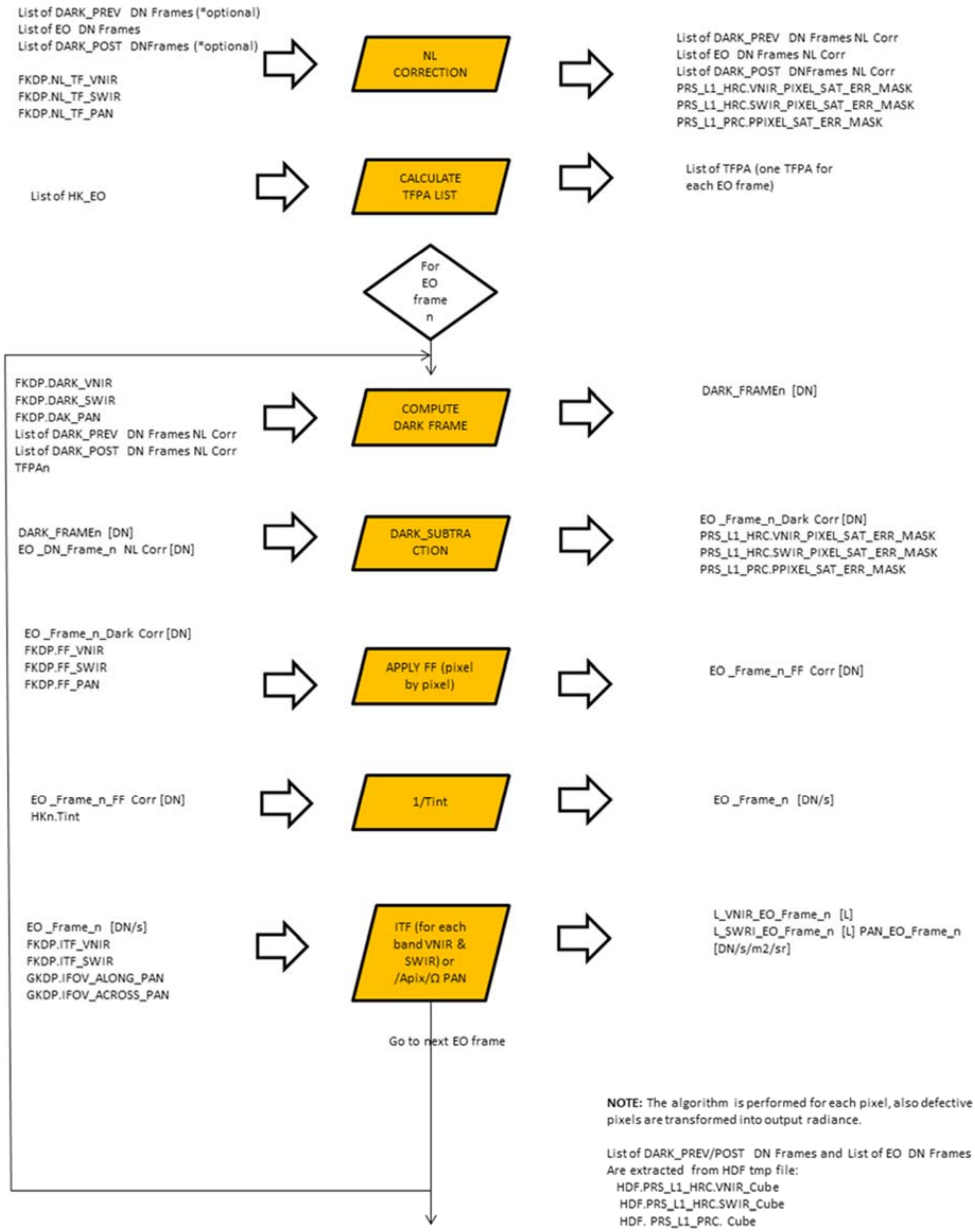
PRS_L1_PRC	PAN IMAGE DN/(s*str*m^2)=> Dark-Subtracted, Flat-Field and Radiometric Corrected, Calibrated and Repaired Panchromatic Radiance. Atmospheric Attenuation not subtracted. Data are processed at full spatial resolution. In case of SOI-A-1, data binning can be applied as the last processing step if requested by the user.	Size: nPanAcrossPixel x nPanAlongPixel Attributes: -PIXEL_SAT_ERR_MATRIX -UTC TIME -LAT, LON
PRS_L1_PCO	COREGISTERED PAN IMAGE DN/(s*str*m^2)=>=> Dark-Subtracted, Flat-Field and Radiometric Corrected, Calibrated, Repaired and Coregistered Panchromatic Radiance. Atmospheric Attenuation not subtracted. Data are processed at full spatial resolution. In case of SOI-A-1, data binning can be applied as the last processing step if requested by the user.	Size: nPanAcrossPixel x nPanAlongPixel Attributes: -PIXEL_SAT_ERR_MATRIX -UTC TIME -LAT, LON
PRS_L1_HRC	VNIR &SWIR RADIANCE CUBES=> Dark-Subtracted, Flat-Field and Radiometric Corrected Calibrated and Repaired Radiance in at maximum 66 VNIR + 173 SWIR bands. Atmospheric Attenuation not subtracted. Data are processed at full spatial resolution. In case of SOI-A-1, data binning can be applied as the last processing step if requested by the user.	Size: nHypAcrossPixel x nBandVnir x nHypAlongPixel nHypAcrossPixel x nBandSwir x nHypAlongPixel Attributes: -VNIR_PIXEL_SAT_ERR_MATRIX -SWIR_PIXEL_SAT_ERR_MATRIX -UTC TIME -LAT, LON
PRS_L1_HCO	VNIR&SWIR COREGISTERED RADIANCE CUBES=> Dark-Subtracted, Flat-Field and Radiometric Corrected, Calibrated and Repaired Radiance in at maximum 66VNIR + 173 SWIR bands Coregistered. Atmospheric Attenuation not subtracted. Data are processed at full spatial resolution. In case of SOI-A-1, data binning can be applied as the last processing step if requested by the user.	Size: nHypAcrossPixel x nBandVnir x nHypAlongPixel nHypAcrossPixel x nBandSwir x nHypAlongPixel Attributes: -VNIR_PIXEL_SAT_ERR_MATRIX -SWIR_PIXEL_SAT_ERR_MATRIX -CLOUD_MASK -LAND_COVER_MASK -UTC TIME -LAT, LON

Table 7-1: List of PRISMA L1 Layers

The block diagram of the L1 Processing is reported below:



The block diagram of the Radiance Generation Processing is reported below:



NOTE: The algorithm is performed for each pixel, also defective pixels are transformed into output radiance.

List of DARK_PREV/POST DN Frames and List of EO DN Frames Are extracted from HDF tmp file:
HDF.PRS_L1_HRC.VNIR_Cube
HDF.PRS_L1_HRC.SWIR_Cube
HDF. PRS_L1_PRC. Cube

List of HK_EO is extracted from HDF tmp file :
HDF.Info.Housekeeping[n] = housekepeing are in phisical units.

7.2 L1 PRODUCT STRUCTURE

The Level 1 Earth Observation product file consists of a file in the HDF-EOS5 format that reports, per each incoming L0a Earth Observation or L0a Earth Observation Special from the input SOI, the list of radiance frames and the relevant attributes.

The file reports 4 list of frames, organized according to different layers:

- Radiometrically Calibrated HYPER land-observation frames list, with relevant attributes;
- Radiometrically Calibrated PAN land-observation frames list, with relevant attributes;
- Radiometrically Calibrated Coregistered HYPER land-observation frames list, with relevant attributes;
- Radiometrically Calibrated Coregistered PAN land-observation frames list, with relevant attributes.

-Missing frames are not reported both in the coregistered and not coregistered cubes

-Corrputed frames are reported both in the coregistered and not coregsitered cubes: they are processed as it is

-Defecitve Pixel are processed as it is both in coregistered and not corgesitered cubes. Inteporlation is made excluiding the usage defective pixel as boundaries.

Corrupted Frame List=It notifies the corrupted frame list for those earth observation/earth observation special frames marked as corrupted.

This Data Field contains information about the Corrupted Frames of the cube.
It is a two-dimensional Data Field. The first dimension (i.e. number of lines of the matrix dataset) is given by the number of frames that compose the cube (nHypAlongPixel). The second dimension (i.e. number of column) is equal to 2: each column has a precise meaning which is explained in the attribute “Legend” of this Data Field :

1st Column = 1 if the frame is corrupted 0 if the frame is ok.
2th Column = Damage *(1=corrupted frame, 2=missing frame)

A frame is missing if, for a frame number from 0 to the max Number to be Acquired (in the header packet), happens one of the following condition:

- The entire set of packets for a given frame number is missing
- The Header Packet is checksum failed or missing.

A frame is corrupted if one of the following condition happens:

- Header packet is not received or the checksum is failed.
- At least one packet (not the Header!) is not received or the checksum is failed.
- There have been problem in building the entire frame, when the frame is divided into two frame parts.
- The relevant hk are out of ranges or out of mean values

The L1 Product file is generated only in case of SOI-A processing.

As previously stated (section 7), for each layer the data are organized in a Cube format, i.e. a three-dimensional data set.

In the case of HYPER channel the cubes in the L1 Product, both Radiometrically Calibrated and Radiometrically Calibrated Coregistered, have the following dimensions[2]:

- o The first dimension (x axis) is the spectral direction component which represents the Band (up to 66 (VNIR) and 173 (SWIR));
- o the second dimension (y axis) represents the along track direction which represents the Line/Frames (if the input L0a Earth Observation file is Not Special, the along track extension is at least 30 km;

2 In the L1 Product the axis of the cubes are changed with respect to the cubes produced by the frame collector algorithm to allow a better visualization through the tools of browsing of the HDF-EOS files.

therefore the corresponding L1 products will contain up to 1000 pixels in the along-track direction to obtain 30 km x 30 km images);

- the third dimension (z axis) is aligned with the across track direction which represents the Sample (up to 1000 pixels).

Each (y,z) plane represents a monochromatic image (of up to 30Km x 30Km for Not Special Products), while each (x,z) plane represents an hyperspectral frame.

In the case of PAN, both the Radiometrically Calibrated and Radiometrically Calibrated Coregistered images have the following axis-meaning (there is no spectral direction):

- the x axis is aligned with the along track direction (if the input L0a Earth Observation file is Not Special, the along track extension is at least 30 km; therefore, the corresponding L1 products will contain up to 6000 pixels in the along-track direction to obtain 30 km x 30 km images);
- the y axis represents the across track direction.

For each one of the previous layers, the data file uses HDF-EOS5 Swath data structure (see sec. 10.2.1 for details).

Besides the above described four main layers, the L1 Product also contains another group of **Info** data collecting all the information, as ancillary or housekeeping data, extracted from the Header Packets of the L0a products.

The L1 Earth Observation product generation is accompanied by additional information reported in the so-called “attributes”, which are integrated part of the L1 Product and contain relevant information on the product and processing conditions. The information relevant to the whole product are contained in the Global Attributes, whereas the information relevant to specific part of the product, like the cubes, are part of the Houseekpeing and Ancillary Attirbuted.

7.2.1 PAN IMAGES

In this section, the characteristics of the Panchromatic image are specified. Table 7-2 summarizes its basic features.

Parameter Description		RC = Raw Calibrated	CO = Coregistered
Line Spacing (m)		5	5
Pixel Spacing (m)	Grouping 1 (1)	5	5
	Grouping 2	10	10
	Grouping 4	20	20
Number of lines		Up to 6000 if the L1 Product has been originated starting from an L0a file Not Special for Validation; undefined otherwise.	Up to 6000 if the L1 Product has been originated starting from an L0a file Not Special for Validation; undefined otherwise.
Number of pixels in a line of the image	Grouping 1	6000	6000
	Grouping 2	3000	3000
	Grouping 4	1500	1500
Product Size		Number of pixel x 2 bytes.	Number of pixel x 2 bytes.

Table 7-2: PAN Image Features

(1) It is referred to grouping factor commanded into PRS_TC_ACQUISTION.

7.2.2 HYPER IMAGES

In this section, the characteristics of the Hyperspectral image are reported. Table 7-3 summarizes the basic features.

Parameter Description		RC	CO
Line Spacing (m)		30	30
Pixel Spacing (m)	Grouping 1	30	30
	Grouping 2	60	60
	Grouping 4	120	120
Number of lines		Up to 1000 if the L1 Product has been originated starting from an L0a file Not Special for Validation; undefined otherwise	Up to 1000 if the L1 Product has been originated starting from an L0a file Not Special for Validation; undefined otherwise
Number of pixels in a line of the image	Grouping 1	1000	1000
	Grouping 2	500	500
	Grouping 4	250	250
Product Size		Number of pixel x 2 bytes.	Number of pixel x 2 bytes.

Table 7-3: HYPER Image Features

7.3 L1 IMAGES QUALITY PERFORMANCES EVALUATION

Following table lists the quality performances for L1 products in order to evaluate if a single image is a good quality image or if it is bad. Such quality performances are guaranteed under the assumption the scene acquisition is performed under instrument and platform nominal condition.

Cloud coverage percentage	The percentage of cloud coverage on the image shall be lower than 20%	It is reported into the GlobalAttribute.ProductReport section of the HDF5 file, inside the L1QualityInfo.
Corrupted Frames	Total number of corrupted frames in the image shall be less than 20%	It is reported into the Global Attribute section of the HDF5 file : -VNIR_Corrputed_Frame_Percetage -SWIR_Corrupted_Frame_Percentage -PAN_Corrupted_Frame_Percentage.
L1 Exit Code	The processor shall return with and Exit Code set at 0. That means that the I0 and I1 quality flags reported in the Metadata quality flags are all set to zero.	No warning have been occurred.
Integration Time	Following fields shall be set at correct value: GlobalAttribute.Integration_Time = 4.11msec GlobalAttribute.Sync_Time = 4.31msec GlobalAttribute.Pan_Integration_Time = 718usec GlobalAttribute.Pan_N_Int =6	Integration time shall have been correctly commanded.
FPA Temperature	The HDF5 section INFO.Housekeeping contains the temperature and voltages of the instrument.	Temperature and voltages shall be in the allowed ranges=> in case a farme has hk out of ranges the frame is marked as corrupted.

Table 9-3: L1 Image Quality parameters

Other quality parameters for the images as the radiometric accuracy, spectral and geometrical accuracy are automatically guaranteed since each L1 image is produced with validated FKDPs.
Hence, once the formal check of the image has been completed and passed as reported in the table above, the image is assumed to be good. The only additional check that the operator shall perform is to check if the KDP set is operative and updated, verifying if the CALVAL WG has not received a validity flag set low and not yet processed.
It is not possible to guarantee a good radiometric quality of the image for those images whose UTC time is comprised between the moment of generation of new FKDP and the validation of FKDP by the CVWG: any time the Calibration Facility returns a new set of FKDP to be updated in the CNM, the L1 re-processing should be commanded for all those images whose UTC time is successive to those of the new FKDP file.

7.4 L1 PRODUCT ORGANIZATION

The Earth Observation product file shall contain the following classes of data:

- ***Science data on a pixel-by-pixel basis.*** They are the Hyerspectral or Panchromatic Radiometrically Calibrated and Coregistered cubes. These data are stored as DataFields objects within four different Swaths.
- ***Geolocation data for the pixels***. These data include latitude and longitude corresponding to all or to a subset of the pixels. Interpolation may be used to recover latitude and longitude of all pixels. These data are stored as HDF-EOS5 GeolocationFields within the Swath.
- ***Product Attributes.*** These data include a wide variety of ancillary and quality assurance (QA) information for each file. These data are stored in HDF-EOS5 attributes (global, group, object or local) or in specific Datasets.

The architecture of the PRISMA L1 Earth Observation HDF-EOS5 product file is depicted in Figure 7-1. Data are organized to meet meet storage needs of acquired SOI-A and SOI-B-2 scenes. For the sake of simplicity only one Swath object is represented in the diagram.

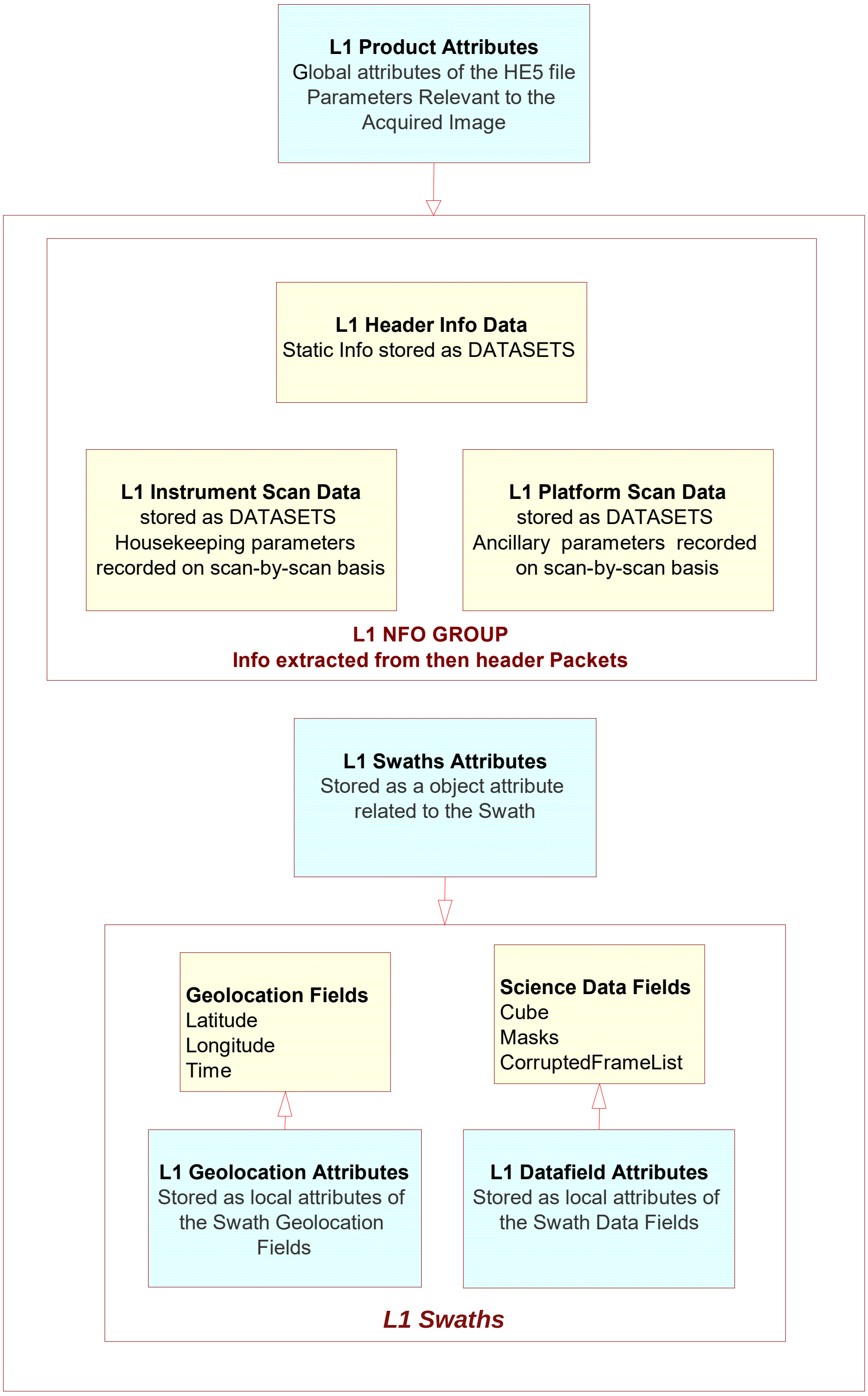


Figure 7-1: Architecture of the PRISMA Level 1 Earth Observation Products

The L1 Earth Observation product shall contain the following objects:

– **PRS_L1_HRC Swath Object**
  This is a Swath datatype defined in sect 10.2.1 , containing the Radiometric Calibrated Hyperspectral Cube.

– **PRS_L1_HCO Swath Object**
  This is a Swath datatype containing the Co-registered Hyperspectral Cube.

– **PRS_L1_PRC Swath Object**
This is a Swath datatype containing the Radiometric Calibrated Panchromatic Cube.

– **PRS_L1_PCO Swath Object**
This is a Swath datatype containing the Co-registered Panchromatic Cube.

– **L1 INFO Group Object**
This is an HDF5 group. It collects all the information extracted from the header packets. This group in turn contains three sub-groups with the following content:

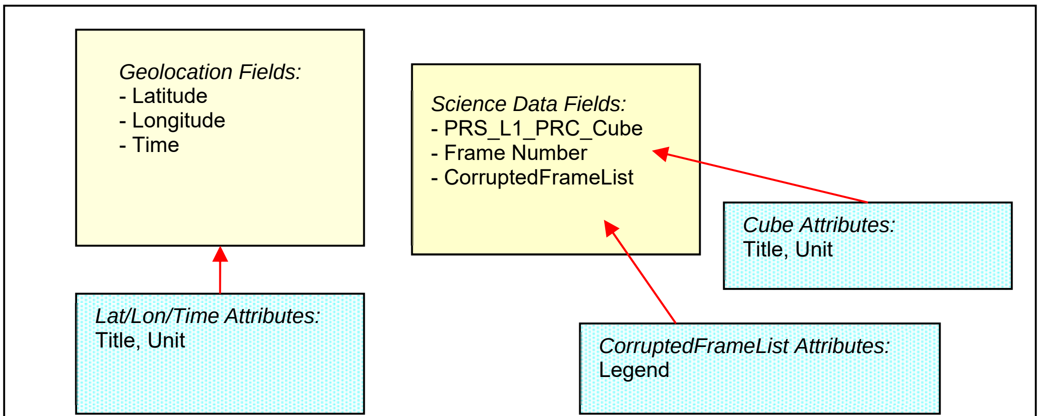
- Static information, corresponding to the fixed part of the header packet data source, stored as datasets;
- Housekeeping dynamic data, stored as one-dimensional datasets, one for each parameter, containing a value for each frame (i.e. time);
- Ancillary dynamic information, relevant to platform data (State vectors, Attitude, etc.), stored as one-dimensional datasets, one for each parameter, containing a value for each frame (i.e. time).

– **Attributes**
As explained in section 10.2 , four types of attributes are defined in the HDF-EOS5 format, which can be classified as follows:

- Global Attributes → attributes relevant to the entire product
- Object Attributes → attributes relevant to the Swath
- Group Attributes → attributes relevant to the group (i.e. Data Fields group or Geolocation Fields group)
- Local Attributes → attributes relevant to specific data (for example Cubes, Latitude or Cloud Mask).

Concerning HDF5 objects, the description of attributes has been provided in section 10.1.4 .

In the next figure (Figure 7-2) the structure of each Swath is schematically represented. The yellow boxes represent the Data Fields and the Geolocation Fields groups. Each blue box represents the local attributes referred to a specific Data Set.



Prisma L1 Swath – PRS_L1_PRC

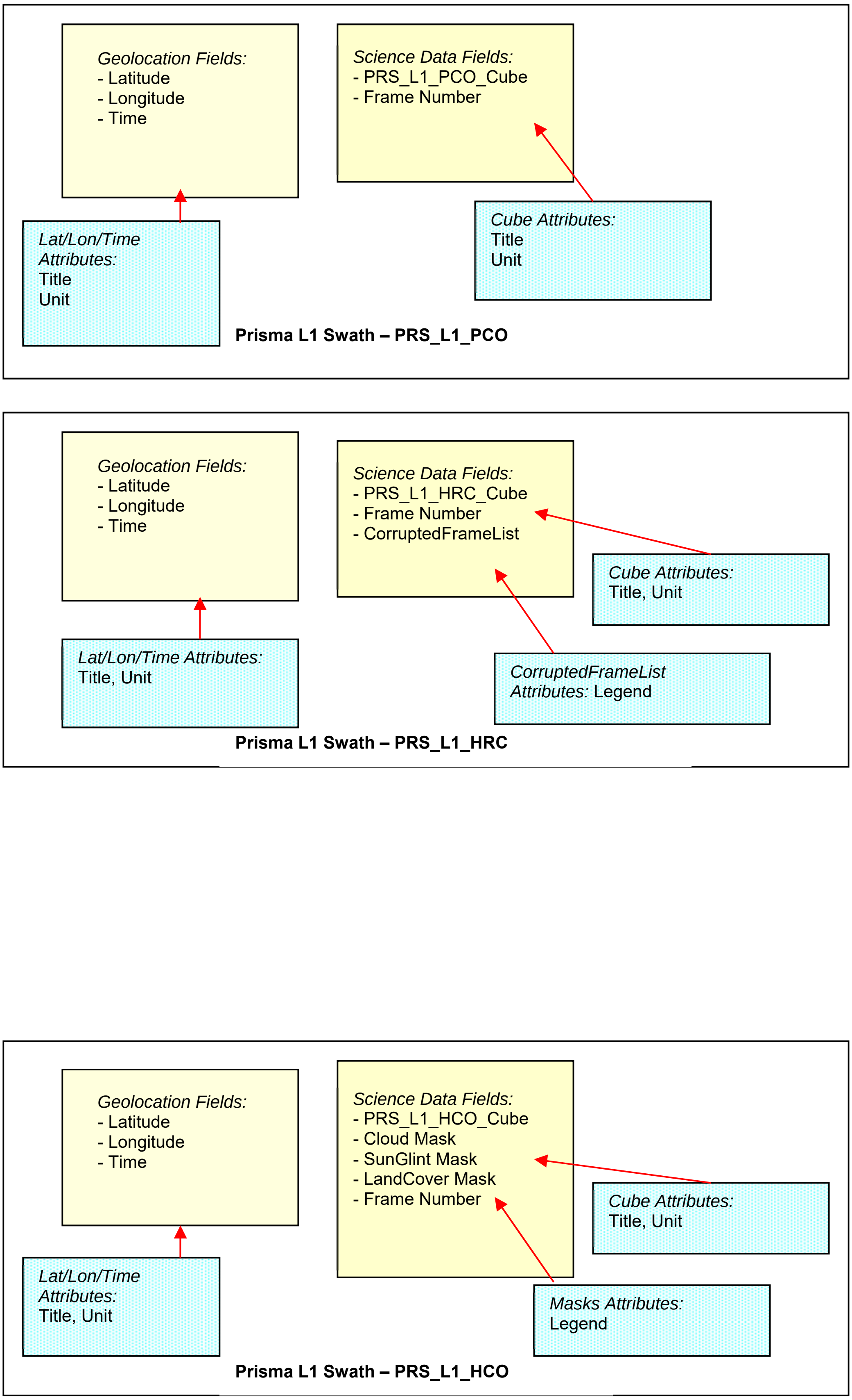


Figure 7-2: Block Diagrams of the Swaths' structure in the L1 Earth Observation product

7.4.1.1 HIERARCHIC ORGANIZATION

The HDF5 allows the hierarchical organization of the information to be stored. In order to standardize the data organization and the access to the image layers stored by the HDF5 support format, each level of the HDF5 hierarchy is univocally assigned to the storage of a specific level of information of the PRISMA L1 products according to the following scheme.

/ Root group

It includes:

- HDFEOS group, which contains the /SWATHS Group;
- HDFEOS INFORMATION group, automatically created by the HDFEOS library and left unused;
- Info group, containing the information extracted from the Header Packets of the L0a file.

/SWATHS group

It includes the four HDF-EOS5 Swaths structures:

/PRC_L1_HRC

/PRC_L1_HCO

/PRC_L1_PRC

/PRC_L1_PCO

Each Swath contains the following members:

- **/Data Fields** group

  It includes:

  - the dataset named "*SwathName*_Cube" containing, at least, Hyperspectral or Panchromatic (Radiometrically Calibrated or Co-registered) Cubes datafields, and eventually other datasets (such as the Cloud Coverage masks);
  - Dataset Local attributes.

- **/Geolocation Fields group**

  It includes:

  - the Dataset named "Longitude" containing Longitude values for Cube geolocation;
  - "Longitude" Dataset local attributes;
  - the Dataset named "Latitude" containing Latitude values for Cube geolocation;
  - "Latitude" Dataset local attributes;
  - the Dataset named "Time" containing the time of each frame in the cubes;
  - "Time" Dataset local attributes.

- **/Info group**

  It is a sub-group of the Root group that contains the following nested groups:

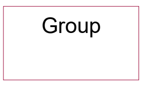
  - **Ancillary** group, containing the Frame-dependent Ancillary Parameters;
  - **Housekeeping** group, containing the Frame-dependent HK Parameters.

- **Attributes**

  A large variety of attributes are included in the PRISMA L1 Earth Observation Product, of both types HDF5 Attributes (described in sec. 10.1.4) and HDF-EOS5 Attributes (described in sec. 10.2).

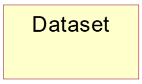
The hierarchical organization is graphically represented in the following diagrams

A not colour filled structure



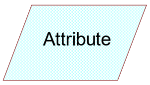
represents a HDF5 structure group.

A yellow-filled structure



represents a generic HDF5 dataset.

A cyan-filled structure



represents a generic HDF5 set of attributes.

In the next figure (Figure 7-3) the hierarchical structure of the PRISMA L1 product is reported: for the sake of simplicity only one of the four Swaths and only the main dataset of this Swath (i.e. the Cube) are depicted.

7.4.1.2 DATA STORAGE POLICY

The arrangement used for storage of Swath data of the PRISMA L1 Earth Observation Product into HDF-EOS5 datasets is listed in the following table.

Data	Structure
Hyperspectral Science Data Fields	Three-dimensional array having: -the first dimension (x-axis) corresponding to the **spectral bands** (up to 66 VNIR and 173 SWIR bands); -the second dimension (y-axis) corresponding to the number of lines of the data array (**along track**; up to 1000 if the L1 Product has been originated starting from a L0a file Not Special for Validation; undefined otherwise); -the third dimension (z-axis) corresponding to the number of samples of the data array (**across track**; up to 1000 pixels); In such a representation: - a frame corresponds to a (x,z) slice (y-plane) of the cube; - a monochromatic image corresponds to a (y,z) slice (x-plane) of the cube. Science data are represented as a 2 bytes Unsigned Short Integer
Panchromatic Science Data Fields	Bi-dimensional array having: -the first dimension (**x-axis**) corresponding to the number of lines of the data array (**along track**; up to 6000 if the L1 Product has been originated starting from a L0a file Not Special for Validation; undefined otherwise); -the second dimension (**y-axis**) corresponding to the number of samples of the data array (**across track**; up to 6000 pixels). Science data are represented as a 2 bytes Unsigned Short Integer
Geolocation field	• One array for the frame time, UTC stored as MJD2000 decimal days, the dimension corresponding to the along-track direction. • Two bi-dimensional arrays, one for the Latitude and one for the Longitude, having: -the first dimension aligned with the along track dimension; -the second dimension aligned with the across track dimension. Latitude and Longitude data are represented as a 4 bytes Floating Point; UTC Time data as 8 bytes Double.

Table 7-4: L1 Earth Observation Products Storage Policy

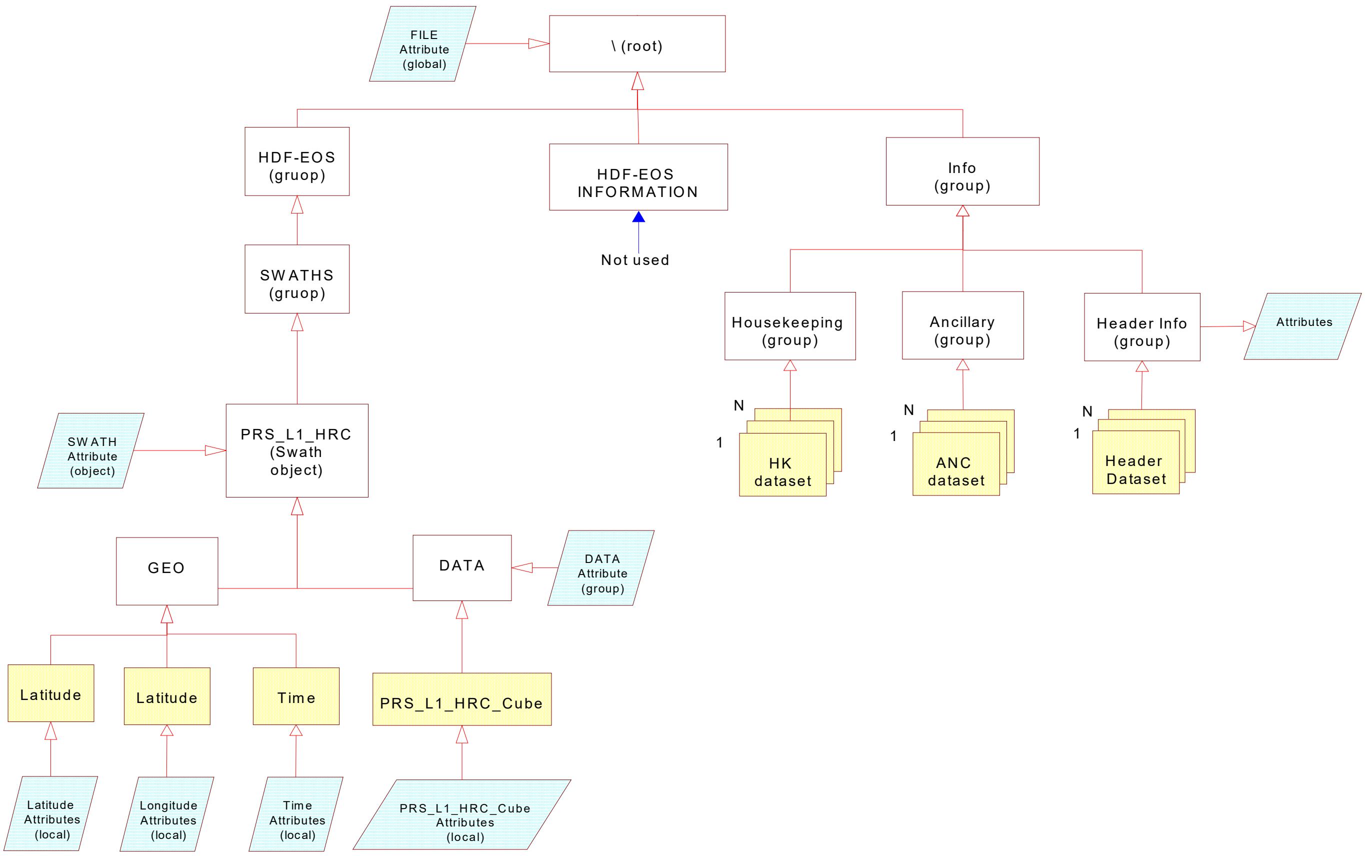


Figure 7-3: Hierarchical Structure of PRISMA L1 Earth Observation HE5 file

7.5 L1 PRODUCT NAMING CONVENTION

The following naming convention will be used for the identification of the PRISMA L1 Products files:

```
PRS_L1_<PRT>_<ORDT>_<YYYYMMDDhhmmss>_<YYYYMMDDhhmmss>_<XXXX>.he5 (54 chars)
```

The semantic of the variable sub-strings is reported in the following table:

Sub-string code	Meaning	Allowed values
PRS_L1_<PRT> is the file type (10 chars), defined in [L1-ICD].		
<PRT>	Product Type (3 chars)	STD = L1 Earth Observation Product
<ORDT>	Order Type	“NRT” =on request processing “OFFL” = “SYSTEMATIC processing”; “RPRO” = if it is necessary to make a “REPROCESSING” in future (for example in some missions – non PRISMA- the attitude data are not good at the beginning but data can be processed. They are marked RPRO and then successively reprocessed with good attitude data. Default value = “OFFL”.

<YYYYMMDDhhmmss>	UTC Sensing Start Time truncated to the closest integer second. This is the UTC datation of the first frame stored in the L1 EO product (14 chars)	YYYY = year MM = month DD = day of the month hh = hour mm = minute ss = second
<YYYYMMDDhhmmss>	UTC Sensing Stop Time truncated to the closest integer second. This is the UTC datation of the first frame stored in the L1 EO product (14 chars)	As for sensing start time
<XXXX>	Product Version (4 chars) – used fro reprocessing	e.g.: 0001

Table 7-5: L1 Products File naming convention

7.6 L1 PRODUCT FORMAT DESCRIPTION

Each HDF-EOS5 file is composed according to a tree structure with the following format:

HDF-EOS5.		
	GlobalAttribute	
	INFO.	
		Header [nHypAlongPixel + NExtendedFrames]
		Housekeeping [nHypAlongPixel + NExtendedFrames]
		Ancillary [nHypAlongPixel + NExtendedFrames]
	KDP_AUX	LOS_VNIR, SWIR and PAN
	KDP_AUX	CW_VNIR, CW_SWIR
	PRS_L1_HRC	VNIR/SWIR_Cube [nHypAcrossPixel x nBands x nHypAlongPixel]
	PRS_L1_HCO	VNIR/SWIR_Cube [nHypAcrossPixel x nBands x nHypAlongPixel]
	PRS_L1_PRC	Cube [nPanAcrossPixel x nPanAlongPixel]
	PRS_L1_PCO	Cube [nPanAcrossPixel x nPanAlongPixel]

This means that the Header, Housekeeping and Ancillary data set are wider than 1000 frames: they comprise also the extended frames.

Instead the 4 SWATH cubes are all referred to 1000 frames: PAN cubes are along track aligned to HYP cubes.

Each L1 EO file has a size of about 2.1GB not compressed.

7.6.1 GLOBAL ATTRIBUTES

The following table describes the structure of the global attributes relevant to the L1 Earth Observation product.

Nb. Those Global Attributes that are extracted from the HeaderPacket fixed part, can use the Header Packet of the first Surface_Obs frames: each Surface_Obs frame has the same fixed part!

Attribute Name	Type	Value/Units	Notes

Product_Name	String	“PRS_L1_STD_<XXXX>_<YYYYMMDDhhmmss>_<YYYYMMDDhhmmss>_<XX>.he5”	Product Name according to naming convention
Product_ID	String	“PRS_L1_STD”	
Processor_Name	String	“L1_A_EO” for not Special Product “L1_A_ES” for Special Product	Processor name as read from the JobOrder file
Processing_Level	String	“1”	
Processor_Version	String	XX.XX with X = 0..9	
Acquisition_Station	String		Acquisition Station read from the JobOrder file
Processing_Station	String		Processing Station read from the JobOrder file
Product_StartTime	String	yyyy-mm-ddThh:mm:ss.uuuuuu	UTC time of the first valid frame stored in the product
Product_StopTime	String	yyyy-mm-ddThh:mm:ss.uuuuuu	UTC time of the last valid frame stored in the product.
Acquisition_Type	String	“EARTH OBSERVATION”	
Acquisition_Purpose	String	“NOT SPECIAL PRODUCT” or “SPECIAL PRODUCT FOR VALIDATION”	
Frame_Type	String	“SURFACE OBSERVATION”	
Acquisiton_Size	String	“30 km” in case of SOI-A-1 (Not Special Product), “x km” in case of SOI-A-2, where x represents the number of km in the along track direction covered by the current file.	Note that the total coverage will be a multiple of 30 m, which is the spatial resolution of the instrument in the HYPER channel.
Integration_Time	float	seconds	Integration Time used for Hyperspectral Channel = HeaderPacket.Integration_Time
Synch_Time	float	seconds	Sync Time = Sync thime used for Hyperspectral Frame = HeaderPacket.Synch_Time
PAN_Int_Time	float	seconds	Integration Time used for Pan Channel =HeaderPacket.Pan_Int_Time
Pan_N_Int	Uint8	1…6	Default N=6= number of pan-frames acquired during a Sync_Time. =HeaderPacket.Pan_N_Int
Num_Frames	Uint32		Number of Hyperspectral VNIR and SWIR frames acquired in the current L1 file. It is the dimension of the lines of the VNIR and SWIR SWATHs cubes.
Pan_Num_Frames	Uint32		Number of PAN frames acquired in the current L1 file. It is the dimension of the lines of the PAN SWATHs cubes.

VNIR_Corrupted_Frame_Percentage	String	"nn.nn %"	Percentage of corrupted+missing frames on the total set of EO/EOS frames in the "nn.nn %" format. (Extracted from the GlobalAttributes.VNIRCorruptedFrameList)
SWIR_Corrupted_Frame_Percentage	String	"nn.nn %"	Percentage of corrupted+missing frames on the total set of EO/EOS frames in the "nn.nn %" format. (Extracted from the GlobalAttributes.SWIRCorruptedFrameList)
PAN_Corrupted_Frame_Percentage	String	"nn.nn %"	Percentage of corrupted+missing frames on the total set of EO/EOS frames in the "nn.nn %" format. (Extracted from the GlobalAttributes.PANCorruptedFrameList)
Main_Electronic_Unit	string	"0= ME Main" "1 = ME Redundant"	=HeaderPacket.MainElectronic_Main_Red_flag.
Sun_zenith_angle	float	degrees	Sun Zenith angle of the central pixel of the image
Sun_azimuth_angle	float	degrees	Sun azimuth angle of the central pixel of the image.
CUBE-INFO			
List_Cw_Vnir	Float[66]	66 values	List of 66 Central Wavelenghs (nm) for the VNIR channel: they are the CW associated to the boresight pixel.
List_Cw_Vnir_Flags	Uint8[66]	66 values	1 if that CW is present in the cube.
List_Fwhm_Vnir	Float[66]	66 values	List of 66 band amplitude for the VNIR channel: they are the FWHM associated to the boresight pixel.
List_Cw_Swir	Float[173]	173 values	List of 173 Central Wavelenghs (nm) for the SWIR channel. they are the CW associated to the boresight pixel.
List_Cw_Swir_Flags	Uint8[173]	173 values	1 if that CW is present in the cube
List_Fwhm_Swir	Float[173]	173 values	List of 173 band amplitude for the SWIR channel. they are the FWHM associated to the boresight pixel.
ScaleFactor_Vnir	float	Default value =100	Scale factor, to be used in order to transform Vnir Cube from Digital Number 16 bit to radiance W/m2srum. This means that the COREGISTERED and NOT COREGISTRED CUBES shall be divided by this ScaleFactor, in order to obtain the true output radiance. This value is retrieved from ConfigFile.ScaleFactor_Vnir

Offset_Vnir	float	Default value =0	Offset factor, to be used in order to transform Vnir Cube from Digital Number 16 bit to radiance W/m2srum. Radiance = DN/ ScaleFactor - Offset This value is retrieved from ConfigFile.Offset_Vnir
ScaleFactor_Swir	float	Default value =100	Scale factor, to be used in order to transform Swir Cube from Digital Number 16 bit to radiance W/m2srum. This means that the COREGISTERED and NOT COREGISTRED CUBES shall be divided by this ScaleFactor, in order to obtain the true output radiance. This vaule is retrieved from ConfigFile.ScaleFactor_Swir
Offset_Swir	float	Default value =0	Offset factor, to be used in order to transform Swir Cube from Digital Number 16 bit to radiance W/m2srum. Radiance = DN/ ScaleFactor - Offset This vaule is retrieved from ConfigFile.Offset_Swir
ScaleFactor_Pan	float	Default value =1	Scale factor, used in order to transform Pan image from Float to Digital Number 16 bit =ConfigFile.ScaleFactor_Pan
Offset_Pan	float	Default value =0	Offset factor, used in order to transform Pan Image Float to Digital Number 16 bit float value = DN / ScaleFactor - Offset =ConfigFile.Offset_Pan
PAN_HYP_ACT_RESIDUAL_m	Float32		Additional information suitable for higher level processing (L2): it reports the measurement in meters of the Across track offset (meter distance computed using combination of frame and subframe)
PAN_HYP_ALT_RESIDUAL_m	Float 32		Additional information suitable for higher level processing (L2): it reports the measurement in meters of the Along track offset (meter distance computed using combination of frame and subframe)
PAN_HYP_START_SYNC_FRAME	Uint32		Applied number of PAN-HYP delay frames in the Along track direction to

			synch first HYP cube's line with first PAN cube's line. It's computed on the first frame of the 30km x 30km image Applied in PAN-HYP coarse coregistration.
PAN_HYP_START_SYNC_SUB_FRAME	Uint32	[0, 5]	Applied number of PAN-HYP delay SUB-frames in the Along track direction to synch first HYP cube's line with first PAN cube's line. It's computed on the first frame of the 30km x 30km image. Applied in PAN-HYP coarse coregistration.
PAN_HYP_STOP_SYNC_FRAME	Uint32		Additional information suitable for higher level processing (L2): Number of PAN-HYP delay frames in the Along track direction to synch last HYP cube's line with last PAN cube's line. It's computed on the last frame of the 30km x 30km image NOT applied in the PAN-HYP coarse coregistration.
PAN_HYP_STOP_SYNC_SUB_FRAME	Uint32	[0,5]	Additional information suitable for higher level processing (L2): number of PAN-HYP delay SUB-frames in the Along track direction to synch last HYP cube's line with last PAN cube's line. It's computed on the last frame of the 30km x 30km image. NOT applied in the PAN-HYP coarse coregistratin.
PA YLOAD BINNING INFO			
SWIR_HGRP	unit8	1, 2 or 4	This attribute contains the information about the grouping (or spatial binning) in the SWIR channel. "1" means that no grouping is applied "2" means that each pixel contains the averaged value of two contiguous pixels in the across track direction "4" means that each pixel contains the averaged value of four contiguous pixels in the across track direction **= HeaderPacket.SWIR_HGRP**
VNIR_HGRP	unit8	1, 2 or 4	This attribute contains the information about the grouping (or spatial binning) in the VNIR channel. "1" means that no grouping is applied "2" means that each pixel contains the averaged value of two contiguous pixels in the across track direction

			"4" means that each pixel contains the averaged value of four contiguous pixels in the across track direction **= HeaderPacket.VNIR_HGRP**
PAN_HGRP	unit8	1, 2 or 4	This attribute contains the information about the grouping (or spatial binning) in the PAN channel. This information is contained in the Level 0 product. "1" means that no grouping is applied "2" means that each pixel contains the averaged value of two contiguous pixels in the across track direction "4" means that each pixel contains the averaged value of four contiguous pixels in the across track direction **= HeaderPacket.PAN_HGRP**
PAN_ACQ	unit8	1 if PAN channel is present in the telemetry. 0 in the contrary case.	**= HeaderPacket.Pan_ACQ**
SWIR_BNSTART	Uint8	Value between 0 and 255; if binning isn't applied the SW-BNSTART = 255 and the SW-BNSTOP =0	Starting band for binning in the SWIR **=HeaderPacket.SWIR_BNSTART**
SWIR_BNSTOP	Uint8	Value between 0 and 255; if binning isn't applied the SW-BNSTART = 255 and the SW-BNSTOP =0	Ending band for binning in the SWIR **=HeaderPacket.SWIR_BNSTOP**
VNIR_BNSTART	Uint8	Value between 0 and 255; if binning isn't applied the SW-BNSTART = 255 and the SW-BNSTOP =0	Starting band for binning in the VNIR**=HeaderPacket.VNIR_BNSTART**
VNIR_BNSTOP	Uint8	Value between 0 and 255; if binning isn't applied the SW-BNSTART = 255 and the SW-BNSTOP =0	Ending band for binning in the VNIR **=HeaderPacket.VNIR_BNSTOP**
SWIR_X	Uint8 [256]	Vector of 256 elements: a 0 or 1 value for each spectral line that the on-board instrument can acquire in the SWIR channel	Editing Info in the SWIR channel (and of PE and SDAB editing info) **=HeaderPacket.SDAB_SWIR && HeaderPacket.PE_SWIR**
VNIR_X	Uint8 [256]	Vector of 256 elements: a 0 or 1 value for each spectral line in the VNIR channel	Editing Info in the VNIR channel (and of PE and SDAB editing info) **=HeaderPacket.SDAB_VNIR && HeaderPacket.PE_VNIR**
Start_index_EO_SWIR	Uint8	0..255	It is extracted from GKDP: it indicates the start column index on the array of 256 for the image VNIR when Earth is observed.
Stop_index_EO_VNIR	Uint8	0..255	It is extracted from GKDP: it indicates the stop column index on the array of 256 for the image VNIR when Earth is observed.

Start_index_EO_SWIR	Uint8	0..255	It is extracted from GKDP: it indicates the start column index on the array of 256 for the image SWIR when Earth is observed.
Stop_index_EO_SWIR	Uint8	0..255	It is extracted from GKDP: it indicates the stop column index on the array of 256 for the image SwIR when Earth is observed.
PE_Gain_SWIR	Uint8 [256]	Vector of 256 elements: a 0 or 1 value for each spectral line in the SWIR channel	**=HeaderPacket.PE_Gain_SWIR**
PE_Gain_VNIR	Uint8 [256]	Vector of 256 elements: a 0 or 1 value for each spectral line in the VNIR channel	**=HeaderPacket.PE_Gain_VNIR**
END-USER BINNING INFO			
SPATIAL_GROUPING	Uint8	[1..10]	N=1 no gropuing is applied. END USER SPATIAL GROUPING SELECTION N >1 a factor of grouping N is applied both in the spatial and in the line (=time) direction: squares of NxN pixel are spatially averaged both per SWIR, VNIR, and PAN. If the original image is not an integer multiply of N, the pixel at the bottom row of the image (fov ~+500) are obtained by averaging a reduced number of pixel in the fov direction. The last bottom pixel (=+500fov and last time) is obtained by averaging a reduced number of pixel in the fov and in the line direction.
SPECTRAL_GROUPING	Uint8	[1..20]	END USER SPECTRAL GROUPING SELECTION N=1 no gropuing is applied. N >1 a factor of grouping N is applied in the band direction: N adjacent bands are averaged in an unique output band both for VNIR and SWIR. Adjacent bands are those selected with the on-board editing mask (for example if it selected 2 and 10, 10 is the bands immedialy adjacent to 2) If the original image is not an integer multiply of N in the band directon, the band at the end of the VNIR and SWIR spectrum is obtained by averaging a reduced number of bands.
VNIR-BAND-SELECTION	Uint8[66]	Vector of 66 elements: a 0 or 1 value for each spectral line in the VNIR channel:	END-USER BAND SELECTION It is mutually exclusive with SPATIAL and SPECTRAL GROUPING
SWIR-BAND-SELECTION	Uint8[176]	Vector of 176 elements: a 0 or 1 value for each spectral line in the SWIR channel.	END-USER BAND SELECTION. It is mutually exclusive with SPATIAL and SPECTRAL GROUPING
PAN-BAND-SELECTION	Uint8	0/1	It is mutually exclusive with SPATIAL and SPECTRAL GROUPING

			0= PAN not present 1= PAN present
PRODUCT REPORT INFO			
Image_ID	Uint16		Identifier of the acquired image in the Acquisition Plan: it is retrieved from the Header Packet. **=HeaderPacket.ImageID**
ISF_ID_Start	Uint32		ID of the first ISF file associated to the current Image_ID: it is retrieved from the header packet. **=HeaderPacket.ISF_ID_Start**
Number_of_ISF	Uint16		Number of ISF files contained in the current image: it is retrieved from the header packet. **=HeaderPacket.NumberofISF**
Processing_Time	String	yyyy-mm-ddThh:mm:ss.uuuuuu	Creation date of the L1 Product in UTC Time format
Exit_Code	Uint8	0=Ok 1=Warning 255= Error	
L1_Quality_CCPerc	Float 32		Percentage of clouds on the L1 image.
L1_Quality_info	string		String. It ha the same format of the MD.QualityInfo. See par. 7.6.10
Prev_FKdp_File_Name	String		File passed in input with the Scene of Interest Info (SOI)
Prev_Cdp_File_Name	String		File passed in input with the Scene of Interest Info (SOI)
Prev_ICU_CDP_File_Name	String		File passed in input with the Scene of Interest Info (SOI)
Prev_Gkdp_File_Name	String		File passed in input with the Scene of Interest Info (SOI) Nb. This GKDP contains also reference to the SRF and LOS GKDP useful to the scientist.
Soi_Prev_Dark_Calibration_L0aFile	String		File passed in input with the Scene of Interest Info (SOI)
Soi_L0a_EO-EOS	String		File passed in input with the Scene of Interest Info (SOI)
Soi_Post_Dark_Calibration_L0aFile	String		File passed in input with the Scene of Interest Info (SOI)
Aux_SunEarthDistance	String		File passed in input with the Scene of Interest Info (SOI)
Aux_SunIrradiance	String		File passed in input with the Scene of Interest Info (SOI)
CORRUPTED FRAME LIST			
VNIRCorruptedFrameList	uint8[nHypAlongPixel][2]	Matrix of nHypAlongPixel x 2	This Data Field contains information about the Corrupted Frames of the HYPER RC cube. It is a two-dimensional Data Field. The first dimension (i.e. number of lines of the matrix dataset) is given by the number of frames that compose the cube (nHypAlongPixel). The second dimension (i.e. number of column) is equal to 2: each column has a precise meaning which is explained in the attribute "Legend" of this Data Field "1st Column = 1 if the frame is corrupted 0 if the frame is ok.

			2th Column = Damage *(1=corrupted frame, 2=missing frame) **= Output of the FrameHealthCheck Algorithm.** **Notes:** • This attribute matches the cube's along track dimension. So, extended frames are not considered. • the first two frames are always marked as corrupted when the L1 product represents the first 30Km (along track) of a new sub-acquisition.
SWIRCorruptedFrameList	uint8[nHypAlongPixel][2]	Matrix of nHypAlongPixel x 2	Cf. VNIRCorruptedFrameList
PANCorruptedFrameList	uint8[nPanAlongPixel][2]	Matrix of nPanAlongPixel x 2	**= Output of the FrameHealthCheck Algorithm.** **Notes:** • This attribute matches the cube's along track dimension. So, extended frames are not considered. • Because the applied PAN_HYP delay, the first two frames (12 lines) are NOT always marked as corrupted, as explained in VNIRCorruptedFrameList

*Damage Description

A frame is corrupted if:

- at least one packet (not the Header!) is not retrieved or the checksum isfailed.
- there have been problem in building the entire frame, when the frame is divided into two frame part
- the relevant hk are out of ranges or out of mean values.

A frame is missing if:

- the header packet is corrupted or missing
- the entire set of related packet is missing

7.6.2 INFO.HEADER

This group contains the frame number of each frame (including the "extended" frames added at the end).

It will match as number of elements the array containting the frames housekeeping and ancillary respectively stored inside sections /Info/Housekeeping and /Info/Ancillary which indeed lacked the FrameNumber.

The FrameNumber allows a one to one association between the SWATH frames (they have their FrameNumber) and the Housekeeping and Ancillary Data. More accurate relationship to Ancillary Data will be achieved by using the SWATH frame time and the Ancillary GPS and StarTracker time).

Dataset Name	Type	Value/Units	Notes
FrameNumber	Uint32	counter	Absolute Frame number in the file. For example it start from 33 (first EO frame after prev dark) and stops at 1134 taking into account also of the extended frames. For the second 30x30 image it starts from 1033 and ends at 2136. It is used in order to associate the frame number to each INFO.HOUSEKEEPING and to each INFO.ANCILLARY data. Also each SWATH data section has its frame number associated, in order to allow unique matching between data and Hk and Ancillary.
Frame_Corrupted	Uint8	0,1	Flag, it is 1 in case of corrupted frames. At this level a frame is corrupted if: - unexpected values found in hk data - crc errors in data packets - error occurred decoding frame It differs from the field VNIR/SWIR/PANCorruptedFramelist of the globalAttribute, that marks a frame as corrupted also if the channel data are not ok.
Frame_Missing	Uint8	0,1	Flag, it is 1 in case of missing frame (missing or critical error in header packet).

7.6.3 INFO.HOUSEKEEPING

This group contains Frame-dependent HK Parameters: all parameters are stored as one-dimensional Dataset of “nHypAlongPixel” elements, where “nHypAlongPixel” is the number of pixels in the along-track direction in the Hyperspectral cubes and coincides with the number of frames contained in the L1 products.

Dataset Name	Type	Value/Units	Notes
HK_UTC_Time	Double	Decimal Days	UTC Time at the moment of HK collecting (MJD2000 Decimal Days)
SW_MODE	Uint8	0x01...0x06 0x11 0x12	PL SW Actual mode 0x01=INI 0x03=IDLE, 0x02=SURV 0x04=SW_MAINT, 0x05= DEIC_MAINT 0x06=SW_UPD 0x11= ACQ 0x12=CAL
SW_PREMODE	Uint8	0x01...0x06 0x11 0x12	PL SW previous mode 0x01=INI 0x03=IDLE, 0x02=SURV 0x04=SW_MAINT, 0x05= DEIC_MAINT 0x06=SW_UPD 0x11= ACQ 0x12=CAL
SYNCHRO_STATUS	Uint8	0..2	Info about the 1553 synchro mode code reception. 0=Received

			1=Not received 2=Received with wrong period (outside the PL "locking slot")
TOD_STATUS	Uint8	0b01 0b10 0b11	Contains the info about the last TOD reception. 0b01=synchronization with TOD not executed due to running acquisition 0b10=TOD message not received for a time >600 sec (TBC) 0b11=Synchronization with TOD OK
PRI_COM	Uint8		It is a copy of the SDAC Primary Communication register: **bit [15] FRAME_ERR**: high when the number of frames acquired is not equal to the programmed one after the reception of the END character. The bit is reset after the reception of the BEGIN character. **bit [14] PAN_PLOST**: high when the number of lines received from the PAN is not equal to the expected one (by setting the PAN_ACQ register bit 0). **bit [13] VNIR_PLOST**: high when the number of lines received from the VNIR is not equal to the expected one (by setting the VNIR_X[0..15] registers). . **bit [12] SWIR_PLOST**: high when the number of lines received from the SWIR is not equal to the expected one (by setting the SWIR_X[0..15] registers). The bit is reset after the reception of the BEGIN character. **bit [11] PAN_OVERR:** high when overrun condition occur on the PAN input Fifo. The bit is reset after the register is read. **bit [10] VNIR_OVERR**: high when overrun occur on the VNIR input Fifo. **bit [9] SWIR_OVERR**: This bit is high when overrun condition occur on the SWIR input Fifo. The bit is reset after the register is read. **bit [8]: PRI_IF_ERR** This bit is high when an error occurs on the TM/TC I/F. The bit is reset after the register is read. **bit[7:6]:NC** Not Used **bit [5]: FILL_STATUS** When the Autotest enable bit is set, it goeshigh when the memory banks have been filled **bit [4]: AUTOTEST_ENABLE** When the bit is set the SDAC FPGA fills the memories with a fixed pattern. Each location is written with five 12-bit pixels. Each pixel value is the previous one plus 1. **bit[3]: END_CMD** When issued the END character is sent on the PDHT I/F. The bit is auto cleared after it is written with 1. **bit[2]: BEGIN_CMD** When issued the BEGIN character is sent on the PDHT I/F. The bit is auto cleared after it is written with 1. **bit[1]: BANK_SWITCH_CMD** Switch of the variable part of the Header Packet. The bit is auto cleared after it is written with 1. The switch of the bank is performed on the reception of the Sync signal after the command is received. **bit[0]:** CCSDS_FRAME_RESET_CMD Reset command for the Frame counter inside the CCSDS packet. The bit is auto cleared after it is written with 1.
SEC_COM	Uint8	0b01 0b10 0b11	SDAC Secondary Communication Register, as reported by SDAC Technical Note on FPGA registers space. The used fields are the following: 1: BUF_ERR: The amount of data to send to the PDHT is greater than the maximum allowable by PDHT link rate 0: SEC_IF_ERR: Error condition on the TM/TC I/F, the source of error are in write or read transactions.
HEALTH	Uint8	0x0..0x3F	The complete SDAC HEALTH register dump. **bit [11] PG_1V8:** Status of the POWER_GOOD signal of the 1.8V POL. Power is good when bit is high. **bit [10] PG_1V0:** Status of the POWER_GOOD signal of the 1.0V POL. Power is good when bit is high. **bit [9] PG_2V5:** Status of the POWER_GOOD signal of the 2.5V POL. Power is good when bit is high. **bit [8] PG_3V3:** Status of the POWER_GOOD signal of the 3.3V POL. Power is good when bit is high. **bit [7] PROG_ERR:** It goes high in case of failure of the Primary FPGA programming.

			bit [6] PROG_END: It goes high at the end of the Primary FPGA programming. **bit [5] FLASH_CFG_CMD:** Command that starts the loading of the bitstream located in the Flash memory into the Primary FPGA. The bit is auto cleared after it is written with 1. **bit [4] OTP_CFG_CMD:** Command that starts the loading of the bitstream located in the OTP memory into the Primary FPGA. The bit is auto cleared after it is written with 1. The command is executed automatically after power up. **bit [3:2]:** NC Not Used **bit [1] PROT_EN:** When high, enables the powering off the Primary FPGA when a POL voltage is not good. High at reset. **bit [0] PWR ON_OFF:** When high, Primary FPGA is powered ON. When low, Primary FPGA is powered OFF. High at reset.
SDAC_COMP	16	0x0.. 0xFFFF	SWIR and VNIR Compressors setting and status. **bit [15:12]: N.C.** Not used **bit [11:8] FRAME_RESET:** Number of frames before prediction reset. Number of frames is: 16*FRAME_RESET Reset value is "001" (16 frames) **bit [7:4] Quantization:** Permitted values: 0x0; 0x1, 0x2, 0x3 Reset value is zero. **bit [3] VNIR_COMP_OVF:** This bit is high when the VNIR compressor internal buffer overflows. **bit [2] SWIR_B_COMP_OVF:** This bit is high when the SWIR_B compressor internal buffer overflows. **bit [1] SWIR_A_COMP_OVF:** This bit is high when the SWIR_A compressor internal buffer overflows. **bit [0]: COMP_EN** When this bit is set the SWIR and VNIR compressors are enabled. Reset value is zero. Note: it this field is 0, no compression was commanded on data.
PS_VOLT_5V	float	V	Power Supply 5V value
PS_VOLT_28V	float	V	Power Supply 28V value
PSR_VOLT_28V	float	V	Regulated Power Supply 28V value
PS_VOLT_3_3V	float	V	Power Supply 3.3V value
V_LAMP	float	V	Lamp voltage
PS_VOLT_6V	float	V	Power Supply 6V value
V_LED	float	V	Led voltage
PS_VOLT_MINUS_15V	float	V	Power Supply -15V value
PS_VOLT_PLUS_15V	float	V	Power Supply +15V value

I_PHOTODIODE_SIGNAL	float	A	Photodiode current (signal)
I_PHOTODIODE_SAFETY	float	A	Photodiode current (safety)
POSITON_SOLAR_PORT_ MAIN_COVER_HES	Uint16	0x0.. 0xFFFF	Position for Main Cover and Solar Port HES
SPS_STATUS	Uint16	0x0.. 0xFFFF	Sun Protection System Status (Enable/Disable)
RTC_C_4W_1	float	DN	Calibration resistance 4W RTD 1
RTC_C_4W_2	float	DN	Calibration resistance 4W RTD 2
RTC_C_2W_1	float	DN	Calibration resistance 2W RTD 1
RTC_C_2W_2	float	DN	Calibration resistance 2W RTD 2
POS_POT	float	degrees	Potentiometer angle
MAIN_PORT_LOCK_EN	uint8	0/1	Main Cover Lock 1=ENABLED 0=DISABLED
MAIN_PORT _EMERGENCY_EN	uint8	0/1	Main Cover Emergency mechanism 1=ENABLED 0=DISABLED
SOLAR_PORT _EMERGENCY_EN	uint8	0/1	Solar Port emergency mechanism 1=ENABLED 0=DISABLED
SWIR_PE_ERR	Uint16	0x0.. 0xFFFF	SWIR PE error status
SWIR_PE_STATUS1	Uint16	0x0.. 0xFFFF	SWIR PE Status
SWIR_PE_STATUS2	Uint16	0x0.. 0xFFFF	SWIR PE Status
SWIR_PE_VDET	float	V	SWIR PE VDET voltage
SWIR_PE_VDDA	float	V	SWIR PE VDDA voltage
SWIR_PE_VDD	float	V	SWIR PE VDD voltage
SWIR_PE_VDDO	float	V	SWIR PE VDDO voltage
SWIR_PE_6_5PWR	float	V	SWIR PE 6.5 PWR
VNIR_PE_ERR	Uint16	0x0.. 0xFFFF	VNIR PE error status
VNIR_PE_STATUS1	Uint16	0x0.. 0xFFFF	VNIR PE Status
VNIR_PE_STATUS2	Uint16	0x0.. 0xFFFF	VNIR PE Status
VNIR_PE_VDET	float	V	VNIR PE VDET voltage
VNIR_PE_VDDA	float	V	VNIR PE VDDA voltage
VNIR_PE_VDD	float	V	VNIR PE VDD voltage

VNIR_PE_VDDO	float	V	VNIR PE VDDO voltage
VNIR_PE_6_5PWR	float	V	VNIR PE 6.5 PWR
PAN_PE_ERR	Uint16	0x0.. 0xFFFF	PAN PE Error status
PAN_PEV3_3	float	V	PAN PE 3.3V voltage
PAN_PE_V6_5	float	V	PAN PE 6.5V voltage
PAN_PE_V13DR	float	V	PAN PE 13V DR voltage
PAN_PE_V_6_5	float	V	PAN PE -6.5V voltage
PAN_PE_V18_5	float	V	PAN PE 18.5V voltage
PAN_PE_STATUS1	Uint16	0x0.. 0xFFFF	PAN PE status
PAN_PE_STATUS2	Uint16	0x0.. 0xFFFF	PAN PE status
FPA_SWIR_T1	float	K	SWIR FPA Temperature 1
FPA_SWIR_T2	float	K	SWIR FPA Temperature 2
FPA_VNIR_T1	float	K	VNIR FPA Temperature 1
FPA_VNIR_T2	float	K	VNIR FPA Temperature 2
FPA_PAN_T1	float	K	PAN FPA Temperature 1
FPA_PAN_T2	float	K	PAN FPA Temperature 2
PE_SWIR_T	float	K	SWIR PE temperature
PE_VNIR_T	float	K	VNIR PE temperature
PE_PAN_T	float	K	PAN PE temperature
TMA_T1	float	K	TMA temperature 1
TMA_T2	float	K	TMA temperature 2
TMA_T3	float	K	TMA temperature 3
UP_CARTER_T	float	K	Temperature of UP carter
LOW_CARTER_T	float	K	Temperature of LOW carter
SPECT_T1	float	K	Spectrometer temperature 1
SPECT_T2	float	K	Spectrometer temperature 2
SPECT_T3	float	K	Spectrometer temperature 3

TMA_M1_T	float	K	TMA M1 temperature
TMA_M2_T	float	K	TMA M2 temperature
TMA_M3_T	float	K	TMA M3 temperature
PRISM_VNIR_T1	float	K	VNIR Prism temperature 1
FPA_PT1000_VNIR_T	float	K	Temperature of PT1000 on cold strap close to VNIR FPA
FPA_PT1000_SWIR_T	float	K	Temperature of PT1000 on cold strap close to SWIR FPA
PRISM_VNIR_T2	float	K	VNIR Prism temperature 2
PRISM_SWIR_T1	float	K	SWIR Prism temperature 1
PRISM_SWIR_T2	float	K	SWIR Prism temperature 2
HEAT_PIPE_VNIR_T	float	K	VNIR heat pipe temperature
HEAT_PIPE_SWIR_T	float	K	SWIR heat pipe temperature
RADIATOR_T	float	K	Radiator Temperature
ICU_T	float	K	ICU temperature
LAMPS_T	float	K	Lamps temperature
LEDS_T	float	K	Leds temperature
TM_ES_OPPOSITE _SIDE_SA_BA	float	K	Earth Shield Temperature In case of MainElectornic Nominal, it is the thermistor on the ES Panel opposite to the Solar Array In case of Main Electronic Redundant, it is the thermistor on the ES Panel opposite to the Baffle
RADIATOR_VNIR	float	K	Radiator VNIR Temperature
TM_ES_SIDE_SA_BA	float	K	Earth Shield Temperature In case of MainElectornic Nominal, it is the thermistor on the ES Panel on the Solar Array side. In case of Main Electronic Redundant, it is the thermistor on the ES Panel on the Baffle side.
PhotoDiode_High _Rate_Section	Uint8	0…3	0 = register from 741..756 are not significant 1= register from 741…756 are significant.=> first group of the 48 samples is written. 2 = register from 741…756 are significant.=> second group of the 48 samples is written. 3 = register from 741…756 are significant.=> third group of the 48 samples is written. 4 = register are significant.=>fourth group of the 48 samples is written.

I_PhotoDiode_High _Rate_Sample	Float[16]	V	Value samples (they are 16 samples of section reported in) of photodiode current sampled during the opening/closing of the solar port They are significant only if **PhotoDiode_High_Rate_Section!=0**

The word from 656 to 742 of the header packet variable part are copied in the INFO.HOUSEKEEPING: in this case, the header packet is used after the FrameHealthCheck algorithm, that provide to transform DN in to Analogic Values.

It is generated 1 Data Set of INFO.HOUSEKEEPING for each frame in the HypCube.

7.6.4 INFO.ANCILLARY

This group contains Frame-dependent Ancillary Parameters (ancillary data are GPS and StartTracker data, in particular they are contained from word n.584 up to word n. 655 of L0 Header Packet): all parameters are stored as one-dimensional Dataset of "nHypAlongPixel" elements, where "nHypAlongPixel" is the number of pixels in the along-track direction in the Hyperspectral cubes and coincides with the number of frames contained in the L1 products. Units are reported beside each parametrs.

. The Ancillary group is divided in four sub-groups:

- GyroData;
- PVSdata ;
- StarTracker1;
- StarTracker2.

The word from 584 to 655 of the header packet variable part are copied in the INFO.HOUSEKEEPING: in this case, as header packet is used directly those received in input from the L0 module (no transoformation to analogic values are needed).

It is generated 1 Data Set of INFO.ANCILLARY for each frame in the HypCube.

Data are opportunely shifted by the number of frames reported int ATT_DELAY and GPS_DELAY. These two field are retrieved from L1 config file. Their default value is 0.

Sub-group Name	Dataset Name	Type	Value/Units	Notes
StarTracker1	NAV_APROP_EKF_values	16 (uint)	0x0.. 0xFFFF	Bit15..12: EKF_rate Bit11..8: EKF_attitude Bit7..4: APROP_rate Bit3..0: APROP_attitude Range value for each nibble = [0..6] (see Figure 7-1)
	Navigation_time	32 (uint)	> 600825600	Navigation Time: number of seconds since 01/01/2000 00:00:00 Expected value: > 600825600 (15/01/2019)
	NAV_ENA_values	8 (uint)	0x0.. 0xFF	Bit_14_15= Enable Bias_ EKF Bit_12_13= Enable Bias_APROP Bit_10_11 = Enable EKF Bit_8_9 = Enable APROP Range value for each one = 0 (disable) or 1 (enable) (see Figure 7-1)

	NAV_ALG_values	8 (uint)	0x0.. 0xFF	bit3..0: ALG_attitude [1,2] bit7..4: ALG_rate [1,2] Range value for each nibble 1 (APROP) or 2 (EKF) (see Figure 7-1)

	q_ECI_2_Body_1	32 (float)	IEEE	q_ECI_2_Body_1
				Output of AOCS Navigation (available in each AOCS state).
				1st component of the vectorial part of the quaternion representing a rotation from J2000 ECI reference frame to S/C body reference frame.
				
				Quaternion: Range [-1.0; +1.0]
				
				float 32 standard
				`Bit [31]=sign`
				`Bit[30:23]=exp`
				`Bit[22:0] =mantissa`

	q_ECI_2_Body_2	32 (float)	IEEE	q_ECI_2_Body_2
				Output of AOCS Navigation (available in each AOCS state).
				
				2nd component of the vectorial part of the quaternion representing a rotation from J2000 ECI reference frame to S/C body reference frame.
				
				Quaternion: Range [-1.0; +1.0]
				
				IEEE float 32 standard
				`Bit [31]=sign`
				`Bit[30:23]=exp`
				`Bit[22:0] =mantissa`

	q_ECI_2_Body_3	32 (float)	IEEE	q_ECI_2_Body_3
				Output of AOCS Navigation (available in each AOCS state).
				
				3rd component of the vectorial part of the quaternion representing a rotation from J2000 ECI reference frame to S/C body reference frame.
				
				Quaternion: Range [-1.0; +1.0]
				
				IEEE float 32 standard
				`Bit [31]=sign`
				`Bit[30:23]=exp`
				`Bit[22:0] =mantissa`

	q_ECI_2_Body_4	32 (float)	IEEE	q_ECI_2_Body_4 Output of AOCS Navigation (available in each AOCS state). Scalar component of the quaternion representing a rotation from J2000 ECI

				reference frame to S/C body reference frame.
				
				Quaternion: Range [-1.0; +1.0]
				
				IEEE float 32 standard
				`Bit [31]=sign`
				`Bit[30:23]=exp`
				`Bit[22:0] =mantissa`

	w_body_1	32 (float)	IEEE	w_body_1
				Output of AOCS Navigation (available in each AOCS state)
				
				x-component of angular velocity expressed in the S/C body reference frame.
				
				Rad/s: range:-0.5:0.5
				
				IEEE float 32 standard
				`Bit [31]=sign`
				`Bit[30:23]=exp`
				`Bit[22:0] =mantissa`

	w_body_2	32 (float)	IEEE	w_body_2
				Output of AOCS Navigation (available in each AOCS state)
				
				y-component of angular velocity expressed in the S/C body reference frame.
				
				Rad/s: range:-0.5:0.5
				
				IEEE float 32 standard
				`Bit [31]=sign`
				`Bit[30:23]=exp`
				`Bit[22:0] =mantissa`

	w_body_3	32 (float)	IEEE	w_body_3
				Output of AOCS Navigation (available in each AOCS state)
				
				z-component of angular velocity expressed in the S/C body reference frame.
				
				Rad/s: range:-0.5:0.5
				
				IEEE float 32 standard
				`Bit [31]=sign`
				`Bit[30:23]=exp`
				`Bit[22:0] =mantissa`

StarTracker2	Time_day_ss	16 (uint)	0x0.. 0xFFFF	Start sensor data, taken from Anc8Hz message Number of days since 1st Jan 1958
	Time_msec_ss	32 (uint)	0x0.. 0xFFFF FFFF	Milliseconds of day. Range: 0:86400000
	Data_valid_ss	8 (uint)	0x0.. 0xFF	Binary coded attitude validity flags 00 = NEAT/HEAT with quaternion 01 = NEAT/HEAT without quaternion 10 = NEAT/HEAT error

				Bit 7: set if quaternion is not valid Bit 6: set if angular rate is not valid Bit 5-2: spare set to 0 Bit 1-0: cycle status (for NEAT/HEAT)
	Attitude_status_ss	8 (uint)	0x0.. 0xFF	Status of attitude, it can assume following values: 0 = no error 1 = not enough (<2) matched stars in AAD 2 = not enough (<1) pre-processed segments in AAD search 3 = not enough (< 1) objects after clustering in AAD search 4 = number of predicted stars is lower than number of tracked stars in AAD_P confirmation 5 = only zero or one tracking window has been prepared for the next NEAT/HEAT/AAD_V cycle 6 = spare 7 = not enough linked stars (if AAD_P, AAD_V, NEAT, HEAT) 8 = angular rate higher than ω max (settable parameter mode depending) 9 = quaternion not convergent
	Quaternion_1_ss	32 (int)	0xfff0bd c0 0x000f4 240	Quaternion*10^6: Range -10^6:10^6 1st component of the vectorial part of the quaternion representing a rotation between the J2000 ECI reference frame and the Star Sensor reference frame [RD-15]
	Quaternion_2_ss	32 (int)	0xfff0bd c0 0x000f4 240	Quaternion*10^6: Range -10^6:10^6 2nd component of the vectorial part of the quaternion representing a rotation between the J2000 ECI reference frame and the Star Sensor reference frame [RD-15]
	Quaternion_3_ss	32 (int)	0xfff0bd c0 0x000f4 240	Quaternion*10^6: Range -10^6:10^6 3rd component of the vectorial part of the quaternion representing a rotation between the J2000 ECI reference frame and the Star Sensor reference frame [RD-15]
	Quaternion_4_ss	32 (int)	0xfff0bd c0 0x000f4 240	Quaternion*10^6: Range -10^6:10^6 Scalar component of the quaternion representing a rotation between the J2000 ECI reference frame and the Star Sensor reference frame [RD-15]
	Omega_x_ss	32 (int)	0x0007a 120 0xfff85e e0	Rad/s*10^6: range:-0.5e+6:0.5e+6 x-component of angular velocity expressed in the J2000 ECI reference frame.
	Omega_y_ss	32 (int)	0x0007a 120 0xfff85e e0	Rad/s*10^6: range:-0.5e+6:0.5e+6 y-component of angular velocity expressed in the J2000 ECI reference frame.

GyroData	Omega_z_ss	32 (int)	0x0007a120 0xfff85ee0	Rad/s*10^6: range:-0.5e+6:0.5e+6 z-component of angular velocity expressed in the J2000 ECI reference frame.
	Gyro_1_data_ angle	24 (24 bit of an int 32)	0x800000 0x7FFFFF	Gyro 1 data, taken from Anc8Hz message It is a 24-bit integer data type. Range [-8388608 ; +8388607]. To properly use this datum a specific conversion is needed. According to [RD-14] for Incremental Angle Mode: LSB value: 2.384 * 10-7°; Range of Incremental Angle +-2°. See [RD-15] for the definition of the Gyro reference frame.
	Gyro_1_data_byte	8 (uint)	0x0.. 0xFF	8bit Gyro_1 Status Byte Range [0-0xFF]. Bitwise of: Bit0 = NOGO (0x1) Bit1 = Reset acknowledge (0x2) Bit2 = Not Used Bit3 = Temp. warning (0x8) Bit4 = Auxiliary Control Loop Error (0x10) Bit5 = HW Bit Error (0x20) Bit6 = Measurement Range Exceeded (0x40) Bit7 = Unknown command (0x80)
	Gyro_2_data_ angle	24 (24 bit of an int 32)	0x800000 0x7FFFFF	Gyro 2 data, taken from Anc8Hz message For range and values see description of word 620 and 621 Bit 15-8 1° bit is the sign
	Gyro_2_data_byte	8 (uint)	0x0.. 0xFF	8bit Gyro_2 Status Byte For range and values see description of word 621 Bit 7-0
	Gyro_3_data_angle	24 (24 bit of an int 32)	0x800000 0x7FFFFF 1° bit is the sign	Gyro 3 data, taken from Anc8Hz message For range and values see description of word 620 and 621 Bit 15-8
	Gyro_3_data_byte	8 (uint)	0x0.. 0xFF	8bit Gyro_3 Status Byte For range and values see description of word 621 Bit 7-0
	Gyro_4_data_ angle	24 (24 bit of an int 32)	0x800000 0x7FFFFF	Gyro 4 data, taken from Anc8Hz message For range and values see description of word 620 and 621 Bit 15-8 1° bit is the sign
	Gyro_4_data_byte	8 (uint)	0x0.. 0xFF	8bit Gyro_4 Status Byte For range and values see description of word 621 Bit 7-0

	Gyro_5_data_angle	24 (24 bit of an int 32)	0x800000 0x7FFFFF	Gyro 5 data, taken from Anc8Hz message For range and values see description of word 620 and 621 Bit 15-8 1° bit is the sign
	Gyro_5_data_byte	8 (uint)	0x0.. 0xFF	8bit Gyro_5 Status Byte For range and values see description of word 621 Bit 7-0
	Gyro_6_data_ angle	24 (24 bit of an int 32)	0x800000 0x7FFFFF	Gyro 6 data, taken from Anc8Hz message For range and values see description of word 620 and 621 Bit 15-8 1° bit is the sign
	Gyro_6_data_byte	8 (uint)	0x0.. 0xFF	8bit Gyro_6 Status Byte For range and values see description of word 621 Bit 7-0
PVSdata	Star_sensors_&_Gyros_Data_validity	8 (uint)	0x0.. 0xFF	Validity flags: 1 means available, 0 not available. Bit 8: Star Sensor1 (1 means SS1 copied in TC) Bit 9: Star Sensor2 (1 means SS2 copied in TC) The value bit8=1 and bit9=1 at the same time is not allowed. Bit 15..10: gyro flags Bit_10 = gyro_1A validity flag (1=valid, 0 = not valid) Bit_11 = gyro_2A validity flag (1=valid, 0 = not valid) Bit_12 = gyro_3A validity flag (1=valid, 0 = not valid) Bit_13 = gyro_1B validity flag (1=valid, 0 = not valid) Bit_14 = gyro_2B validity flag (1=valid, 0 = not valid) Bit_15 = gyro_3B validity flag (1=valid, 0 = not valid)
	AOCS_Stat	8 (uint)	0x0.. 0xFF	AOCS Status, taken from Anc8Hz message AOCS Current SW State: 1=Damping, 2 =Coarse, 3=StandBy, 4=Fine, 5=Orbit, 6=Safe, 7=Initial Test
	Wgs84_pos_x	32 (float)	IEEE	GPS Data, taken from Anc1Hz message Float. GPS Position [m] x-component of the S/C position expressed in the WGS84 ECEF reference frame. Range:-10^7+10^7 IEEE float 32 standard Bit [31]=sign Bit[30:23]=exp Bit[22:0] =mantissa
	Wgs84_pos_y	32 (float)	IEEE	 Float. GPS Position [m]

				y-component of the S/C position expressed in the WGS84 ECEF reference frame.
				
				Range:-10^7+10^7
				
				IEEE float 32 standard
				`Bit [31]=sign`
				`Bit[30:23]=exp`
				`Bit[22:0] =mantissa`

	Wgs_84_pos_z	32 (float)	IEEE	Float. GPS Position [m]
				
				z-component of the S/C position expressed in the WGS84 ECEF reference frame.
				
				Range:-10^7+10^7
				
				IEEE float 32 standard
				`Bit [31]=sign`
				`Bit[30:23]=exp`
				`Bit[22:0] =mantissa`

	Wgs84_vel_x	32 (float)	IEEE	Float. GPS Velocity [m/s]
				
				x-component of the S/C velocity expressed in the WGS84 ECEF reference frame.
				
				Range. -10^4+10^4
				
				IEEE float 32 standard
				`Bit [31]=sign`
				`Bit[30:23]=exp`
				`Bit[22:0] =mantissa`

	Wgs84_vel_y	32 (float)	IEEE	Float. GPS Velocity [m/s]
				
				y-component of the S/C velocity expressed in the WGS84 ECEF reference frame.
				
				Range. -10^4+10^4
				
				IEEE float 32 standard
				`Bit [31]=sign`
				`Bit[30:23]=exp`
				`Bit[22:0] =mantissa`

	Wgs84_vel_z	32 (float)	IEEE	Float. GPS Velocity [m/s]
				
				z-component of the S/C velocity expressed in the WGS84 ECEF reference frame.
				
				Range. -10^4+10^4
				
				IEEE float 32 standard
				`Bit [31]=sign`
				`Bit[30:23]=exp`
				`Bit[22:0] =mantissa`

	Week_Number	16 (short)	0x0.. 0xFFFF	Weeks since 6/1/1980 Range: 1900-2500
	GPS_Time_of_Last _Position	64 (double)	IEEE	Seconds in week Range: 0- 604800 The UTC shall be derived subtracting the leap seconds (according to IERS Bulletin C).

				IEEE double 64 standard
				`Bit [63]=sign`
				`Bit[62:52]=exp`
				`Bit[51:0] =mantissa`

	Clock Bias (* speed of light c)	32 (float)	IEEE	Float
				GPS Clock Bias [m]
				
				Range: -1000:+1000
				
				IEEE float 32 standard
				`Bit [31]=sign`
				`Bit[30:23]=exp`
				`Bit[22:0] =mantissa`

	Clock Bias Rate (* speed of light c)	32 (float)	IEEE	Float
				GPS Clock Bias Rate [m/s]
				
				Range: -1000:+1000
				
				IEEE float 32 standard
				`Bit [31]=sign`
				`Bit[30:23]=exp`
				`Bit[22:0] =mantissa`

	Number of Satellites	8 (uint)	0x0.. 0xFF	Number of Satellites used in position fix. Range: 0:50
	Gdop	8 (uint)	0x0.. 0xFF	Uint 8 Geometric Dilution of Precision GDOP*10 Range: 0:100
	Position Fix Validity	8 (uint)	0x0.. 0xFF	Uint8 Position Fix Validty 0 = No Navigation 1 = 2D Fix 2 = 3D Fix
	GPS-OBDH Synch Status	8 (uint)	0x0.. 0xFF	Flag 0/1: 1 means OBDH is synchronized with GPS

7.6.4.1 NAVIGATION FLAGS

Flag type	Damping	Coarse	Stand-by	Fine	Orbit C.	Safe
Baseline_APROP	0 5	0 5	2 6	1 6	1 6	0 5
Baseline_EKF	0 0	0 0	3 6	1 6	1 6	0 0
Baseline_BEST	0 0	0 0	3 6	1 6	1 6	0 0
Baseline_ALG	1 1	1 1	2 2	2 2	2 2	1 1
Baseline_ENA	1 0 0	1 0 0	1 1 1	1 1 1	1 1 1	1 0 0
Baseline_BIAS	0 0	0 0	0 1	1 1	1 1	0 0

Legend:
Baseline_APROP: defines the baseline strategy when using APROP. First flag is for attitude, second flag is for rate. See the following for flags values.
Baseline_EKF: defines the baseline strategy when using EKF. First flag is for attitude, second flag is for rate. See the following for flags values.
Baseline_BEST: defines the baseline strategy when using bias estimator. First flag is for attitude, second flag is for rate. See the following for flags values.

```
--------------- baseline_NAV --------------------
  ATTITUDE FLAG          |    RATE FLAG
    propagator           |    propagator
0 = dummy quaternion     |  0 = [0 0 0]
1 = STM                  |  1 = STM
2 = TRIAD                |  2 = TRIAD
3 = STR 1                |  3 = STR 1
4 = STR 2                |  4 = STR 2
5 = n/a                  |  5 = COARSE RATE EST
6 = n/a                  |  6 = GYRO
```

Baseline_ALG: defines which algorithm is the baseline. First flag is for attitude, second flag is for rate. 1=APROP, 2=EKF.
Baseline_ENA: defines if the algorithms are enabled or not. First flag is for APROP, second flag is for EKF, third flag is for BEST. 0=disabled, 1=enabled.
Baseline_BIAS: defines which bias estimation is to be used. First flag is for APROP, second flag is for EKF. 0=Dummy, 1= EKF bias, 2=BEST bias, 3=Freeze EKF bias.

Figure 7-1:Navigation flags

7.6.5 KDP_AUX

This section contains the vector of LOS, and the matrix of CW and FWHM extracted form KDP by interpolation of them according to the temperature of the optical bench associated to the current L1 product. They shall be used for the ground pointing and for the atmospheric correction retrieval.

LOS_Vnir	Float[1000][3] if GROUPING =1or Float[500][3] if GROUPING =2 or Float[250][3] if GROUPING =4	1000x3 value or 500 x3 value or 250 x 3 value	Vnir LOS versor. One value per each FOV. Note: it shall be used always LOS_Vnir versor in case of coregistered images VNIR, SWIR and PAN. In case of grouping the number of FOV pixel is reduced of a factor 2 or 4. It is extracted from LOS_MATRIX_GKDP by interpolation in temperature according to the t_spect associated to the l1 prodcut.
LOS_Swir	Float[1000][3] if GROUPING =1 or Float[500][3] if GROUPING =2 or Float[250][3] if GROUPING =4	1000x3 value or 500 x3 value or 250 x 3 value	Swir LOS versor. One value per each FOV. In case of grouping the number of FOV pixel is reduced of a factor 2 or 4. It is extracted from LOS_MATRIX_GKDP by interpolation in temperature according to the t_spect associated to the l1 prodcut.
LOS_Pan	Float[6000][3] if GROUPING =1 or Float[3000][3] if GROUPING =2 or	6000x3 value or 3000 x3 value or 1500 x 3 value	Pan LOS versor. One value per each FOV. In case of grouping the number of FOV pixel is reduced of a factor 2 or 4.

	Float[1500][3] if GROUPING =4		It is extracted from LOS_MATRIX_GKDP by interpolation in temperature according to the t_spect associated to the l1 prodcut.
Cw_Vnir_Matrix	Float[1000,256] if GROUPING =1 or Float[500,256] if GROUPING =2 or Float[250,256] if GROUPING =4	1000x256 value or 500 x256 value or 250 x 256 value	Matrix of 1000x256 Central Wavelenghs (nm) for the VNIR channel. In case of grouping the number of FOV pixel is reduced of a factor 2 or 4. It is extracted from SRF_GKDP by interpolation in temperature according to the t_spect associated to the l1 prodcut. It shall be associated only to the notc coregistered cubes, since the coregistered cubes have the GLOBAL attribute List_cw_vnir
Fwhm_Vnir_Matrix	Float[1000,256] if GROUPING =1 or Float[500,256] if GROUPING =2 or Float[250,256] if GROUPING =4	1000x256 value or 500 x256 value or 250 x 256 value	Matrix of 1000x256 band amplitude for the VNIR channel. In case of grouping the number of FOV pixel is reduced of a factor 2 or 4. It is extracted from SRF_GKDP by interpolation in temperature according to the t_spect associated to the l1 prodcut. It shall be associated only to the notc coregistered cubes, since the coregistered cubes have the GLOBAL attribute List_fhwm_vnir
Cw_Swir_Matrix	Float[1000,256] if GROUPING =1 or Float[500,256] if GROUPING =2 or Float[250,256] if GROUPING =4	1000x256 value or 500 x256 value or 250 x 256 value	Matrix of 1000x256 Central Wavelenghs (nm) for the SWIR channel. In case of grouping the number of FOV pixel is reduced of a factor 2 or 4. It is extracted from SRF_GKDP by interpolation in temperature according to the t_spect associated to the l1 prodcut. It shall be associated only to the notc coregistered cubes, since the coregistered cubes have the GLOBAL attribute List_cw_swir
Fwhm_Swir_Matrix	Float[1000,256] if GROUPING =1 or Float[500,256] if GROUPING =2 or Float[250,256] if GROUPING =4	1000x256 value or 500 x256 value or 250 x 256 value	Matrix of 1000x256 band amplitude for the SWIR channel. In case of grouping the number of FOV pixel is reduced of a factor 2 or 4. It is extracted from SRF_GKDP by interpolation in temperature according to the t_spect associated to the l1 prodcut.

			It shall be associated only to the notc coregistered cubes, since the coregistered cubes have the GLOBAL attribute List_fhwm_swir

7.6.6 PRS_L1_HRC SWATHS

The main data contained in the PRS_L1_HRC Swath is the Radiometric Calibrated Hyperspectral Cube.

Swath		Name	Type	Dimen sions	Unit	Description
PRS_L1 _HRC	Data Fields	VNIR_Cube	Uint16[1000*][66][nHypAlongPixel]	nHypAcrossPixel nBands VNIR, nHypAlongPixel, =BIL Format!	DN	Data saved into the cubes are all Uint16: they are obtained as values of radiometrically calibrated radiances in the Hyperspectral channels (VNIR) transformed in Uint16 to the range [0,65535]: It shall be used global attributes ScaleFactor_Vnir, and Offset_Vnir in order to transform DN into physical unit W/(str*um*m^2). NOTE: EO cube is always made by 66 bands VNIR and 173 bands SWIR. If some bands internally to VNIR or SWIR spectral dispersion are not selected from the on-board editing mask , the relevant band column in the cube is set to 0. *NOTE: in case of missing frame, the relevant position in the cube is a frame completely set to 0. The radiance values are obtained by correcting also the effect of GlobalOffset, Straylight and Keystone. In case of grouping the number of FOV pixel is reduced of a factor 2 or 4.
		SWIR_Cube	Uint16[1000*][173][nHypAlongPixel]	nHypAcrossPixel nBands SWIR, nHypAlongPixel, =BIL Format!	DN	Data saved into the cubes are all Uint16: they are obtained as values of radiometrically calibrated radiances in the Hyperspectral channels (SWIR) scaled to the range [0,65535]: It shall be used global attribute ScaleFactor_Swir, and Offset_Swir in order to transform DN into physical unit W/(str*um*m^2). NOTE: EO cube is always made by 66 bands VNIR and 173 bands SWIR. If some bands internally to VNIR or SWIR spectral dispersion are not selected from the on-board editing mask , the relevant band column in the cube is set to 0. *NOTE: in case of missing frame, the relevant position in the cube is a frame completely set to 0. The radiance values are obtained by correcting also the effect of GlobalOffset, Straylight and Keystone. In case of grouping the number of FOV pixel is reduced of a factor 2 or 4.

		VNIR_PIXEL_SAT_ERR_MATRIX	Uint8[1000*][66][nHypAlongPixel]	nHypAcrossPixel nBandsVNIR, nHypAlongPixel	Enum 0=pixel ok 1=DEFECTIVE PIXEL from KDP 2=pixel in saturation. 3= lower radiometric confidence 4= pixel at NaN or Inf	Mask that notify if errors in pixel radiance processing has occurred. It values 0 if all it is ok It values 1 in case DEFECTIVE PIXEL from KDP It values 2 in case of pixel in saturation. It values 3 in case of pixel with lower radiometric accuracy, due to coregistration effectrs. It values 4 in case the pixel becomes NaN or Inf during processing. In case of grouping the number of FOV pixel is reduced of a factor 2 or 4.
		SWIR_PIXEL_SAT_ERR_MATRIX	Uint8[1000*][173][nHypAlongPixel]	nHypAcrossPixel nBandsSWIR, nHypAlongPixel	Enum 0=pixel ok 1=DEFECTIVE PIXEL from KDP 2=pixel in saturation. 3= lower radiometric confidence 4= pixel at NaN or Inf	Mask that notify if errors in pixel radiance processing has occurred. It values 0 if all it is ok It values 1 in case DEFECTIVE PIXEL from KDP It values 2 in case of pixel in saturation. It values 3 in case of pixel with lower radiometric accuracy, due to coregistration effectrs. It values 4 in case the pixel becomes NaN or Inf during processing. In case of grouping the number of FOV pixel is reduced of a factor 2 or 4.
		FrameNumber	Uint32nHypAlongPixel]	nHypAlongPixel	Dimensionless	Vector of integers representing the Frame number, as read from the Header Packet (absolute framenumber in the sequence of frames associated to the current acquisitions-also prev dark frames are part of the same acquisition, so if prev dark is present, the first frame number is 33)
	Geolocation Fields	Time	Double[nHypAlongPixel]	nHypAlongPixel	MJD2000 Decimal days	UTC time for each frame in processing format. Since the first two frames of each acquisition are not significant, but hk and ancillary data are significant (due to double buffering of the SDAC and detector), the frame time is corrected of two frames = 2*4.31msec in order to allow to the user to associate each frame of the cube to the correct ancillary and hk time. Note: The frameNumber allows a one to one association between the SWATH frames (they have their frameNumber) and the Housekeeping and Ancillary Data. Nevertlhless the correct association to Ancillary Data for ground pointing shall be executed by using frame time and the Ancillary GPS and StarTracker time

		Latitude_VNIR	Float [1000*][nHypAlongPixel]	nHypAcrossPixel,nHypAlongPixel	Deg [-90 to 90]	Latitude for each pixel in the Hyperspectral image VNIR It is obtained from the L0a corners by interpolation. In case of grouping the number of FOV pixel is reduced of a factor 2 or 4.
		Longitude_VNIR	Float [1000*][nHypAlongPixel]	nHypAcrossPixel,nHypAlongPixel	Deg [-180 to 180]	Longitude for each pixel in the Hyperspectral image VNIR It is obtained from the L0a corners by interpolation. In case of grouping the number of FOV pixel is reduced of a factor 2 or 4.
		Latitude_SWIR	Float [1000*][nHypAlongPixel]	nHypAcrossPixel,nHypAlongPixel	Deg [-90 to 90]	Latitude for each pixel in the Hyperspectral image SWIR It is the same than VNIR Latitude= it is obtained from the L0a corners by interpolation, and L0a corners are refereed only to VNIR. In case of grouping the number of FOV pixel is reduced of a factor 2 or 4.
		Longitude_SWIR	Float [1000*][nHypAlongPixel]	nHypAcrossPixel,nHypAlongPixel	Deg [-180 to 180]	Longitude for each pixel in the Hyperspectral image SWIR. It is the same than VNIR Longitude= it is obtained form the L0a corners by interpolation and L0a corners are refereed only to VNIR. In case of grouping the number of FOV pixel is reduced of a factor 2 or 4.

1000* = in case of grouping it can be also 500 or 250

7.6.7 PRS_L1_HCO SWATHS

The main data contained in the PRS_L1_HRC Swath is the Radiometric Calibrated Coregistersed Hyperspectral Cube. All bands of VNIR Cube and all bands of SWIR Cube are keystone corrected with respect to VNIR Cube band 128 only considering shift Across track, reported into GKDP /COREGISTRTION/VNIR_LOS_corr and SWIR_LOS_corr.

The smile correction is made by using the GKDP /SMILE/VNIR_SM_corr and SWIR_SM_corr: each pixel is smile corrected with respect to the VNIR or SWIR cube at boresight position.

Swath		Name	Type	Dimensions	Unit	Description
PRS_L1_HCO	Data Fields	VNIR_Cube	Uint16[1000*][66][nHypAlongPixel]	nHypAcrossPixel, nBandsVNIR, nHypAlongPixel, =BIL Format	DN	Data saved into the cubes are all Uint16: they are obtained as values of radiometrically calibrated and coregistered radiances in the Hyperspectral channels (VNIR) transformed in Uint16 to the range [0,65535]: It shall be used global attributes ScaleFactor_Vnir, and Offset_Vnir in order to transform DN into physical unit W/(str*um*m^2). *NOTE: in case of missing frame, the relevant position in the cube is a frame completely set to 0. NOTE: EO cube is always made by 66 bands VNIR and 173 bands SWIR. If

						some bands internally to VNIR or SWIR spectral dispersion are not selected from the on-board editing mask , the relevant band column in the cube is set to 0. In case of grouping the number of FOV pixel is reduced of a factor 2 or 4.
		SWIR_Cube	Uint16[1000*][173][nHypAlongPixel]	nHypAcrossPixel, nBandsSWIR, nHypAlongPixel, =BIL Format	DN	Data saved into the cubes are all Uint16: they are obtained as values of radiometrically calibrated and coregistered radiances in the Hyperspectral channels (SWIR) transformed in Uint16 to the range [0,65535]: It shall be used global attributes ScaleFactor_Swir, and Offset_Swir in order to transform DN into physical unit W/(str*um*m^2). *NOTE: in case of missing frame, the relevant position in the cube is a frame completely set to 0. NOTE: EO cube is always made by 66 bands VNIR and 173 bands SWIR. If some bands internally to VNIR or SWIR spectral dispersion are not selected from the on-board editing mask , the relevant band column in the cube is set to 0. In case of grouping the number of FOV pixel is reduced of a factor 2 or 4.
		VNIR_PIXEL_SAT_ERR_MATRIX	Uint8[1000*][66][nHypAlongPixel]	nHypAcrossPixel nBandsVNIR, nHypAlongPixel	Enum 0=pixel ok 1=DEFECTIVE PIXEL from KDP 2=pixel in saturation. 3= lower radiometric confidence 4= pixel at NaN or Inf	Mask that notify if errors in pixel radiance processing has occurred. It values 0 if all it is ok It values 1 in case DEFECTIVE PIXEL from KDP It values 2 in case of pixel in saturation. It values 3 in case of pixel with lower radiometric accuracy, due to coregistration effectrs. It values 4 in case the pixel becomes NaN or Inf during processing. In case of grouping the number of FOV pixel is reduced of a factor 2 or 4.
		SWIR_PIXEL_SAT_ERR_MATRIX	Uint8[1000*][173][nHypAlongPixel]	nHypAcrossPixel nBandsSWIR, nHypAlongPixel	Enum 0=pixel ok 1=DEFECTIVE PIXEL from KDP 2=pixel in saturation. 3= lower radiometric confidence 4= pixel at NaN or Inf	Mask that notify if errors in pixel radiance processing has occurred. It values 0 if all it is ok It values 1 in case DEFECTIVE PIXEL from KDP It values 2 in case of pixel in saturation. It values 3 in case of pixel with lower radiometric accuracy, due to coregistration effectrs. It values 4 in case the pixel becomes NaN or Inf during processing. In case of grouping the number of FOV pixel is reduced of a factor 2 or 4.
		Cloud_Mask **Note**: This Data Filed is not always	uint8 [1000*][nHypAlongPixel]	nHypAcrossPixel ,nHypAlongPixel	Dimensionless	0 for not cloudy pixel 1 for cloudy pixel 10 = for not of all previous classification 255 = error

	present in the L1 Earth Observation Product: if any of the bands required for the classification of cloudy pixels is not found in the L0a input file, the calculation of this mask is not performed and the corresponding Data Filed is not written in the L1 product.				In case of grouping the number of FOV pixel is reduced of a factor 2 or 4.
	SunGlint_Mask **Note**: This Data Filed is not always present in the L1 Earth Observation Product: if any of the bands required for the classification of sun glint pixels is not found in the L0a input file, the calculation of this mask is not performed and the corresponding Data Filed is not written in the L1 product.	uint8 [1000*][nHypAlongPixel]	nHypAcrossPixel, nHypAlongPixel	Dimensionless	0 for not sun glint 1 for sun glint 10 = for not of all previous classification 255 = error In case of grouping the number of FOV pixel is reduced of a factor 2 or 4.
	LandCover_Mask **Note**: This Data Filed is not always present in the L1 Earth Observation Product: if any of the bands	uint8 [1000*][nHypAlongPixel]	nHypAcrossPixel, nHypAlongPixel	Dimensionless	0 for water pixel 1 for snow pixel (and ice) 2 for not-vegetated land pixel :bare soil) 3 for crop and rangeland pixel 4 for forst pixel 5 for wetland pixel 6 for not-vegetated land pixel :urban component 10 = for not of all previous classification 255 = error In case of grouping the number of FOV pixel is reduced of a factor 2 or 4.

		required for the classification of the pixels is not found in the L0a input file, the calculation of this mask is not performed and the corresponding Data Filed is not written in the L1 product.				
		FrameNumber	Uint32[nHypAlongPixel]	nHypAlongPixel	Dimensionless	Vector of integers representing the Frame number, as read from the Header Packet (absolute framenumber in the sequence of frames associated to the current acquisitions-also prev dark frames are part of the same acquisition, so if prev dark is present, the first frame number is 33)
	Geolocation Fields	Time	Double[nHypAlongPixel]	nHypAlongPixel	MJD2000 Decimal days	UTC time for each frame in processing format. Since the first two frames of each acquisition are not significant, but hk and ancillary data are significant (due to double buffering of the SDAC and detector), the frame time is corrected of two frames = 2*4.31msec in order to allow to the user to associate each frame of the cube to the correct ancillary and hk time Note: The frameNumber allows a one to one association between the SWATH frames (they have their frameNumber) and the Housekeeping and Ancillary Data. Nevertlhless the correct association to Ancillary Data for ground pointing shall be executed by using frame time and the Ancillary GPS and StarTracker time
		Latitude_VNIR	Float [1000*][nHypAlongPixel]	nHypAcrossPixel,nHypAlongPixel	Deg [-90 to 90]	Latitude for each pixel in the Hyperspectral image VNIR It is obtained from the L0a corners by interpolation: it is exactly the same matrix than those of the not coregistered cube. In case of grouping the number of FOV pixel is reduced of a factor 2 or 4.
		Longitude_VNIR	Float [1000*][nHypAlongPixel]	nHypAcrossPixel,nHypAlongPixel	Deg [-180 to 180]	Longitude for each pixel in the Hyperspectral image VNIR . It is obtained from the L0a corners by interpolation: it is exactly the same matrix than those of the not coregistered cube In case of grouping the number of FOV pixel is reduced of a factor 2 or 4.
		Latitude_SWIR	Float [1000*][nHypAlongPixel]	nHypAcrossPixel,nHypAlongPixel	Deg [-90 to 90]	Latitude for each pixel in the Hyperspectral image SWIR It is obtained from the L0a corners by interpolation: it is exactly the same matrix than those of the

						not coregistered cube and coinicides also with the VNIR lat lon matrix. In case of grouping the number of FOV pixel is reduced of a factor 2 or 4.
		Longitude_SWIR	Float [1000*][nHypAlongPixel]	nHypAcrossPixel,nHypAlongPixel	Deg [-180 to 180]	Longitude for each pixel in the Hyperspectral image SWIR It is obtained from the L0a corners by interpolation: it is exactly the same matrix than those of the not coregistered cube and coinicides also with the VNIR lat lon matrix In case of grouping the number of FOV pixel is reduced of a factor 2 or 4.

7.6.8 PRS_L1_PRC SWATHS

The PRS_L1_PRC Swath basically contains the Radiometric Calibrated Panchromatic Image.

PAN PRC Cube is coregistered with respect to VNIR Cube by L1 taking into account of the Along Track coregistration, that are the number of HYP frames and PAN sub frames reported into the Global Attributes PAN_HYP_Start_Sync_Frame and PAN_HYP_Start_Sync_SubFrame:

At this level It still miss the Across track coregistration between PAN and VNIR.

Swath		Name	Type	Dimensions	Unit	Description
PRS_L1_PRC	Data Fields	Cube	Uint16[6000][nPanAlongPixel]	nPanAcrossPixel nPanAlongPixel,	DN	Data saved into cubes are all UInt16: they are obtained as values of radiometrically calibrated data of the Panchromatic channel transformed in Uint16 -range [0,65535]. It shall be used global attributes ScaleFactor_Pan, and Offset_Pan in order to transform DN into FLOAT. In case of grouping the number of FOV pixel is reduced of a factor 2 or 4.
		FrameNumber	Uint32[nPanAlongPixel]	nPanAlongPixel	Dimensionless	Vector of integers representing the Frame number, as read from the Header Packet (absolute framenumber in the sequence of frames associated to the current acquisitions-also prev dark frames are part of the same acquisition, so if prev dark is present, the first frame number is 33+PAN_HYP_DELAY). Note that the L0a files contain a Header Packet every 6 panchromatic sub-frames: for this reason the “FrameNumber” Data Filed contains as many values as the “nHypAlongPixel” number of frames of the Hyperspectral cubes: it is replicated 6 times.

						For example 133,133,133,133,133,133 134, 134,134,134,134,134 And so on.
		PIXEL_SAT_ERR_MATRIX	Uint8[6000][nPanAlongPixel]	nPanAcrossPixel nPanAlongPixel	Enum 0=pixel ok 1=DEFECTIVE PIXEL from KDP 2=pixel in saturation. 3= lower radiometric confidence 4= pixel at NaN or Inf	Mask that notify if errors in pixel radiance processing has occurred. It values 0 if all it is ok It values 1 in case DEFECTIVE PIXEL from KDP It values 2 in case of pixel in saturation. It values 3 in case of pixel with lower radiometric accuracy, due to coregistration effectrs. It values 4 in case the pixel becomes NaN or Inf during processing. In case of grouping the number of FOV pixel is reduced of a factor 2 or 4.
	Geolocation Fields	Time	Double[nPanAlongPixel]	nPanAlongPixel	MJD2000 Decimal days	UTC time for each frame in processing format. Since the first two frames of each acquisition are not significant, but hk and ancillary data are significant (due to double buffering of the SDAC and detector), the frame time is corrected of two frames = 2*4.31msec in order to allow to the user to associate each frame of the cube to the correct ancillary and hk time Note: The frameNumber allows a one to one association between the SWATH frames (they have their frameNumber) and the Housekeeping and Ancillary Data. Nevertlhless the correct association to Ancillary Data for ground pointing shall be executed by using frame time and the Ancillary GPS and StarTracker time
		Latitude	Float[6000][nPanAlongPixel]	nPanAcrossPixel, nPanAlongPixel	deg [-90 to 90]	Latitude for each pixel in the Panchromatic image : it is obtained by interpolation from the L0a corners. In case of grouping the number of FOV pixel is reduced of a factor 2 or 4.
		Longitude	Float[6000][nPanAlongPixel]	nPanAcrossPixel, nPanAlongPixel	deg [-180 to 180]	Longitude for each pixel in the Panchromatic image : it is obtained by interpolation from the L0a corners. In case of grouping the number of FOV pixel is reduced of a factor 2 or 4.

7.6.9 PRS_L1_PCO SWATHS

The PRS_L1_PRC Swath basically contains the Radiometric Calibrated Coregistered Panchromatic Image.

As the PAN PRC Cube, PAN PCO Cube is coregistered with respect to VNIR Cube taking into account of the Along Track coregistration, that are the number of HYP frames and PAN sub frames reported into the Global Attributed PAN_HYP_Start_Sync_Frame and PAN_HYP_Start_Sync_SubFrame.

PAN PCO Cube also takes into account the Across track offset PAN – VNIR. All pixel of PAN Cube are keystone corrected with respect to VNIR Cube band 128 only considering shift Across track, reported into GKDP /COREGISTRATION/PAN_LOS_corr.

Swath		Name	Type	Dimensions	Unit	Description
PRS_L1_PCO	Data Fields	Cube	Uint16[6000][nPanAlongPixel]	nPanAcrossPixel, nPanAlongPixel	DN	Data saved into cubes are all Uint16: they are obtained as values of radiometrically calibrated and coregistered data of the Panchromatic channel transformed in Uint16 -range [0,65535]. In case of grouping the number of FOV pixel is reduced of a factor 2 or 4.
		FrameNumber	Uint32nPanAlongPixel]	nHypAlongPixel	Dimensionless	Vector of integers representing the Frame number, as read from the Header Packet (absolute framenumber in the sequence of frames associated to the current acquisitions-also prev dark frames are part of the same acquisition, so if prev dark is present, the first frame number is 33+PAN_HYP_DELAY). Note that the L0a files contain a Header Packet every 6 panchromatic sub-frames: for this reason the “FrameNumber” Data Filed contains as many values as the “nHypAlongPixel” number of frames of the Hyperspectral cubes: it is replicated 6 times. For example 133,133,133,133,133,133 134, 134,134,134,134,134 And so on.
		PIXEL_SAT_ERR_MATRIX	Uint8[6000][nPanAlongPixel]	nPanAcrossPixel nPanAlongPixel	Enum 0=pixel ok 1=DEFECTIVE PIXEL from KDP 2=pixel in saturation. 3= lower radiometric confidence 4= pixel at NaN or Inf	Mask that notify if errors in pixel radiance processing has occurred. It values 0 if all it is ok It values 1 in case DEFECTIVE PIXEL from KDP It values 2 in case of pixel in saturation. It values 3 in case of pixel with lower radiometric accuracy, due to coregistration effectrs. It values 4 in case the pixel becomes NaN or Inf during processing. In case of grouping the number of FOV pixel is reduced of a factor 2 or 4.
	Geolocation Fields	Time	Double[nPanAlongPixel]	nHypAlongPixel	MJD2000 Decimal days	UTC time for each frame in processing format. Since the first two frames of each acquisition are not significant, but hk and ancillary data are significant (due to double buffering of the SDAC and detector), the frame time is corrected of two frames = 2*4.31msec

						in order to allow to the user to associate each frame of the cube to the correct ancillary and hk time Note: The frameNumber allows a one to one association between the SWATH frames (they have their frameNumber) and the Housekeeping and Ancillary Data. Nevertlhless the correct association to Ancillary Data for ground pointing shall be executed by using frame time and the Ancillary GPS and StarTracker time
		Latitude	Float[6000][nPanAlongPixel]	nPanAcrossPixel, nPanAlongPixel	Deg [-90 to 90]	Latitude for each pixel in the co-registered Panchromatic image .It is obtained from the L0a corners by interpolation: it is exactly the same matrix than those of the not coregistered cube. In case of grouping the number of FOV pixel is reduced of a factor 2 or 4.
		Longitude	Float[6000][nPanAlongPixel]	nPanAcrossPixel, nPanAlongPixel	Deg [-180 to 180]	Longitude for each pixel in the co-registered Panchromatic image . It is obtained from the L0a corners by interpolation: it is exactly the same matrix than those of the not coregistered cube. In case of grouping the number of FOV pixel is reduced of a factor 2 or 4.

7.6.9.1 SWATH LEGEND

Next table lists the dimensions used to define the Swaths Data and Geolocation Fields:

Dimension Name	Size	Dimension Description
nHypAcrossPixel	- 1000 if no grouping is applied - 500 if grouping 2 is applied - 250 if grouping 4 is applied	Number of pixels in the across track direction composing a monochromatic image in the Hyperspectral cubes (1000 is the number of pixels composing a Hyperspectral Frame in case maximal spatial resolution, i.e. no grouping applied)
nHypAlongPixel	Up to 1000 if the L1 Product has been originated starting from a L0a file Not Special for Validation; undefined otherwise	Number of pixels in the along track direction composing a monochromatic image in the Hyperspectral cubes (each frame is composed by a unique pixel in the along track direction and there are up to 1000 frames in each L1 product if it has been originated starting from a L0a file Not Special for Validation)
nBands	Up to 66 VNIR and 173 SWIR bands	Number of spectral bands in the Hyperspectral cubes (SWIR and VNIR bands).
nPanAcrossPixel	- 6000 if no grouping is applied - 3000 if grouping 2 is applied	Number of pixels in the across track direction composing a Panchromatic image (6000 is the number of pixel in the across track direction for each Panchromatic frame in case of maximal spatial resolution, i.e. no grouping applied)

	- 1500 if grouping 4 is applied	
nPanAlongPixel	Up to 6000 if the L1 Product has been originated starting from a L0a file Not Special for Validation; undefined otherwise	Number of pixels in the along track composing a Panchromatic image (6 pixel in the along track direction compose a panchromatic frame and there is a maximum of 1000 frames in each L1 product if it has been originated starting from an L0a file Not Special for Validation)

7.6.10 L1 EO MD QUALITY INFO

This section reports the quality info for the L1 product.

It is a STRING of 56 characters reported into the Catalogue Metadata file.

The field “Quality_Info” is as string reported inside the L1 Metadata Catalogue file and inside the L1 HDF5 file

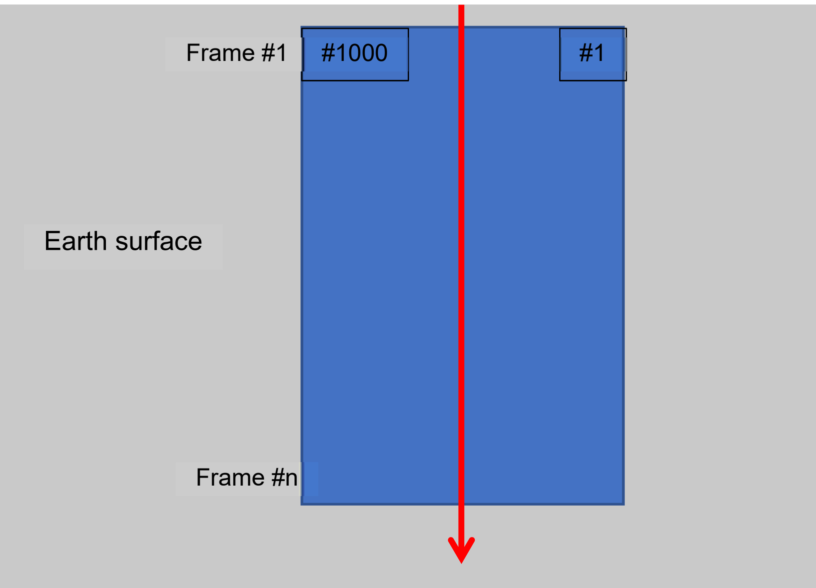
Each position of the character in the string has an opportune meaning, following reported:

Position in the string	Meaning of the flag
0,1	-00 ok -01 Warning : L1 files associated to the Image can be used by CNM=> if any of the successvie flags is eet to 1, the L1 exit code is marked at warning. -10 Error: L1 files associated to the Image shall not be used by CNM, since they are corrupted.
2	1= L1 EO file corrupted/missing at more than 20%
3	1= Mask Coverage not good since the input wavelengts are not present
4	1= Problems occurred during LatLonGeneration()
5	1=Problems occurred during Coregistration()
6	1=missing of prev Dark File
7	1= missing of post Dark file
8	Not Used
9	1= VNIR_GRP, SWIR_GRP and PAN_GRP are different each other: PRS-L1-HCO & PRS-L1-PCO cubes not generated.
10	1 = Percentage of input Cloud Coverage overcome the 20%
11.55	Not used

LIST OF ERRORS to be marked inside the Log file and into the exit code	
Error Code 56	Input Soi file not valid or missing (L0a, Aux, and KDP)
Error Code 58	Config file not valid
Error Code 59	Job Order not valid
Error Code 60	Parameter file missing or not valid
Error Code 70	L1 product not created since the percentage of CC overseed the value set into the Parameter File
Error Code 71	L1 product not created since the BandSelect of the parameter file selects bands that are not present at level 0
Error Code 72	L1 product not created because: ON_BOARD VNIR_HGRP is different from ON_BOARD SWIR_HGRP (Incompatible hdf-eos dimensions)

7.7 L1 IMAGE REPRESENTATION

In order to build the image on ground starting form the L1 reference cube, it shall be taken into account that the orbit is descendant and thus the pixel 1 of frame 1 is referred to the upper left corner of the image, as reported into the following picture:



In practice, the pixel 1 of each frame has a longitude higher than the pixel 1000 of the same frame: the longitude is decreasing along the fov.

7.8 PRISMA CCDB CONTENT AND FORMAT

PRISMA CCDB (Configuration Charaterization DataBase) is a set made by following 4 files:

- GKDP = Ground Key Data Parameters (NETCDF4 file) = Parameters that characterize the entire instrument. They are measured only during Ground Calibration Campaign. All GKDP can be useful in order to transform DN to Radiance.
- FKDP = Flight Key Data Parameters (NETCDF4 file) = Parameters that characterize the entire instrument. They are measured the first time during Ground Calibration Campaign and successively they are measurable during flight. Not all the FKDP can be useful in the transformation from DN to Radiance (see for example Defocusin), but they have been classiefied in this section since they are paramters that characterize the instrument and are updatable during flight.
- ICU_CDP= In-flight Calibration Unit Characterization Data Parameters (NETCDF4 file) = Parameters that characterize onlyt the on board ICU. They are needed in input to processors L0 and L1 in order produce the output product. For example Lamp Spectral Features, NIST file spectral features, lamp nominal current.
- CDP = Characterization Data Parameters (NETCDF4 file) = Parameters measured during Ground Calibration that characterize the

Each file is saved according to the NETCDF4 standard.

The exact content of each file is reported below (aligned to CCDB version 37)

7.8.1 GKDP FORMAT

GKDP shall be a NETCDF4 FILE, containing the following variables:

0	UTC_TIME	uint16 date[8]	UTC time of the KDP data set Generation - the same reported into Catalogue Metadata date[0] = Year date[1] = Month date[2] = Day of Month date[3] = Hour date[4] = Minute date[5] = Seconds date[6] = uint16 10^-2 Sec date[7] = uint16 10^-4 Sec
1	BAND_VNIR	int16 spectral_range[2] int16 auxiliary[10]	Default Values: spectral_range [96,161] = [Band column start, Band column end] for EO acquisition. auxiliary = [3,4,-1,-1,-1,-1,-1,-1,-1,-1]=[Column 1, Column 2] for auxiliary uses Note: these spectral_range indexes are referred to 0 a start.
2	BAND_SWIR	int16 spectral_range[2] int16 auxiliary[10]	Default Values: spectral_range [81, 253]= [Band column start, Band column end] for EO acquisition. auxiliary = [3,4,-1,-1,-1,-1,-1,-1,-1,-1]=[Column 1, Column 2] for auxiliary uses Note: these spectral_range indexes are referred to 0 a start.
3	SWIR_POS	float along_track_offset float angle[1000]	along_track_offset: Average angle between LOS array SWIR band n. 128 and VNIR band n.128 angle: Residual angle to be added to average angle in order to obtaine the totla angle between LOS of pixel n. i SWIR band n. 128 and VNIR pixel n. i band 128.
4	PAN_POS	float along_track_offset float angle[6000]	along_track_offset: Average angle between LOS array PAN and VNIR band n.128 angle: Residual angle to be added to average angle in order to obtaine the totla angle between LOS of pixel n. i PAN and VNIR pixel n. i band 128.
5	LOS_MATRIX_VNIR	float versor[1000][256][3][3] uint16 interp_flag[1000][256][3][3] float spec_temp_OB[3]	versor = Line of Sight unit vector for each sample in the PL OH Optical reference system [Ux,Uy,Uz] interp_flag: for each sample, it notifies if the LOS has been directly measured or obtained by linear interpolation. spec_temp_OB: OB temperature values at which has been carried out the on-ground calibration, the first position reports the reference temperature. DIMENSION LEGEND: [FOV][BAND][Temp_OB][Versor_direction] [Temp_OB] [Temp_OB]=[18,21,24]

6	LOS__MATRIX_SWIR	float versor[1000][256][3][3] uint16 interp_flag[1000][256][3][3] float spec_temp_OB[3]	See LOS_MATRIX_VNIR
7	LOS_MATRIX_PAN	float versor[6000][1][3][3] uint16 interp_flag[6000][1][3][3] float spec_temp_OB[3]	See LOS_MATRIX_VNIR 18°C missing
8	LOS_VNIR	float versor_OB[1000][3][3] float spec_temp_OB[3] float versor[1000*][3]	versor_OB = NOT USED spec_temp_OB: NOT USED versor = LOS to be used by for the ground pointing.They are the versor of LOS interpolated in temperature with respect to the L1 product temperature (optical bench), and extracted for the reference band VNIR that is the 128°. (DIMENSION LEGEND: [FOV][Temp_OB][Versor_direction] [Temp_OB]=[18,21,24] Remark: In order to use the LOS on the COREGISTERED images, it shall be used only LOS_VNIR/versor for all the three detector VNIR, SWIR, PAN (for PAN it shall be interpoled). In case the LOS shall be used on the NOT COREGISTERED IMAGES, it shall be used: • For VNIR, the VNIR_LOS but it is referred only to band 128 so the image is affected by keystone since it is not corrected at this level. • For SWIR, the SWIR_LOS but it is referred only to band 128 so the image is affected by keystone since it is not corrected at this level. • For PAN, the PAN_LOS. The correct association to Ancillary Data for ground pointing shall be executed by using frame time reported into each VNIR, SWIR and PAN cube, and the Ancillary GPS and StarTracker time *If GROUPING =1 it is 1000x3. If GROUPING =2 it is 500x3. If grouping =4 it is 250x3.
9	LOS_SWIR	float versor_OB[1000][3][3] float spec_temp_OB[3] float versor[1000][3]	See LOS_VNIR
10	LOS_PAN	float versor_OB[6000][3][3] float spec_temp_OB[3] float versor[6000][3]	See LOS_VNIR 18°C missing

1 1	LSF_ALONG_SLIT_VNIR	float spec_temp_OB[3] float data_avg[1000][256][100][2][3] float data_std[1000][256][100][2][3] float x_data[1000][256][100][2][3] float gaussfit_error[1000][256][2][2][3] float gaussfit_center[1000][256][2][3] float gaussfit_fwhm[1000][256][2][3] float interpfit_error[1000][256][2][2][3] float interpfit_center[1000][256][2][3] float interpfit_fwhm[1000][256][2][3] float center[1000][256][2][3] float fwhm[1000][256][2][3] uint8 data_mask[1000][256][2][3]	spec_temp_OB: OB temperature values at which has been carried out the on-ground calibration, the first position reports the reference temperature. data_avg: Temporal average values of the collected data for the spatial scan (100steps), for each pixel (1000,256), for each gain (2) and for each analyzed temperature (3). data_std : Temporal STD values of the collected data for the spatial scan (100steps), for each pixel (1000,256), for each gain (2) and for each analyzed temperature (3). x_data : Spatial scan values ([μm]) gaussfit_error: Analysis error on the Center value derived by fitting procedure of a gaussian model on the measured data. gaussfit_center: Gaussian fitting Center value gaussfit_fwhm: Gaussian fitting IFOV value interpfit_error: Discrepancy between gaussian fitting results in term of center values and the center values obtained after interpolation fitting on the whole matrix. Where this evaluation is not possible (FPA not analyzed regions) we will set an error value equal to 1000. interpfit_center: center values derived by interpolation fitting interpfit_fwhm: IFOV values derived by interpolation fitting center: Interpfit_center minus interpfit_center(500,128). Center values to be used. By default this matrix contains Interpfit_Center values. If requested the interpfit_center values related to the measured pixels can be sobstituted with Gaussfit_Center values. [Deg] fwhm: IFOV values to be used. By default this matrix contains Interpfit_FWHM values. If requested the Interpfit_FWHM values related to the measured pixels can be sobstituted with Gaussfit_FWHM values.[Deg] data_mask: mask matrix to track the origin of the FWHM and center values used: 1 means Interpoled value, 0 means gaussian fitting value. DIMENSION LEGEND: [Temp_OB] [FOV] [BAND] [STEP] [GAIN] [Temp_OB] [FOV] [BAND] [STEP] [GAIN][ERR_TYPE] [Temp_OB] [FOV] [BAND] [GAIN] [Temp_OB] [GAIN]=[HIGH GAIN, LOW GAIN] [Temp_OB]=[18,21,24] [ERR_TYPE]=[CW error, FWHM error]

1 2	LSF_ALONG_SLIT_SWIR	float spec_temp_OB[3] float data_avg[1000][256][100][2][3] float data_std[1000][256][100][2][3] float x_data[1000][256][100][2][3] float gaussfit_error[1000][256][2][2][3] float gaussfit_center[1000][256][2][3] float gaussfit_fwhm[1000][256][2][3] float interpfit_error[1000][256][2][2][3] float interpfit_center[1000][256][2][3] float interpfit_fwhm[1000][256][2][3] float center[1000][256][2][3] float fwhm[1000][256][2][3] uint8 data_mask[1000][256][2][3]	See LSF_ALONG_SLIT_VNIR
1 3	LSF_ALONG_SLIT_PAN	float spec_temp_OB[3] float data_avg[6000][1][200][3] float data_std[6000][1][200][3] float x_data[6000][1][200][3] float gaussfit_error[6000][1][2][3] float gaussfit_center[6000][1][3] float gaussfit_fwhm[6000][1][3] float interpfit_error[6000][1][2][3] float interpfit_center[6000][1][3] float interpfit_fwhm[6000][1][3] float center[6000][1][3] float fwhm[6000][1][3] uint8 data_mask[6000][1][3]	spec_temp_OB: OB temperature values at which has been carried out the on-ground calibration, the first position reports the reference temperature. data_avg: Temporal average values of the collected data for the spatial scan (100steps), for each pixel (1000,256), for each gain (2) and for each analyzed temperature (3). data_std : Temporal STD values of the collected data for the spatial scan (100steps), for each pixel (1000,256), for each gain (2) and for each analyzed temperature (3). x_data : Spatial scan values ([µm]) gaussfit_error: Analysis error on the Center value derived by fitting procedure of a gaussian model on the measured data. gaussfit_center: Gaussian fitting Center value gaussfit_fwhm: Gaussian fitting IFOV value interpfit_error: Discrepancy between gaussian fitting results in term of center values and the center values obtained after interpolation fitting on the whole matrix. Where this evaluation is not possible (FPA not analyzed regions) we will set an error value equal to 1000. interpfit_center: center values derived by interpolation fitting interpfit_fwhm: IFOV values derived by interpolation fitting center: Interpfit_center minus interpfit_center(3000). Center values to be used. By default this matrix contains Interpfit_Center values. If requested the interpfit_center values related to the measured pixels can be sobstituted with Gaussfit_Center values. [Deg] fwhm: IFOV values to be used. By default this matrix contains Interpfit_FWHM values. If requested the Interpfit_FWHM values related to the measured pixels can be sobstituted with Gaussfit_FWHM values. [Deg] data_mask: mask matrix to track the origin of the FWHM and center values used: 1 means Interpoled value, 0

			means gaussian fitting value. DIMENSION LEGEND: [Temp_OB] [FOV] [BAND] [STEP] [Temp_OB] [FOV] [BAND] [STEP] [ERR_TYPE] [Temp_OB] [FOV] [BAND] [Temp_OB] [Temp_OB]=[18,21,24] [ERR_TYPE]=[CW error, FWHM error]
14	LSF_ACROSS_SLIT_VNIR	float spec_temp_OB[3] float data_avg[1000][256][100][2][3] float data_std[1000][256][100][2][3] float x_data[1000][256][100][2][3] float gaussfit_error[1000][256][2][2][3] float gaussfit_center[1000][256][2][3] float gaussfit_fwhm[1000][256][2][3] float interpfit_error[1000][256][2][2][3] float interpfit_center[1000][256][2][3] float interpfit_fwhm[1000][256][2][3] float center[1000][256][2][3] float fwhm[1000][256][2][3] uint8 data_mask[1000][256][2][3]	See LSF_ALONG_SLIT_VNIR

15	LSF_ACROSS_SLIT_SWIR	float spec_temp_OB[3] float data_avg[1000][256][100][2][3] float data_std[1000][256][100][2][3] float x_data[1000][256][100][2][3] float gaussfit_error[1000][256][2][2][3] float gaussfit_center[1000][256][2][3] float gaussfit_fwhm[1000][256][2][3] float interpfit_error[1000][256][2][2][3] float interpfit_center[1000][256][2][3] float interpfit_fwhm[1000][256][2][3] float center[1000][256][2][3] float fwhm[1000][256][2][3] uint8 data_mask[1000][256][2][3]	See LSF_ALONG_SLIT_VNIR
16	LSF_ACROSS_SLIT_PAN	float spec_temp_OB[3] float data_avg[6000][1][200][3] float data_std[6000][1][200][3] float x_data[6000][1][200][3] float gaussfit_error[6000][1][2][3] float gaussfit_center[6000][1][3] float gaussfit_fwhm[6000][1][3] float interpfit_error[6000][1][2][3] float interpfit_center[6000][1][3] float interpfit_fwhm[6000][1][3] float center[6000][1][3] float fwhm[6000][1][3] uint8 data_mask[6000][1][3]	See LSF_ALONG_SLIT_PAN
17	DP_VNIR	uint8 defpix[1000][256][2] float temp_thres[1000][256][2][2] float a1[1000][256][2] float a2[1000][256][2] float reftemp_FPA	defpix: Defective pixel mask temp_thres: a1 and a2: spare matrix reftemp_FPA: reference temperature at witch the calibration measurements have been performed DIMENSION LEGEND: [FOV][BAND][GAIN] [GAIN]=[HIGH GAIN, LOW GAIN]
18	DP_SWIR	uint8 defpix[1000][256][2] float temp_thres[1000][256][2][2] float a1[1000][256][2] float a2[1000][256][2] float reftemp_FPA	See DP_VNIR
19	DP_PAN	uint8 defpix[6000] float temp_thres[6000][2] float a1[6000] float a2[6000] float reftemp_FPA	defpix: Defective pixel mask temp_thres: a1 and a2: spare matrix reftemp_FPA: reference temperature at witch the calibration measurements have been performed DIMENSION LEGEND: [FOV]

20	FF_VNIR	float ff[1000][256][2] float a1[1000][256][2] float a2[1000][256][2] float reftemp_FPA	ff: Matrix of FF coefficients obtained by means of an uniform illumination given by OGSE integrating sphere sources in the directions of bands, they are modulated by NIST filter (in DN). A temporal average frame is obtained by repetition of the same measurements. a1 and a2 empty spare variables. reftemp_FPA: reference temperature at witch the calibration measurements have been performed DIMENSION LEGEND: [FOV][BAND][GAIN] [GAIN]=[HIGH GAIN, LOW GAIN]
21	FF_SWIR	float ff[1000][256][2] float a1[1000][256][2] float a2[1000][256][2] float reftemp_FPA	See FF_VNIR
22	FF_PAN	float ff[6000] float a1[6000] float a2[6000] float reftemp_FPA	ff: Matrix of FF coefficients obtained by means of an uniform illumination given by OGSE integrating sphere sources in the directions of bands, they are modulated by NIST filter (in DN). A temporal average frame is obtained by repetition of the same measurements. a1 and a2 empty spare variables. reftemp_FPA: reference temperature at witch the calibration measurements have been performed DIMENSION LEGEND: [FOV]
23	ITF_VNIR	float itf[1000][256][2][3] float a1[1000][256][2][3] float a2[1000][256][2][3] float spec_temp_FPA [3]	ITF: Matrix of ITF coefficients obtained by means of an uniform illumination given by Moon in the directions of bands, they are modulated by NIST filter (in DN). A temporal average frame is obtained by repetition of the same measurements. A1 and A2 empty spare variables. spec_temp_FPA: reference temperature at witch the calibration measurements have been performed DIMENSION LEGEND: [FOV][BAND][GAIN][FPA_Temp] [FPA_Temp] [GAIN]=[HIGH GAIN, LOW GAIN] [FPA_Temp]=[175,185,195]
24	ITF_SWIR	float itf[1000][256][2][3] float a1[1000][256][2][3] float a2[1000][256][2][3] float spec_temp_FPA [3]	See ITF_VNIR

25	NL_VNIR	float a1[1000][256][2][3] float a2[1000][256][2][3] float a3[1000][256][2][3] float spm1[1000][256][2][3] float yth1[1000][256][2][3] float m[1000][256][2][3] float q[1000][256][2][3] float b1[1000][256][2][3] float b2[1000][256][2][3] float b3[1000][256][2][3] float spm2[1000][256][2][3] float yth2[1000][256][2][3] float xsat[1000][256][2][3] float ysat[1000][256][2][3] float spec_temp_FPA[3]	This represent the not lineatiry transfer function. It is computed the first time on ground by means of OGSE, and successively it is updated in flight by using as Lamp source. a1 = coefficient of Texp^2 for low parabola a2 = coefficient of Texp for low parabola a3 = note term for low parabola spm1= percentage of max distance between the true value with respect to the parabolic interpolation for low parabola. yth1 = low threshold (in DN) associated to the begin of the linear zone. mm= angular coefficient of line of the linear zone qq= note term of the line of the linear zone b1 = coefficient of Texp^2 for upper parabola b2 = coefficient of Texp for upper parabola b3 = note term for upper parabola spm2= percentage of max distance between the true value with respect to the parabolic interpolation for upper parabola. yth2 = upper threshold (in DN) associated to the end of the linear zone. xsat= radiance value at which is associated the saturation for the current pixel. ysat= saturation value in DN associated to current pixel. Spec_Temp_FPA: reference temperature at witch the calibration measurements have been performed DIMENSION LEGEND: [FOV] [BAND] [GAIN] [FPA_Temp] [FPA_Temp] [GAIN]=[HIGH GAIN, LOW GAIN] [FPA_Temp]=[175,185,195]
26	NL_SWIR	float a1 [1000][256][2][3] float a2 [1000][256][2][3] float a3 [1000][256][2][3] float spm1 [1000][256][2][3] float yth1 [1000][256][2][3] float m [1000][256][2][3] float q [1000][256][2][3] float b1 [1000][256][2][3] float b2 [1000][256][2][3] float b3 [1000][256][2][3] float spm2 [1000][256][2][3] float yth2 [1000][256][2][3] float xsat [1000][256][2][3] float ysat [1000][256][2][3] float spec_temp_FPA [3]	See NL_VNIR

27	NL_PAN	float a1[6000][3] float a2[6000][3] float a3[6000][3] float spm1[6000][3] float yth1[6000][3] float m[6000][3] float q[6000][3] float b1[6000][3] float b2[6000][3] float b3[6000][3] float spm2[6000][3] float yth2[6000][3] float xsat[6000][3] float ysat[6000][3] float spec_temp_FPA[3]	This represent the not lineatiry transfer function. It is computed the first time on ground by means of OGSE, and successively it is updated in flight by using as Lamp source. a1 = coefficient of Texp^2 for low parabola a2 = coefficient of Texp for low parabola a3 = note term for low parabola spm1= percentage of max distance between the true value with respect to the parabolic interpolation for low parabola. yth1 = low threshold (in DN) associated to the begin of the linear zone. mm= angular coefficient of line of the linear zone qq= note term of the line of the linear zone b1 = coefficient of Texp^2 for upper parabola b2 = coefficient of Texp for upper parabola b3 = note term for upper parabola spm2= percentage of max distance between the true value with respect to the parabolic interpolation for upper parabola. yth2 = upper threshold (in DN) associated to the end of the linear zone. xsat= radiance value at which is associated the saturation for the current pixel. ysat= saturation value in DN associated to current pixel. spec_temp_FPA: reference temperature at witch the calibration measurements have been performed DIMENSION LEGEND: [FOV][FPA_Temp] [FPA_Temp]=[18,21,24]
28	OFFSET_VNIR	float img_avg[1000][256][2][3][3] float img_std[1000][256][2][3][3] float spec_temp[2][2][3][3]	On-ground BKG (acq time 4.11ms) reference images (performed with shutter closed) img_avg: detector frame image acquired with the defined condition specified for BKG acquisitions. img_std: detector frame image reporting the std data for the relative img_avg data. Spec_Temp: reference OB and FPA temperature at witch the calibration measurements have been performed (in K) Dimension legend: [FOV][BAND][GAIN][Temp_FPA][Temp_OB] [Meas_Temp][GAIN][Temp_FPA][Temp_OB] [GAIN]=[HIGH GAIN, LOW GAIN] [Temp_FPA]=[175,185,195] [Temp_OB]=[18,21,24] [Meas_Temp]=[temp_FPA, Temp_OB]
29	OFFSET_SWIR	float img_avg[1000][256][2][3][3] float img_std[1000][256][2][3][3] float spec_temp[2][2][3][3]	See OFFSET_VNIR

30	OFFSET_PAN	float img_avg[6000][1][1][3][3] float img_std[6000][1][1][3][3] float spec_temp[2][1][3][3]	See OFFSET_VNIR Dimension legend: [FOV][BAND][GAIN][Temp_FPA][Temp_OB] [Meas_Temp][GAIN][Temp_FPA][Temp_OB] [GAIN]= only 1 gain [Temp_FPA]=[18,21,24] [Temp_OB]=[18,21,24] [Meas_Temp]=[temp_FPA, Temp_OB]
31	EL_OFF_VNIR	float img_avg[1000][256][2][3][3] float img_std[1000][256][2][3][3] float spec_temp[2][2][3][3]	On-ground Electronic Offset (Acq time 0.11ms) reference images (performed with shutter closed) img_avg: detector frame image acquired with the defined condition specified for electronic offset acquisitions. img_std: detector frame image reporting the std data for the relative img_avg data. spec_temp: reference OB and FPA temperature at witch the calibration measurements have been performed Dimension legend: [FOV][BAND][GAIN][Temp_FPA][Temp_OB] [Meas_Temp][GAIN][Temp_FPA][Temp_OB] [GAIN]=[HIGH GAIN, LOW GAIN] [Temp_FPA]=[175,185,195] [Temp_OB]=[18,21,24] [Meas_Temp]=[temp_FPA, Temp_OB]
32	EL_OFF_SWIR	float img_avg[1000][256][2][3][3] float img_std[1000][256][2][3][3] float spec_temp[2][2][3][3]	See EL_OFF_VNIR
33	EL_OFF_PAN	float img_avg[6000][1][1][3][3] float img_std[6000][1][1][3][3] float spec_temp[2][1][3][3]	See EL_OFF_VNIR Dimension legend: [GAIN]= only 1 gain [Temp_FPA]=[18,21,24] [Temp_OB]=[18,21,24] [Meas_Temp]=[temp_FPA, Temp_OB]

34	SRF_VNIR	float spec_temp_OB[3] float data_avg[1000][256][440][2][3] float data_std[1000][256][440][2][3] float x_data[1000][256][440][2][3] float gaussfit_error[1000][256][2][2][3] float gaussfit_center[1000][256][2][3] float gaussfit_fwhm[1000][256][2][3] float interpfit_error[1000][256][2][2][3] float interpfit_center[1000][256][2][3] float interpfit_fwhm[1000][256][2][3] float center[1000][256][2][3] float fwhm[1000][256][2][3] uint8 data_mask[1000][256][2][3]	spec_temp_OB: OB temperature values at which has been carried out the on-ground calibration, the first position reports the reference temperature. data_avg: Temporal average values of the collected data for the spectral scan (440steps), for each pixel (1000,256), for each gain (2) and for each analyzed temperature (3). data_std : Temporal STD values of the collected data for the spectral scan (440steps), for each pixel (1000,256), for each gain (2) and for each analyzed temperature (3). x_data : Wavelength scan values ([nm]) gaussfit_error: Analysis error on the Center value derived by fitting procedure of a gaussian model on the measured data. gaussfit_center: Gaussian fitting CW value gaussfit_fwhm: Gaussian fitting FWHM value interpfit_error: Discrepancy between gaussian fitting results in term of center values and the center values obtained after interpolation fitting on the whole matrix. Where this evaluation is not possible (FPA not analyzed regions) we will set an error value equal to 1000. interpfit_center: CW values derived by interpolation fitting interpfit_fwhm: FWHM values derived by interpolation fitting center: CW values to be used. By default this matrix contains Interpfit_Center values. If requested the Interpfit_Center values related to the measured pixels can be sobstituted with Gaussfit_Center values. fwhm: Spectral Width values to be used. By default this matrix contains Interpfit_FWHM values. If requested the interpfit_fwhm values related to the measured pixels can be sobstituted with Gaussfit_FWHM values. data_mask: mask matrix to track the origin of the FWHM and center values used: 1 means Interpoled value, 0 means gaussian fitting value. DIMENSION LEGEND: [Temp_OB] [FOV] [BAND] [STEP] [GAIN] [Temp_OB] [FOV] [BAND] [STEP] [GAIN] [ERR_TYPE][Temp_OB] [FOV] [BAND] [GAIN] [Temp_OB] [GAIN]=[HIGH GAIN, LOW GAIN] [Temp_OB]=[18,21,24] [ERR_TYPE]=[CW error, FWHM error]

35	SRF_SWIR	float spec_temp_OB[3] float data_avg[1000][256][440][2][3] float data_std[1000][256][440][2][3] float x_data[1000][256][440][2][3] float gaussfit_error[1000][256][2][2][3] float gaussfit_center[1000][256][2][3] float gaussfit_fwhm[1000][256][2][3] float interpfit_error[1000][256][2][2][3] float interpfit_center[1000][256][2][3] float interpfit_fwhm[1000][256][2][3] float center[1000][256][2][3] float fwhm[1000][256][2][3] uint8 data_mask[1000][256][2][3]	See SRF_VNIR
36	SPST_VNIR	float data_avg[1000][256][2][21]	SPST measuremnts are reported here as simple detector frame images. Each case presents 21 different illumination position over the detector matrix: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 Dimension legend: [FOV][BAND][GAIN][SPST_POS] [GAIN]=[HIGH GAIN, LOW GAIN]
37	SPST_SWIR	float data_avg[1000][256][2][21]	See SPST_VNIR Dimension legend: [FOV][BAND][GAIN][SPST_POS]
38	SPST_PAN	float data_avg[6000][1][1][7]	SPST measuremnts are reported here as simple detector frame images. Each case presents 7 different illumination position over the detector matrix: 1 2 3 4 5 6 7 Dimension legend: [FOV][BAND][GAIN][SPST_POS] [GAIN]= only 1 gain

39	GLOBAL_OFFSET_VNIR	float fit_coeff[16][2][2] float x_lim[2][2][2] float y_lim[2][2][2]	fit_coeff: polynomial fitting coefficients xlim: x limits of the function ylim: y limits of the function Dimension legend: [FIT_COEFF][GAIN][POS] [2][GAIN][POS] [2][GAIN][POS] [GAIN]=[HIGH GAIN, LOW GAIN] [POS]=[HIGH FOV, LOW FOV]
40	GLOBAL_OFFSET_SWIR	float fit_coeff[16][2][2] float x_lim[2][2][2] float y_lim[2][2][2]	See GLOBAL_OFFSET_VNIR
41	MEM_EFFECT_VNIR	float val	val: memory effect correction factor
42	MEM_EFFECT_SWIR	float val	val: memory effect correction factor
43	COREGISTRATION	float VNIR_LOS_corr[1000][256] float SWIR_LOS_corr[1000][256] float PAN_LOS_corr[6000]	Coregsitration shift to be used for the correction of Keystone and of VNIR SWIR PAN coregistration. VNIR_LOS_corr = **for each pixel i,j it notifies of how many fraction of VNIR pixel it shall be moved in order to coregister the VNIR bands with respect to the position of VNIR central band (index 128).** **SWIR_LOS_corr = for each pixel i,j it notifies of how many fraction of VNIR pixel it shall be moved in order to coregister the SWIR bands with respect to the position of VNIR central band (index 128).** **PAN_LOS_corr = for each pixel i,j it notifies of how many fraction of PAN pixel it shall be moved in order to coregister the PAN swath with respect to the position of VNIR central band (index 128).** DIMENSION LEGEND: [FOV] [BAND] [FOV] [BAND]
44	CW_FWHM_VNIR	float center[1000][256] float fwhm[1000][256] float L1_OB_temp	This KDP reports the CW and FWHM that are associated to the current L1 Product in the working dir: they are obtained by interpolation of CW and FWHM KDP matrixes according to OB temperature of the L1 product. L1_OB_temp reports the Optical Bench temperature associated to the L1 Product in the working dir. Center and Fwhm shall be read in the range BAND_VNIR/spectral_range or BAND_SWIR/spectral_range. Note that the indexes of the spectral_range are referred to a range of [0 255] as band indexes.
45	CW_FWHM_SWIR	float center[1000][256] float fwhm[1000][256] float L1_OB_temp	See CW_FWHM_VNIR

46	VNIR_POS	float along_track_offset float angle[1000]	along_track_offset: Average angle between LOS array VNIR band n. 128 and VNIR band n.128. It is 0 by construction. angle: Residual angle to be added to average angle in order to obtaine the totla angle between LOS of pixel n. i VNIR band n. 128 and VNIR pixel n. i band 128.
47	SMILE	float VNIR_SM_corr [1000][256] float SWIR_SM_corr [1000][256]	Spectral shift to be used for the correction of SMILE. VNIR_SM_corr = for each pixel i,j it notifies of how many fraction of VNIR pixel it shall be moved in order to coregister the current FOV with respect to VNIR boresight (=500° fov starting from 1) SWIR_SM_corr = for each pixel i,j it notifies of how many fraction of VNIR pixel it shall be moved in order to coregister the current FOV with respect to SWIR boresight (=500° fov starting from 1) DIMENSION LEGEND: [FOV] [BAND] [FOV] [BAND]

7.8.2 FKDP FORMAT

The L1 processor updates the parameters contained in the FKDP input file through the calibration processing. If the updated FKDP parameters are different from the input ones repect to a threshold defined into the coinfigfile, the updated FKDP file turns out to be an output of the L1 processing chain. The updated FKDP shall have the same format as the input one while both content and filename shall be updated.

FKDP shall be a NETCDF4 FILE, containing the following variables:

0	UTC_TIME	uint16 date[8]	UTC time of the KDP data set Generation - the same reported into Catalogue Metadata date[0] = Year date[1] = Month date[2] = Day of Month date[3] = Hour date[4] = Minute date[5] = Seconds date[6] = uint16 10^-2 Sec date[7] = uint16 10^-4 Sec

1	SOURCE_LABEL	uint8 source_label	This label has the purpose to identify who is the source of KDP updating: -when KDP are generated from the LEONARDO processor, the source label is 0 = "L1" -when KDP are generated form the CVWG, the source label is 1 = "CVWG"
2	VALIDATION_FLAG	uint8 validation_flag	It shall be set at 0 if at least a FlagVaried in the table fields is set at 1 It shall be set at 1 if all FlagVaried in the table fields are set at 0
3	BAND_SELECT	uint8 OpMark_VNIR uint8 OpMark_SWIR	BAND type selection Choose BAND variable to be used setting OpMark_XXX value according to the following list: - 0 -> BAND_XXX (GKDP) - 1 -> BAND_XXX (FKDP) 'XXX' -> VNIR, SWIR
4	BAND_VNIR	uint8 spectral_range[2] int8 auxiliary[10]	Default Values: spectral_range[96,161] = [Band column start, Band column end] for EO acquisition. auxiliary = [3,4,-1,-1,-1,-1,-1,-1,-1,-1]=[Column 1, Column 2] for auxiliary uses Note: these spectral_range indexes are referred to 0 a start.
5	BAND_SWIR	uint8 spectral_range[2] int8 auxiliary[10]	Default Values: spectral_range [81, 253]= [Band column start, Band column end] for EO acquisition. auxiliary = [3,4,-1,-1,-1,-1,-1,-1,-1,-1]=[Column 1, Column 2] for auxiliary uses Note: these spectral_range indexes are referred to 0 a start.
7	DP_SELECT	uint8 OpMark_VNIR[2] uint8 OpMark_SWIR[2] uint8 OpMark_PAN	Defective pixel type selection Choose DP variable to be used setting OpMark_XXX value according to the following list: - 0 -> DP_XXX (GKDP) - 1 -> DP_XXX (FKDP) 'XXX' -> VNIR, SWIR, PAN DIMENSION LEGEND: [GAIN]

8	DP_VNIR	uint8 defpixupd[1000][256][2] Uint8 defpix[1000][256][2] float temp_thres[1000][256][2][2] float a1[1000][256][2] float a2[1000][256][2] float reftemp_FPA uint8 flagvaried	defpixUpd: viene aggiornato da soib0 in automatico. poi sta all'operatore della cf capire se aggioranre defpix o no defpix:Defective pixel mask temp_thres: sup and inf temperature threshold values to change the pixel state from defective to not defective and vice versa a1 and a2: spare matrix reftemp_FPA: reference FPA temperature at witch the calibration measurements have been performed flagvaried: Flag to keep under control changes in the parameters. [0,1]=[not varied, varied] DIMENSION LEGEND: [FOV] [BAND] [GAIN] [FOV] [BAND] [GAIN] [THRES] [GAIN]=[HIGH GAIN, LOW GAIN] [THRES]=[Sup_temp, Inf_temp]
9	DP_SWIR	uint8 defpixupd[1000][256][2] uint8 defpix[1000][256][2] float temp_thres[1000][256][2][2] float a1[1000][256][2] float a2[1000][256][2] float reftemp_FPA uint8 flagvaried	See DP_VNIR
10	DP_PAN	uint8 defpixupd[6000] uint8 defpix[6000] float temp_thres[6000][2] float a1[6000] float a2[6000] float reftemp_FPA uint8 flagvaried	defpix: Defective pixel mask temp_thres: sup and inf temperature threshold values to change the pixel state from defective to not defective and vice versa a1 and a2: spare matrix refremp_FPA: reference FPA temperature at witch the calibration measurements have been performed flagvaried: Flag to keep under control changes in the parameters. [0,1]=[not varied, varied] DIMENSION LEGEND: [FOV] [FOV] [THRES] [GAIN]=[HIGH GAIN, LOW GAIN] [THRES]=[Sup_temp, Inf_temp]
11	OFFSET_SELECT	uint8 OpMark_VNIR[2] uint8 OpMark_SWIR[2] uint8 OpMark_PAN	OFFSET TYPE SELECTION Choose OFFSET variable to be used setting OpMark_XXX value according to the following list: - 0 -> OFFSET_XXX (GKDP) - 1 -> OFFSET_XXX (FKDP) - 2 -> OFFSET already measured pre or post acquisition 'XXX' -> VNIR, SWIR, PAN DIMENSION LEGEND: [GAIN] [GAIN]=[HIGH GAIN, LOW GAIN]

12	OFFSET_VNIR	float img_avg[1000][256][2] float img_std[1000][256][2] float a[1000][256][2] float b[1000][256][2] float c[1000][256][2] float d[1000][256][2] float e[1000][256][2] uint8 mask_el_off[1000][256][2] uint8 mask_dark_sig[1000][256][2] uint8 mask_bkg_sig[1000][256][2] uint8 mask_tot_model_valid[1000][256][2] float reftemp_FPA[2] float reftemp_OB[2] uint8 flagvaried	NOTE: For each EO acquisition, a dark acquisition before the EO observation and an other one after the EO observation is foreseen. Dark model take into account to be able to correct a possible variation of the dark signal due to FPA and OB temperature variation during the EO acquisition over specified threshold. The model foreseens three different behaviors for the three different type signals that contribute to the OverAll_Offset value. Acquisition performed at 4.11ms img_avg: offset acquisition (average matrix) = (cover closed shutter open= bkg icu acquisition) at reftemp_FPA at reftemp_OB . img_std: offset acquisition (std matrix) a: Matrix composed by the m values of the linear fitting of the curve that defines the behavior of Electronic offset with respect to the FPA temeprature. b: Matrix composed by the values of the quadratic term of the quadratic fitting of the curve that defines the behavior of Dark offset with respect to the FPA temeprature. c: Matrix composed by the values of the linear term of the quadratic fitting of the curve that defines the behavior of Dark offset with respect to the FPA temeprature. d: Matrix composed by the values of the quadratic term of the quadratic fitting of the curve that defines the behavior of BKG offset with respect to the OB temeprature. e: Matrix composed by the values of the linear term of the quadratic fitting of the curve that defines the behavior of BKG offset with respect to the OB temeprature. mask_el_off: pixel on which the electronic offset model is valid mask_dark_sig: pixel on which dark model is valid mask_bkg_sig: pixel on which the bkg signal is valid mask_tot_model_valid: and of the previous three mask: at the moment set to all 1. reftemp_OB: reference OB temperature at witch the calibration measurements have been performed in K reftemp_FPA: reference FPA temperature at witch the calibration measurements have been performed in K flagvaried: Flag to keep under control changes in the parameters. [0,1]=[not varied, varied] DIMENSION LEGEND:

			[FOV] [BAND] [GAIN] [GAIN]=[HIGH GAIN, LOW GAIN]
13	OFFSET_SWIR	float img_avg[1000][256][2] float img_std[1000][256][2] float a[1000][256][2] float b[1000][256][2] float c[1000][256][2] float d[1000][256][2] float e[1000][256][2] uint8 mask_el_off[1000][256][2] uint8 mask_dark_sig[1000][256][2] uint8 mask_bkg_sig[1000][256][2] uint8 mask_tot_model_valid[1000][256][2] float reftemp_FPA[2] float reftemp_OB[2] uint8 flagvaried	See OFFSET_VNIR

14	OFFSET_PAN	float img_avg[6000] float img_std[6000] float a[6000] float b[6000] float c[6000] float d[6000] float e[6000] uint8 mask_el_off[6000] uint8 mask_dark_sig[6000] uint8 mask_bkg_sig[6000] uint8 mask_tot_model_valid[6000] float reftemp_FPA float reftemp_OB uint8 flagvaried	NOTE: For each EO acquisition, a dark acquisition before the EO observation and an other one after the EO observation is foreseen. Dark model take into account to be able to correct a possible variation of the dark signal due to FPA and OB temperature variation during the EO acquisition over specified threshold. The model foreseens three different behaviors for the three different type signals that contribute to the OverAll_Offset value. Acquisition performed at 4.11ms img_avg: offset acquisition (average matrix) img_std: offset acquisition (std matrix) a: Matrix composed by the m values of the linear fitting of the curve that defines the behavior of Electronic offset with respect to the FPA temeprature. b: Matrix composed by the values of the quadratic term of the quadratic fitting of the curve that defines the behavior of Dark offset with respect to the FPA temeprature. c: Matrix composed by the values of the linear term of the quadratic fitting of the curve that defines the behavior of Dark offset with respect to the FPA temeprature. d: Matrix composed by the values of the quadratic term of the quadratic fitting of the curve that defines the behavior of BKG offset with respect to the OB temeprature. e: Matrix composed by the values of the linear term of the quadratic fitting of the curve that defines the behavior of BKG offset with respect to the OB temeprature. mask_el_off: mask_dark_sig: mask_bkg_sig: mask_tot_model_valid: reftemp_OB: reference OB temperature at witch the calibration measurements have been performed in K reftemp_FPA: reference FPA temperature at witch the calibration measurements have been performed in K flagvaried: Flag to keep under control changes in the parameters. [0,1]=[not varied, varied] DIMENSION LEGEND: [FOV]

15	FF_SELECT	uint8 OpMark_VNIR[2] uint8 OpMark_SWIR[2] uint8 OpMark_PAN	Flat Field type selection: Choose FF variable to be used setting OpMark_XXX value according to the following list: - 0 -> FF_XXX (GKDP) - 1 -> FF_XXX_ICU_LAMP_NOM (FKDP) - 2 -> FF_XXX_ICU_LAMP_RED (FKDP) - 3 -> FF_XXX_ICU_LED_NOM (FKDP) - 4 -> FF_XXX_ICU_LED_RED (FKDP) - 5 -> FF_XXX_SUN (FKDP) - 6 -> FF_XXX_EXT (FKDP) 'XXX' -> VNIR, SWIR, PAN DIMENSION LEGEND: [GAIN] [GAIN]=[HIGH GAIN, LOW GAIN]
16	FF_VNIR_ICU_LAMP_NOM	float ff[1000][256][2] float a1[1000][256][2] float a2[1000][256][2] float reftemp_FPA uint8 flagvaried	ff: Matrix of FF coefficients obtained by means of an uniform illumination given by ICU Lamp sources in the directions of bands, they are modulated by NIST filter (in DN). A temporal average frame is obtained by repetition of the same measurements. a1 and a2 empty spare variables. reftemp_FPA: reference FPA temperature at which have been performed the measurements flagvaried: Flag to keep under control changes in the parameters. [0,1]=[not varied, varied] DIMENSION LEGEND: [FOV] [BAND] [GAIN] [GAIN]=[HIGH GAIN, LOW GAIN]
17	FF_SWIR_ICU_LAMP_NOM	float ff[1000][256][2] float a1[1000][256][2] float a2[1000][256][2] float reftemp_FPA uint8 flagvaried	See FF_VNIR_ICU_LAMP_NOM
18	FF_PAN_ICU_LAMP_NOM	float ff[6000] float a1[6000] float a2[6000] float reftemp_FPA uint8 flagvaried	ff: Matrix of FF coefficients obtained by means of an uniform illumination given by ICU Lamp in the directions of bands, they are modulated by NIST filter (in DN). A temporal average frame is obtained by repetition of the same measurements. a1 and a2 empty spare variables. reftemp_FPA: reference FPA temperature at which have been performed the measurements flagvaried: Flag to keep under control changes in the parameters. [0,1]=[not varied, varied] DIMENSION LEGEND: [FOV]
19	FF_VNIR_ICU_LAMP_RED	float ff[1000][256][2] float a1[1000][256][2] float a2[1000][256][2] float reftemp_FPA uint8 flagvaried	See FF_VNIR_ICU_LAMP_NOM

20	FF_SWIR_ICU_LAMP_RED	float ff[1000][256][2] float a1[1000][256][2] float a2[1000][256][2] float reftemp_FPA uint8 flagvaried	See FF_VNIR_ICU_LAMP_NOM
21	FF_PAN_ICU_LAMP_RED	float ff[6000] float a1[6000] float a2[6000] float reftemp_FPA uint8 flagvaried	See FF_PAN_ICU_LAMP_NOM
22	FF_VNIR_ICU_LED_NOM	float ff[1000][256][2] float a1[1000][256][2] float a2[1000][256][2] float reftemp_FPA uint8 flagvaried	ff: Matrix of FF coefficients obtained by means of an uniform illumination given by ICU LED sources in the directions of bands, they are modulated by NIST filter (in DN). A temporal average frame is obtained by repetition of the same measurements. a1 and a2 empty spare variables. reftemp_FPA: reference FPA temperature at which have been performed the measurements flagvaried: Flag to keep under control changes in the parameters. [0,1]=[not varied, varied] DIMENSION LEGEND: [FOV] [BAND] [GAIN] [GAIN]=[HIGH GAIN, LOW GAIN]
23	FF_SWIR_ICU_LED_NOM	float ff[1000][256][2] float a1[1000][256][2] float a2[1000][256][2] float reftemp_FPA uint8 flagvaried	ff: Matrix of FF coefficients obtained by means of an uniform illumination given by ICU LED sources in the directions of bands, they are modulated by NIST filter (in DN). A temporal average frame is obtained by repetition of the same measurements. a1 and a2 empty spare variables. reftemp_FPA: reference FPA temperature at which have been performed the measurements flagvaried: Flag to keep under control changes in the parameters. [0,1]=[not varied, varied] DIMENSION LEGEND: [FOV] [BAND] [GAIN] [GAIN]=[HIGH GAIN, LOW GAIN]
24	FF_PAN_ICU_LED_NOM	float ff[6000] float a1[6000] float a2[6000] float reftemp_FPA uint8 flagvaried	ff: Matrix of FF coefficients obtained by means of an uniform illumination given by ICU LED in the directions of bands, they are modulated by NIST filter (in DN). A temporal average frame is obtained by repetition of the same measurements. a1 and a2 empty spare variables. reftemp_FPA: reference FPA temperature at which have been performed the measurements flagvaried: Flag to keep under control changes in the parameters. [0,1]=[not varied, varied] DIMENSION LEGEND: [FOV]

25	FF_VNIR_ICU_LED_RED	float ff[1000][256][2] float a1[1000][256][2] float a2[1000][256][2] float reftemp_FPA uint8 flagvaried	See FF_VNIR_ICU_LED_NOM
26	FF_SWIR_ICU_LED_RED	float ff[1000][256][2] float a1[1000][256][2] float a2[1000][256][2] float reftemp_FPA uint8 flagvaried	See FF_VNIR_ICU_LED_NOM
27	FF_PAN_ICU_LED_RED	float ff[6000] float a1[6000] float a2[6000] float reftemp_FPA uint8 flagvaried	See FF_PAN_ICU_LED_NOM
28	FF_VNIR_SUN	float ff[1000][256][2] float a1[1000][256][2] float a2[1000][256][2] float reftemp_FPA uint8 flagvaried	ff: Matrix of FF coefficients obtained by means of an uniform illumination given by Sun in the directions of bands, they are modulated by NIST filter (in DN). A temporal average frame is obtained by repetition of the same measurements. a1 and a2 empty spare variables. reftemp_FPA: reference FPA temperature at which have been performed the measurements flagvaried: Flag to keep under control changes in the parameters. [0,1]=[not varied, varied] DIMENSION LEGEND: [FOV] [BAND] [GAIN] [GAIN]=[HIGH GAIN, LOW GAIN]
29	FF_SWIR_SUN	float ff[1000][256][2] float a1[1000][256][2] float a2[1000][256][2] float reftemp_FPA uint8 flagvaried	See FF_VNIR_SUN
30	FF_PAN_SUN	float ff[6000] float a1[6000] float a2[6000] float reftemp_FPA uint8 flagvaried	ff: Matrix of FF coefficients obtained by means of an uniform illumination given by Sun in the directions of bands, they are modulated by NIST filter (in DN). A temporal average frame is obtained by repetition of the same measurements. a1 and a2 empty spare variables. reftemp_FPA: reference FPA temperature at which have been performed the measurements flagvaried: Flag to keep under control changes in the parameters. [0,1]=[not varied, varied] DIMENSION LEGEND: [FOV]
31	FF_VNIR_EXT	float ff[1000][256][2] float a1[1000][256][2] float a2[1000][256][2] float reftemp_FPA uint8 flagvaried	ff: Matrix of FF coefficients obtained by means of an uniform illumination given by External sources (ex. vicarious) in the direction of bands, they are modulated by NIST filter (in DN). A temporal average frame is obtained by repetition of the same measurements. a1 and a2 empty spare variables. reftemp_FPA: reference FPA temperature at which have been performed the measurements

			flagvaried: Flag to keep under control changes in the parameters. [0,1]=[not varied, varied] DIMENSION LEGEND: [FOV] [BAND] [GAIN] [GAIN]=[HIGH GAIN, LOW GAIN]
32	FF_SWIR_EXT	float ff[1000][256][2] float a1[1000][256][2] float a2[1000][256][2] float reftemp_FPA uint8 flagvaried	See FF_VNIR_EXT
33	FF_PAN_EXT	float ff[6000] float a1[6000] float a2[6000] float reftemp_FPA uint8 flagvaried	ff: Matrix of FF coefficients obtained by means of an uniform illumination given by External sources (ex vicarious) in the directions of bands, they are modulated by NIST filter (in DN). A temporal average frame is obtained by repetition of the same measurements. a1 and a2 empty spare variables. reftemp_FPA: reference FPA temperature at which have been performed the measurements flagvaried: Flag to keep under control changes in the parameters. [0,1]=[not varied, varied] DIMENSION LEGEND: [FOV]
34	FF_VNIR_MOON	float ff[1000][256][2] float a1[1000][256][2] float a2[1000][256][2] float reftemp_FPA uint8 flagvaried	ff: Matrix of FF coefficients obtained by means of an uniform illumination given by Moon in the directions of bands, they are modulated by NIST filter (in DN). A temporal average frame is obtained by repetition of the same measurements. a1 and a2 empty spare variables. reftemp_FPA: reference FPA temperature at which have been performed the measurements flagvaried: Flag to keep under control changes in the parameters. [0,1]=[not varied, varied] DIMENSION LEGEND: [FOV] [BAND] [GAIN] [GAIN]=[HIGH GAIN, LOW GAIN]
35	FF_SWIR_MOON	float ff[1000][256][2] float a1[1000][256][2] float a2[1000][256][2] float reftemp_FPA uint8 flagvaried	See FF_VNIR_EXT
36	FF_PAN_MOON	float ff[6000] float a1[6000] float a2[6000] float reftemp_FPA uint8 flagvaried	ff: Matrix of FF coefficients obtained by means of an uniform illumination given by Moon in the directions of bands, they are modulated by NIST filter (in DN). A temporal average frame is obtained by repetition of the same measurements. a1 and a2 empty spare variables. reftemp_FPA: reference FPA temperature at which have been

			performed the measurements flagvaried: Flag to keep under control changes in the parameters. [0,1]=[not varied, varied] DIMENSION LEGEND: [FOV]
37	ITF_SELECT	uint8 OpMark_VNIR[2] uint8 OpMark_SWIR[2]	Absolute Radiometric Gain (ITF) type selection: Choose ITF variable to be used setting OpMark_XXX value according to the following list: - 0 -> ITF_XXX (GKDP) - 1 -> ITF_XXX_ICU_LAMP_NOM (FKDP) - 2 -> ITF_XXX_ICU_LAMP_RED (FKDP) - 3 -> ITF_XXX_ICU_LED_NOM (FKDP) - 4 -> ITF_XXX_ICU_LED_RED (FKDP) - 5 -> ITF_XXX_SUN (FKDP) - 6 -> ITF_XXX_MOON (FKDP) 'XXX' -> VNIR, SWIR DIMENSION LEGEND: [GAIN] [GAIN]=[HIGH GAIN, LOW GAIN]
38	ITF_VNIR_ICU_LAMP_NOM	float itf[1000][256][2][3] float a1[1000][256][2][3] float a2[1000][256][2][3] float spec_temp_FPA[3] uint8 flagvaried	itf: Matrix of ITF coefficients obtained by means of an uniform illumination given by ICU LAMP in the directions of bands, they are modulated by NIST filter (in DN). A temporal average frame is obtained by repetition of the same measurements. a1 and a2 empty spare variables. spec_temp_FPA: reference temperature at which have been performed the measurements flagvaried: Flag to keep under control changes in the parameters. [0,1]=[not varied, varied] DIMENSION LEGEND: [FOV] [BAND] [GAIN] [FPA_Temp] [GAIN]=[HIGH GAIN, LOW GAIN] [FPA_Temp]=[175,185,195]
39	ITF_SWIR_ICU_LAMP_NOM	float itf[1000][256][2][3] float a1[1000][256][2][3] float a2[1000][256][2][3] float spec_temp_FPA[3] uint8 flagvaried	See ITF_VNIR_ICU_LAMP_NOM
40	ITF_VNIR_ICU_LAMP_RED	float itf[1000][256][2][3] float a1[1000][256][2][3] float a2[1000][256][2][3] float spec_temp_FPA[3] uint8 flagvaried	See ITF_VNIR_ICU_LAMP_NOM
41	ITF_SWIR_ICU_LAMP_RED	float itf[1000][256][2][3] float a1[1000][256][2][3] float a2[1000][256][2][3] float spec_temp_FPA[3] uint8 flagvaried	See ITF_VNIR_ICU_LAMP_NOM

42	ITF_VNIR_ICU_LED_NOM	float itf[1000][256][2][3] float a1[1000][256][2][3] float a2[1000][256][2][3] float spec_temp_FPA[3] uint8 flagvaried	See ITF_VNIR_ICU_LAMP_NOM
43	ITF_VNIR_ICU_LED_RED	float itf[1000][256][2][3] float a1[1000][256][2][3] float a2[1000][256][2][3] float spec_temp_FPA[3] uint8 flagvaried	See ITF_VNIR_ICU_LAMP_NOM
44	ITF_VNIR_SUN	float itf[1000][256][2][3] float a1[1000][256][2][3] float a2[1000][256][2][3] float spec_temp_FPA[3] uint8 flagvaried	See ITF_VNIR_ICU_LAMP_NOM
45	ITF_SWIR_SUN	float itf[1000][256][2][3] float a1[1000][256][2][3] float a2[1000][256][2][3] float spec_temp_FPA[3] uint8 flagvaried	See ITF_VNIR_ICU_LAMP_NOM
46	ITF_VNIR_MOON	float itf[1000][256][2][3] float a1[1000][256][2][3] float a2[1000][256][2][3] float spec_temp_FPA[3] uint8 flagvaried	See ITF_VNIR_ICU_LAMP_NOM
47	ITF_SWIR_MOON	float itf[1000][256][2][3] float a1[1000][256][2][3] float a2[1000][256][2][3] float spec_temp_FPA[3] uint8 flagvaried	See ITF_VNIR_ICU_LAMP_NOM
48	NL_SELECT	uint8 OpMark_VNIR[2] uint8 OpMark_SWIR[2] uint8 OpMark_PAN	Non-Linearity type selection: Choose NL variable to be used setting OpMark_XXX value according to the following list: - 0 -> NL_XXX (GKDP) - 1 -> NL_XXX_ICU_LAMP_NOM (FKDP) - 2 -> NL_XXX_ICU_LAMP_RED (FKDP) - 3 -> NL_XXX_ICU_LED_NOM (FKDP) - 4 -> NL_XXX_ICU_LED_RED (FKDP) 'XXX' -> VNIR, SWIR, PAN DIMENSION LEGEND: [FOV][BAND][GAIN][Temp_FPA] [GAIN]=[HIGH GAIN, LOW GAIN] [Temp_FPA] =[18,21,24]

49	NL_VNIR_ICU_LAMP_NOM	float a1[1000][256][2][3] float a2[1000][256][2][3] float a3[1000][256][2][3] float spm1[1000][256][2][3] float yth1[1000][256][2][3] float m[1000][256][2][3] float q[1000][256][2][3] float b1[1000][256][2][3] float b2[1000][256][2][3] float b3[1000][256][2][3] float spm2[1000][256][2][3] float yth2[1000][256][2][3] float xsat[1000][256][2][3] float ysat[1000][256][2][3] float spec_temp_FPA[3] uint8 flagvaried	This represent the not lineatiry transfer function. It is computed the first time on ground by means of OGSE, and successively it is updated in flight by using as Lamp source. a1 = coefficient of Texp^2 for low parabola a2 = coefficient of Texp for low parabola a3 = note term for low parabola spm1= percentage of max distance between the true value with respect to the parabolic interpolation for low parabola. yth1 = low threshold (in DN) associated to the begin of the linear zone. mm= angular coefficient of line of the linear zone qq= note term of the line of the linear zone b1 = coefficient of Texp^2 for upper parabola b2 = coefficient of Texp for upper parabola b3 = note term for upper parabola spm2= percentage of max distance between the true value with respect to the parabolic interpolation for upper parabola. yth2 = upper threshold (in DN) associated to the end of the linear zone. xsat= texp value at which is associated the saturation for the current pixel. ysat= saturation value in DN associated to current pixel. spec_temp_FPA: reference FPA temperature at which have been performed the measurements flagvaried: Flag to keep under control changes in the parameters. [0,1]=[not varied, varied] DIMENSION LEGEND: [FOV] [BAND] [GAIN] [FPA_Temp] [GAIN]=[HIGH GAIN, LOW GAIN] [FPA_Temp]=[175,185,195]
50	NL_SWIR_ICU_LAMP_NOM	float a1[1000][256][2][3] float a2[1000][256][2][3] float a3[1000][256][2][3] float spm1[1000][256][2][3] float yth1[1000][256][2][3] float m[1000][256][2][3] float q[1000][256][2][3] float b1[1000][256][2][3] float b2[1000][256][2][3] float b3[1000][256][2][3] float spm2[1000][256][2][3] float yth2[1000][256][2][3] float xsat[1000][256][2][3] float ysat[1000][256][2][3] float spec_temp_FPA[3] uint8 flagvaried	See NL_VNIR_ICU_LAMP_NOM

51	NL_PAN_ICU_LAMP_NOM	float a1[6000][1][1][3] float a2[6000][1][1][3] float a3[6000][1][1][3] float spm1[6000][1][1][3] float yth1[6000][1][1][3] float m[6000][1][1][3] float q[6000][1][1][3] float b1[6000][1][1][3] float b2[6000][1][1][3] float b3[6000][1][1][3] float spm2[6000][1][1][3] float yth2[6000][1][1][3] float xsat[6000][1][1][3] float ysat[6000][1][1][3] float spec_temp_FPA[3] uint8 flagvaried	This represent the not lineatiry transfer function. It is computed the first time on ground by means of OGSE, and successively it is updated in flight by using as Lamp source. a1 = coefficient of Texp^2 for low parabola a2 = coefficient of Texp for low parabola a3 = note term for low parabola spm1= percentage of max distance between the true value with respect to the parabolic interpolation for low parabola. yth1 = low threshold (in DN) associated to the begin of the linear zone. mm= angular coefficient of line of the linear zone qq= note term of the line of the linear zone b1 = coefficient of Texp^2 for upper parabola b2 = coefficient of Texp for upper parabola b3 = note term for upper parabola spm2= percentage of max distance between the true value with respect to the parabolic interpolation for upper parabola. yth2 = upper threshold (in DN) associated to the end of the linear zone. xsat= texp value at which is associated the saturation for the current pixel. ysat= saturation value in DN associated to current pixel. spec_temp_FPA: reference FPA temperature at which have been performed the measurements flagvaried: Flag to keep under control changes in the parameters. [0,1]=[not varied, varied] DIMENSION LEGEND: [FOV][FPA_Temp] [FPA_Temp]=[18,21,24]
52	NL_VNIR_ICU_LAMP_RED	float a1[1000][256][2][3] float a2[1000][256][2][3] float a3[1000][256][2][3] float spm1[1000][256][2][3] float yth1[1000][256][2][3] float m[1000][256][2][3] float q[1000][256][2][3] float b1[1000][256][2][3] float b2[1000][256][2][3] float b3[1000][256][2][3] float spm2[1000][256][2][3] float yth2[1000][256][2][3] float xsat[1000][256][2][3] float ysat[1000][256][2][3] float spec_temp_FPA[3] uint8 flagvaried	See NL_VNIR_ICU_LAMP_NOM

53	NL_SWIR_ICU_LAMP_RED	float a1[1000][256][2][3] float a2[1000][256][2][3] float a3[1000][256][2][3] float spm1[1000][256][2][3] float yth1[1000][256][2][3] float m[1000][256][2][3] float q[1000][256][2][3] float b1[1000][256][2][3] float b2[1000][256][2][3] float b3[1000][256][2][3] float spm2[1000][256][2][3] float yth2[1000][256][2][3] float xsat[1000][256][2][3] float ysat[1000][256][2][3] float spec_temp_FPA[3] uint8 flagvaried	See NL_VNIR_ICU_LAMP_NOM
54	NL_PAN_ICU_LAMP_RED	float a1[6000][1][1][3] float a2[6000][1][1][3] float a3[6000][1][1][3] float spm1[6000][1][1][3] float yth1[6000][1][1][3] float m[6000][1][1][3] float q[6000][1][1][3] float b1[6000][1][1][3] float b2[6000][1][1][3] float b3[6000][1][1][3] float spm2[6000][1][1][3] float yth2[6000][1][1][3] float xsat[6000][1][1][3] float ysat[6000][1][1][3] float spec_temp_FPA[3] uint8 flagvaried	See NL_PAN_ICU_LAMP_NOM
55	NL_VNIR_ICU_LED_NOM	float a1[1000][256][2][3] float a2[1000][256][2][3] float a3[1000][256][2][3] float spm1[1000][256][2][3] float yth1[1000][256][2][3] float m[1000][256][2][3] float q[1000][256][2][3] float b1[1000][256][2][3] float b2[1000][256][2][3] float b3[1000][256][2][3] float spm2[1000][256][2][3] float yth2[1000][256][2][3] float xsat[1000][256][2][3] float ysat[1000][256][2][3] float spec_temp_FPA[3] uint8 flagvaried	This represent the not lineatiry transfer function. It is computed the first time on ground by means of OGSE, and successively it is updated in flight by using as LED source. a1 = coefficient of Texp^2 for low parabola a2 = coefficient of Texp for low parabola a3 = note term for low parabola spm1= percentage of max distance between the true value with respect to the parabolic interpolation for low parabola. yth1 = low threshold (in DN) associated to the begin of the linear zone. mm= angular coefficient of line of the linear zone qq= note term of the line of the linear zone b1 = coefficient of Texp^2 for upper parabola b2 = coefficient of Texp for upper parabola b3 = note term for upper parabola spm2= percentage of max distance between the true value with respect to the parabolic interpolation for upper parabola. yth2 = upper threshold (in DN) associated to the end of the linear zone. xsat= texp value at which is associated the saturation for

			the current pixel. ysat= saturation value in DN associated to current pixel. spec_temp_FPA: reference FPA temperature at which have been performed the measurements flagvaried: Flag to keep under control changes in the parameters. [0,1]=[not varied, varied] DIMENSION LEGEND: [FOV] [BAND] [GAIN] [FPA_Temp] [GAIN]=[HIGH GAIN, LOW GAIN] [FPA_Temp]=[175,185,195]
56	NL_SWIR_ICU_LED_NOM	float a1[1000][256][2][3] float a2[1000][256][2][3] float a3[1000][256][2][3] float spm1[1000][256][2][3] float yth1[1000][256][2][3] float m[1000][256][2][3] float q[1000][256][2][3] float b1[1000][256][2][3] float b2[1000][256][2][3] float b3[1000][256][2][3] float spm2[1000][256][2][3] float yth2[1000][256][2][3] float xsat[1000][256][2][3] float ysat[1000][256][2][3] float spec_temp_FPA[3] uint8 flagvaried	This represent the not lineatiry transfer function. It is computed the first time on ground by means of OGSE, and successively it is updated in flight by using as LED source. a1 = coefficient of Texp^2 for low parabola a2 = coefficient of Texp for low parabola a3 = note term for low parabola spm1= percentage of max distance between the true value with respect to the parabolic interpolation for low parabola. yth1 = low threshold (in DN) associated to the begin of the linear zone. mm= angular coefficient of line of the linear zone qq= note term of the line of the linear zone b1 = coefficient of Texp^2 for upper parabola b2 = coefficient of Texp for upper parabola b3 = note term for upper parabola spm2= percentage of max distance between the true value with respect to the parabolic interpolation for upper parabola. yth2 = upper threshold (in DN) associated to the end of the linear zone. xsat= texp value at which is associated the saturation for the current pixel. ysat= saturation value in DN associated to current pixel. spec_temp_FPA: reference FPA temperature at which have been performed the measurements

			flagvaried: Flag to keep under control changes in the parameters. [0,1]=[not varied, varied] DIMENSION LEGEND: [FOV] [BAND] [GAIN] [FPA_Temp] [GAIN]=[HIGH GAIN, LOW GAIN] [FPA_Temp]=[175,185,195]
57	NL_PAN_ICU_LED_NOM	float a1[6000][1][1][3] float a2[6000][1][1][3] float a3[6000][1][1][3] float spm1[6000][1][1][3] float yth1[6000][1][1][3] float m[6000][1][1][3] float q[6000][1][1][3] float b1[6000][1][1][3] float b2[6000][1][1][3] float b3[6000][1][1][3] float spm2[6000][1][1][3] float yth2[6000][1][1][3] float xsat[6000][1][1][3] float ysat[6000][1][1][3] float spec_temp_FPA[3] uint8 flagvaried	This represent the not lineatiry transfer function. It is computed the first time on ground by means of OGSE, and successively it is updated in flight by using as LED source. a1 = coefficient of Texp^2 for low parabola a2 = coefficient of Texp for low parabola a3 = note term for low parabola spm1= percentage of max distance between the true value with respect to the parabolic interpolation for low parabola. yth1 = low threshold (in DN) associated to the begin of the linear zone. mm= angular coefficient of line of the linear zone qq= note term of the line of the linear zone b1 = coefficient of Texp^2 for upper parabola b2 = coefficient of Texp for upper parabola b3 = note term for upper parabola spm2= percentage of max distance between the true value with respect to the parabolic interpolation for upper parabola. yth2 = upper threshold (in DN) associated to the end of the linear zone. xsat= texp value at which is associated the saturation for the current pixel. ysat= saturation value in DN associated to current pixel. spec_temp_FPA: reference temperature

			flagvaried: Flag to keep under control changes in the parameters. [0,1]=[not varied, varied] DIMENSION LEGEND: [FOV][FPA_Temp] [FPA_Temp]=[18,21,24]
58	NL_VNIR_ICU_LED_RED	float a1[1000][256][2][3] float a2[1000][256][2][3] float a3[1000][256][2][3] float spm1[1000][256][2][3] float yth1[1000][256][2][3] float m[1000][256][2][3] float q[1000][256][2][3] float b1[1000][256][2][3] float b2[1000][256][2][3] float b3[1000][256][2][3] float spm2[1000][256][2][3] float yth2[1000][256][2][3] float xsat[1000][256][2][3] float ysat[1000][256][2][3] float spec_temp_FPA[3] uint8 flagvaried	See NL_VNIR_ICU_LED_NOM
59	NL_SWIR_ICU_LED_RED	float a1[1000][256][2][3] float a2[1000][256][2][3] float a3[1000][256][2][3] float spm1[1000][256][2][3] float yth1[1000][256][2][3] float m[1000][256][2][3] float q[1000][256][2][3] float b1[1000][256][2][3] float b2[1000][256][2][3] float b3[1000][256][2][3] float spm2[1000][256][2][3] float yth2[1000][256][2][3] float xsat[1000][256][2][3] float ysat[1000][256][2][3] float spec_temp_FPA[3] uint8 flagvaried	See NL_VNIR_ICU_LED_NOM

60	NL_PAN_ICU_LED_RED	float a1[6000][1][1][3] float a2[6000][1][1][3] float a3[6000][1][1][3] float spm1[6000][1][1][3] float yth1[6000][1][1][3] float m[6000][1][1][3] float q[6000][1][1][3] float b1[6000][1][1][3] float b2[6000][1][1][3] float b3[6000][1][1][3] float spm2[6000][1][1][3] float yth2[6000][1][1][3] float xsat[6000][1][1][3] float ysat[6000][1][1][3] float spec_temp_FPA[3] uint8 flagvaried	See NL_PAN_ICU_LED_NOM
61	SRF_SELECT	uint16 OpMark_VNIR[2] uint16 OpMark_SWIR[2]	SRF type selection Choose SRF variable to be used setting OpMark_XXX value according to the following list: - 0 -> SRF_XXX (GKDP) - 1 -> SRF_XXX (FKDP) 'XXX' -> VNIR, SWIR DIMENSION LEGEND: [GAIN] [GAIN]=[HIGH GAIN, LOW GAIN]
62	SRF_VNIR	float spec_temp_OB[3] float center[1000][256][2][3] float fwhm[1000][256][2][3] uint8 flagvaried	center: CW values to be used. fwhm: Spectral Width values to be used. flagvaried: Flag to keep under control changes in the parameters. [0,1]=[not varied, varied] DIMENSION LEGEND: [OB_Temp] [FOV] [BAND] [STEP] [GAIN] [OB_Temp] [FOV] [BAND] [GAIN] [OB_Temp] [FOV] [BAND] [GAIN] [ERR_TYPE][OB_Temp] [GAIN]=[HIGH GAIN, LOW GAIN] [OB_Temp]=[18,21,24] [ERR_TYPE]=[CW_error,FWHM_error]
63	SRF_SWIR	float spec_temp_OB[3] float center[1000][256][2][3] float fwhm[1000][256][2][3] uint8 flagvaried	See SRF_VNIR
64	LSF_ALONG_SLIT_SELECT	uint8 OpMark_VNIR[2] uint8 OpMark_SWIR[2] uint8 OpMark_PAN	LSF_ALONG_SLIT TYPE SELECTION Choose LSF_ALONG_SLIT variable to be used setting OpMark_XXX value according to the following list: - 0 -> LSF_ALONG_SLIT_XXX (GKDP) - 1 -> LSF_ALONG_SLIT_XXX (FKDP) 'XXX' -> VNIR, SWIR, PAN DIMENSION LEGEND: [GAIN] [GAIN]=[HIGH GAIN, LOW GAIN]

65	LSF_ALONG_SLIT_VNIR	float spec_temp_OB[3] float center[1000][256][2][3] float fwhm[1000][256][2][3] uint8 flagvaried	spec_temp_OB: OB temperature values at which has been carried out the in-flightcalibration center: Center values to be used [FOV angle deg] fwhm: IFOV values to be used [deg] flagvaried: Flag to keep under control changes in the parameters. [0,1]=[not varied, varied] DIMENSION LEGEND: [OB_Temp] [FOV] [BAND] [STEP] [GAIN] [OB_Temp] [FOV] [BAND] [GAIN] [OB_Temp] [FOV] [BAND] [GAIN] [ERR_TYPE][OB_Temp] [GAIN]=[HIGH GAIN, LOW GAIN] [OB_Temp]=[18,21,24] [ERR_TYPE]=[CW_error,FWHM_error]
66	LSF_ALONG_SLIT_SWIR	float spec_temp_OB[3] float center[1000][256][2][3] float fwhm[1000][256][2][3] uint8 flagvaried	See LSF_ALONG_SLIT_VNIR
67	LSF_ALONG_SLIT_PAN	float spec_temp_OB[3] float center[6000][1][1][3] float fwhm[6000][1][1][3] uint8 flagvaried	spec_temp_OB: OB temperature values at which has been carried out the in-flightcalibration center: Center values to be used [FOV angle deg] fwhm: IFOV values to be used [deg] flagvaried: Flag to keep under control changes in the parameters. [0,1]=[not varied, varied] DIMENSION LEGEND: [OB_Temp] [FOV] [BAND] [STEP] [OB_Temp] [FOV] [BAND] [OB_Temp] [FOV] [BAND] [ERR_TYPE][OB_Temp] [OB_Temp]=[18,21,24] [ERR_TYPE]=[CW_error,FWHM_error]
68	LSF_ACROSS_SLIT_SELECT	uint8 OpMark_VNIR[2] uint8 OpMark_SWIR[2] uint8 OpMark_PAN	LSF_ACROSS_SLIT TYPE SELECTION Choose LSF_ACROSS_SLIT variable to be used setting OpMark_XXX value according to the following list: - 0 -> LSF_ACROSS_SLIT_XXX (GKDP) - 1 -> LSF_ACROSS_SLIT_XXX (FKDP) 'XXX' -> VNIR, SWIR, PAN DIMENSION LEGEND: [GAIN] [GAIN]=[HIGH GAIN, LOW GAIN]
69	LSF_ACROSS_SLIT_VNIR	float spec_temp_OB[3] float center[1000][256][2][3] float fwhm[1000][256][2][3] uint8 flagvaried	See LSF_ALONG_SLIT_VNIR
70	LSF_ACROSS_SLIT_SWIR	float spec_temp_OB[3] float center[1000][256][2][3] float fwhm[1000][256][2][3] uint8 flagvaried	See LSF_ALONG_SLIT_VNIR

71	LSF_ACROSS_SLIT_PAN	float spec_temp_OB[3] float center[6000][1][1][3] float fwhm[6000][1][1][3] uint8 flagvaried	See LSF_ALONG_SLIT_PAN
72	GLOBAL_OFFSET_SELECT	uint8 OpMark_VNIR[2] uint8 OpMark_SWIR[2]	Global offset type selection: Choose GLOBAL_OFFSET variable to be used setting OpMark_XXX value according to the following list: - 0 -> GLOBAL_OFFSET_XXXX (GKDP) - 1 -> GLOBAL_OFFSET_XXXX (FKDP) 'XXX' -> VNIR, SWIR DIMENSION LEGEND: [GAIN] [GAIN]=[HIGH GAIN, LOW GAIN]
73	GLOBAL_OFFSET_VNIR	float fit_coeff[16][2][2] float x_lim[2][2][2] float y_lim[2][2][2] uint8 flagvaried	fit_coeff: polynomial fitting coefficients x_lim: x limits of the function y_lim: y limits of the function flagvaried: Flag to keep under control changes in the parameters. [0,1]=[not varied, varied] Dimension legend: [FIT_COEFF][GAIN][POS] [2][GAIN][POS] [2][GAIN][POS] [GAIN]=[HIGH GAIN, LOW GAIN] [POS]=[HIGH FOV, LOW FOV]
74	GLOBAL_OFFSET_SWIR	float fit_coeff[16][2][2] float x_lim[2][2][2] float y_lim[2][2][2] uint8 flagvaried	See GLOBAL_OFFSET_VNIR
75	L_DN_ICU_LAMP_NOM	float VNIR[1000][256][2] float SWIR[1000][256][2] float PAN[6000] uint8 flagvaried	The measurements are acquired with the nominal lamp ON supplied with 500 mA of current. VNIR: VNIR average frame over 100 acquisition, with BKG subtration applied SWIR: SWIR average frame over 100 acquisition, with BKG subtration applied PAN: PAN average frame over 100 acquisition, with BKG subtration applied flagvaried: Flag to keep under control changes in the parameters. [0,1]=[not varied, varied] DIMENSION LEGEND: [FOV][BAND][GAIN] [FOV] [GAIN]=[HIGH GAIN, LOW GAIN]
76	L_DN_ICU_LAMP_RED	float VNIR[1000][256][2] float SWIR[1000][256][2] float PAN[6000] uint8 flagvaried	See L_DN_ICU_LAMP_NOM
77	L_DN_ICU_LED_NOM	float VNIR[1000][256][2] float SWIR[1000][256][2] float PAN[6000] uint8 flagvaried	See L_DN_ICU_LAMP_NOM
78	L_DN_ICU_LED_RED	float VNIR[1000][256][2] float SWIR[1000][256][2] float PAN[6000] uint8 flagvaried	See L_DN_ICU_LAMP_NOM

79	L_DN_ICU_SUN	float VNIR[1000][256][2] float SWIR[1000][256][2] float PAN[6000] uint8 flagvaried	See L_DN_ICU_LAMP_NOM
80	ROTATION_VNIR	float m[8] float delta_m[8] float q[8] float detla_q[8] uint8 flagvaried	m[8] = angolar coeffecient of the line that best fits the filter VNIR centroid position in bands along the FOV (=idx_band / FOV) Δm[8]= the std error found on m_VNIR (TBC if used) q[8] = FOV_position of the line Δq[8]= the std error found on q_VNIR (TBC if used)
81	ROTATION_SWIR	float m[8] float delta_m[8] float q[8] float delta_q[8] uint8 flagvaried	m[8] = angolar coeffecient of the line that best fits the filter SWIR centroid position in bands along the FOV. Δm[8]= the std error found on m_SWIR (TBC if used)
82	SHIFT_A_VNIR	float idx_edge_rise [256] float idx_edge_fall [256] uin8 flagvaried	idx_edge_rise = fov idx where the signal reaches the 80% of it maximum duirng the rise edge idx_edge_fall = fov idx where the signal raches the 80% of it maxium during the fall edge
83	SHIFT_A_SWIR	float idx_edge_rise [256] float idx_edge_fall [256] uin8 flagvaried	idx_edge_rise = fov idx where the signal reaches the 80% of it maximum duirng the rise edge idx_edge_fall = fov idx where the signal raches the 80% of it maxium during the fall edge
84	SHIFT_C_VNIR	float um_shift uin8 flagvaried	shift in term of um in the across slit direction .
85	SHIFT_C_SWIR	float um_shift uin8 flagvaried	
86	SHIFT_A_PAN	float idx_edge_rise float idx_edge_fall uin8 flagvaried	
87	ICU_FILTER_VNIR	float cntd_fupdated_nom[1000[8][2] float cntd_fupdated_red[1000][8][2] uint8 flagvaried	Mean(1) value, of centroid coordinates measured pixel fraction. it reports the positon of the absorption feature centroid measured with the Sun and the internal illumination sources=> they are associated to the spectrum of L_ICU_LAMP_NOM.LampSignal L_ICU_LAMP_RED.LampSignal [1000 FOV] [8 cetroid] [1° column = idx centroid 2° column = cw]

88	ICU_FILTER_SWIR	float cntd_fupdated_nom[1000][8][2] float cntd_fupdated_red[1000][8][2] uint8 flagvaried	Mean(1) value, of centroid coordinates measured pixel fraction. it reports the positon of the absorption feature centroid measured with the Sun and the internal illumination sources=> they are associated to the spectrum of L_ICU_LAMP_NOM.LampSignal L_ICU_LAMP_RED.LampSignal [1000 FOV] [8 cetroid] [1° column = idx centroid 2° column = cw]
89	ICU_FILTER_BORDER	float idx_sx[16] float idx_dx[16] uint8 flagvaried	They represent the band index coordinates of the previous and successive peak that precede and succeed each absorption feature of the filter.
90	SPECTRUM_SHIFT_VNIR	float shift_T[451][6] Uint8 flagvaried	shift_T: spectrum shift with the temperature of the optical bench: (average 0.177 px/K) It is computed for the FOV range [250:700],and for the 6 filter absorption features detectable. When used it is used, for each FOV, the average shift on all the 6 features.
91	SPECTRUM_SHIFT_SWIR	float shift_T[451][6] Uint8 flagvaried	shift_T: spectrum shift with the temperature of the optical bench: (average 0.049 px/K) It is computed for the FOV range [250:700],and for the 6 filter absorption features detectable. When used it is used, for each FOV, the average shift on all the 6 features.
92	SPARE_1	float meas1[1000][256][2][3][100] float meas2[1000][256][2][3][100] float a[1000][256][2][3] float b[1000][256][2][3] float c[1000][256][2][3] float d[1000][256][2][3] float e[1000][256][2][3] float temp[10]	meas1: spare measurement matrix meas2: spare measurement matrix a: spare matrix b: spare matrix c: spare matrix d: spare matrix e: spare matrix temp: temperature array values DIMENSION LEGEND: [FOV] [BAND] [GAIN] [TEMP][STEP] [FOV] [BAND] [GAIN] [TEMP] [TEMP] [GAIN]=[HIGH GAIN, LOW GAIN]
93	SPARE_2	float meas1[1000][256][2][3][100] float meas2[1000][256][2][3][100] float a[1000][256][2][3] float b[1000][256][2][3] float c[1000][256][2][3] float d[1000][256][2][3] float e[1000][256][2][3] float temp[10] uint8 flagvaried	See SPARE_1

94	SPARE_3	float meas1[1000][256][2][3][100] float meas2[1000][256][2][3][100] float a[1000][256][2][3] float b[1000][256][2][3] float c[1000][256][2][3] float d[1000][256][2][3] float e[1000][256][2][3] float temp[10] uint8 flagvaried	See SPARE_1
95	SPARE_4	float meas1[1000][256][2][3][100] float meas2[1000][256][2][3][100] float a[1000][256][2][3] float b[1000][256][2][3] float c[1000][256][2][3] float d[1000][256][2][3] float e[1000][256][2][3] float temp[10] uint8 flagvaried	See SPARE_1
96	SPARE_5	float meas1[1000][256][2][3][100] float meas2[1000][256][2][3][100] float a[1000][256][2][3] float b[1000][256][2][3] float c[1000][256][2][3] float d[1000][256][2][3] float e[1000][256][2][3] float temp[10] uint8 flagvaried	See SPARE_1

7.8.3 ICU CDP FORMAT

ICU CDP parameter file shall be a NETCDF4 FILE, containing the following variables:

Note: These parameters will be updated with the correct values after the on-ground calibration campaing.

Number	Name	Content	Description
0	UTC_TIME	Unit16 date [8]	UTC time of the KDP data set Generation - the same reported into Catalogue Metadata UTC_TIME[0]=Year UTC_TIME[0]=Month UTC_TIME[0]=Day of Month UTC_TIME[0]=Hour UTC_TIME[0]=Minute UTC_TIME[0]=Seconds UTC_TIME[0]=Uint8 10-2Sec UTC_TIME[0]=Uint8 10-4Sec
1	LAMP_NOM_CUR	Float val	val: Lamp current expressed in mA in case of Main Electronic Nominal used (see MainElectronic_Main_Red_Flag in the HK).Default = 500mA.
2	LAMP_RED_CUR	Float val	val: Lamp current expressed in mA in case of Main Electronic Redundant used (see MainElectronic_Main_Red_Flag in the HK). Default = 500mA.
3	LED_NOM_CUR	Float val	val: Led current expressed in mA in case of Main Electronic Nominal used (see MainElectronic_Main_Red_Flag in the HK). Default = 350mA.
4	LED_RED_CUR	Float val	val: Led current expressed in mA in case of Main Electronic Redunant used (see

			MainElectronic_Main_Red_Flag in the HK).Default = 350mA.
5	L_ICU_LAMP_NOM	Float Signal[2101] Float Lambda[2101] Float V_ph Float I_ph	Signal = it reports the radiance signal[W/m2/sr/nm] measured on the exit of the ICU Integrated Sphere with the spectroradiometer Fieldspec with ICU internal lamp main switched on in case of MainElectronic_Main. Lambda = list of wavelengths (nm) associated to signal. From 400 to 2500nm at step of 1nm. V_photodiode = tension (V) of photodiode main associated to the measurement. I_photodiode = phodiode current [A] (V_photoidiode measured /2000ohm)
6	L_ICU_LAMP_RED	Float Signal[2101] Float Lambda[2101] Float V_ph Float I_ph	Signal = it reports the radiance signal[W/m2/sr/nm] measured on the exit of the ICU Integrated Sphere with lamp redundant switched on, in case of MainElectronic_Redundant . Lambda = list of wavelengths in nm associated to signal. From 400 to 2500um at step of 1nm. V_photodiode=tension (V) of photodiode redundant associated to the measurement. I_photodiode = phodiode current [A] (V_photoidiode measured /2000ohm)
7	L_ICU_LED_NOM	Float Signal[2101] Float Lambda[2101] Float V_ph Float I_ph	Signal = it reports the radiance signal[W/m2/sr/nm] measured on the exit port of the ICU Integrated Sphere with LED main switched on in case MainElectronic_Main . Lambda = list of wavelengths in [nm]associated to signal. From 400 to 2500um at step of 1nm. V_photodiode=tension [V] of photodiode nominale associated to the measurement. I_photodiode = phodiode current [A] (V_photoidiode measured /2000ohm)
8	L_ICU_LED_RED	Float Signal[2101] Float Lambda[2101] Float V_ph Float I_ph	Signal = it reports the radiance signal[W/m2/sr/nm] measured on the exit port of the ICU integrated sphere with LED redundant switched on in case MainElectronic_Redundant . Lambda = list of wavelengths [nm] associated to signal. From 400 to 2500um at step of 1nm. V_photodiode=tension [V] of photodiode associated to the measurement. I_photodiode = phodiode current [A] (V_photoidiode measured /2000ohm)
9	L_ICU_SUN	Float Signal [2101] Float Lambda[2101] Float V_ph[2] Float I_ph[2]	Signal = it reports the radiance signal[W/m2/sr/um] measured on the entry of telescope when Sun illuminates the ICU. It correspond to the measurement of the radiance on the entry of telescope when the laboratory lamp illuminates the ICU multiplied by the KLS ratio. Spectral radiance measured From 400 to 2500um at step of 1um. Where KLS = L_sun/L_qth external to the ICU. V_photodiode=current of photodiode associated to the measurement. [V_photodiode] = [NOM, RED] I_photodiode = phodiode current [A] (V_photoidiode measured /2000ohm)
10	ICU_FILTER_WAV	Float Lambda[1851] Float NormSignalMeas[1851] Float BorderWvSX1[15] Float BorderWvDX1[15] Float BorderWvSX2[15] Float BorderWvDX2[15] Float LampNomWvMeas[15] Float LampRedWvMeas[15] Float LedNomWvMeas[15] Float LedRedWvMeas[15]	The shape of the spectral filter,which is positioned on the exit port of the ICU integrated sphere, at nm resolution (measured with FieldSpec) is given. The filter presents a total of 15 bsorption features in the PRISMA operative spectral range. -Lambda[1851] = 1851 values of lambda from 350nm to 2200 nm at step of 1 nm -NormSignalMeas = filter transmittance For each asbsorption features it is provided: -BorderWvSX1 and BorderWvDX1 left and right extremes in lambda [nm] that contain the nearest maximus on the left side of each abosortion feature; -BorderWvSX2 and BorderWvDX2 = left and right extremes in lambda [nm] that contain the nearest maximus on the right side of each abortion feature; -LampNomWvMeas = it reports the positon in [nm] of the absorption feature measured with the Fieldspec positioned at the ICU Integrated Sphere exit port when the nominal lamp is switched on. This values

		Float SunWvMeas[15] Float NISTNomWvMeas[15]	are obtained using the Nist Algorthm. -LampRedWvMeas = it reports the positon in [nm]of the absorption feature measured with the Fieldspec positioned at the ICU Integrated Sphere exit port when the redundant lamp is switched on. This values are obtained using the Nist Algorthm. -LedNomWvMeas = it reports the positon in [nm] of the absorption feature measured with the Fieldspec positioned at the ICU Integrated Sphere exit port when the nominal led is switched on. This values are obtained using the Nist Algorthm. -LedRedWvMeas = it reports the positon in [nm] of the absorption feature measured with the Fieldspec positioned at the ICU Integrated Sphere exit port when the redundant led is switched on. This values are obtained using the Nist Algorthm. - SunWvMeas [nm] it reports the positon in [nm] of the absorption feature estimated at the ICU Integrated Sphere exit port when the Sun irradiance enters through the solar port inside the ICU Integrated Sphere. This values are obtained using the Nist Algorthm. The Nist algorithm is used to evaluate the wavelength and it is called PEAKCO.m. This algorithm shall be embedded into the L1 processor algorithms, in order to operate with the sampling (the bands) of PRISMA OH.
11	ICU_MIRR_TR	Float Ro[2101] Float Lambda[2101]	Ro = Global Reflectance [not dimensional] of the two mirrors internal to the ICU between the integrating sphere and the TMA (folding mirror and main cover mirror). Lambda = list of wavelengths associated to signal of transmittance. From 400 to 2500um at step of 1um.
12	Spare_1		
13	Spare_2		
14	Spare_3		
15	Spare_4		
16	Spare_5		

7.8.4 CDP FORMAT

Characteriziation Data Parameter file shall be a NETCDF4 FILE, containing the following variables:

Number	Name	Content	Description
0	UTC_TIME	Unit16 date [8]	UTC time of the KDP data set Generation - the same reported into Catalogue Metadata UTC_TIME[0]=Year UTC_TIME[0]=Month UTC_TIME[0]=Day of Month UTC_TIME[0]=Hour UTC_TIME[0]=Minute UTC_TIME[0]=Seconds UTC_TIME[0]=Uint8 10-2Sec UTC_TIME[0]=Uint8 10-4Sec
1	VNIR_MTF	Float val[1000][256][2]	MTF for each band VNIR range [0..1] @Nyquist Freq. DIMENSION LEGEND: [FOV] [BAND] [GAIN] [GAIN]=[HIGH GAIN, LOW GAIN]

2	SWIR_MTF	Float val[1000][256][2]	MTF for each band SWIR [0..1] @Nyquist Freq. DIMENSION LEGEND: [FOV] [BAND] [GAIN] [GAIN]=[HIGH GAIN, LOW GAIN]
3	PAN_MTF	Float val[6000]	MTF for PAN [0..1] @Nyquist Freq. DIMENSION LEGEND: [FOV]
4	VNIR_SNR	Float val[1000][256][2]	SNR for each band VNIR in condition of nominal flux DIMENSION LEGEND: [FOV] [BAND] [GAIN] [GAIN]=[HIGH GAIN, LOW GAIN]
5	SWIR_SNR	Float val[1000][256][2]	SNR for each band SWIR in condition of nominal flux DIMENSION LEGEND: [FOV] [BAND] [GAIN] [GAIN]=[HIGH GAIN, LOW GAIN]
6	PAN_SNR	Float val[6000]	SNR for PAN in condition of nominal flux DIMENSION LEGEND: [FOV]
7	VNIR_NEDL	Float val[1000][256][2]	Noise Equivalent Delta Radiance for each band VNIR=W/m2/sr/um DIMENSION LEGEND: [FOV] [BAND] [GAIN] [GAIN]=[HIGH GAIN, LOW GAIN]
8	SWIR_NEDL	Float val[1000][256][2]	Noise Equivalent Delta Radiance for each band SWIR=W/m2/sr/um DIMENSION LEGEND: [FOV] [BAND] [GAIN] [GAIN]=[HIGH GAIN, LOW GAIN]
9	VNIR_SMILE	Float val[256]	Smile effect for VNIR=percentage value DIMENSION LEGEND: [BAND]
10	SWIR_SMILE	Float val[256]	Smile effect for SWIR=percentage value DIMENSION LEGEND: [BAND]
11	VNIR_KEYSTONE	Float val[1000]	Keystone effect for VNIR=percentage value DIMENSION LEGEND: [FOV]
12	SWIR_KEYSTONE	Float val[1000]	Keystone effect for SWIR=percentage value DIMENSION LEGEND: [FOV]

13	VNIR_FOCAL_LENGHT	Float val	Focal length of VNIR channel (mm)
14	SWIR_FOCAL_LENGHT	Float val	Focal length of SWIR channel (mm)
15	PAN_FOCAL_LENGHT	Float val	Focal length of PAN channel (mm)
16	HYP_PUPIL_DIAM	Float val	Pupil diameter of VNIR and SWIR channel (mm)
17	PAN_PUPIL_DIAM	Float val	Pupil diameter of PAN channel (mm)
18	VNIR_POL_SENS	Float val	Polarization sensitivity for VNIR channel = percentage value
19	SWIR_POL_SENS	Float val	Polarization sensitivity for SWIR channel = percentage value
20	PAN_POL_SENS	Float val	Polarization sensitivity for PAN channel = percentage value
21	PAN_SPECTRAL_RANGE	Float val[2]	val[1] = lower range (um) val[1] = upper range (um)
22	VNIR_SPC_CALIB_ACC	Float val[1000][256]	Spectral calibration accuracy for VNIR channel in um DIMENSION LEGEND: [FOV] [BAND]
23	SWIR_SPC_CALIB_ACC	Float val[1000][256]	Spectral calibration accuracy for SWIR channel in um DIMENSION LEGEND: [FOV] [BAND]
24	VNIR_RAD_CALIB_ACC	Float val[1000][256]	Radiometric calibration accuracy VNIR = percentage value DIMENSION LEGEND: [FOV] [BAND]
25	SWIR_RAD_CALIB_ACC	Float val[1000][256]	Radiometric calibration accuracy SWIR = percentage value DIMENSION LEGEND: [FOV] [BAND]
26	VNIR_SAT	Float val[1000][256][2][2]	val: lower and upper values of VNIR FullWell in DN DIMENSION LEGEND: [FOV] [BAND] [VNIR_FWELL] [VNIR_FWELL]=[lower, higher]
27	SWIR_SAT	Float val[1000][256][2][2]	val: lower and upper values of VNIR FullWell in DN DIMENSION LEGEND: [FOV] [BAND] [VNIR_FWELL] [VNIR_FWELL]=[lower, higher]

28	PAN_SAT	Float val[6000][1][2]	val: lower and upper values of VNIR FullWell in DN DIMENSION LEGEND: [FOV] [BAND] [VNIR_FWELL] [VNIR_FWELL]=[lower, higher]
29	VNIR_BORE	Float val	Vnir boresight index – 499
30	SWIR_BORE	Float val	Swir boresight index – 499
31	PAN_BORE	Float val	PAN boresight index – 2999
32	VNIR_L_lim	Float val [611][3]	VNIR Radiance working limits as a function of wavelength in the range 400-1010 nm (1nm sampling). - Val[:][1] wavelegnth; - Val[:][2] L_min; - Val[:][1] L_max.
33	SWIR_L_lim	Float val [1581][3]	VNIR Radiance working limits as a function of wavelength in the range 920-2500 nm (1nm sampling). - Val[:][1] wavelegnth; - Val[:][2] L_min; - Val[:][1] L_max.
34	Spare_1	float Meas1 [1000][256][2][3][100] float Meas2 [1000][256][2][3][100] float A [1000][256][2][3] float B [1000][256][2][3] float C [1000][256][2][3] float D [1000][256][2][3] float E [1000][256][2][3] Float Temp [10] Uint16 FlagVaried	Meas1: spare measurement matrix Meas2: spare measurement matrix A: spare matrix B: spare matrix C: spare matrix D: spare matrix E: spare matrix Float Temp: temperature array values DIMENSION LEGEND: [FOV] [BAND] [GAIN] [TEMP][STEP] [FOV] [BAND] [GAIN] [TEMP] [TEMP] [GAIN]=[HIGH GAIN, LOW GAIN]

35	Spare_2	float Meas1 [1000][256][2][3][100] float Meas2 [1000][256][2][3][100] float A [1000][256][2][3] float B [1000][256][2][3] float C [1000][256][2][3] float D [1000][256][2][3] float E [1000][256][2][3] Float Temp [10] Uint16 FlagVaried	Meas1: spare measurement matrix Meas2: spare measurement matrix A: spare matrix B: spare matrix C: spare matrix D: spare matrix E: spare matrix Float Temp: temperature array values DIMENSION LEGEND: [FOV] [BAND] [GAIN] [TEMP][STEP] [FOV] [BAND] [GAIN] [TEMP] [TEMP] [GAIN]=[HIGH GAIN, LOW GAIN]
36	Spare_3	float Meas1 [1000][256][2][3][100] float Meas2 [1000][256][2][3][100] float A [1000][256][2][3] float B [1000][256][2][3] float C [1000][256][2][3] float D [1000][256][2][3] float E [1000][256][2][3] Float Temp [10] Uint16 FlagVaried	Meas1: spare measurement matrix Meas2: spare measurement matrix A: spare matrix B: spare matrix C: spare matrix D: spare matrix E: spare matrix Float Temp: temperature array values DIMENSION LEGEND: [FOV] [BAND] [GAIN] [TEMP][STEP] [FOV] [BAND] [GAIN] [TEMP] [TEMP] [GAIN]=[0,1]=[HIGH GAIN, LOW GAIN]
37	Spare_4	float Meas1 [1000][256][2][3][100] float Meas2 [1000][256][2][3][100] float A [1000][256][2][3] float B [1000][256][2][3] float C [1000][256][2][3] float D [1000][256][2][3] float E [1000][256][2][3] Float Temp [10] Uint16 FlagVaried	Meas1: spare measurement matrix Meas2: spare measurement matrix A: spare matrix B: spare matrix C: spare matrix D: spare matrix E: spare matrix Float Temp: temperature array values DIMENSION LEGEND: [FOV] [BAND] [GAIN] [TEMP][STEP] [FOV] [BAND] [GAIN] [TEMP] [TEMP] [GAIN]=[HIGH GAIN, LOW GAIN]

38	Spare_5	float Meas1 [1000][256][2][3][100] float Meas2 [1000][256][2][3][100] float A [1000][256][2][3] float B [1000][256][2][3] float C [1000][256][2][3] float D [1000][256][2][3] float E [1000][256][2][3] Float Temp [10] Uint16 FlagVaried	Meas1: spare measurement matrix Meas2: spare measurement matrix A: spare matrix B: spare matrix C: spare matrix D: spare matrix E: spare matrix Float Temp: temperature array values DIMENSION LEGEND: [FOV] [BAND] [GAIN] [TEMP][STEP] [FOV] [BAND] [GAIN] [TEMP] [TEMP] [GAIN]=[HIGH GAIN, LOW GAIN]

7.8.5 FKDP, GKDP, ICU-KDP AND CDP PRODUCTS NAMING CONVENTION

The following naming convention will be used for the identification of the PRISMA FKDP,GKDP, ICU-KDP and CDP Products files:

Note that for the generated CDP fie, also the File Type is different from that of the input product.

PRS_<P>_
<PRODTY>_<ORDT>_<YYYYMMDDhhmmss>_<YYYYMMDDhhmmss>_<VVVV>_<FVALID>.DAT
(54 chars)

The semantic of the variable sub-strings is reported in the following table:

Sub-string code	Meaning	Allowed values
<P>	Processing level (2 char)	L1 = if KDP are generated by L1processor CF = if KDP are generated ex-novo or validated by CF
<PRODTY>	Product Type (6 chars)	AX_FDP = In-Flight Data Parameters (FKDP Product, produced by Calibratoin Facilith and by L1 Processor.) AX_CDP = Characterization Data Parameters (CDP) (produced only from Calibration Facility machine). AX_IDP = ICU_CDP (produced only from Calibration Facility machine). AX_GDP= Ground Data Parameters (GKDP) (produced only from Calibration Facility machine).

<ORDT>	Order Type	It brings the ordt of the L0a file that has generated the L1 processing for FKDP updating. In case KDP are inserted by Calibration Facility, it is set to CF. "NRT_", =user demand "SYST" =systematic processing "REPR":=reprocessing "CF" if the file has been inserted from the Calibration Facility. In case the file is only updated by CF, the order_type is not changed.
<VVVV>	Product Version (4 chars) – used for reprocessing	e.g.: 0001 When the file is updated by CF, the product version is not increased.
<YYYYMMDDhhmmss>	Start Validity UTC time of the first frame of the previous L0a Internal Calibration file (14 chars) of the SOI	YYYY = year MM = month DD = day of the month hh = hour mm = minute ss = second When the file is updated by CF, this field is not changed. When the file is inserted from CF, this field shall be written by CVWG with the utc start validity of the kdp
<YYYYMMDDhhmmss>	UTC time of the last frame of the successive L0a Internal Calibration file (14 chars) of the SOI. (not used by CNM)	As for sensing start time When the file is updated by CF, this field is not changed. When the file is inserted from CF, this field shall be written by CVWG.
<FVALID>	KDP validation flag: it means that the KDP has been validated.	0= if KDP file is valid 1 =if KDP file shall still be validated. Always set at 0 in case of AX_GDP

Table 7-6: FKDP,GKDP, ICU_CDP and CDP Products File naming convention

7.8.6 FKDP MD QUALITY INFO

This section reports the quality info for the the FKDP file.

It is a STRING of 56 characters reported into the Catalogue Metadata file and inside the FKDP file.

The field "Quality_Info" is as string reported inside the L1 Metadata Catalogue file.

Each position of the character in the string has an opportune meaning, following reported:

Position in the string	**Meaning of the flag**
0,1	-00 ok -01 Warning

	-10 Error
2	1 = FKDP validation flag raised. FKDP file updated.
3	1 = Bkg updated respect to input FKDP
4	1 = FF updated respect to input FKDP
5	1 = ITF updated respect to input FKDP
6	1 = CW VNIR updated respect to input FKDP
7	1 = CW SWIR updated respect to input FKDP
8	1 = Defective pixel updated respect input FKDP
9	1 = CW VNIR updated with rigid shift 2= CW VNIR updated with smile shift (rigid shift per samples) 3= CW VNIR updated with no rigid shift
10	1= CW SWIR updated with rigid shift 2= CW SWIR updated with smile shift (rigid shift per samples) 3= CW SWIR updated with no rigid shift
11	1= DARK updated respect to input FKDP
12	1 = NL_TF updated respect to input FKDP
13	1 =NL_TF_LED updated respect to input FKDP
14	1= ICU_UNIFORMITY_MAIN updated respect to input FKDP 2 =ICU_UNIFORMITY_RED updated respect to input FKDP
15	1 = VNIR ROTATION updated respect to input FKDP
16	1 = SWIR ROTATION updated respect to in input FKDP
17	1 = VNIR SHIFT CROSS SLIT updated respect to input FKDP
18	1 = SWIR SHIFT CROSS SLIT update respect to input FKDP
19	1 = VNIR SHIFT ALONG SLIT updated respect to input FKDP
20	1 = SWIR SHIFT ALONG SLIT update respect to input FKDP
21	1= PAN SHIFT ALONG SLIT updated respect to input FKDP
22	1 = VNIR ROTATION updated with rigid rotation 2= ANOMALY VNIR ROTATION updated with no rigid rotation
23	1= VNIR SHIFT CROSS SLIT updated with rigid translation 2= ANOMALY VNIR SHIFT CROSS SLIT updated with no rigid translation
24	1= VNIR SHIFT ALONG SLIT updated with rigid translation 2=ANOMALY VNIR SHIFT ALONG SLIT updated with no rigid translation
25	1=ANOMALY VNIR ACROSS SLIT ROTATION DIFFERS FROM VNIR ALONG SLIT ROTATION
26	1 = SWIR ROTATION updated with rigid rotation 2= ANOMALY SWIR ROTATION updated with no rigid rotation
27	1= SWIR SHIFT CROSS SLIT updated with rigid translation 2=ANOMALY SWIR SHIFT CROSS SLIT updated with no rigid traslation
28	1= SWIR SHIFT ALONG SLIT updated with rigid translation 2= ANOMALY SWIR SHIFT ALONG SLIT updated with no rigid traslation
29	1= ANOMALY SWIR ACROSS SLIT ROTATION DIFFERS FROM VNIR ALONG SLIT ROTATION

30	1 = VNIR DEFOCUSING TILT ANGLE Updated
31	1 = SWIR DEFOCUSING TILT ANGLE Updated
32	1 = HYP Exteral FF updated respect to current FF FKDP
33	1 = PAN External FF updated respect to current FF FKDP
34	1 = ITF MOON updated respect to current ITF FKDP (with Moon Obs frames)
35	1 = ITF SUN updated respect to current ITF FKDP (with Sun Flux Frames)
36	1 = FF_SUN Updated respect to input FKDP
37	1 = Problems occurred in CW FKDP updating processing. CW FKDP have not been updated.
38	1= Problems occurred in DEFECTIVE PIXEL FKDP updating processing. DEFECTIVE PIXEL FKDP have not been updated.
39	1 = Problems occurred in FF FKDP updating processing. FF FKDP have not been updated.
40	1 = Problems occurred in ITF FKDP updating (ITF Updating Sun) processing. ITF FKDP have not been updated.
41	1 = not used
42	1 = Photodiode on SUN is not stable
43	1 = Photodiode on Lamp is not stable
44	1 = Photodiode on Led is not stable
45…55	Not used

LIST OF ERRORS to be marked into Exit Code and into Log file	
ErrorCode[56]	1 = Input Soi file not valid or missing (L0a , Aux, and KDP)
ErrorCode[57]	1 = Config file not valid
ErrorCode[58]	1 = Job Order not valid
ErrorCode[59]	1= Parameter file missing
ErrorCode[60..64]	Not used

8. LEVEL 2 PRODUCTS

8.1 LEVEL 2 PROCESSING OVERVIEW

The Level 2 processing is in charge of processing *Top-of-Atmosphere* spectral radiance measurements into geophysical parameters. These parameters depend on the observed pixels and provide information on:

- The at-surface radiance/reflectance;
- The properties of the atmosphere above the surface:
    - Aerosol Optical Thickness and Angstrom Exponent;
    - Water Vapour;
    - Thin Cloud Optical Thickness.

The general scheme of Level 2 processing is illustrated in Figure 8-1.
The processing steps which allow the transformation from *Top-of-Atmosphere* spectral radiance (Level 1) to at-surface reflectance (Level 2c) are generally called atmospheric correction.
The processing step which brings to the level 2d is identified as geocoding.

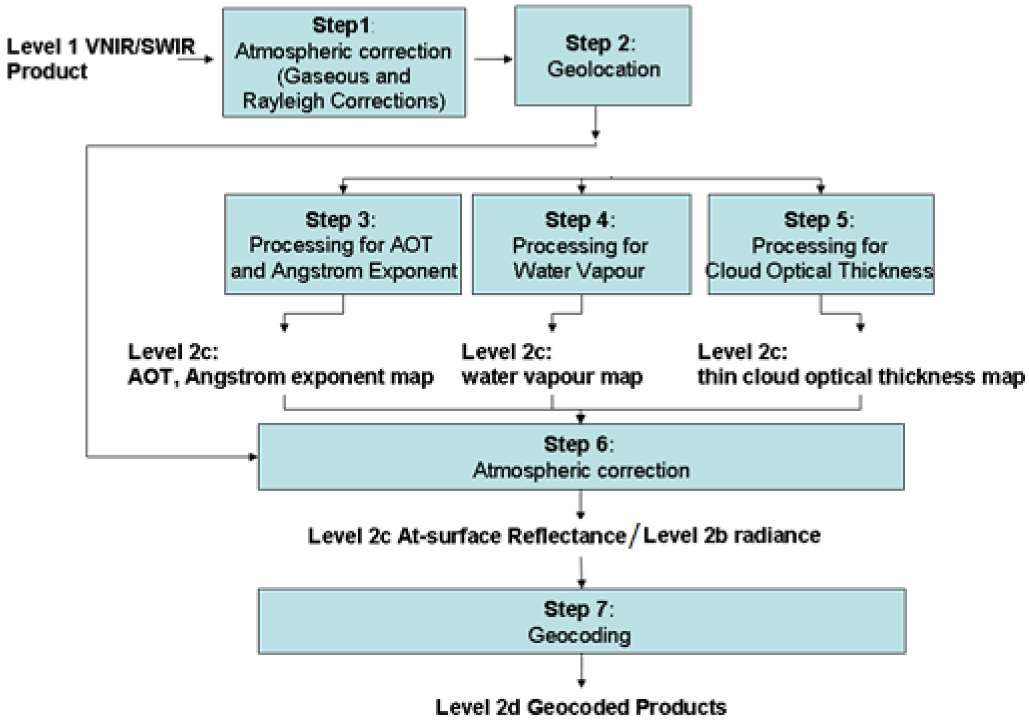


Figure 8-1: Level 2 processing scheme

Step 1 – Atmospheric correction

Atmospheric corrections of Hyperspectral images aims at removing the effect of atmospheric components (i.e. molecules and aerosols scattering and gaseous absorption) from TOA measured radiance.

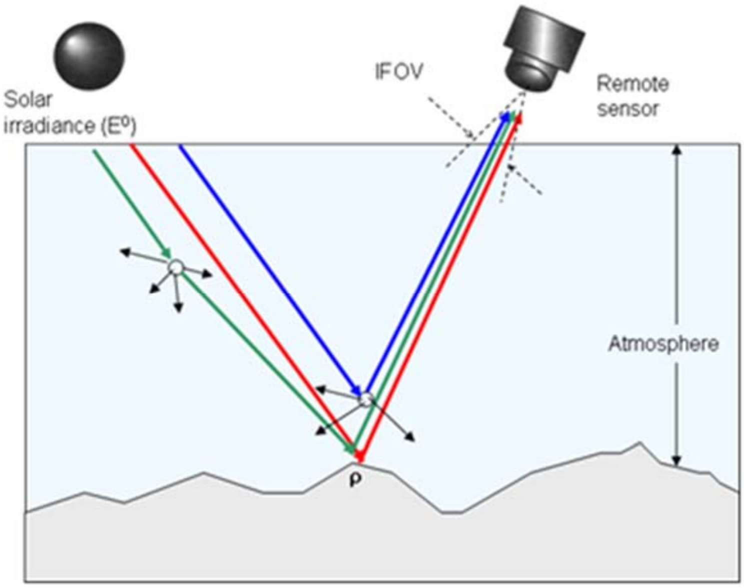


Figure 8-2: Solar radiation scattering and generation of at-instrument radiance process (simplified scheme)

The result is the radiance emerging from (i.e. the radiance reflected by) the lower boundary, which obviously is the Earth surface in absence of clouds.
Boundary reflection coefficient, i.e. the ratio between the emerging and the incoming radiance, at boundary, can be also easily obtained.
These two quantities are stored respectively into Level 2b and 2c PRISMA products.

To remove the effects of the atmosphere, first the atmospheric parameters, most notably an aerosol description (the visibility or optical depth, and, if possible, an aerosol "type") and the column water amount, are retrieved. Usually aerosol retrieval is possible over a very limited set of surface types (water and dark land pixels) and typically an average visibility is obtained for the whole scene.
This is sufficient for small scenes as PRISMA; as aerosols concentration and types have small variation along a standard PRISMA image extension.
On the contrary, the spectral signature of water vapour is sufficiently distinct over each pixel and the column amount may be retrieved on a pixel-by-pixel basis. The water band typically used is at 1.13 µm.

Then the solution of the atmospheric RT equation for the given aerosol and column water vapour is performed to retrieve the radiance reflected at boundary.
This is achieved by inverting the RT by an iterative method, by minimizing a suitable cost function representing the difference between the spectrum simulated by the RT at given surface reflectance (i.e. the simulated TOA radiance) and the one measured by the instrument (i.e. the measured TOA radiance).

A standard equation for spectral radiance at a sensor pixel, in the solar wavelength range (neglecting thermal emission) from a flat Lambertian surface may be used. To improve accuracy, corrections factors taking into account of adjacency effects of pixels surrounding the target may be adopted.
To increase RT solution speed, simulated TOA radiances are stored in LUT derived by complex RT runs (as MODTRAN).
From RT inversion is also possible to determine the surface reflectance by applying the same processing scheme.

In order to perform atmospheric corrections, the following ancillary and auxiliary data are specifically used:

- Product file information set
- Product acquisition and location information set
- Acquisition/processing constraints ancillary set
- Ancillary data generated by satellite set
- Housekeeping data generated by payload set
- Atmospheric vertical profiles: to characterize vertical distribution of atmospheric components
- Data bank of optical characteristics of atmospheric constituents: to calculate the radiative behaviour of the atmosphere above the observed scene

- LUT of RTM runs for different surface types and atmospheric loads: to invert the RTM
- Solar irradiance spectra: to estimate the incident radiance from space

Step 2 – Geolocation
The geolocation aims at producing an update of the product in input for metadata part only that refers to the geolocation of scene, so no processing on the raster data are foreseen. This process takes in account the platform data orbit at the time of the acquisition and/or GPCs selected for the image by that the necessary information are computed to define the geolocation of the corners of the scene (see understanding of PRS-MRD-0215) or interpolator polynomial coefficients to cover the PRS-MRD-0216.

In order to perform image geolocation the following ancillary and auxiliary data are used:
- Product file information set
- Product acquisition and location information set
- Acquisition/processing constraints ancillary set
- Ancillary data generated by satellite set
- Housekeeping data generated by payload set
- DEM/DTM
- GCP Data bank (if requested by the user)

Level 2c processing – Geolocated Aerosol Characterisation (AOT and Angstrom exponent)
Step 3 - Processing for AOT and Angstrom exponent
The aerosol characterization is carried out by using the required Level 1 (cloud mask, sun-glint mask and general classification mask), Level 2 (spectral radiance at-ground) and ancillary data. For aerosol retrieval, the swath pixels are collected into a certain number of pixel boxes. Each of these boxes is separately considered for aerosol characterization. In general the pixel box dimension of the aerosol product can be around 600 m x 600 m.

In addition to the cloud mask, the land use product also identifies whether a pixel is a 'land' pixel or a 'water' pixel. If all pixels in the box are considered water, the algorithm proceeds with the over-ocean retrieval. However, if any pixel is considered land, then it proceeds with the over-land algorithm. This helps to minimize problems introduced by underwater reflectance in shallow water near the coasts.

In order to perform Aerosol product generation the following ancillary and auxiliary data are specifically used:
- Product file information set
- Product acquisition and location information set
- Acquisition/processing constraints ancillary set
- Ancillary data generated by satellite set
- Housekeeping data generated by payload set
- Atmospheric vertical profiles: to characterize vertical distribution of atmospheric components
- Data bank of optical characteristics of atmospheric constituents: to calculate the radiative behaviour of the atmosphere above the observed scene
- LUT of RTM runs for different surface types and atmospheric loads: to invert the RTM
- Solar and lunar irradiance spectra: to estimate the incident radiance from space

Level 2c processing – Water Vapour Map
Step 4 - Processing for Water Vapour
The Water Vapour Map consists of column water vapour amounts over clear land areas of the globe, and above clouds over both land and ocean. Water vapour estimates are also made over extended oceanic areas with Sun glint. The retrieval relies on observations of water vapour attenuation of near-IR solar radiation reflected by surfaces and clouds. The product is produced only over areas that have reflective surfaces in the near-IR (Gao, Kaufman, MODIS ATBD).
Techniques employing ratios of water vapour absorbing channels centred 0.94 um with atmospheric window channels around 0.865 and 1.0 um are used. The ratios partially remove the effects of variation of surface reflectance with wavelengths and result in the atmospheric water vapour transmittances. The column water vapour amounts are derived from the transmittances based on theoretical radiative transfer calculations and using look-up table procedures.
The water vapour estimation is carried out separately on cloud free pixel and cloud covered pixel.

In order to perform Water vapour product generation the following ancillary and auxiliary data are specifically used:

- Product file information set
- Product acquisition and location information set
- Acquisition/processing constraints ancillary set
- Ancillary data generated by satellite set
- Housekeeping data generated by payload set
- Atmospheric vertical profiles: to characterize vertical distribution of atmospheric components
- Data bank of optical characteristics of atmospheric constituents: to calculate the radiative behaviour of the atmosphere above the observed scene
- LUT of RTM runs for different surface types and atmospheric loads: to invert the RTM
- Solar irradiance spectra: to estimate the incident radiance from space

Level 2c processing – Cloud Characterisation (COT)
Step 5 - Processing for cloud optical thickness
The determination of cloud optical thickness along with other parameters (such as effective particle) from spectral reflectance measurements represents an inverse problem and it is typically resolved by comparing the measured reflectance with entries in a lookup table and searching for the combination of parameters that gives the best fit. The look-up table is built by introducing in a radiative transfer code, a set of cloud parameters and calculating the corresponding reflectances (King, et al. 1997).
The processing requires information about the cloud mask and the land-water mask. According to different surfaces, different sensor channels are required:

- 0.645 µm for cloud optical thickness over land;
- 0.865 µm for cloud optical thickness over ocean;
- 1.24 µm for cloud optical thickness over snow and ice surfaces;
- 1.64 µm for snow/cloud discrimination; thermodynamic phase;
- 2.13 µm for cloud effective radius.

At this stage, also the viewing information are required. As indicated in the previous algorithm prior to the retrieval procedure, the atmospheric corrections for Rayleigh, water vapour and absorbing gases is performed on radiance data.

In order to perform COT product generation, the following ancillary and auxiliary data are specifically used:

- Product file information set
- Product acquisition and location information set
- Acquisition/processing constraints ancillary set
- Ancillary data generated by satellite set
- Housekeeping data generated by payload set
- Atmospheric vertical profiles: to characterize vertical distribution of atmospheric components
- Data bank of optical characteristics of atmospheric constituents: to calculate the radiative behaviour of the atmosphere above the observed scene
- LUT of RTM runs for different surface types and atmospheric loads: to invert the RTM
- Solar irradiance spectra: to estimate the incident radiance from space

Level 2c processing – Geolocated at-Surface Reflectance
Step 6 - Processing for atmospheric correction
In order to obtain the at-surface reflectance another step of the atmospheric correction is required.
The information retrieved and stacked in Level 2c Water Vapour Map and Aerosol Characterization are input to the radiative transfer model and performed the last atmospheric correction.
Radiances are converted to reflectances, using the Sun zenith angle cosine interpolated at the pixel and the Sun spectral flux read from the Level 1 product annotations.

The Level 2 c processing considers the quality checks performed at level 1 in order to select the pixels to be processed.

In order to perform Surface reflectance product generation the following ancillary and auxiliary data are specifically used:

- Product file information set
- Product acquisition and location information set
- Acquisition/processing constraints ancillary set
- Ancillary data generated by satellite set
- Housekeeping data generated by payload set
- Atmospheric vertical profiles: to characterize vertical distribution of atmospheric components

- Data bank of optical characteristics of atmospheric constituents: to calculate the radiative behaviour of the atmosphere above the observed scene
- LUT of RTM runs for different surface types and atmospheric loads: to invert the RTM
- Solar irradiance spectra: to estimate the incident radiance from space

Table 8-1: Summary of input-output products for the Level 2b-2c Data processing chain

Input	Step	Output
Level 1 VNIR/SWIR	**Step 1**: Atmospheric correction (Gaseous and Rayleigh Correction) **Step 2**: Geolocation	Intermediate radiance
Intermediate radiance	**Step 3**: Processing for AOT and Angstrom exponent	**Level 2c**: AOT, Angstrom exponent map
Intermediate radiance	**Step 4**: Processing for water vapour	**Level 2c**: water vapour map
Intermediate radiance	**Step 5**: Processing for cloud optical thickness	**Level 2c**: thin cloud optical thickness map
Level 2c: AOT, Angstrom exponent map **Level 2c**: water vapour map **Level 2c**: thin cloud optical thickness map	**Step 6**: Atmospheric corrections	**Level 2c**: at-surface reflectance / **Level 2b:** radiance

Level 2d processing – Geocoded Products
Step 7 – Geocoding
As final step of the processing chain there is the geocoding of the Level-2c products, called also orthorectification.

The orthorectification process foresees the correction of all image distortions caused by the collection geometry (this includes the optical sensor characteristics) and the variable terrain.
The topographical variations in the surface of the earth and the tilt of the satellite or sensor affects the distance with which features on the satellite are displayed. The more topographically diverse the landscape, the more distortion inherent in the photograph.
Image data acquired by satellite sensors are affected by systematic sensor, platform-induced geometry errors, thereby introducing terrain distortions when the Image sensor is not pointing directly at the Nadir location of the sensor.
Terrain displacement can be hundreds of meters. For example, if the satellite sensor acquires Image data over an area with a kilometer of vertical relief with the sensor having an elevation angle of 60° (30° from Nadir) the Image product will have nearly 600 meters of terrain displacement. Additional terrain displacement can result from errors in setting the reference elevation. For these reasons, the orthorectification is required

In order to perform image geocoding the following ancillary and auxiliary data are used:
- Product file information set
- Product acquisition and location information set
- Acquisition/processing constraints ancillary set
- DEM/DTM to project the image over the real Earth surface
- Geographic coordinates of scene centre
- Geolocation coefficients, to interpolate image pixels (image warping)
- Geographic coordinates derived by geolocation

The following metadata, annexed to level 2 product are specifically impacted by the geolocation step as described above:
- Geographic coordinates derived by geocoding set
- Image ground resolution in latitude and longitude direction
- UTM zone
- Quality flags

8.2 LEVEL 2B PRODUCT FORMAT DESCRIPTION

Each HDF5 file is composed according to a tree structure with the following format:

HDF5 (root).					
GlobalAttribute					
	INFO.				
		Ancillary[NPixelAlong] *copied from L1 product*			
			StarTracker1		
			StarTracker2		
			GyroData		
			PVSdata		
		Header			
	HDFEOS				
		SWATHS			
			GCP attributes		
			PRS_L2B_HCO		
				Data Fields	
				Geolocation Fields	
				Geometric Fields	
				Geocoding Model	
			PRS_L2B_PCO		
				Data Fields	
				Geolocation Fields	
				Geocoding Model	
	KDP_AUX				

8.2.1 GLOBAL ATTRIBUTES

The following table describes the structure of the global attributes relevant to the L2 b product.

Dataset Name	Type	Value/Units	Notes
Product_Name	String (H5T_NATIVE_CHAR)	“PRS_L2_L2B_<XXXX>_<YYYYMMDDhhmmss>_<YYYYMMDDhhmmss>_<XX>.he5”	
Product_ID	String (H5T_NATIVE_CHAR)	“PRS_L2B_STD”	
Processor_Name	String (H5T_NATIVE_CHAR)	“L2B”	Processor name as read from the JobOrder file
Processing_Level	String (HE5T_NATIVE_CHAR)	“2B”	
Processor_Version	String (H5T_NATIVE_CHAR)	XX.XX with X = 0..9	
Acquisition_Station	String (H5T_NATIVE_CHAR)		Copied from L1 input product
Processing_Station	String (H5T_NATIVE_CHAR)		Copied from L1 input product

Processing_Time	String (H5T_NATIVE_CHAR)	yyyy-mm-ddThh:mm:ss.uuuuuu	Creation date and time of the L2b Product in UTC Time format
Product_StartTime	String (H5T_NATIVE_CHAR)	yyyy-mm-ddThh:mm:ss.uuuuuu	UTC time of the first valid frame stored in the product (Copied from L1 input product)
Product_StopTime	String (H5T_NATIVE_CHAR)	yyyy-mm-ddThh:mm:ss.uuuuuu	UTC time of the last valid frame stored in the product (Copied from L1 input product)
Product_center_long	Float (HE5T_NATIVE_FLOAT)	Deg	Longitude of HYP image center
Product_center_lat	Float (HE5T_NATIVE_FLOAT)	Deg	Latitude of HYP image center
Product_ULcorner_long	Float (HE5T_NATIVE_FLOAT)	Deg	Longitude of HYP image Upper Left corner
Product_ULcorner_lat	Float (HE5T_NATIVE_FLOAT)	Deg	Latitude of HYP image Upper Left corner
Product_URcorner_long	Float (HE5T_NATIVE_FLOAT)	Deg	Longitude of HYP image Upper Right corner
Product_URcorner_lat	Float (HE5T_NATIVE_FLOAT)	Deg	Latitude of HYP image Upper Right corner
Product_LLcorner_long	Float (HE5T_NATIVE_FLOAT)	Deg	Longitude of HYP image Lower Left corner
Product_LLcorner_lat	Float (HE5T_NATIVE_FLOAT)	Deg	Latitude of HYP image Lower Left corner
Product_LRcorner_long	Float (HE5T_NATIVE_FLOAT)	Deg	Longitude of HYP image Lower Right corner
Product_LRcorner_lat	Float (HE5T_NATIVE_FLOAT)	Deg	Latitude of HYP image Lower Right corner
Integration_Time	Unsigned Long (H5T_NATIVE_ULONG)	seconds	Integration Time used for Hyperspectral Channel (Copied from L1 input product)
Sync_Time	Unsigned Long (H5T_NATIVE_ULONG)	seconds	Sync Time = Hyperspectral Frame Lasting Time (Copied from L1 input product)
PAN_Int_Time	Unsigned Long (H5T_NATIVE_ULONG)	seconds	Integration Time used for Pan Channel (Copied from L1 input product)
Pan_N_Int	Unsigned Short (H5T_NATIVE_USHORT)	1…6	Default N=6= number of pan-frames acquired during a Sync_Time. (Copied from L1 input product)
Frame_Type	String	"SURFACE OBSERVATION"	(Copied from L1 input product)
Num_Frames	Unsigned Short (H5T_NATIVE_USHORT)		Number of Hyperspectral VNIR and SWIR frames acquired in current L1 file (Copied from L1 input product)

Pan_Num_Frames	Unsigned Short (H5T_NATIVE_USHORT)		Number of PAN frames acquired in current L1 file (Copied from L1 input product)
VNIR_Corrupted_Frame_Percentage	String (H5T_NATIVE_CHAR)	"nn.nn %"	Percentage of corrupted frames on the total set of EO/EOS frames in the "nn.nn %" format. (Copied from L1 input product)
SWIR_Corrupted_Frame_Percentage	String (H5T_NATIVE_CHAR)	"nn.nn %"	Percentage of corrupted frames on the total set of EO/EOS frames in the "nn.nn %" format. (Copied from L1 input product)
PAN_Corrupted_Frame_Percentage	String (H5T_NATIVE_CHAR)	"nn.nn %"	Percentage of corrupted frames on the total set of EO/EOS frames in the "nn.nn %" format. (Copied from L1 input product)
Main_Electornic_Unit	Unsigned Short (H5T_NATIVE_USHORT)	0 = Main 1 = Redundant	Copied from L1 input product
Sun_zenith_angle	Float (HE5T_NATIVE_FLOAT)	Deg	Sun Zenith angle of the central pixel of the image Copied from L1 input product
Sun_azimuth_angle	Float (HE5T_NATIVE_FLOAT)	Deg	Sun azimuth angle of the central pixel of the image Copied from L1 input product
CUBE-INFO			
List_Cw_Vnir	Unsigned Short (HE5T_NATIVE_USHORT)	66 values	List of 66 Central Wavelenghs (nm) for the VNIR channel (Copied from L1 input product)
List_Fwhm_Vnir	Unsigned Short (HE5T_NATIVE_USHORT)	66 values	List of 66 band amplitude for the VNIR channel (Copied from L1 input product)
List_Cw_Swir	Unsigned Short (HE5T_NATIVE_USHORT)	173 values	List of 173 Central Wavelenghs (nm) for the SWIR channel (Copied from L1 input product)
List_Fwhm_Swir	Unsigned Short (HE5T_NATIVE_USHORT)	173 values	List of 173 band amplitude for the SWIR channel (Copied from L1 input product)
L2ScaleVnirMin	Float32		Scaling factor for VNIR cube in order to transform uint16 DN to radiances units [W/(m2+sr+um)] as follows: Radiance_f32 = L2ScaleVnirMin+DN_uint16*(L2ScaleVnirMax-L2ScaleVnirMin) /65535
L2ScaleVnirMax	Float32		Scaling factor for VNIR cube in order to transform uint16 DN to radiances units [W/(m2+sr+um)] as follows: Radiance_f32 = L2ScaleVnirMin+DN_uint16*(L2ScaleVnirMax-L2ScaleVnirMin) /65535

L2ScaleSwirMin	Float32		Scaling factor for SWIR cube in order to transform uint16 DN to radiances units [W/(m2+sr+um)] as follows: Radiance_f32 = L2ScaleSwirMin+DN_uint16*(L2ScaleSwirMax- L2ScaleSwirMin) /65535
L2ScaleSwirMax	Float32		Scaling factor for SWIR cube in order to transform uint16 DN to radiances units [W/(m2+sr+um)] as follows: Radiance_f32 = L2ScaleSwirMin+DN_uint16*(L2ScaleSwirMax- L2ScaleSwirMin) /65535
L2ScalePanMin	Float32		Scaling factor for PAN image in order to transform uint16 DN to radiances units [W/(m2+sr+um)] as follows: Radiance_f32 = L2ScalePanMin+DN_uint16*(L2ScalePanMax- L2ScalePanMin) /65535
L2ScalePanMax	Float32		Scaling factor for PAN image in order to transform uint16 DN to radiances units [W/(m2+sr+um)] as follows: Radiance_f32 = L2ScalePanMin+DN_uint16*(L2ScalePanMax- L2ScalePanMin) /65535
PAN_HYP_ACT_RESIDUAL_m	Float32		Additional information suitable for higher level processing (L2): it reports the measurement in meters of the Across track offset (meter distance computed using combination of frame and subframe)
PAN_HYP_ALT_RESIDUAL_m	Float 32		Additional information suitable for higher level processing (L2): it reports the measurement in meters of the Along track offset (meter distance computed using combination of frame and subframe)

PAN_HYP_START_SYNC_FRAME	Uint32		Applied number of PAN-HYP delay frames in the Along track direction to synch first HYP cube's line with first PAN cube's line. It's computed on the first frame of the 30km x 30km image `Applied in PAN-HYP coarse coregistration.`
PAN_HYP_START_SYNC_SUBFRAME	Uint32	[0, 5]	Applied number of PAN-HYP delay SUB-frames in the Along track direction to synch first HYP cube's line with first PAN cube's line. It's computed on the first frame of the 30km x 30km image. `Applied in PAN-HYP coarse coregistration.`
PAN_HYP_STOP_SYNC_FRAME	Uint32		Additional information suitable for higher level processing (L2): Number of PAN-HYP delay frames in the Along track direction to synch last HYP cube's line with last PAN cube's line. It's computed on the last frame of the 30km x 30km image `NOT applied in the PAN-HYP coarse coregistration.`
PAN_HYP_STOP_SYNC_SUBFRAME	Uint32	[0,5]	Additional information suitable for higher level processing (L2): number of PAN-HYP delay SUB-frames in the Along track direction to synch last HYP cube's line with last PAN cube's line. It's computed on the last frame of the 30km x 30km image. `NOT applied in the PAN-HYP coarse coregistratin.`
PAYLOAD BINNING INFO			

SWIR_HGRP	Unsigned Char (H5T_NATIVE_UCHAR)	1, 2 or 4	This attribute contains the information about the grouping (or spatial binning) in the SWIR channel. “1” means that no grouping is applied “2” means that each pixel contains the averaged value of two contiguous pixels in the across track direction “4” means that each pixel contains the averaged value of four contiguous pixels in the across track direction (Copied from L1 input product)
VNIR_HGRP	Unsigned Char (H5T_NATIVE_UCHAR)	1, 2 or 4	This attribute contains the information about the grouping (or spatial binning) in the VNIR channel. “1” means that no grouping is applied “2” means that each pixel contains the averaged value of two contiguous pixels in the across track direction “4” means that each pixel contains the averaged value of four contiguous pixels in the across track direction (Copied from L1 input product)
PAN_HGRP	Unsigned Char (H5T_NATIVE_UCHAR)	1, 2 or 4	This attribute contains the information about the grouping (or spatial binning) in the PAN channel. This information is contained in the Level 0 product. “1” means that no grouping is applied “2” means that each pixel contains the averaged value of two contiguous pixels in the across track direction “4” means that each pixel contains the averaged value of four contiguous pixels in the across track direction (Copied from L1 input product)
PAN_ACQ	Unsigned Char (H5T_NATIVE_UCHAR)	“1” if PAN channel is present in the telemetry. “0” in the contrary case.	(Copied from L1 input product)
SWIR_BNSTART	Unsigned Short (H5T_NATIVE_USHOR T)	Value between 0 and 255; if binning isn’t applied the SW-BNSTART = 255 and the SW-BNSTOP =0	Starting band for binning in the SWIR (Copied from L1 input product)
SWIR_BNSTOP	Unsigned Short (H5T_NATIVE_USHOR T)	Value between 0 and 255; if binning isn’t applied the SW-BNSTART = 255 and the SW-BNSTOP =0	Ending band for binning in the SWIR (Copied from L1 input product)

VNIR_BNSTART	Unsigned Short (H5T_NATIVE_USHORT)	Value between 0 and 255; if binning isn't applied the SW-BNSTART = 255 and the SW-BNSTOP =0	Starting band for binning in the VNIR (Copied from L1 input product)
VNIR_BNSTOP	Unsigned Short (H5T_NATIVE_USHORT)	Value between 0 and 255; if binning isn't applied the SW-BNSTART = 255 and the SW-BNSTOP =0	Ending band for binning in the VNIR (Copied from L1 input product)
SWIR_X	Unsigned Short (H5T_NATIVE_USHORT)	Vector of 256 elements: a "0" or "1" value for each spectral line that the on-board instrument can acquire in the SWIR channel	Editing Info in the SWIR channel (and of PE and SDAB editing info)
VNIR_X	Unsigned Short (H5T_NATIVE_USHORT)	Vector of 256 elements: a "0" or "1" value for each spectral line in the VNIR channel	Editing Info in the VNIR channel (and of PE and SDAB editing info)
PE_Gain_SWIR	Unsigned Short (H5T_NATIVE_USHORT)	Vector of 256 elements: a "0" or "1" value for each spectral line in the SWIR channel	
PE_Gain_VNIR	Unsigned Short (H5T_NATIVE_USHORT)	Vector of 256 elements: a "0" or "1" value for each spectral line in the VNIR channel	
END-USER BINNING INFO			
CNM_L2_HGRP	Unsigned Short (H5T_NATIVE_USHORT)	Value between 1 and 10 where 1 means no grouping	Spatial Grouping Factor Applied (Copied from L1 input product)
CNM_L2_BSEL_ON	Unsigned Short (H5T_NATIVE_USHORT)	"1" if Band Selection has been selected by the user in the Parameter file; "0" otherwise;	Flag indicating if Band Selection has been applied. Mutually exclusive with respect to binning operations (Copied from L1 input product)
CNM_L2_BIN_ON	Unsigned Short (H5T_NATIVE_USHORT)	"1" if Binning has been selected by the user in the Parameter file; "0" otherwise;	Flag indicating if Binning has been applied. Mutually exclusive with respect to band selection operations (Copied from L1 input product)
CNM_L2_BINNING	Unsigned Short (H5T_NATIVE_USHORT)	Value between 1 and 20 where 1 means no binning	Spectral Binning Factor Applied (Copied from L1 input product)
CNM_SWIR_ACQ	Unsigned Short (H5T_NATIVE_USHORT)	"1" if SWIR channel has been selected by the user in the Parameter file; "0" otherwise;	Flag indicating if SWIR channel has been selected by the user. (Copied from L1 input product)
CNM_VNIR_ACQ	Unsigned Short (H5T_NATIVE_USHORT)	"1" if VNIR channel has been selected by the user in the Parameter file; "0" otherwise;	Flag indicating if VNIR channel has been selected by the user. (Copied from L1 input product)
CNM_SWIR_SELECT	Unsigned Int (H5T_NATIVE_UINT)	Array of 176 values set to "1" or "0" if the corresponding SWIR band has been selected or not by the user;	(Copied from L1 input product)
CNM_VNIR_SELECT	Unsigned Int (H5T_NATIVE_UINT)	Array of 67 values set to "1" or "0" if the corresponding VNIR band has been selected or not by the user;	(Copied from L1 input product)

CNM_PAN_ACQ	Unsigned Short (H5T_NATIVE_USHORT)	"1" if PAN channel has been selected by the user in the Parameter file; "0" otherwise;	Flag indicating if PAN channel has been selected by the user. (Copied from L1 input product)
PRODUCT REPORT INFO			
Image_ID	Uint16		Identifier of the acquired image in the Acquisition Plan: it is retrieved from the Header Packet. (Copied from L1 input product)
ISF_ID_Start	Uint32		ID of the first ISF file associated to the current Image_ID: it is retrieved from the header packet. (Copied from L1 input product)
Number_of_ISF	Uint16		Number of ISF files contained in the current image: it is retrieved from the header packet. (Copied from L1 input product)
L1_Quality_CCPerc	Float 32		Percentage of clouds on the L1 image. (Copied from L1 input product)
L1_Quality_info	String		(Copied from L1 input product)
L1_Processor_Version	String		(Copied from L1 input product)
Exit_Code	Unsigned Char (H5T_NATIVE_UCHAR)	0=Ok 1=Warning 255= Error	According to CNM ICD
Prev_FKdp_File_Name	String (HE5T_NATIVE_CHAR)		Scene of Interest Info (SOI) (copied from L1)
Prev_Cdp_File_Name	String (HE5T_NATIVE_CHAR)		Scene of Interest Info (SOI) (copied from L1)
Prev_Gkdp_File_Name	String (HE5T_NATIVE_CHAR)		Scene of Interest Info (SOI) (copied from L1)
Soi_Prev_Dark_Calibration_L0aFile	String (HE5T_NATIVE_CHAR)		Scene of Interest Info (SOI) (copied from L1)
Soi_L0a_EO-EOS	String (HE5T_NATIVE_CHAR)		Scene of Interest Info (SOI) (copied from L1)
Soi_Post_Dark_Calibration_L0aFile	String (HE5T_NATIVE_CHAR)		Scene of Interest Info (SOI) (copied from L1)
Aux_SunEarthDistance	String (HE5T_NATIVE_CHAR)		Scene of Interest Info (SOI) (copied from L1)
Aux_SunIrradiance	String (HE5T_NATIVE_CHAR)		Scene of Interest Info (SOI) (copied from L1)
CORRUPTED FRAME LIST			

VNIRCorruptedFrameList	Unsigned Short (HE5T_NATIVE_USHORT)	Matrix of nHypAlongPixelx2	This Data Field contains information about the Corrupted Frames of the HYPER RC cube. It is a two-dimensional Data Field. The first dimension (i.e. number of lines of the matrix dataset) is given by the number of frames that compose the cube (nHypAlongPixel). The second dimension (i.e. number of column) is equal to 5: each column has a precise meaning which is explained in the attribute "Legend" of this Data Field "1st Column = 1 if the frame is corrupted 0 if the frame is ok. 2th Column = Damage *(1=corrupted frame, 2=missing frame) (copied from L1)
SWIRCorruptedFrameList	Unsigned Short (HE5T_NATIVE_USHORT)	Matrix of nHypAlongPixelx2	(copied from L1)
PANCorruptedFrameList	Unsigned Short (HE5T_NATIVE_USHORT)	Matrix of nPanAlongPixelx2	(copied from L1)
AUX DATA INFO			
DEM_info	String (HE5T_NATIVE_CHAR)	String of characters	String of 32 characters indicating the origin of DEM/DTM used in data processing
Atmo_profile_info	String (HE5T_NATIVE_CHAR)	String of characters	String of 32 characters indicating the origin of Atmospheric profiles data used in data processing, among {ATM_MIDLAT_SUMMER, ATM_TROPICAL, ATM_MIDLAT_WINTER}
Atm_Lut_version	String (HE5T_NATIVE_CHAR)	String of characters	String of 32 character indicating the current version of the RTM Look-Up table
Atm_LutGeomInfo_RelativeAzimuth	Unsigned Int (H5T_NATIVE_UINT)	Array of 2 values indicating the couple of Relative Azimuth Angles used to enter the RTM LUT for the current geometry	
Atm_LutGeomInfo_SunZenith	Unsigned Int (H5T_NATIVE_UINT)	Array of 2 values indicating the couple of Sun Zenith Angles used to enter the RTM LUT for the current geometry	
Atm_LutGeomInfo_ViewZenith	Unsigned Int (H5T_NATIVE_UINT)	Array of 2 values indicating the couple of View Zenith Angles used to enter the RTM LUT for the current geometry	
Atmo_RTM_info	String (HE5T_NATIVE_CHAR)	String of characters	String of 32 characters indicating the origin of Radiative transfer model used in data processing (e.g. "MODTRAN6")
GCP_info	String (HE5T_NATIVE_CHAR)	String of characters	String of 1 character indicating if GCPs have been used in data processing

QUALITY FLAGS			
L2b_Quality_flags	String (HE5T_NATIVE_CHAR)	String of characters	String of 3 chars, each one representing a flag with the following meaning: 0 NOK (quality check not passed, 1 OK quality check passed) Char[0] flag on cloud mask existence in the L1 product Char[1] flag on sea/land surface mask existence in the L1 product Char[2] flag on Sun Glint mask existence in the L1 product
Cloudy_pixels_percentage	Float (HE5T_NATIVE_FLOAT)	Percentage	It counts the percentage of cloudy sky pixels
Sea_pixels_percentage	Float (HE5T_NATIVE_FLOAT)	Percentage	It counts the percentage of sea pixels
Map_WV_accuracy	Float (HE5T_NATIVE_FLOAT)	Quality index	It quantifies the accuracy in the generation of WV map. It is expressed as the standard deviation of water vapor values for pixel marked as "Land" in Land Cover mask
Map_AOT_accuracy	Float (HE5T_NATIVE_FLOAT)	Quality index	It quantifies the accuracy in the generation of AOT map. It is expressed as the average minimization fitting error for not null pixel in AOT map

8.2.2 INFO.ANCILLARY

The following table describes the structure of the global attributes relevant to the L2 b product.
They are copied from the Level 1b data. See sec. 7.6.4 for attributes' information.

8.2.3 GEOCODING MODEL

This section describes the geocoding model used in the ortho-rectification of the L2d product. The adopted geocoding model is the Rational Polynomial Coefficients one: *RPC00B - Rapid Positioning Capability*, as defined in the National Imagery and Mapping Agency (NIMA) standard (see [RD-13]). Its detailed description has been reported in [RD-9].
This section is part of the product starting from L2b level on; it is added to product structure at the time the model is evaluated. Once the model is added its content it is no more updated in next processing levels.
Image coordinates are specified units of pixels; ground coordinates are latitude and longitude in units of decimal degrees and the geodetic elevation in units of meters. Ground coordinates are referenced to WGS-84.

Dataset Name	Type	Value/Units	Notes
Model_ID	String (H5T_NATIVE_CHAR)	RPC00B	
SUCCESS	Flag (H5T_NATIVE_SHORT)	1 / 0	RPC00B required field
ERR_BIAS	Float (H5T_NATIVE_FLOAT)	meters (0000.00 to 9999.99)	RPC00B required field
ERR_RAND	Float (H5T_NATIVE_FLOAT)	meters (0000.00 to 9999.99)	RPC00B required field
LINE_OFF	Int (H5T_NATIVE_SHORT)	samples (0000.00 to 9999.99)	RPC00B required field
SAMP_OFF	Int (H5T_NATIVE_SHORT)	pixels (0000.00 to 9999.99)	RPC00B required field
LAT_OFF	Float (H5T_NATIVE_FLOAT)	degrees (±90.0000)	RPC00B required field
LONG_OFF	Float (H5T_NATIVE_FLOAT)	degrees (±180.0000)	RPC00B required field
HEIGHT_OFF	Float (H5T_NATIVE_FLOAT)	meters (±9999)	RPC00B required field
LINE_SCALE	Float (H5T_NATIVE_FLOAT)	samples (000001 to 999999)	RPC00B required field
SAMP_SCALE	Float (H5T_NATIVE_FLOAT)	samples (000001 to 999999)	RPC00B required field
LAT_SCALE	Float (H5T_NATIVE_FLOAT)	degrees (±90.0000)	RPC00B required field
LONG_SCALE	Float (H5T_NATIVE_FLOAT)	degrees (±180.0000)	RPC00B required field
HEIGHT_SCALE	Float (H5T_NATIVE_FLOAT)	meters (±9999)	RPC00B required field
LINE_NUM_COEFF	Float array [20] (H5T_NATIVE_FLOAT)	±0.999999E±9 --- ±0.999999E±9	RPC00B required field

LINE_DEN_COEFF	Float array [20] (H5T_NATIVE_FLOAT)	±0.999999E±9 --- ±0.999999E±9	RPC00B required field
SAMP_NUM_COEFF	Float array [20] (H5T_NATIVE_FLOAT)	±0.999999E±9 --- ±0.999999E±9	RPC00B required field
SAMP_DEN_COEFF	Float array [20] (H5T_NATIVE_FLOAT)	±0.999999E±9 --- ±0.999999E±9	RPC00B required field

8.2.4 GCP ATTRIBUTES

This section will be present only in case GCPs are used in geocoding. It contains the information related to the GCP used for L2b product generation.

Dataset Name	Type	Value/Units	Notes
GCP_ID	String array [N] (H5T_NATIVE_CHAR)		The array contains the ID of the GCPs used for L2b product generation
GCP_LAT_DB	Float array [N] (H5T_NATIVE_FLOAT)		The array contains the latitude of the GCPs used for L2b product generation as provided by GCP-DB
GCP_LON_DB	Float array [N] (H5T_NATIVE_FLOAT)		The array contains the longitude of the GCPs used for L2b product generation as provided by GCP-DB
GCP_Validity	String array [N] (H5T_NATIVE_CHAR)		The array contains the validity of the GCPs used for L2b product generation
GCP_QP_DB	Float array [N] (H5T_NATIVE_FLOAT)		The array contains the Quality Parameter of the GCPs used for L2b product generation as provided by GCP-DB
GCP_LAT_RET	Float array [N] (H5T_NATIVE_FLOAT)		The array contains the latitude of the GCPs used for L2b product generation retrieved by the processor
GCP_LON_RET	Float array [N] (H5T_NATIVE_FLOAT)		The array contains the longitude of the GCPs used for L2b product generation retrieved by the processor
GCP_PLAN_ERROR	Float array [N] (H5T_NATIVE_FLOAT)	Meters	The array contains the planimetric errors of the retrived position of GCP.
GCP_Quality_PAR	Float array [N] (H5T_NATIVE_FLOAT)		The array contains the quality factor of the GCP computed during the L2b product generation

8.2.5 PRS_L2B_HCO SWATHS

The main data contained in the PRS_L2B_HCO Swath is the surface spectral radiance Coregistersed Hyperspectral Cube (in instrument geometric reference).
This section is part of the product starting from L2b level on; it is added to product structure at the time the model is evaluated. Once the model is added its content it is no more updated in next processing levels.Image coordinates are specified units of pixels; ground coordinates are latitude and longitude in units of decimal degrees and the geodetic elevation in units of meters. Ground coordinates are referenced to WGS-84.

Swath		Name	Type	Dimensions	Unit	Description
PRS_L2B_HCO	Data Fields	VNIR_Cube	Unsigned short (HE5T_NATIVE_USHORT)	nHypAcrossPixel, nBands, nHypAlongPixel, =BIL Format	Dimensionless (ratio)	Co-registered data in the Hyperspectral channels (VNIR) scaled to the range [0,65535]
		SWIR_Cube	Unsigned short (HE5T_NATIVE_USHORT)	nHypAcrossPixel, nBands, nHypAlongPixel, =BIL Format	Dimensionless (ratio)	Co-registered data in the Hyperspectral channels (SWIR) scaled to the range [0,65535]
		VNIR_PIXEL_L2_ERR_MATRIX	Unsigned Char (H5T_NATIVE_UCHAR)	nHypAcrossPixel nBandsVNIR, nHypAlongPixel	Enum 0=pixel ok 1=Invalid pixel from L1 product 2=Negative value after atmospheric correction 3=Saturated value after atmospheric correction	Mask that notifies if errors in pixel radiance processing has occurred. These are the values to be intended as a base. The actual values can be any combination of this base.
		SWIR_PIXEL_L2_ERR_MATRIX	Unsigned Char (H5T_NATIVE_UCHAR)	nHypAcrossPixel nBandsSWIR, nHypAlongPixel	Enum 0=pixel ok 1=Invalid pixel from L1 product 2=Negative value after atmospheric correction 3=Saturated value after atmospheric	Mask that notifies if errors in pixel radiance processing has occurred. These are the values to be intended as a base. The actual values can be any combination of this base
	Geolocation Fields	Time	Double (HE5T_NATIVE_DOUBLE)	nHypAlongPixel	MJD2000 Decimal days	UTC time for each frame in processing format (as read from L1 input product)
		Latitude	Float (HE5T_NATIVE_FLOAT)	nHypAcrossPixel, nHypAlongPixel	Deg [-90 to 90]	Latitude for each pixel in the co-registered Hyperspectral image
		Longitude	Float (HE5T_NATIVE_FLOAT)	nHypAcrossPixel, nHypAlongPixel	Deg [-180 to 180]	Longitude for each pixel in the co-registered Hyperspectral image

	Geometric Fields	Solar_Zenith_Angle	Float (HE5T_NATIVE_FLOAT)	nHypAcrossPixel, nHypAlongPixel	Deg [0 to 90]	Solar Zenith Angle for each pixel in the co-registered Hyperspectral image
		Observing_Angle	Float (HE5T_NATIVE_FLOAT)	nHypAcrossPixel, nHypAlongPixel	Deg [0 to 90]	Angle between the local zenith and the satellite viewing direction for each pixel in the co-registered Hyperspectral image
		Rel_Azimuth_Angle	Float (HE5T_NATIVE_FLOAT)	nHypAcrossPixel, nHypAlongPixel	Deg [0 to 180]	Relative Azimuth Angle computed as difference between the satellite and sun azimuth angle (i.e between observing direction and sun illumination direction) normalized in [0,180] for each pixel in the co-registered Hyperspectral image
	Geocoding Model	Model_ID	String (H5T_NATIVE_CHAR)	RPC00B		RPC00B required field
		SUCCESS	Flag (H5T_NATIVE_SHORT)	1 / 0		RPC00B required field
		ERR_BIAS	Float (H5T_NATIVE_FLOAT)	meters (0000.00 to 9999.99)		RPC00B required field
		ERR_RAND	Float (H5T_NATIVE_FLOAT)	meters (0000.00 to 9999.99)		RPC00B required field
		LINE_OFF	Float (H5T_NATIVE_SHORT)	samples (0000.00 to 9999.99)		RPC00B required field
		SAMP_OFF	Float (H5T_NATIVE_SHORT)	pixels (0000.00 to 9999.99)		RPC00B required field
		LAT_OFF	Float (H5T_NATIVE_FLOAT)	degrees (±90.0000)		RPC00B required field
		LONG_OFF	Float (H5T_NATIVE_FLOAT)	degrees (±180.0000)		RPC00B required field

		HEIGHT_OFF	Float (H5T_NATIVE_FLOAT)	meters (±9999)		RPC00B required field
		LINE_SCALE	Float (H5T_NATIVE_FLOAT)	samples (000001 to 999999)		RPC00B required field
		SAMP_SCALE	Float (H5T_NATIVE_FLOAT)	samples (000001 to 999999)		RPC00B required field
		LAT_SCALE	Float (H5T_NATIVE_FLOAT)	degrees (±90.0000)		RPC00B required field
		LONG_SCALE	Float (H5T_NATIVE_FLOAT)	degrees (±180.0000)		RPC00B required field
		HEIGHT_SCALE	Float (H5T_NATIVE_FLOAT)	meters (±9999)		RPC00B required field
		LINE_NUM_COEFF	Float array [20] (H5T_NATIVE_FLOAT)	±0.999999E±9 --- ±0.999999E±9		RPC00B required field
		LINE_DEN_COEFF	Float array [20] (H5T_NATIVE_FLOAT)	±0.999999E±9 --- ±0.999999E±9		RPC00B required field
		SAMP_NUM_COEFF	Float array [20] (H5T_NATIVE_FLOAT)	±0.999999E±9 --- ±0.999999E±9		RPC00B required field
		SAMP_DEN_COEFF	Float array [20] (H5T_NATIVE_FLOAT)	±0.999999E±9 --- ±0.999999E±9		

8.2.6 PRS_L2B_PCO SWATHS

The main data contained in the PRS_L2B_PCO Swath is the surface panchromatic reflectance image (in instrument geometric reference).

This section is part of the product starting from L2b level on; it is added to product structure at the time the model is evaluated. Once the model is added its content it is no more updated in next processing levels.

Image coordinates are specified units of pixels; ground coordinates are latitude and longitude in units of decimal degrees and the geodetic elevation in units of meters. Ground coordinates are referenced to WGS-84.

Swath		Name	Type	Dimensions	Unit	Description
PRS_L2B_PCO	Data Fields	Cube	Unsigned Short (HE5T_NATIVE_USHORT)	nPanAcrossPixel, nPanAlongPixel	Dimensionless (ratio)	Image data in the Panchromatic channel scaled to the range [0,65535]
		PIXEL_L2_ERR_MATRIX	Unsigned Char (H5T_NATIVE_UCHAR)	nPanAcrossPixel nPanAlongPixel	Enum 0=pixel ok 1=Invalid pixel from L1 product 2=Negative value after atmospheric correction 3=Saturated value after atmospheric correction	Mask that notifies if errors in pixel radiance processing has occurred. These are the values to be intended as a base. The actual values can be any combination of this base.

	Geolocation Fields	Time	Double (HE5T_NATIVE_DOUBLE)	nPanAlongPixel	MJD2000 Decimal days	UTC time for each frame in processing format (as read from L1 input product)
		Latitude	Float (HE5T_NATIVE_FLOAT)	nPanAcrossPixel, nPanAlongPixel	Deg [-90 to 90]	Latitude for each pixel in the co-registered Panchromatic image
		Longitude	Float (HE5T_NATIVE_FLOAT)	nPanAcrossPixel, nPanAlongPixel	Deg [-180 to 180]	Longitude for each pixel in the co-registered Panchromatic image (
	Geocoding Model	Model_ID	String (H5T_NATIVE_CHAR)	RPC00B		RPC00B required field
		SUCCESS	Flag (H5T_NATIVE_SHORT)	1 / 0		RPC00B required field
		ERR_BIAS	Float (H5T_NATIVE_FLOAT)	meters (0000.00 to 9999.99)		RPC00B required field
		ERR_RAND	Float (H5T_NATIVE_FLOAT)	meters (0000.00 to 9999.99)		RPC00B required field
		LINE_OFF	Float (H5T_NATIVE_SHORT)	samples (0000.00 to 9999.99)		RPC00B required field
		SAMP_OFF	Float (H5T_NATIVE_SHORT)	pixels (0000.00 to 9999.99)		RPC00B required field
		LAT_OFF	Float (H5T_NATIVE_FLOAT)	degrees (±90.0000)		RPC00B required field
		LONG_OFF	Float (H5T_NATIVE_FLOAT)	degrees (±180.0000)		RPC00B required field
		HEIGHT_OFF	Float (H5T_NATIVE_FLOAT)	meters (±9999)		RPC00B required field
		LINE_SCALE	Float (H5T_NATIVE_FLOAT)	samples (000001 to 999999)		RPC00B required field
		SAMP_SCALE	Float (H5T_NATIVE_FLOAT)	samples (000001 to 999999)		RPC00B required field
		LAT_SCALE	Float (H5T_NATIVE_FLOAT)	degrees (±90.0000)		RPC00B required field
		LONG_SCALE	Float (H5T_NATIVE_FLOAT)	degrees (±180.0000)		RPC00B required field
		HEIGHT_SCALE	Float (H5T_NATIVE_FLOAT)	meters (±9999)		RPC00B required field
		LINE_NUM_COEFF	Float array [20] (H5T_NATIVE_FLOAT)	±0.999999E±9 ---±0.999999E±9		RPC00B required field
		LINE_DEN_COEFF	Float array [20] (H5T_NATIVE_FLOAT)	±0.999999E±9 ---±0.999999E±9		RPC00B required field
		SAMP_NUM_COEFF	Float array [20] (H5T_NATIVE_FLOAT)	±0.999999E±9 ---±0.999999E±9		RPC00B required field
		SAMP_DEN_COEFF	Float array [20] (H5T_NATIVE_FLOAT)	±0.999999E±9 ---±0.999999E±9		

8.2.7 KDP_AUX

This section contains the vector of LOS, and the matrix of CW and FWHM extracted form KDP by interpolation of them according to the temperature of the optical bench associated to the current L1 product. They are copied from the Level 1b product with the following structure:

HDF5 (root).	Group	Dataset
	KDP_AUX	Cw_Swir_Matrix
		Cw_Vnir_Matrix
		Fwhm_Swir_Matrix
		Fwhm_Vnir_Matrix
		LOS_Pan
		LOS_Swir
		LOS_Vnir

See Section 7.6.5 for detailed information.

8.3 LEVEL 2C PRODUCT FORMAT DESCRIPTION

Each HDF5 file is composed according to a tree structure with the following format:

HDF5 (root).					
GlobalAttribute					
	INFO.				
		Ancillary[NPixelAlong] *as per copy from L1 product*			
			StarTracker1		
			StarTracker2		
			GyroData		
			PVSdata		
		Header			
	HDFEOS				
		SWATHS			
			GCP attributes		
			PRS_L2C_HCO		
				Data Fields	
				Geolocation Fields	
				Geometric Fields	
				Geocoding Model	
			PRS_L2C_PCO		
				Data Fields	
				Geolocation Fields	
				Geocoding Model	
			PRS_L2C_AOT		
				Data Fields	
				Geolocation Fields	

			PRS_L2C_AEX		
				Data Fields	
				Geolocation Fields	
			PRS_L2C_WVM		
				Data Fields	
				Geolocation Fields	
			PRS_L2C_COT		
				Data Fields	
				Geolocation Fields	
	KDP_AUX				

8.3.1 GLOBAL ATTRIBUTES

The following table describes the structure of the global attributes relevant to the L2 b product.

Dataset Name	Type	Value/Units	Notes
Product_Name	String (H5T_NATIVE_CHAR)	"PRS_L2_L2C_<XXXX>_<YYYYYMMDDhhmmss>_<YYYYMMDDhhmmss>_<XX>.he5"	
Product_ID	String (H5T_NATIVE_CHAR)	" PRS_L2C_STD"	
Processor_Name	String (H5T_NATIVE_CHAR)	"L2C"	Processor name as read from the JobOrder file
Processing_Level	String (HE5T_NATIVE_CHAR)	"2C"	
Processor_Version	String (H5T_NATIVE_CHAR)	XX.XX with X = 0..9	
Acquisition_Station	String (H5T_NATIVE_CHAR)		Copied from L1 input product
Processing_Station	String (H5T_NATIVE_CHAR)		Copied from L1 input product
Processing_Time	String (H5T_NATIVE_CHAR)	yyyy-mm-ddThh:mm:ss.uuuuuu	Creation date and time of the L2c Product in UTC Time format
Product_StartTime	String (H5T_NATIVE_CHAR)	yyyy-mm-ddThh:mm:ss.uuuuuu	UTC time of the first valid frame stored in the product (Copied from L1 input product)
Product_StopTime	String (H5T_NATIVE_CHAR)	yyyy-mm-ddThh:mm:ss.uuuuuu	UTC time of the last valid frame stored in the product (Copied from L1 input product)
Product_center_long	Float (HE5T_NATIVE_FLOAT)	Deg	Longitude of HYP image center
Product_center_lat	Float (HE5T_NATIVE_FLOAT)	Deg	Latitude of HYP image center
Product_ULcorner_long	Float (HE5T_NATIVE_FLOAT)	Deg	Longitude of HYP image Upper Left corner
Product_ULcorner_lat	Float (HE5T_NATIVE_FLOAT)	Deg	Latitude of HYP image Upper Left corner

Product_URcorner_long	Float (HE5T_NATIVE_FLOAT)	Deg	Longitude of HYP image Upper Right corner
Product_URcorner_lat	Float (HE5T_NATIVE_FLOAT)	Deg	Latitude of HYP image Upper Right corner
Product_LLcorner_long	Float (HE5T_NATIVE_FLOAT)	Deg	Longitude of HYP image Lower Left corner
Product_LLcorner_lat	Float (HE5T_NATIVE_FLOAT)	Deg	Latitude of HYP image Lower Left corner
Product_LRcorner_long	Float (HE5T_NATIVE_FLOAT)	Deg	Longitude of HYP image Lower Right corner
Product_LRcorner_lat	Float (HE5T_NATIVE_FLOAT)	Deg	Latitude of HYP image Lower Right corner
Integration_Time	Unsigned Long (H5T_NATIVE_ULONG)	seconds	Integration Time used for Hyperspectral Channel (Copied from L1 input product)
Sync_Time	Unsigned Long (H5T_NATIVE_ULONG)	seconds	Sync Time = Hyperspectral Frame Lasting Time (Copied from L1 input product)
PAN_Int_Time	Unsigned Long (H5T_NATIVE_ULONG)	seconds	Integration Time used for Pan Channel (Copied from L1 input product)
Pan_N_Int	Unsigned Short (H5T_NATIVE_USHORT)	1…6	Default N=6= number of pan-frames acquired during a Sync_Time. (Copied from L1 input product)
Frame_Type	String	“SURFACE OBSERVATION”	(Copied from L1 input product)
Num_Frames	Unsigned Short (H5T_NATIVE_USHORT)		Number of Hyperspectral VNIR and SWIR frames acquired in current L1 file (Copied from L1 input product)
Pan_Num_Frames	Unsigned Short (H5T_NATIVE_USHORT)		Number of PAN frames acquired in current L1 file (Copied from L1 input product)
VNIR_Corrupted_Frame_Percentage	String (H5T_NATIVE_CHAR)	“nn.nn %”	Percentage of corrupted frames on the total set of EO/EOS frames in the “nn.nn %” format. (Copied from L1 input product)
SWIR_Corrupted_Frame_Percentage	String (H5T_NATIVE_CHAR)	“nn.nn %”	Percentage of corrupted frames on the total set of EO/EOS frames in the “nn.nn %” format. (Copied from L1 input product)
PAN_Corrupted_Frame_Percentage	String (H5T_NATIVE_CHAR)	“nn.nn %”	Percentage of corrupted frames on the total set of EO/EOS frames in the “nn.nn %” format. (Copied from L1 input product)
Main_Electornic_Unit	Unsigned Short (H5T_NATIVE_USHORT)	0 = Main 1 = Redundant	Copied from L1 input product
Sun_zenith_angle	Float (HE5T_NATIVE_FLOAT)	Deg	Sun Zenith angle of the central pixel of the image Copied from L1 input product
Sun_azimuth_angle	Float (HE5T_NATIVE_FLOAT)	Deg	Sun azimuth angle of the central pixel of the image Copied from L1 input product
CUBE-INFO			

List_Cw_Vnir	Unsigned Short (HE5T_NATIVE_USHORT)	66 values	List of 66 Central Wavelenghs (nm) for the VNIR channel (Copied from L1 input product)
List_Fwhm_Vnir	Unsigned Short (HE5T_NATIVE_USHORT)	66 values	List of 66 band amplitude for the VNIR channel (Copied from L1 input product)
List_Cw_Swir	Unsigned Short (HE5T_NATIVE_USHORT)	173 values	List of 173 Central Wavelenghs (nm) for the SWIR channel (Copied from L1 input product)
List_Fwhm_Swir	Unsigned Short (HE5T_NATIVE_USHORT)	173 values	List of 173 band amplitude for the SWIR channel (Copied from L1 input product)
L2ScaleVnirMin	Float32		Scaling factor for VNIR cube in order to transform uint16 DN to reflectance units as follows: Reflectance_f32 = L2ScaleVnirMin+DN_uint16*(L2ScaleVnirMax-L2ScaleVnirMin) /65535
L2ScaleVnirMax	Float32		Scaling factor for VNIR cube in order to transform uint16 DN to reflectance units as follows: Reflectance_f32 = L2ScaleVnirMin+DN_uint16*(L2ScaleVnirMax-L2ScaleVnirMin) /65535
L2ScaleSwirMin	Float32		Scaling factor for SWIR cube in order to transform uint16 DN to reflectance units as follows: Reflectance_f32 = L2ScaleSwirMin+DN_uint16*(L2ScaleSwirMax-L2ScaleSwirMin) /65535
L2ScaleSwirMax	Float32		Scaling factor for SWIR cube in order to transform uint16 DN to reflectance units as follows: Reflectance_f32 = L2ScaleSwirMin+DN_uint16*(L2ScaleSwirMax-L2ScaleSwirMin) /65535
L2ScalePanMin	Float32		Scaling factor for PAN image in order to transform uint16 DN to reflectance units as follows: Reflectance_f32 = L2ScalePanMin+DN_uint16*(L2ScalePanMax-L2ScalePanMin) /65535
L2ScalePanMax	Float32		Scaling factor for PAN image in order to transform uint16 DN to reflectance units as follows: Reflectance_f32 = L2ScalePanMin+DN_uint16*(L2ScalePanMax-L2ScalePanMin) /65535

L2ScaleWVMMin	Float32		Scaling factor for Water Vapor Map in order to transform uint16 DN to units [g/cm2] as follows: wvm_f32 = L2ScaleWVMMin+DN_uint16*(L2ScaleWVMMax-L2ScaleWVMMin)/65535
L2ScaleWVMMax	Float32		Scaling factor for Water Vapor Map in order to transform uint16 DN to units [g/cm2] as follows: wvm_f32 = L2ScaleWVMMin+DN_uint16*(L2ScaleWVMMax-L2ScaleWVMMin)/65535
L2ScaleAOTMin	Float32		Scaling factor for Aerosol Optical Thikcness Map in order to transform uint16 DN to operational units as follows: aot_f32 = L2ScaleAOTMin+DN_uint16*(L2ScaleAOTMax-L2ScaleAOTMin)/65535
L2ScaleAOTMax	Float32		Scaling factor for Aerosol Optical Thikcness Map in order to transform uint16 DN to operational units as follows: aot_f32 = L2ScaleAOTMin+DN_uint16*(L2ScaleAOTMax-L2ScaleAOTMin)/65535
L2ScaleAEXMin	Float32		Scaling factor for Angstrom Exponent Map in order to transform uint16 DN to operational units as follows: aot_f32 = L2ScaleAEXMin+DN_uint16*(L2ScaleAEXMax-L2ScaleAEXMin)/65535
L2ScaleAEXMax	Float32		Scaling factor for Angstrom Exponent Map in order to transform uint16 DN to operational units as follows: aot_f32 = L2ScaleAEXMin+DN_uint16*(L2ScaleAEXMax-L2ScaleAEXMin)/65535

L2ScaleCOTMin	Float32		Scaling factor for Cloud Optical Thockness Map in order to transform uint16 DN to operational units as follows: cot_f32 = L2ScaleCOTMin+DN_uint16*(L2ScaleCOTMax-L2ScaleCOTMin)/65535
L2ScaleCOTMax	Float32		Scaling factor for Cloud Optical Thockness Map in order to transform uint16 DN to operational units as follows: cot_f32 = L2ScaleCOTMin+DN_uint16*(L2ScaleCOTMax-L2ScaleCOTMin)/65535
PAN_HYP_ACT_RESIDUAL_m	Float32		Additional information suitable for higher level processing (L2): it reports the measurement in meters of the Across track offset (meter distance computed using combination of frame and subframe)
PAN_HYP_ALT_RESIDUAL_m	Float 32		Additional information suitable for higher level processing (L2): it reports the measurement in meters of the Along track offset (meter distance computed using combination of frame and subframe) (Copied from L1 input product)
PAN_HYP_START_SYNC_FRAME	Uint32		Applied number of PAN-HYP delay frames in the Along track direction to synch first HYP cube's line with first PAN cube's line. It's computed on the first frame of the 30km x 30km image Applied in PAN-HYP coarse coregistration. (Copied from L1 input product)
PAN_HYP_START_SYNC_SUBFRAME	Uint32	[0, 5]	Applied number of PAN-HYP delay SUB-frames in the Along track direction to synch first HYP cube's line with first PAN cube's line. It's computed on the first frame of the 30km x 30km image. Applied in PAN-HYP coarse coregistration. (Copied from L1 input product)

PAN_HYP_STOP_SYNC_FRAME	Uint32		Additional information suitable for higher level processing (L2): Number of PAN-HYP delay frames in the Along track direction to synch last HYP cube's line with last PAN cube's line. It's computed on the last frame of the 30km x 30km image `NOT applied in the PAN-HYP coarse coregistration. (Copied from L1 input product)`
PAN_HYP_STOP_SYNC_SUBFRAME	Uint32	[0,5]	Additional information suitable for higher level processing (L2): number of PAN-HYP delay SUB-frames in the Along track direction to synch last HYP cube's line with last PAN cube's line. It's computed on the last frame of the 30km x 30km image. `NOT applied in the PAN-HYP coarse coregistratin. (Copied from L1 input product)`
PAYLOAD BINNING INFO			
SWIR_HGRP	Unsigned Char (H5T_NATIVE_UCHAR)	1, 2 or 4	This attribute contains the information about the grouping (or spatial binning) in the SWIR channel. "1" means that no grouping is applied "2" means that each pixel contains the averaged value of two contiguous pixels in the across track direction "4" means that each pixel contains the averaged value of four contiguous pixels in the across track direction (Copied from L1 input product)
VNIR_HGRP	Unsigned Char (H5T_NATIVE_UCHAR)	1, 2 or 4	This attribute contains the information about the grouping (or spatial binning) in the VNIR channel. "1" means that no grouping is applied "2" means that each pixel contains the averaged value of two contiguous pixels in the across track direction "4" means that each pixel contains the averaged value of four contiguous pixels in the across track direction (Copied from L1 input product)

PAN_HGRP	Unsigned Char (H5T_NATIVE_UCHAR)	1, 2 or 4	This attribute contains the information about the grouping (or spatial binning) in the PAN channel. This information is contained in the Level 0 product. “1” means that no grouping is applied “2” means that each pixel contains the averaged value of two contiguous pixels in the across track direction “4” means that each pixel contains the averaged value of four contiguous pixels in the across track direction (Copied from L1 input product)
PAN_ACQ	Unsigned Char (H5T_NATIVE_UCHAR)	“1” if PAN channel is present in the telemetry. “0” in the contrary case.	(Copied from L1 input product)
SWIR_BNSTART	Unsigned Short (H5T_NATIVE_USHOR T)	Value between 0 and 255; if binning isn’t applied the SW-BNSTART = 255 and the SW-BNSTOP =0	Starting band for binning in the SWIR (Copied from L1 input product)
SWIR_BNSTOP	Unsigned Short (H5T_NATIVE_USHOR T)	Value between 0 and 255; if binning isn’t applied the SW-BNSTART = 255 and the SW-BNSTOP =0	Ending band for binning in the SWIR (Copied from L1 input product)
VNIR_BNSTART	Unsigned Short (H5T_NATIVE_USHOR T)	Value between 0 and 255; if binning isn’t applied the SW-BNSTART = 255 and the SW-BNSTOP =0	Starting band for binning in the VNIR (Copied from L1 input product)
VNIR_BNSTOP	Unsigned Short (H5T_NATIVE_USHOR T)	Value between 0 and 255; if binning isn’t applied the SW-BNSTART = 255 and the SW-BNSTOP =0	Ending band for binning in the VNIR (Copied from L1 input product)
SWIR_X	Unsigned Short (H5T_NATIVE_USHOR T)	Vector of 256 elements: a “0” or “1” value for each spectral line that the on-board instrument can acquire in the SWIR channel	Editing Info in the SWIR channel (and of PE and SDAB editing info) (Copied from L1 input product)
VNIR_X	Unsigned Short (H5T_NATIVE_USHOR T)	Vector of 256 elements: a “0” or “1” value for each spectral line in the VNIR channel	Editing Info in the VNIR channel (and of PE and SDAB editing info) (Copied from L1 input product)
PE_Gain_SWIR	Unsigned Short (H5T_NATIVE_USHOR T)	Vector of 256 elements: a “0” or “1” value for each spectral line in the SWIR channel	(Copied from L1 input product)
PE_Gain_VNIR	Unsigned Short (H5T_NATIVE_USHOR T)	Vector of 256 elements: a “0” or “1” value for each spectral line in the VNIR channel	(Copied from L1 input product)
END-USER BINNING INFO			
CNM_L2_HGRP	Unsigned Short (H5T_NATIVE_USHOR T)	Value between 1 and 10 where 1 means no grouping	Spatial Grouping Factor Applied (Copied from L1 input product)

CNM_L2_BSEL_ON	Unsigned Short (H5T_NATIVE_USHORT)	"1" if Band Selection has been selected by the user in the Parameter file; "0" otherwise;	Flag indicating if Band Selection has been applied. Mutually exclusive with respect to binning operations (Copied from L1 input product)
CNM_L2_BIN_ON	Unsigned Short (H5T_NATIVE_USHORT)	"1" if Binning has been selected by the user in the Parameter file; "0" otherwise;	Flag indicating if Binning has been applied. Mutually exclusive with respect to band selection operations (Copied from L1 input product)
CNM_L2_BINNING	Unsigned Short (H5T_NATIVE_USHORT)	Value between 1 and 20 where 1 means no binning	Spectral Binning Factor Applied (Copied from L1 input product)
CNM_SWIR_ACQ	Unsigned Short (H5T_NATIVE_USHORT)	"1" if SWIR channel has been selected by the user in the Parameter file; "0" otherwise;	Flag indicating if SWIR channel has been selected by the user. (Copied from L1 input product)
CNM_VNIR_ACQ	Unsigned Short (H5T_NATIVE_USHORT)	"1" if VNIR channel has been selected by the user in the Parameter file; "0" otherwise;	Flag indicating if VNIR channel has been selected by the user. (Copied from L1 input product)
CNM_SWIR_SELECT	Unsigned Int (H5T_NATIVE_UINT)	Array of 176 values set to "1" or "0" if the corresponding SWIR band has been selected or not by the user;	(Copied from L1 input product)
CNM_VNIR_SELECT	Unsigned Int (H5T_NATIVE_UINT)	Array of 67 values set to "1" or "0" if the corresponding VNIR band has been selected or not by the user;	(Copied from L1 input product)
CNM_PAN_ACQ	Unsigned Short (H5T_NATIVE_USHORT)	"1" if PAN channel has been selected by the user in the Parameter file; "0" otherwise;	Flag indicating if PAN channel has been selected by the user. (Copied from L1 input product)
PRODUCT REPORT INFO			
Image_ID	Uint16		Identifier of the acquired image in the Acquisition Plan: it is retrieved from the Header Packet. (Copied from L1 input product)
ISF_ID_Start	Uint32		ID of the first ISF file associated to the current Image_ID: it is retrieved from the header packet. (Copied from L1 input product)
Number_of_ISF	Uint16		Number of ISF files contained in the current image: it is retrieved from the header packet. (Copied from L1 input product)
L1_Quality_CCPerc	Float 32		Percentage of clouds on the L1 image.
L1_Quality_info	String		(Copied from L1 input product)
L1_Processor_Version	String		(Copied from L1 input product)
Exit_Code	Unsigned Char (H5T_NATIVE_UCHAR)	0=Ok 1=Warning 255= Error	According to CNM ICD
Prev_FKdp_File_Name	String (HE5T_NATIVE_CHAR)		Scene of Interest Info (SOI) (Copied from L1 input product)
Prev_Cdp_File_Name	String (HE5T_NATIVE_CHAR)		Scene of Interest Info (SOI) (Copied from L1 input product)
Prev_Gkdp_File_Name	String (HE5T_NATIVE_CHAR)		Scene of Interest Info (SOI) (Copied from L1 input product)

Soi_Prev_Dark_Calibration_L0aFile	String (HE5T_NATIVE_CHAR)		Scene of Interest Info (SOI) (Copied from L1 input product)
Soi_L0a_EO-EOS	String (HE5T_NATIVE_CHAR)		Scene of Interest Info (SOI) (Copied from L1 input product)
Soi_Post_Dark_Calibration_L0aFile	String (HE5T_NATIVE_CHAR)		Scene of Interest Info (SOI) (Copied from L1 input product)
Aux_SunEarthDistance	String (HE5T_NATIVE_CHAR)		Scene of Interest Info (SOI) (Copied from L1 input product)
Aux_SunIrradiance	String (HE5T_NATIVE_CHAR)		Scene of Interest Info (SOI) (Copied from L1 input product)
CORRUPTED FRAME LIST			
VNIRCorruptedFrameList	Unsigned Short (HE5T_NATIVE_USHORT)	Matrix of nHypAlongPixelx2	This Data Field contains information about the Corrupted Frames of the HYPER RC cube. It is a two-dimensional Data Field. The first dimension (i.e. number of lines of the matrix dataset) is given by the number of frames that compose the cube (nHypAlongPixel). The second dimension (i.e. number of column) is equal to 5: each column has a precise meaning which is explained in the attribute “Legend” of this Data Field “1st Column = 1 if the frame is corrupted 0 if the frame is ok. 2th Column = Damage *(1=corrupted frame, 2=missing frame) (Copied from L1 input product)
SWIRCorruptedFrameList	Unsigned Short (HE5T_NATIVE_USHORT)	Matrix of nHypAlongPixelx2	(Copied from L1 input product)
PANCorruptedFrameList	Unsigned Short (HE5T_NATIVE_USHORT)	Matrix of nPanAlongPixelx2	(Copied from L1 input product)
AUX DATA INFO			
DEM_info	String (HE5T_NATIVE_CHAR)	String of characters	String of 32 characters indicating the origin of DEM/DTM used in data processing
Atmo_profile_info	String (HE5T_NATIVE_CHAR)	String of characters	String of 32 characters indicating the origin of Atmospheric profiles data used in data processing, among. {ATM_MIDLAT_SUMMER, ATM_TROPICAL, ATM_MIDLAT_WINTER}
Atm_Lut_version	String (HE5T_NATIVE_CHAR)	String of characters	String of 32 character indicating the current version of the RTM Look-Up table
Atm_LutGeomInfo_RelativeAzimuth	Unsigned Int (H5T_NATIVE_UINT)	Array of 2 values indicating the couple of Relative Azimuth Angles used to enter the RTM LUT for the current geometry	
Atm_LutGeomInfo_SunZenith	Unsigned Int (H5T_NATIVE_UINT)	Array of 2 values indicating the couple of Sun Zenith Angles used to enter the RTM LUT for the current geometry	

Atm_LutGeomInfo_ViewZenith	Unsigned Int (H5T_NATIVE_UINT)	Array of 2 values indicating the couple of View Zenith Angles used to enter the RTM LUT for the current geometry	
Atmo_RTM_info	String (HE5T_NATIVE_CHAR)	String of characters	String of 32 characters indicating the origin of Radiative transfer model used in data processing (e.g. "MODTRAN6")
GCP_info	String (HE5T_NATIVE_CHAR)	String of characters	String of 1 character indicating if GCPs have been used in data processing
QUALITY FLAGS			
L2c_Quality_flags	String (HE5T_NATIVE_CHAR)	String of characters	String of 3 chars, each one representing a flag with the following meaning: 0 NOK (quality check not passed, 1 OK quality check passed) Char[0] flag on cloud mask existence in the L1 product Char[1] flag on sea/land surface mask existence in the L1 product Char[2] flag on Sun Glint mask existence in the L1 product
Cloudy_pixels_percentage	Float (HE5T_NATIVE_FLOAT)	Percentage	It counts the percentage of cloudy sky pixels
Sea_pixels_percentage	Float (HE5T_NATIVE_FLOAT)	Percentage	It counts the percentage of sea pixels
Map_WV_accuracy	Float (HE5T_NATIVE_FLOAT)	Quality index	It quantifies the accuracy in the generation of WV map. It is expressed as the standard deviation of water vapor values for pixel marked as "Land" in Land Cover mask
Map_AOT_accuracy	Float (HE5T_NATIVE_FLOAT)	Quality index	It quantifies the accuracy in the generation of AOT map. It is expressed as the average minimization fitting error for not null pixel in AOT map
Map_COT_accuracy	Float (HE5T_NATIVE_FLOAT)	Quality index	It quantifies the accuracy in the generation of COT map. It is expressed as the average residual of not null pixels in COT map
Map_AEX_accuracy	Float (HE5T_NATIVE_FLOAT)	Quality index	It quantifies the accuracy in the generation of AEX map. It is expressed as the standard deviation of Angstrom Exponent values for not null pixel in AEX map

8.3.2 INFO.ANCILLARY

The following table describes the structure of the global attributes relevant to the L2 b product.
They are copied from the Level 1b data. See sec. 7.6.3 for attributes' information.

8.3.3 GEOCODING MODEL

This section describes the geocoding model used in the ortho-rectification of the L2d product. The adopted geocoding model is the Rational Polynomial Coefficients one: *RPC00B - Rapid Positioning Capability*, as defined in the National Imagery and Mapping Agency (NIMA) standard (see [RD-13]). Its detailed description has been reported in [RD-9].
This section is part of the product starting from L2b level on; it is added to product structure at the time the model is evaluated. Once the model is added its content it is no more updated in next processing levels.

Image coordinates are specified units of pixels; ground coordinates are latitude and longitude in units of decimal degrees and the geodetic elevation in units of meters. Ground coordinates are referenced to WGS-84.

Dataset Name	Type	Value/Units	Notes
Model_ID	String (H5T_NATIVE_CHAR)	RPC00B	
SUCCESS	Flag (H5T_NATIVE_SHORT)	1 / 0	RPC00B required field
ERR_BIAS	Float (H5T_NATIVE_FLOAT)	meters (0000.00 to 9999.99)	RPC00B required field
ERR_RAND	Float (H5T_NATIVE_FLOAT)	meters (0000.00 to 9999.99)	RPC00B required field
LINE_OFF	Int (H5T_NATIVE_SHORT)	samples (0000.00 to 9999.99)	RPC00B required field
SAMP_OFF	Int (H5T_NATIVE_SHORT)	pixels (0000.00 to 9999.99)	RPC00B required field
LAT_OFF	Float (H5T_NATIVE_FLOAT)	degrees (±90.0000)	RPC00B required field
LONG_OFF	Float (H5T_NATIVE_FLOAT)	degrees (±180.0000)	RPC00B required field
HEIGHT_OFF	Float (H5T_NATIVE_FLOAT)	meters (±9999)	RPC00B required field
LINE_SCALE	Float (H5T_NATIVE_FLOAT)	samples (000001 to 999999)	RPC00B required field
SAMP_SCALE	Float (H5T_NATIVE_FLOAT)	samples (000001 to 999999)	RPC00B required field
LAT_SCALE	Float (H5T_NATIVE_FLOAT)	degrees (±90.0000)	RPC00B required field
LONG_SCALE	Float (H5T_NATIVE_FLOAT)	degrees (±180.0000)	RPC00B required field
HEIGHT_SCALE	Float (H5T_NATIVE_FLOAT)	meters (±9999)	RPC00B required field
LINE_NUM_COEFF	Float array [20] (H5T_NATIVE_FLOAT)	±0.999999E±9 --- ±0.999999E±9	RPC00B required field

LINE_DEN_COEFF	Float array [20] (H5T_NATIVE_FLOAT)	±0.999999E±9 --- ±0.999999E±9	RPC00B required field
SAMP_NUM_COEFF	Float array [20] (H5T_NATIVE_FLOAT)	±0.999999E±9 --- ±0.999999E±9	RPC00B required field
SAMP_DEN_COEFF	Float array [20] (H5T_NATIVE_FLOAT)	±0.999999E±9 --- ±0.999999E±9	RPC00B required field

8.3.4 GCP ATTRIBUTES

This section will be present only in case GCPs are used in geocoding. It contains the information related to the GCP used for L2c product generation.

Dataset Name	Type	Value/Units	Notes
GCP_ID	String array [N] (H5T_NATIVE_CHAR)		The array contains the ID of the GCPs used for L2d product generation
GCP_LAT_DB	Float array [N] (H5T_NATIVE_FLOAT)		The array contains the latitude of the GCPs used for L2d product generation as provided by GCP-DB
GCP_LON_DB	Float array [N] (H5T_NATIVE_FLOAT)		The array contains the longitude of the GCPs used for L2d product generation as provided by GCP-DB
GCP_Validity	String array [N] (H5T_NATIVE_CHAR)		The array contains the validity of the GCPs used for L2d product generation
GCP_QP_DB	Float array [N] (H5T_NATIVE_FLOAT)		The array contains the Quality Parameter of the GCPs used for L2d product generation as provided by GCP-DB
GCP_LAT_RET	Float array [N] (H5T_NATIVE_FLOAT)		The array contains the latitude of the GCPs used for L2d product generation retrieved by the processor
GCP_LON_RET	Float array [N] (H5T_NATIVE_FLOAT)		The array contains the longitude of the GCPs used for L2d product generation retrieved by the processor
GCP_PLAN_ERROR	Float array [N] (H5T_NATIVE_FLOAT)	Meters	The array contains the planimetric errors of the retrived position of GCP.
GCP_Quality_PAR	Float array [N] (H5T_NATIVE_FLOAT)		The array contains the quality factor of the GCP computed during the L2d product generation

8.3.5 PRS_L2C_HCO SWATHS

The main data contained in the PRS_L2c_HRO Swath is the surface spectral reflectance Coregistersed Hyperspectral Cube (in instrument geometric reference).

Swath		Name	Type	Dimensions	Unit	Description
PRS_L2C_HCO	Data Fields	VNIR_Cube	Unsigned short (HE5T_NATIVE_USHORT)	nHypAcrossPixel, nBands, nHypAlongPixel, =BIL Format	Dimensionless (ratio)	Co-registered data in the Hyperspectral channels (VNIR) scaled to the range [0,65535]
		SWIR_Cube	Unsigned short (HE5T_NATIVE_USHORT)	nHypAcrossPixel, nBands, nHypAlongPixel, =BIL Format	Dimensionless (ratio)	Co-registered data in the Hyperspectral channels (SWIR) scaled to the range [0,65535]
		VNIR_PIXEL_L2_ERR_MATRIX	Unsigned Char (H5T_NATIVE_UCHAR)	nHypAcrossPixel nBandsVNIR, nHypAlongPixel	Enum 0=pixel ok 1=Invalid pixel from L1 product 2=Negative value after atmospheric correction 3=Saturated value after atmospheric correction	Mask that notifies if errors in pixel radiance processing has occurred. These are the values to be intended as a base. The actual values can be any combination of this base.
		SWIR_PIXEL_L2_ERR_MATRIX	Unsigned Char (H5T_NATIVE_UCHAR)	nHypAcrossPixel nBandsSWIR, nHypAlongPixel	Enum 0=pixel ok 1=Invalid pixel from L1 product 2=Negative value after atmospheric correction 3=Saturated value after atmospheric	Mask that notifies if errors in pixel radiance processing has occurred. These are the values to be intended as a base. The actual values can be any combination of this base

		MAPS_PIXEL_L2_ERR_MATRIX	Unsigned Char (H5T_NATIVE_UCHAR)	nHypAcrossPixel, nHypAlongPixel	Enum 0=pixel ok 1=Invalid pixel in WVM evaluation 2=Full-scale pixel in WVM evaluation (> max) 4=Full-scale pixel in WVM evaluation (< min) 8=AOD map not evaluated (not Dark-Dense Vegetation pixel or invalid pixel) 16=Full-scale pixel in AOD evaluation (> max) 32=Full-scale pixel in AOD evaluation (< min) 64=Invalid pixel in AEX evaluation 128=Invalid pixel in COT evaluation	Mask that notifies if errors in masks generation mechanism has occurred. These are the values to be intended as a base. The actual values can be any combination of this base. Furthermore, this process is to be intended as cumulative for all masks.
	Geolocation Fields	Time	Double (HE5T_NATIVE_DOUBLE)	nHypAlongPixel	MJD2000 Decimal days	UTC time for each frame in processing format (as read from L1 input product)
		Latitude	Float (HE5T_NATIVE_FLOAT)	nHypAcrossPixel, nHypAlongPixel	Deg [-90 to 90]	Latitude for each pixel in the co-registered Hyperspectral image
		Longitude	Float (HE5T_NATIVE_FLOAT)	nHypAcrossPixel, nHypAlongPixel	Deg [-180 to 180]	Longitude for each pixel in the co-registered Hyperspectral image

	Geometric Fields	Solar_Zenith_Angle	Float (HE5T_NATIVE_FLOAT)	nHypAcrossPixel, nHypAlongPixel	Deg [0 to 90]	Solar Zenith Angle for each pixel in the co-registered Hyperspectral image
		Observing_Angle	Float (HE5T_NATIVE_FLOAT)	nHypAcrossPixel, nHypAlongPixel	Deg [0 to 90]	Angle between the local zenith and the satellite viewing direction for each pixel in the co-registered Hyperspectral image
		Rel_Azimuth_Angle	Float (HE5T_NATIVE_FLOAT)	nHypAcrossPixel, nHypAlongPixel	Deg [0 to 180]	Relative Azimuth Angle computed as difference between satellite and Sun azimuth angle (i.e. between observing direction and sun illumination direction) normalized in [0,180] for each pixel in the co-registered Hyperspectral image
	Geocoding Model	Model_ID	String (H5T_NATIVE_CHAR)	RPC00B		RPC00B required field
		SUCCESS	Flag (H5T_NATIVE_SHORT)	1 / 0		RPC00B required field
		ERR_BIAS	Float (H5T_NATIVE_FLOAT)	meters (0000.00 to 9999.99)		RPC00B required field
		ERR_RAND	Float (H5T_NATIVE_FLOAT)	meters (0000.00 to 9999.99)		RPC00B required field
		LINE_OFF	Float (H5T_NATIVE_SHORT)	samples (0000.00 to 9999.99)		RPC00B required field
		SAMP_OFF	Float (H5T_NATIVE_SHORT)	pixels (0000.00 to 9999.99)		RPC00B required field
		LAT_OFF	Float (H5T_NATIVE_FLOAT)	degrees (±90.0000)		RPC00B required field

		LONG_OFF	Float (H5T_NATIVE_FLOAT)	degrees (±180.0000)		RPC00B required field
		HEIGHT_OFF	Float (H5T_NATIVE_FLOAT)	meters (±9999)		RPC00B required field
		LINE_SCALE	Float (H5T_NATIVE_FLOAT)	samples (000001 to 999999)		RPC00B required field
		SAMP_SCALE	Float (H5T_NATIVE_FLOAT)	samples (000001 to 999999)		RPC00B required field
		LAT_SCALE	Float (H5T_NATIVE_FLOAT)	degrees (±90.0000)		RPC00B required field
		LONG_SCALE	Float (H5T_NATIVE_FLOAT)	degrees (±180.0000)		RPC00B required field
		HEIGHT_SCALE	Float (H5T_NATIVE_FLOAT)	meters (±9999)		RPC00B required field
		LINE_NUM_COEFF	Float array [20] (H5T_NATIVE_FLOAT)	±0.999999E±9 --- ±0.999999E±9		RPC00B required field
		LINE_DEN_COEFF	Float array [20] (H5T_NATIVE_FLOAT)	±0.999999E±9 --- ±0.999999E±9		RPC00B required field
		SAMP_NUM_COEFF	Float array [20] (H5T_NATIVE_FLOAT)	±0.999999E±9 --- ±0.999999E±9		RPC00B required field
		SAMP_DEN_COEFF	Float array [20] (H5T_NATIVE_FLOAT)	±0.999999E±9 --- ±0.999999E±9		

8.3.6 PRS_L2C_PCO SWATHS

The main data contained in the PRS_L2c_PCO Swath is the surface panchromatic reflectance image (in instrument geometric reference).

Swath		Name	Type	Dimensions	Unit	Description
PRS_L2C_PCO	Data Fields	Cube	Unsigned Short (HE5T_NATIVE_USHORT)	nPanAcrossPixel, nPanAlongPixel	Dimensionless (ratio)	Image data in the Panchromatic channel scaled to the range [0,65535]

		PIXEL_L2_ERR_MATRIX	Unsigned Char (H5T_NATIVE_UCHAR)	nPanAcrossPixel nPanAlongPixel	Enum 0=pixel ok 1=Invalid pixel from L1 product 2=Negative value after atmospheric correction 3=Saturated value after atmospheric correction	Mask that notifies if errors in pixel radiance processing has occurred. These are the values to be intended as a base. The actual values can be any combination of this base.
	Geolocation Fields	Time	Double (HE5T_NATIVE_DOUBLE)	nPanAlongPixel	MJD2000 Decimal days	UTC time for each frame in processing format (as read from L1 input product)
		Latitude	Float (HE5T_NATIVE_FLOAT)	nPanAcrossPixel, nPanAlongPixel	Deg [-90 to 90]	Latitude for each pixel in the co-registered Panchromatic image
		Longitude	Float (HE5T_NATIVE_FLOAT)	nPanAcrossPixel, nPanAlongPixel	Deg [-180 to 180]	Longitude for each pixel in the co-registered Panchromatic image
	Geocoding Model	Model_ID	String (H5T_NATIVE_CHAR)	RPC00B		RPC00B required field
		SUCCESS	Flag (H5T_NATIVE_SHORT)	1 / 0		RPC00B required field
		ERR_BIAS	Float (H5T_NATIVE_FLOAT)	meters (0000.00 to 9999.99)		RPC00B required field
		ERR_RAND	Float (H5T_NATIVE_FLOAT)	meters (0000.00 to 9999.99)		RPC00B required field
		LINE_OFF	Float (H5T_NATIVE_SHORT)	samples (0000.00 to 9999.99)		RPC00B required field
		SAMP_OFF	Float (H5T_NATIVE_SHORT)	pixels (0000.00 to 9999.99)		RPC00B required field
		LAT_OFF	Float (H5T_NATIVE_FLOAT)	degrees (±90.0000)		RPC00B required field
		LONG_OFF	Float (H5T_NATIVE_FLOAT)	degrees (±180.0000)		RPC00B required field
		HEIGHT_OFF	Float (H5T_NATIVE_FLOAT)	meters (±9999)		RPC00B required field
		LINE_SCALE	Float (H5T_NATIVE_FLOAT)	samples (000001 to 999999)		RPC00B required field

		SAMP_SCALE	Float (H5T_NATIVE_FLOAT)	samples (000001 to 999999)		RPC00B required field
		LAT_SCALE	Float (H5T_NATIVE_FLOAT)	degrees (±90.0000)		RPC00B required field
		LONG_SCALE	Float (H5T_NATIVE_FLOAT)	degrees (±180.0000)		RPC00B required field
		HEIGHT_SCALE	Float (H5T_NATIVE_FLOAT)	meters (±9999)		RPC00B required field
		LINE_NUM_COEFF	Float array [20] (H5T_NATIVE_FLOAT)	±0.999999E±9 --±0.999999E±9		RPC00B required field
		LINE_DEN_COEFF	Float array [20] (H5T_NATIVE_FLOAT)	±0.999999E±9 --±0.999999E±9		RPC00B required field
		SAMP_NUM_COEFF	Float array [20] (H5T_NATIVE_FLOAT)	±0.999999E±9 --±0.999999E±9		RPC00B required field
		SAMP_DEN_COEFF	Float array [20] (H5T_NATIVE_FLOAT)	±0.999999E±9 --±0.999999E±9		

8.3.7 PRS_L2C_AOT SWATHS

The main data contained in the PRS_L2c_AOT Swath is the aerosol optical thickness (in instrument geometric reference).

Swath		Name	Type	Dimensions	Unit	Description
PRS_L2C_AOT	Data Fields	AOT_Map	Unsigned Short (HE5T_NATIVE_USHORT)	nAOTAcrossPixel, nAOTAlongPixel	Dimensionless	AOT scaled to the range [0,65535]
	Geolocation Fields	Time	Double (HE5T_NATIVE_DOUBLE)	nAOTAlongPixel	MJD2000 Decimal days	UTC time for each frame in processing format (as read from L1 input product)
		Latitude	Float (HE5T_NATIVE_FLOAT)	nAOTAcrossPixel, nAOTAlongPixel	Deg [-90 to 90]	Latitude for each map pixel
		Longitude	Float (HE5T_NATIVE_FLOAT)	nAOTAcrossPixel, nAOTAlongPixel	Deg [-180 to 180]	Longitude for each map pixel

8.3.8 PRS_L2C_AEX SWATHS

The main data contained in the PRS_L2c_AEX Swath is the Angstrom exponent of the aerosol (in instrument geometric reference).

Swath		Name	Type	Dimensions	Unit	Description
PRS_L2C_AEX	Data Fields	AEX_Map	Unsigned Short (HE5T_NATIVE_USHORT)	nAEXAcrossPixel, nAEXAlongPixel	Dimensionless	Angstrom exponent scaled to the range [0,65535]

	Geolocation Fields	Time	Double (HE5T_NATIVE_DOUBLE)	nAEXAlongPixel	MJD2000 Decimal days	UTC time for each frame in processing format (as read from L1 input product)
		Latitude	Float (HE5T_NATIVE_FLOAT)	nAEXAcrossPixel, nAEXAlongPixel	Deg [-90 to 90]	Latitude for each map pixel
		Longitude	Float (HE5T_NATIVE_FLOAT)	nAEXAcrossPixel, nAEXAlongPixel	Deg [-180 to 180]	Longitude for each map pixel

nAEXAcrossPixel is equal to nAOTAcrossPixel and nAEXAlongPixel is equal to nAOTAlongPixel

8.3.9 PRS_L2C_WVM SWATHS

The main data contained in the PRS_L2c_WVM Swath is the water vapour (in instrument geometric reference).

Swath		Name	Type	Dimensions	Unit	Description
PRS_L2C_WVM	Data Fields	WVM_Map	Unsigned Short (HE5T_NATIVE_USHORT)	nWVMAcrossPixel, nWVMAlongPixel	g/cm2	Water Vapour columnar amount scaled to the range [0,65535]
	Geolocation Fields	Time	Double (HE5T_NATIVE_DOUBLE)	nWVMAlongPixel	MJD2000 Decimal days	UTC time for each frame in processing format (as read from L1 input product)
		Latitude	Float (HE5T_NATIVE_FLOAT)	nWVMAcrossPixel, nWVMAlongPixel	Deg [-90 to 90]	Latitude for each map pixel
		Longitude	Float (HE5T_NATIVE_FLOAT)	nWVMAcrossPixel, nWVMAlongPixel	Deg [-180 to 180]	Longitude for each map pixel

nWVMAcrossPixel is equal to nHypAcrossPixel and nWVMAlongPixel is equal to nHypAlongPixel

8.3.10 PRS_L2C_COT SWATHS

The main data contained in the PRS_L2c_COT Swath is the (thin) Clouds optical thickness (in instrument geometric reference).

Swath		Name	Type	Dimensions	Unit	Description
PRS_L2C_COT	Data Fields	COT_Map	Unsigned Short (HE5T_NATIVE_USHORT)	nCOTAcrossPixel, nCOTAlongPixel	Dimensionless	COT scaled to the range [0,65535]

	Geolocation Fields	Time	Double (HE5T_NATIVE_DOUBLE)	nCOTAlongPixel	MJD2000 Decimal days	UTC time for each frame in processing format (as read from L1 input product)
		Latitude	Float (HE5T_NATIVE_FLOAT)	nCOTAcrossPixel, nCOTAlongPixel	Deg [-90 to 90]	Latitude for each map pixel
		Longitude	Float (HE5T_NATIVE_FLOAT)	nCOTAcrossPixel, nCOTAlongPixel	Deg [-180 to 180]	Longitude for each map pixel

nCOTAcrossPixel is equal to nHypAcrossPixel and nCOTAlongPixel is equal to nHypAlongPixel

8.3.11 KDP_AUX

This section contains the vector of LOS, and the matrix of CW and FWHM extracted form KDP by interpolation of them according to the temperature of the optical bench associated to the current L1 product. They are copied from the Level 1b product with the following structure:

HDF5 (root).	Group	Dataset
	KDP_AUX	Cw_Swir_Matrix
		Cw_Vnir_Matrix
		Fwhm_Swir_Matrix
		Fwhm_Vnir_Matrix
		LOS_Pan
		LOS_Swir
		LOS_Vnir

See Section 7.6.5 for detailed information.

8.4 LEVEL 2D PRODUCT FORMAT DESCRIPTION

Each HDF5 file is composed according to a tree structure with the following format:

HDF5 (root).					
GlobalAttribute					
	INFO.				
		Ancillary[NPixelAlong] as per copy from L1 product			
			StarTracker1		
			StarTracker2		
			GyroData		
			PVSdata		
		Header			
	HDFEOS				
		SWATHS			
			GCP_Attributes		
			Geocoding Attributes		

				Ancillary	
			PRS_L2D_HCO		
				Data Fields	
				Geolocation Fields	
				Geometric Fields	
				Geocoding Model	
			PRS_L2D_PCO		
				Data Fields	
				Geolocation Fields	
				Geocoding Model	
	KDP_AUX				

8.4.1 GLOBAL ATTRIBUTES

The following table describes the structure of the global attributes relevant to the L2d product.

Dataset Name	Type	Value/Units	Notes
Product_Name	String (H5T_NATIVE_CHAR)	"PRS_L2_L2D_<XXXX>_<YYYYYMMDDhhmmss>_<YYYYMMDDhhmmss>_<XX>.he5"	
Product_ID	String (H5T_NATIVE_CHAR)	" PRS_L2D_STD"	
Processor_Name	String (H5T_NATIVE_CHAR)	"L2D"	Processor name as read from the JobOrder file
Processing_Level	String (HE5T_NATIVE_CHAR)	"2D"	
Processor_Version	String (H5T_NATIVE_CHAR)	XX.XX with X = 0..9	
Acquisition_Station	String (H5T_NATIVE_CHAR)		Copied from L1 input product
Processing_Station	String (H5T_NATIVE_CHAR)		Copied from L1 input product
Processing_Time	String (H5T_NATIVE_CHAR)	yyyy-mm-ddThh:mm:ss.uuuuuu	Creation date and time of the L2d Product in UTC Time format (Copied from L1 input product)
Product_StartTime	String (H5T_NATIVE_CHAR)	yyyy-mm-ddThh:mm:ss.uuuuuu	UTC time of the first valid frame stored in the product (Copied from L1 input product)
Product_StopTime	String (H5T_NATIVE_CHAR)	yyyy-mm-ddThh:mm:ss.uuuuuu	UTC time of the last valid frame stored in the product (Copied from L1 input product)
Projection_Id	String (H5T_NATIVE_CHAR)	"UTM32", "UTM33", …	Id of the projection
Projection_Name	String (H5T_NATIVE_CHAR)	"UTM"	Mnemonic name of the projection
Reference_Ellipsoid	String (H5T_NATIVE_CHAR)	"WGS84"	The name of the reference ellipsoid

Epsg_Code	Int (H5T_NATIVE_UINT)		The EPSG code that unambiguously identify the projection
Product_center_long	Float (HE5T_NATIVE_FLOAT)	Deg	Longitude of HYP image center
Product_center_lat	Float (HE5T_NATIVE_FLOAT)	Deg	Latitude of HYP image center
Product_ULcorner_long	Float (HE5T_NATIVE_FLOAT)	Deg	Longitude of HYP image Upper Left corner
Product_ULcorner_lat	Float (HE5T_NATIVE_FLOAT)	Deg	Latitude of HYP image Upper Left corner
Product_URcorner_long	Float (HE5T_NATIVE_FLOAT)	Deg	Longitude of HYP image Upper Right corner
Product_URcorner_lat	Float (HE5T_NATIVE_FLOAT)	Deg	Latitude of HYP image Upper Right corner
Product_LLcorner_long	Float (HE5T_NATIVE_FLOAT)	Deg	Longitude of HYP image Lower Left corner
Product_LLcorner_lat	Float (HE5T_NATIVE_FLOAT)	Deg	Latitude of HYP image Lower Left corner
Product_LRcorner_long	Float (HE5T_NATIVE_FLOAT)	Deg	Longitude of HYP image Lower Right corner
Product_LRcorner_lat	Float (HE5T_NATIVE_FLOAT)	Deg	Latitude of HYP image Lower Right corner
Product_center_easting	Float (HE5T_NATIVE_FLOAT)	meters	Easting (X coord.) of HYP image center
Product_center_northing	Float (HE5T_NATIVE_FLOAT)	meters	Northing (Y coord.) of HYP image center
Product_ULcorner_easting	Float (HE5T_NATIVE_FLOAT)	meters	Easting (X coord.) of HYP image Upper Left corner
Product_ULcorner_northing	Float (HE5T_NATIVE_FLOAT)	meters	Northing (Y coord.) of HYP image Upper Left corner
Product_URcorner_easting	Float (HE5T_NATIVE_FLOAT)	meters	Easting (X coord.) of HYP image Upper Right corner
Product_URcorner_northing	Float (HE5T_NATIVE_FLOAT)	meters	Northing (Y coord.) of HYP image Upper Right corner
Product_LLcorner_easting	Float (HE5T_NATIVE_FLOAT)	meters	Easting (X coord.) of HYP image Lower Left corner
Product_LLcorner_northing	Float (HE5T_NATIVE_FLOAT)	meters	Northing (Y coord.) of HYP image Lower Left corner
Product_LRcorner_easting	Float (HE5T_NATIVE_FLOAT)	meters	Easting (X coord.) of HYP image Lower Right corner

Product_LRcorner_northing	Float (HE5T_NATIVE_FLOAT)	meters	Northing (Y coord.) of HYP image Lower Right corner
Integration_Time	Unsigned Long (H5T_NATIVE_ULONG)	seconds	Integration Time used for Hyperspectral Channel (Copied from L1 input product)
Sync_Time	Unsigned Long (H5T_NATIVE_ULONG)	seconds	Sync Time = Hyperspectral Frame Lasting Time (Copied from L1 input product)
PAN_Int_Time	Unsigned Long (H5T_NATIVE_ULONG)	seconds	Integration Time used for Pan Channel (Copied from L1 input product)
Pan_N_Int	Unsigned Short (H5T_NATIVE_USHORT)	1…6	Default N=6= number of pan-frames acquired during a Sync_Time. (Copied from L1 input product)
Frame_Type	String	"SURFACE OBSERVATION"	(Copied from L1 input product)
Num_Frames	Unsigned Short (H5T_NATIVE_USHORT)		Number of Hyperspectral VNIR and SWIR frames acquired in current L1 file (Copied from L1 input product)
Pan_Num_Frames	Unsigned Short (H5T_NATIVE_USHORT)		Number of PAN frames acquired in current L1 file (Copied from L1 input product)
VNIR_Corrupted_Frame_Percentage	String (H5T_NATIVE_CHAR)	"nn.nn %"	Percentage of corrupted frames on the total set of EO/EOS frames in the "nn.nn %" format. (Copied from L1 input product)
SWIR_Corrupted_Frame_Percentage	String (H5T_NATIVE_CHAR)	"nn.nn %"	Percentage of corrupted frames on the total set of EO/EOS frames in the "nn.nn %" format. (Copied from L1 input product)
PAN_Corrupted_Frame_Percentage	String (H5T_NATIVE_CHAR)	"nn.nn %"	Percentage of corrupted frames on the total set of EO/EOS frames in the "nn.nn %" format. (Copied from L1 input product)
Main_Electronic_Unit	Unsigned Short (H5T_NATIVE_USHORT)	0 = Main 1 = Redundant	Copied from L1 input product
Sun_zenith_angle	Float (HE5T_NATIVE_FLOAT)	Deg	Sun Zenith angle of the central pixel of the image Copied from L1 input product
Sun_azimuth_angle	Float (HE5T_NATIVE_FLOAT)	Deg	Sun azimuth angle of the central pixel of the image Copied from L1 input product
CUBE-INFO			
List_Cw_Vnir	Unsigned Short (HE5T_NATIVE_USHORT)	66 values	List of 66 Central Wavelenghs (nm) for the VNIR channel (Copied from L1 input product)
List_Fwhm_Vnir	Unsigned Short (HE5T_NATIVE_USHORT)	66 values	List of 66 band amplitude for the VNIR channel (Copied from L1 input product)
List_Cw_Swir	Unsigned Short (HE5T_NATIVE_USHORT)	173 values	List of 173 Central Wavelenghs (nm) for the SWIR channel (Copied from L1 input product)
List_Fwhm_Swir	Unsigned Short (HE5T_NATIVE_USHORT)	173 values	List of 173 band amplitude for the SWIR channel (Copied from L1 input product)

L2ScaleVnirMin	Float32		Scaling factor for VNIR cube in order to transform uint16 DN to reflectance units as follows: Reflectance_f32 = L2ScaleVnirMin+DN_uint16*(L2ScaleVnirMax-L2ScaleVnirMin) /65535
L2ScaleVnirMax	Float32		Scaling factor for VNIR cube in order to transform uint16 DN to reflectance units)] as follows: Reflectance _f32 = L2ScaleVnirMin+DN_uint16*(L2ScaleVnirMax-L2ScaleVnirMin) /65535
L2ScaleSwirMin	Float32		Scaling factor for SWIR cube in order to transform uint16 DN to reflectance units as follows: Reflectance _f32 = L2ScaleSwirMin+DN_uint16*(L2ScaleSwirMax-L2ScaleSwirMin) /65535
L2ScaleSwirMax	Float32		Scaling factor for SWIR cube in order to transform uint16 DN to reflectance units as follows: Reflectance _f32 = L2ScaleSwirMin+DN_uint16*(L2ScaleSwirMax-L2ScaleSwirMin) /65535
L2ScalePanMin	Float32		Scaling factor for PAN image in order to transform uint16 DN to reflectance units as follows: Reflectance _f32 = L2ScalePanMin+DN_uint16*(L2ScalePanMax-L2ScalePanMin) /65535
L2ScalePanMax	Float32		Scaling factor for PAN image in order to transform uint16 DN to relfectance units as follows: Reflectance _f32 = L2ScalePanMin+DN_uint16*(L2ScalePanMax-L2ScalePanMin) /65535
PAN_HYP_ACT_RESIDUAL_m	Float32		Additional information suitable for higher level processing (L2): it reports the measurement in meters of the Across track offset (meter distance computed using combination of frame and subframe). (Copied from L1 input product)

PAN_HYP_ALT_RESIDUAL_m	Float 32		Additional information suitable for higher level processing (L2): it reports the measurement in meters of the Along track offset (meter distance computed using combination of frame and subframe). Copied from L1 input product)
PAN_HYP_START_SYNC_FRAME	Uint32		Applied number of PAN-HYP delay frames in the Along track direction to synch first HYP cube's line with first PAN cube's line. It's computed on the first frame of the 30km x 30km image `Applied in PAN-HYP coarse coregistration. (Copied from L1 input product)`
PAN_HYP_START_SYNC_SUBFRAME	Uint32	[0, 5]	Applied number of PAN-HYP delay SUB-frames in the Along track direction to synch first HYP cube's line with first PAN cube's line. It's computed on the first frame of the 30km x 30km image. `Applied in PAN-HYP coarse coregistration. (Copied from L1 input product)`
PAN_HYP_STOP_SYNC_FRAME	Uint32		Additional information suitable for higher level processing (L2): Number of PAN-HYP delay frames in the Along track direction to synch last HYP cube's line with last PAN cube's line. It's computed on the last frame of the 30km x 30km image `NOT applied in the PAN-HYP coarse coregistration. (Copied from L1 input product)`
PAN_HYP_STOP_SYNC_SUBFRAME	Uint32	[0,5]	Additional information suitable for higher level processing (L2): number of PAN-HYP delay SUB-frames in the Along track direction to synch last HYP cube's line with last PAN cube's line. It's computed on the last frame of the 30km x 30km image. `NOT applied in the PAN-HYP coarse coregistratin. (Copied from L1 input product)`
PAYLOAD BINNING INFO			

SWIR_HGRP	Unsigned Char (H5T_NATIVE_UCHAR)	1, 2 or 4	This attribute contains the information about the grouping (or spatial binning) in the SWIR channel. “1” means that no grouping is applied “2” means that each pixel contains the averaged value of two contiguous pixels in the across track direction “4” means that each pixel contains the averaged value of four contiguous pixels in the across track direction (Copied from L1 input product)
VNIR_HGRP	Unsigned Char (H5T_NATIVE_UCHAR)	1, 2 or 4	This attribute contains the information about the grouping (or spatial binning) in the VNIR channel. “1” means that no grouping is applied “2” means that each pixel contains the averaged value of two contiguous pixels in the across track direction “4” means that each pixel contains the averaged value of four contiguous pixels in the across track direction (Copied from L1 input product)
PAN_HGRP	Unsigned Char (H5T_NATIVE_UCHAR)	1, 2 or 4	This attribute contains the information about the grouping (or spatial binning) in the PAN channel. This information is contained in the Level 0 product. “1” means that no grouping is applied “2” means that each pixel contains the averaged value of two contiguous pixels in the across track direction “4” means that each pixel contains the averaged value of four contiguous pixels in the across track direction (Copied from L1 input product)
PAN_ACQ	Unsigned Char (H5T_NATIVE_UCHAR)	“1” if PAN channel is present in the telemetry. “0” in the contrary case.	(Copied from L1 input product)
SWIR_BNSTART	Unsigned Short (H5T_NATIVE_USHORT)	Value between 0 and 255; if binning isn’t applied the SW-BNSTART = 255 and the SW-BNSTOP =0	Starting band for binning in the SWIR (Copied from L1 input product)
SWIR_BNSTOP	Unsigned Short (H5T_NATIVE_USHORT)	Value between 0 and 255; if binning isn’t applied the SW-BNSTART = 255 and the SW-BNSTOP =0	Ending band for binning in the SWIR (Copied from L1 input product)
VNIR_BNSTART	Unsigned Short (H5T_NATIVE_USHORT)	Value between 0 and 255; if binning isn’t applied the SW-BNSTART = 255 and the SW-BNSTOP =0	Starting band for binning in the VNIR (Copied from L1 input product)

VNIR_BNSTOP	Unsigned Short (H5T_NATIVE_USHORT)	Value between 0 and 255; if binning isn't applied the SW-BNSTART = 255 and the SW-BNSTOP =0	Ending band for binning in the VNIR (Copied from L1 input product)
SWIR_X	Unsigned Short (H5T_NATIVE_USHORT)	Vector of 256 elements: a "0" or "1" value for each spectral line that the on-board instrument can acquire in the SWIR channel	Editing Info in the SWIR channel (and of PE and SDAB editing info) (Copied from L1 input product)
VNIR_X	Unsigned Short (H5T_NATIVE_USHORT)	Vector of 256 elements: a "0" or "1" value for each spectral line in the VNIR channel	Editing Info in the VNIR channel (and of PE and SDAB editing info) (Copied from L1 input product)
PE_Gain_SWIR	Unsigned Short (H5T_NATIVE_USHORT)	Vector of 256 elements: a "0" or "1" value for each spectral line in the SWIR channel	(Copied from L1 input product)
PE_Gain_VNIR	Unsigned Short (H5T_NATIVE_USHORT)	Vector of 256 elements: a "0" or "1" value for each spectral line in the VNIR channel	(Copied from L1 input product)
END-USER BINNING INFO			
CNM_L2_HGRP	Unsigned Short (H5T_NATIVE_USHORT)	Value between 1 and 10 where 1 means no grouping	Spatial Grouping Factor Applied (Copied from L1 input product)
CNM_L2_BSEL_ON	Unsigned Short (H5T_NATIVE_USHORT)	"1" if Band Selection has been selected by the user in the Parameter file; "0" otherwise;	Flag indicating if Band Selection has been applied. Mutually exclusive with respect to binning operations (Copied from L1 input product)
CNM_L2_BIN_ON	Unsigned Short (H5T_NATIVE_USHORT)	"1" if Binning has been selected by the user in the Parameter file; "0" otherwise;	Flag indicating if Binning has been applied. Mutually exclusive with respect to band selection operations (Copied from L1 input product)
CNM_L2_BINNING	Unsigned Short (H5T_NATIVE_USHORT)	Value between 1 and 20 where 1 means no binning	Spectral Binning Factor Applied (Copied from L1 input product)
CNM_SWIR_ACQ	Unsigned Short (H5T_NATIVE_USHORT)	"1" if SWIR channel has been selected by the user in the Parameter file; "0" otherwise;	Flag indicating if SWIR channel has been selected by the user. (Copied from L1 input product)
CNM_VNIR_ACQ	Unsigned Short (H5T_NATIVE_USHORT)	"1" if VNIR channel has been selected by the user in the Parameter file; "0" otherwise;	Flag indicating if VNIR channel has been selected by the user. (Copied from L1 input product)
CNM_SWIR_SELECT	Unsigned Int (H5T_NATIVE_UINT)	Array of 176 values set to "1" or "0" if the corresponding SWIR band has been selected or not by the user;	(Copied from L1 input product)
CNM_VNIR_SELECT	Unsigned Int (H5T_NATIVE_UINT)	Array of 67 values set to "1" or "0" if the corresponding VNIR band has been selected or not by the user;	(Copied from L1 input product)
CNM_PAN_ACQ	Unsigned Short (H5T_NATIVE_USHORT)	"1" if PAN channel has been selected by the user in the Parameter file; "0" otherwise;	Flag indicating if PAN channel has been selected by the user. (Copied from L1 input product)As received from thin layer)
PRODUCT REPORT INFO			

Image_ID	Uint16		Identifier of the acquired image in the Acquisition Plan: it is retrieved from the Header Packet. (Copied from L1 input product)
ISF_ID_Start	Uint32		ID of the first ISF file associated to the current Image_ID: it is retrieved from the header packet. (Copied from L1 input product)
Number_of_ISF	Uint16		Number of ISF files contained in the current image: it is retrieved from the header packet. (Copied from L1 input product)
L1_Quality_CCPerc	Float 32		Percentage of clouds on the L1 image. (Copied from L1 input product)
L1_Quality_info	String		(Copied from L1 input product)
L1_Processor_Version	String		(Copied from L1 input product)
Exit_Code	Unsigned Char (H5T_NATIVE_UCHAR)	0=Ok 1=Warning 255= Error	According to CNM ICD
Prev_FKdp_File_Name	String (HE5T_NATIVE_CHAR)		Scene of Interest Info (SOI) (Copied from L1 input product)
Prev_Cdp_File_Name	String (HE5T_NATIVE_CHAR)		Scene of Interest Info (SOI) (Copied from L1 input product)
Prev_Gkdp_File_Name	String (HE5T_NATIVE_CHAR)		Scene of Interest Info (SOI) (Copied from L1 input product)
Soi_Prev_Dark_Calibration_L0aFile	String (HE5T_NATIVE_CHAR)		Scene of Interest Info (SOI) (Copied from L1 input product)
Soi_L0a_EO-EOS	String (HE5T_NATIVE_CHAR)		Scene of Interest Info (SOI) (Copied from L1 input product)
Soi_Post_Dark_Calibration_L0aFile	String (HE5T_NATIVE_CHAR)		Scene of Interest Info (SOI) (Copied from L1 input product)
Aux_SunEarthDistance	String (HE5T_NATIVE_CHAR)		Scene of Interest Info (SOI) (Copied from L1 input product)
Aux_SunIrradiance	String (HE5T_NATIVE_CHAR)		Scene of Interest Info (SOI) (Copied from L1 input product)
CORRUPTED FRAME LIST			
VNIRCorruptedFrameList	Unsigned Short (HE5T_NATIVE_USHORT)	Matrix of nHypAlongPixelx2	This Data Field contains information about the Corrupted Frames of the HYPER RC cube. It is a two-dimensional Data Field. The first dimension (i.e. number of lines of the matrix dataset) is given by the number of frames that compose the cube (nHypAlongPixel). The second dimension (i.e. number of column) is equal to 5: each column has a precise meaning which is explained in the attribute “Legend” of this Data Field “1st Column = 1 if the frame is corrupted 0 if the frame is ok. 2th Column = Damage *(1=corrupted frame, 2=missing frame) (Copied from L1 input product)
SWIRCorruptedFrameList	Unsigned Short (HE5T_NATIVE_USHORT)	Matrix of nHypAlongPixelx2	(Copied from L1 input product)

PANCorruptedFrameList	Unsigned Short (HE5T_NATIVE_USHORT)	Matrix of nPanAlongPixelx2	(Copied from L1 input product)
AUX DATA INFO			
DEM_info	String (HE5T_NATIVE_CHAR)	String of characters	String of 32 characters indicating the origin of DEM/DTM used in data processing
Atmo_profile_info	String (HE5T_NATIVE_CHAR)	String of characters	String of 32 characters indicating the origin of Atmospheric profiles data used in data processing, among {ATM_MIDLAT_SUMMER, ATM_TROPICAL, ATM_MIDLAT_WINTER}
Atm_Lut_version	String (HE5T_NATIVE_CHAR)	String of characters	String of 32 character indicating the current version of the RTM Look-Up table
Atm_LutGeomInfo_RelativeAzimuth	Unsigned Int (H5T_NATIVE_UINT)	Array of 2 values indicating the couple of Relative Azimuth Angles used to enter the RTM LUT for the current geometry	
Atm_LutGeomInfo_SunZenith	Unsigned Int (H5T_NATIVE_UINT)	Array of 2 values indicating the couple of Sun Zenith Angles used to enter the RTM LUT for the current geometry	
Atm_LutGeomInfo_ViewZenith	Unsigned Int (H5T_NATIVE_UINT)	Array of 2 values indicating the couple of View Zenith Angles used to enter the RTM LUT for the current geometry	
Atmo_RTM_info	String (HE5T_NATIVE_CHAR)	String of characters	String of 32 characters indicating the origin of Radiative transfer model used in data processing (e.g. “MODTRAN6”)
GCP_info	String (HE5T_NATIVE_CHAR)	String of characters	String of 1 character indicating if GCPs have beenused in data processing
QUALITY FLAGS			
L2d_Quality_flags	String (HE5T_NATIVE_CHAR)	String of characters	String of 3 chars, each one representing a flag with the following meaning: 0 NOK (quality check not passed, 1 OK quality check passed) Char[0] flag on cloud mask existence in the L1 product Char[1] flag on sea/land surface mask existence in the L1 product Char[2] flag on Sun Glint mask existence in the L1 product
Cloudy_pixels_percentage	Float (HE5T_NATIVE_FLOAT)	Percentage	It counts the percentage of cloudy sky pixels
Sea_pixels_percentage	Float (HE5T_NATIVE_FLOAT)	Percentage	It counts the percentage of sea pixels
Map_WV_accuracy	Float (HE5T_NATIVE_FLOAT)	Quality index	It quantifies the accuracy in the generation of WV map. It is expressed as the standard deviation of water vapor values for pixel marked as "Land" in Land Cover mask

Map_AOT_accuracy	Float (HE5T_NATIVE_FLOAT)	Quality index	It quantifies the accuracy in the generation of AOT map. It is expressed as the average minimization fitting error for not null pixel in AOT map
Geolocation_accuracy	Float (HE5T_NATIVE_FLOAT)		It quantifies the geolocation error

8.4.2 INFO.ANCILLARY

This group escribes the structure of the global attributes relevant to the L2d product.
They are copied from the Level 1b data. See sec. 7.6.4 for attributes' information.

8.4.3 GEOCODING ATTRIBUTES

8.4.3.1 GEOCODING INFO.ANCILLARY

This section describes the structure of the auxiliary information attributes relevant to the L2d product.

Dataset Name	Type	Value/Units	Notes
DEM_Type	String (H5T_NATIVE_CHAR)		
DEM_Resolution	Float (H5T_NATIVE_FLOAT)	meters	
DEM_Horizontal_Accuracy	Float (H5T_NATIVE_FLOAT)	meters	
DEM_Vertical_Accuracy	Float (H5T_NATIVE_FLOAT)	meters	
GCP_Use_Flag	Flag (H5T_NATIVE_SHORT)	1 /0	
GCP_Available	Int (H5T_NATIVE_UINT)	0-M	
GCP_Used	Int (H5T_NATIVE_UINT)	0-N (with N≤M)	
GCP_Overall_Correlation_score	Int (H5T_NATIVE_UINT)	0-100	
GCP_Correlation_score	Int array [N] (H5T_NATIVE_UINT)	0-100	
GCP_Min_Correlation_threshold	Unsigned Int (H5T_NATIVE_UINT)	0-100	
Geocoding_RMS_Error	Float (H5T_NATIVE_FLOAT)	meters	

8.4.3.2 GEOCODING MODEL

This section describes the geocoding model used in the ortho-rectification of the L2d product. The adopted geocoding model is the Rational Polynomial Coefficients one: *RPC00B - Rapid Positioning Capability*, as defined in the National Imagery and Mapping Agency (NIMA) standard (see [RD-13]). Its detailed description has been reported in [RD-9].

This section is part of the product starting from L2b level on; it is added to product structure at the time the model is evaluated. Once the model is added its content it is no more updated in next processing levels.

Image coordinates are specified units of pixels; ground coordinates are latitude and longitude in units of decimal degrees and the geodetic elevation in units of meters. Ground coordinates are referenced to WGS-84.

Dataset Name	Type	Value/Units	Notes
Model_ID	String (H5T_NATIVE_CHAR)	RPC00B	
SUCCESS	Flag (H5T_NATIVE_SHORT)	1 / 0	RPC00B required field
ERR_BIAS	Float (H5T_NATIVE_FLOAT)	meters (0000.00 to 9999.99)	RPC00B required field
ERR_RAND	Float (H5T_NATIVE_FLOAT)	meters (0000.00 to 9999.99)	RPC00B required field
LINE_OFF	Float (H5T_NATIVE_SHORT)	samples (0000.00 to 9999.99)	RPC00B required field
SAMP_OFF	Float (H5T_NATIVE_SHORT)	pixels (0000.00 to 9999.99)	RPC00B required field
LAT_OFF	Float (H5T_NATIVE_FLOAT)	degrees (±90.0000)	RPC00B required field
LONG_OFF	Float (H5T_NATIVE_FLOAT)	degrees (±180.0000)	RPC00B required field
HEIGHT_OFF	Float (H5T_NATIVE_FLOAT)	meters (±9999)	RPC00B required field
LINE_SCALE	Float (H5T_NATIVE_FLOAT)	samples (000001 to 999999)	RPC00B required field
SAMP_SCALE	Float (H5T_NATIVE_FLOAT)	samples (000001 to 999999)	RPC00B required field
LAT_SCALE	Float (H5T_NATIVE_FLOAT)	degrees (±90.0000)	RPC00B required field
LONG_SCALE	Float (H5T_NATIVE_FLOAT)	degrees (±180.0000)	RPC00B required field
HEIGHT_SCALE	Float (H5T_NATIVE_FLOAT)	meters (±9999)	RPC00B required field
LINE_NUM_COEFF	Float array [20] (H5T_NATIVE_FLOAT)	±0.999999E±9 --- ±0.999999E±9	RPC00B required field

LINE_DEN_COEFF	Float array [20] (H5T_NATIVE_FLOAT)	±0.999999E±9 --- ±0.999999E±9	RPC00B required field
SAMP_NUM_COEFF	Float array [20] (H5T_NATIVE_FLOAT)	±0.999999E±9 --- ±0.999999E±9	RPC00B required field
SAMP_DEN_COEFF	Float array [20] (H5T_NATIVE_FLOAT)	±0.999999E±9 --- ±0.999999E±9	RPC00B required field

8.4.4 GCP ATTRIBUTES

This section will be present only in case GCPs are used in geocoding. It contains the information related to the GCP used for L2d product generation.

Dataset Name	Type	Value/Units	Notes
GCP_ID	String array [N] (H5T_NATIVE_CHAR)		The array contains the ID of the GCPs used for L2d product generation
GCP_LAT_DB	Float array [N] (H5T_NATIVE_FLOAT)		The array contains the latitude of the GCPs used for L2d product generation as provided by GCP-DB
GCP_LON_DB	Float array [N] (H5T_NATIVE_FLOAT)		The array contains the longitude of the GCPs used for L2d product generation as provided by GCP-DB
GCP_Validity	String array [N] (H5T_NATIVE_CHAR)		The array contains the validity of the GCPs used for L2d product generation
GCP_QP_DB	Float array [N] (H5T_NATIVE_FLOAT)		The array contains the Quality Parameter of the GCPs used for L2d product generation as provided by GCP-DB
GCP_LAT_RET	Float array [N] (H5T_NATIVE_FLOAT)		The array contains the latitude of the GCPs used for L2d product generation retrieved by the processor
GCP_LON_RE T	Float array [N] (H5T_NATIVE_FLOAT)		The array contains the longitude of the GCPs used for L2d product generation retrieved by the processor
GCP_PLAN_E RROR	Float array [N] (H5T_NATIVE_FLOAT)	Meters	The array contains the planimetric errors of the retrived position of GCP.
GCP_Quality_P AR	Float array [N] (H5T_NATIVE_FLOAT)		The array contains the quality factor of the GCP computed during the L2d product generation

8.4.5 PRS_L2D_HCO SWATHS

The main data contained in the PRS_L2d_HCO Swath is the surface spectral reflectance Coregistersed Hyperspectral Cube (in instrument geometric reference).

Swath		Name	Type	Dimensions	Unit	Description
PRS_L2D_H CO	Data Fields	VNIR_Cube	Unsigned short (HE5T_NATIVE _USHORT)	nEastingPixel, nBands, nNorthingPixel, =BIL Format	Dimensionle ss (ratio)	Co-registered data in the Hyperspectral channels (VNIR) scaled to the range [0,65535]

		SWIR_Cube	Unsigned short (HE5T_NATIVE_USHORT)	nEastingPixel, nBands, nNorthingPixel, =BIL Format	Dimensionless (ratio)	Co-registered data in the Hyperspectral channels (SWIR) scaled to the range [0,65535]
		VNIR_PIXEL_L2_ERR_MATRIX	Unsigned Char (H5T_NATIVE_UCHAR)	nHypAcrossPixel nBandsVNIR, nHypAlongPixel	Enum 0=pixel ok 1=Invalid pixel from L1 product 2=Negative value after atmospheric correction 3=Saturated value after atmospheric correction	Mask that notifies if errors in pixel radiance processing has occurred. These are the values to be intended as a base. The actual values can be any combination of this base.
		SWIR_PIXEL_L2_ERR_MATRIX	Unsigned Char (H5T_NATIVE_UCHAR)	nHypAcrossPixel nBandsSWIR, nHypAlongPixel	Enum 0=pixel ok 1=Invalid pixel from L1 product 2=Negative value after atmospheric correction 3=Saturated value after atmospheric	Mask that notifies if errors in pixel radiance processing has occurred. These are the values to be intended as a base. The actual values can be any combination of this base
	Geolocation Fields	Time	Double (HE5T_NATIVE_DOUBLE)	nHypAlongPixel	MJD2000 Decimal days	UTC time for each frame in processing format (as read from L1 input product)
		Latitude	Float (HE5T_NATIVE_FLOAT)	nEastingPixel, nNorthingPixel	Deg [-90 to 90]	Latitude for each pixel in the co-registered and orthorectified Hyperspectral image
		Longitude	Float (HE5T_NATIVE_FLOAT)	nEastingPixel, nNorthingPixel	Deg [-180 to 180]	Longitude for each pixel in the co-registered and orthorectified Hyperspectral image
	Geometric Fields	Solar_Zenith_Angle	Float (HE5T_NATIVE_FLOAT)	nHypAcrossPixel, nHypAlongPixel	Deg [0 to 90]	Solar Zenith Angle for each pixel in the co-registered Hyperspectral image

		Observing_Angle	Float (HE5T_NATIVE_FLOAT)	nHypAcrossPixel, nHypAlongPixel	Deg [0 to 90]	Angle between the local zenith and the satellite viewing direction for each pixel in the co-registered Hyperspectral image
		Rel_Azimuth_Angle	Float (HE5T_NATIVE_FLOAT)	nHypAcrossPixel, nHypAlongPixel	Deg [0 to 180]	Relative Azimuth Angle computed as difference between the satellite and sun azimuth angle (i.e. between observing direction and sun illumination direction) normalized in [0,180] for each pixel in the co-registered Hyperspectral image
	Geocoding Model	Model_ID	String (H5T_NATIVE_CHAR)	RPC00B		RPC00B required field
		SUCCESS	Flag (H5T_NATIVE_SHORT)	1 / 0		RPC00B required field
		ERR_BIAS	Float (H5T_NATIVE_FLOAT)	meters (0000.00 to 9999.99)		RPC00B required field
		ERR_RAND	Float (H5T_NATIVE_FLOAT)	meters (0000.00 to 9999.99)		RPC00B required field
		LINE_OFF	Float (H5T_NATIVE_SHORT)	samples (0000.00 to 9999.99)		RPC00B required field
		SAMP_OFF	Float (H5T_NATIVE_SHORT)	pixels (0000.00 to 9999.99)		RPC00B required field
		LAT_OFF	Float (H5T_NATIVE_FLOAT)	degrees (±90.0000)		RPC00B required field
		LONG_OFF	Float (H5T_NATIVE_FLOAT)	degrees (±180.0000)		RPC00B required field
		HEIGHT_OFF	Float (H5T_NATIVE_FLOAT)	meters (±9999)		RPC00B required field
		LINE_SCALE	Float (H5T_NATIVE_FLOAT)	samples (000001 to 999999)		RPC00B required field
		SAMP_SCALE	Float (H5T_NATIVE_FLOAT)	samples (000001 to 999999)		RPC00B required field

		LAT_SCALE	Float (H5T_NATIVE_FLOAT)	degrees (±90.0000)		RPC00B required field
		LONG_SCALE	Float (H5T_NATIVE_FLOAT)	degrees (±180.0000)		RPC00B required field
		HEIGHT_SCALE	Float (H5T_NATIVE_FLOAT)	meters (±9999)		RPC00B required field
		LINE_NUM_COEFF	Float array [20] (H5T_NATIVE_FLOAT)	±0.999999E±9 ---±0.999999E±9		RPC00B required field
		LINE_DEN_COEFF	Float array [20] (H5T_NATIVE_FLOAT)	±0.999999E±9 ---±0.999999E±9		RPC00B required field
		SAMP_NUM_COEFF	Float array [20] (H5T_NATIVE_FLOAT)	±0.999999E±9 ---±0.999999E±9		RPC00B required field
		SAMP_DEN_COEFF	Float array [20] (H5T_NATIVE_FLOAT)	±0.999999E±9 ---±0.999999E±9		

8.4.6 PRS_L2D_PCO SWATHS

The main data contained in the PRS_L2d_PCO Swath is the surface panchromatic reflectance image (in instrument geometric reference).

Swath		Name	Type	Dimensions	Unit	Description
PRS_L2D_PCO	Data Fields	Cube	Unsigned Short (HE5T_NATIVE_USHORT)	nEastingPixel, nNorthingPixel	Dimensionless (ratio)	Image data in the Panchromatic channel scaled to the range [0,65535]
		PIXEL_L2_ERR_MATRIX	Unsigned Char (H5T_NATIVE_UCHAR)	nPanAcrossPixel nPanAlongPixel	Enum 0=pixel ok 1=Invalid pixel from L1 product 2=Negative value after atmospheric correction 3=Saturated value after atmospheric correction	Mask that notifies if errors in pixel radiance processing has occurred. These are the values to be intended as a base. The actual values can be any combination of this base.
	Geolocation Fields	Time	Double (HE5T_NATIVE_DOUBLE)	nHypAlongPixel	MJD2000 Decimal days	UTC time for each frame in processing format (as read from L1 input product)
		Latitude	Float (HE5T_NATIVE_FLOAT)	nEastingPixel, nNorthingPixel	Deg [-90 to 90]	Latitude for each pixel in the co-registered and orthorectified Panchromatic image

		Longitude	Float (HE5T_NATIVE_FLOAT)	nEastingPixel, nNorthingPixel	Deg [-180 to 180]	Longitude for each pixel in the co-registered and orthorectified Panchromatic image
	Geocoding Model	Model_ID	String (H5T_NATIVE_CHAR)	RPC00B		RPC00B required field
		SUCCESS	Flag (H5T_NATIVE_SHORT)	1 / 0		RPC00B required field
		ERR_BIAS	Float (H5T_NATIVE_FLOAT)	meters (0000.00 to 9999.99)		RPC00B required field
		ERR_RAND	Float (H5T_NATIVE_FLOAT)	meters (0000.00 to 9999.99)		RPC00B required field
		LINE_OFF	Float (H5T_NATIVE_SHORT)	samples (0000.00 to 9999.99)		RPC00B required field
		SAMP_OFF	Float (H5T_NATIVE_SHORT)	pixels (0000.00 to 9999.99)		RPC00B required field
		LAT_OFF	Float (H5T_NATIVE_FLOAT)	degrees (±90.0000)		RPC00B required field
		LONG_OFF	Float (H5T_NATIVE_FLOAT)	degrees (±180.0000)		RPC00B required field
		HEIGHT_OFF	Float (H5T_NATIVE_FLOAT)	meters (±9999)		RPC00B required field
		LINE_SCALE	Float (H5T_NATIVE_FLOAT)	samples (000001 to 999999)		RPC00B required field
		SAMP_SCALE	Float (H5T_NATIVE_FLOAT)	samples (000001 to 999999)		RPC00B required field
		LAT_SCALE	Float (H5T_NATIVE_FLOAT)	degrees (±90.0000)		RPC00B required field
		LONG_SCALE	Float (H5T_NATIVE_FLOAT)	degrees (±180.0000)		RPC00B required field
		HEIGHT_SCALE	Float (H5T_NATIVE_FLOAT)	meters (±9999)		RPC00B required field
		LINE_NUM_COEFF	Float array [20] (H5T_NATIVE_FLOAT)	±0.999999E±9 --- ±0.999999E±9		RPC00B required field
		LINE_DEN_COEFF	Float array [20] (H5T_NATIVE_FLOAT)	±0.999999E±9 --- ±0.999999E±9		RPC00B required field
		SAMP_NUM_COEFF	Float array [20] (H5T_NATIVE_FLOAT)	±0.999999E±9 --- ±0.999999E±9		RPC00B required field
		SAMP_DEN_COEFF	Float array [20] (H5T_NATIVE_FLOAT)	±0.999999E±9 --- ±0.999999E±9		

8.4.7 KDP_AUX

This section contains the vector of LOS, and the matrix of CW and FWHM extracted form KDP by interpolation of them according to the temperature of the optical bench associated to the current L1 product. They are copied from the Level 1b product with the following structure:

HDF5 (root).	Group	Dataset
	KDP_AUX	Cw_Swir_Matrix
		Cw_Vnir_Matrix
		Fwhm_Swir_Matrix
		Fwhm_Vnir_Matrix
		LOS_Pan
		LOS_Swir
		LOS_Vnir

. See Section 7.6.5 for detailed information.

9. LEVEL 0 QUICKLOOK

Although not properly a PRISMA product, a thumbnail image is available by the PRISMA web catalogue to provide an RGB preview of the catalogued products.

Level 0 QuickLook is generated starting from Level 0 product.
The result of the Level 0 QuickLook processing, i.e. the image quicklook (thumbnail) and is associated to Level 0 product and stored in the PRISMA catalogue.

The purpose of the Level 0 Quicklook is to be associated to the archived product in order to be shown to the user that “browses” the PRISMA products catalogue, helping it to support products selection by a very simple visualization of the selected image(s).
No other purposes are foreseen for this image, that is, Level 0 Quicklook is not a self-standing product to be requested/downloaded by the PRISMA user.

Level 0 products used as input of quicklook (L0 QLK) generation are not calibrated, not geometrically neither radiometrically.
No calibration will be performed by L0 Quicklook processor (this step will be done by level 1 processor). Therefore the resulting quicklook will be relative to uncalibrated (raw) level 0 data.
Colour enhancing/balancing is done in order to improve the quicklook visualization characteristics.

The main steps of the processor are summarized below:

- Sampling type decision (RGB or grey scale, depending on the availability of relevant wavebands in the acquired image)
- Quicklook (thumbnail) generation, including mainly
    - Level 0 images reading and Undersampling
    - Quicklook (thumbnail) colour balancing/enhancing

In the following, such steps are described in details and relevant image processing algorithms is summarized.

9.1 SAMPLING TYPE DECISION

The first step of Level 0 Quicklook generation process is the decision to generate an RGB version or a grey scale version of the Level 0 image.
As PRISMA allows to acquire images by selecting the wavebands of interest, it is possible that RGB channels are in part or completely missing in the image.
It has also to be considered that an incorrect instrument working may cause absence or unavailability of some channels in part of in the whole image.
Therefore it is necessary to define, by a rule, how to proceed to generate the quicklook.

A simple, but very effective rule, is the one adopted for this processor.
If the channels required to generate a meaningful and reliable RGB representation of the hyperspectral image are present the RGB will be generated. Otherwise, the quicklook will be generated in grey scale.

The channels required to generate the RGB quicklook are set as configurable parameters of the processor, in order to be modifiable during the mission lifetime.
In case of absence of the wavebands needed to generate the RGB quicklook, the alternative solution to generate a grey scale quicklook is taken.

Below are listed the set of checks that are done in order to verify that the spectral channels measurements suitable to generate the RGB version of the quicklook are available.

- Verify that the wavebands needed to generate the RGB quicklook are present: compare the wavebands acquired with the list of waveband read by the configuration parameters. If for each channel (R, G and B) at least a predefined percentage of channels are available the RGB quicklook can be generated, otherwise the grey scale quicklook will be generated
- Verify the quality of the spectral input L0 data: scanning the (level 0) hypercube, searching for invalid pixel values (e.g. null values, full scale values, outliers). If the percentage of invalid pixels for one or more RGB waveband is larger than a predefined threshold the grey scale quicklook will be generated. If such threshold is never reached, the RGB quicklook will be generated

If RGB channels are not available (or not enough to generate a reliable RGB quicklook) and the grey scale quicklook is generated, a check to verify if the wavelengths selected for the grey scale quicklook generation are available is performed.
If not enough wavelengths are available (it could happen if, for example, only the SWIR channels are acquired and the grey scale interval selected by the configuration parameters is in the VNIR side of the spectrum), then all wavelengths acquired will be used to generate the grey scale quicklook.

9.2 QUICKLOOK GENERATION

Once the quicklook type, RGB/Grey scale, has been selected according to the availability of the image wavebands present in the Level 0 input product, the process goes ahead with the generation of the quicklook image.
It consists of two main steps:

- The level 0 image spatial and spectral undersampling
- The colour balancing/enhancing of the resulting quicklook image

The level 0 image spatial and spectral undersampling consist mainly on a spectral and spatial average of the Digital Number measurements of the hypercube. No calibration or radiometric/geometric corrections are performed before undersampling.

9.2.1 SPATIAL AND SPECTRAL UNDERSAMPLING

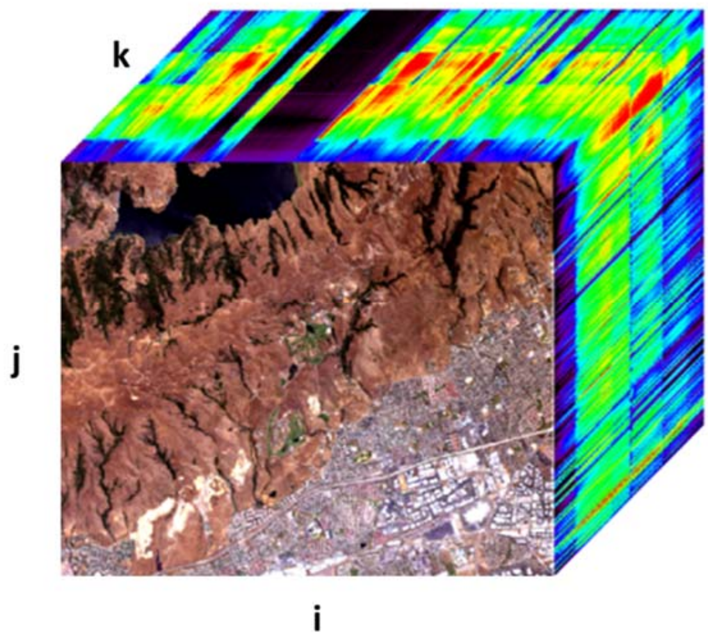


Figure 9-1: Hypercube image scheme

Considering the scheme of the hypercube image reported in Figure 9-1, let the pixels numbered by the indexes:

- i” left to right in the cross-track direction
- “j” bottom to top in the along track direction
- “k” from the smaller (VIS) to the larger (SWIR) wavelenght

The first step is the spectral averaging. For each pixel (i,j) the spectral average is done by performing a weighted average over the spectral samples within the RGB or grey margins (depending on the previous choice to generate an RGB or a grey scale quicklook).
Weighting average is based on the spectral samples distribution.
In case of missing/wrong (spectral) data, it could be not meaningful the calculation of the spectral average. This happens when there are not enough spectral samples within the selected spectral interval (R, G, B or grey).

Therefore, for each spectral average, a preliminary check is done to ensure that there is a suitable number of samples.
If there are several invalid samples, the spectral average is not performed and such I,j averaged pixel is marked as invalid by assigning it a special value (e.g. a negative value).

Spectral average of the image pixels generates a one or three layer i-j matrix depending on the quicklook type selection (RGB or grey-scale). Invalid pixels, if present, are "flagged" by the value that has been assigned to them.
In the second step, the spatial average is calculated for each image layer (R, G, B in case of RGB quicklook or for the unique layer in case of grey-scale quicklook).
The spatial average is obtained by averaging all valid pixels in a square moving window which dimensions are equal to the scaling factor. The resulting quicklook will have the dimension equal the full image dimensions divided by the scaling factor (plus 1 in case of non-integer division result).
Invalid pixels within the moving window will not be considered in the spatial average. In case of presence of several invalid pixels, the average is not performed and its value is set to a conventional value.

9.2.2 COLOUR BALANCING/ENHANCEMENT

In order to improve quicklook appearance, a color adjustment is applied to RGB/grey scale quicklook. The aim is to enhance the image contrast and to balance RGB color channels (in case of RGB quicklook).
To do this a statistic analysis of the image signal is performed in order to rescale it to a range derived by its statistic distribution.
Therefore, in case of grey-scale quicklook, simply, the image signal statistic is obtained by calculating the histogram of the signal distribution, within the minimum and the maximum intensity value on the whole image. An example of the histogram is shown in Figure 9-2.

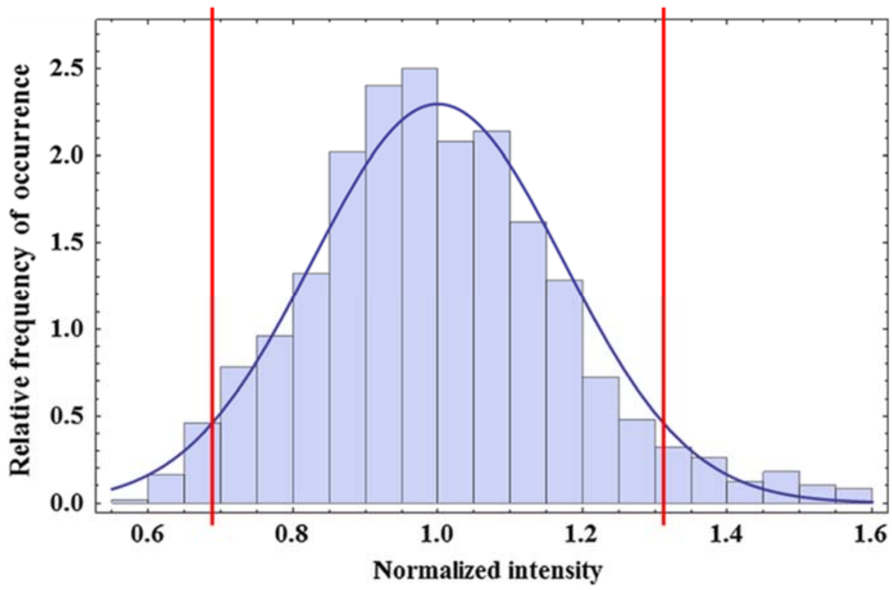


Figure 9-2: Example of image intensity distribution and the rescaling boundaries (in red)

Once the histogram(s) (one in case of grey-scale quicklook, three one for each R, G, B layer in case of RGB quicklook) has been calculated, the lower and the upper rescaling boundaries are evaluated.
These correspond to intensity thresholds (margins) such that a certain percentage of samples (pixels) have an intensity value outside such margins.
For example, if the "lower percentage" is set to 2%, the lower threshold/margin will be the intensity value such that all pixels with intensity lower than the lower threshold are the 2% of the whole image pixels. The same is for the upper threshold, for both the single layer in case of grey-scale quicklook and the three colour layers in case of RGB quicklook.

Once calculated these thresholds/margins, the intensity of each pixel of the layer is linearly rescaled between these two margins in 256 intervals equally spaced (corresponding to an 8 bit per layer representation). A check on the distribution of the resulting rescaled intensity is performed to verify that the rescaled intensity are spread along the 256 bins, in order to prevent distorted/not meaningful quicklook (e.g. in case of highly saturated images or very dark images).

If so, the rescaling is repeated along the overall range of intensity (i.e. putting to zero the upper and lower percentage of that layer) and the check is repeated.
If the problem remains the quicklook is generated without “cutting” the edges.

Rescaling in 256 intervals (bins) means to generate an 8 bit grey-scale or 24 bit RGB image, which is a quite common graphical representation.
Applying the upper and lower thresholds percentages will put to “black” low signal areas and to “white” high signal areas.
For the grey scale quicklook the corresponding effect is an increase of the contrast. For RGB quicklook a colour balance for the R, G and B channels is also accomplished.
Very brilliant targets (e.g. clouds) will appear as saturated and therefore “white”. Very dark signals (e.g. open sea, dark shadows, etc.) could appear as black areas.
Small intensity differences in the image will be enhanced in the quicklook, allowing identification of shapes, patterns and features.

9.2.3 QUICKLOOK IMAGE GENERATION

The last processing step is the conversion of the grey scale or RGB bitmap quicklook in a graphic format.
The selected format is the jpeg without compression.
Below an example of the appearance of a PRISMA quicklook image is shown.

Figure 9-3: An example of a PRISMA quicklook image

10. HDF5 AND HDF-EOS5 FORMAT OVERVIEW

The Hierarchical Data Format (HDF5) is the standard data storage format selected by the Earth Observing System Data and Information System (EOSDIS) Core System (ECS) (see[RD-11]). HDF5 is developed and maintained by the National Center for Supercomputing Applications (NCSA) at the University of Illinois (http://ncsa.uiuc.edu).

HDF5 is designed to allow sharing of self-describing files across heterogeneous platforms. "Self-describing" means that a data set, such as a multidimensional array of numbers, can have additional metadata logically associated with it that describe things such as the rank of the array, number of elements in each dimension, etc. The ability to access files across heterogeneous platforms is a powerful capability that allows one to reads files generated on different machine architectures.

To achieve the above capabilities, HDF5 borrows from the principles of object-oriented programming. Multidimensional arrays, tables and images can be stored in the same file and viewed as discrete objects, rather than a continuous stream of bits. The user can understand the content of the file being accessed in terms of the various HDF5 data object types. The next section describes these data object types, while Appendix in sect.9 describes the availability of common libraries and tools used to support read and write access to these objects.

10.1 HDF5 FILE STRUCTURE

HDF5 files consist of a directory and a collection of data objects. Every data object has a directory entry, containing a pointer to the data object location, and information defining the datatype. There are only two fundamental data objects in HDF5. These objects are groups and dataspaces.
HDF5 files are organized in a hierarchical structure, with two primary structures:

- groups
- datasets

Both Groups and Datasets may have attributes (see sec. 10.1.4).

A grouping structure contains instances of zero or more groups or datasets, together with supporting metadata. Any HDF5 group or dataset may have an associated attribute list. An HDF5 attribute is a user-defined HDF5 structure that provides extra information about an HDF5 object. Attributes are described in more detail below.

The hierarchical organization of the HDF5 format is graphically represented in Figure 10-1.

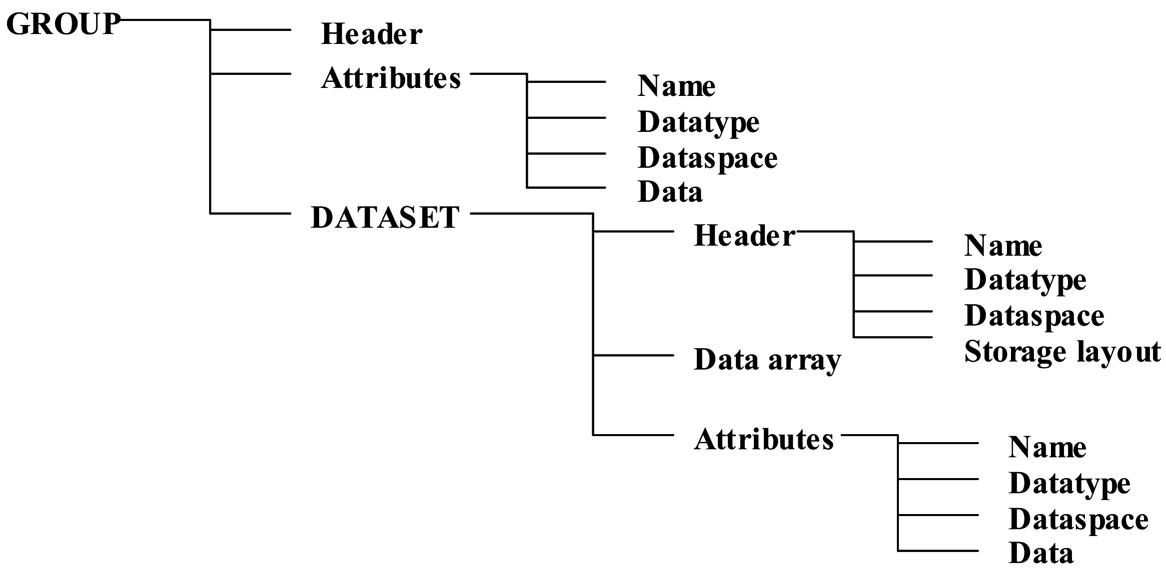


Figure 10-1 HDF5 organization

10.1.1 GROUPS

An HDF5 group is a structure containing zero or more HDF5 objects. A group has two parts:

- A *group header*, which contains a group name and a list of group attributes.
- A *group symbol table*, which is a list of the HDF5 objects that belong to the group.

Working with groups and group members is similar in many ways to working with directories and files in UNIX. As with UNIX directories and files, objects in an HDF5 file are often described by giving their full (or absolute) path names:

/ signifies the root group.

/foo signifies a member of the root group called foo.

/foo/zoo signifies a member of the group foo, which in turn is a member of the root group.

10.1.2 DATASETS

A dataset is a multidimensional array of data elements, together with supporting metadata.
A dataset is stored in a file in two parts

- A header
- A data array.

10.1.3 DATASET HEADER

The header contains information that is needed to interpret the array portion of the dataset, as well as metadata (or pointers to metadata) that describes or annotates the dataset. Header information includes the name of the object, its dimensionality, its number-type, information about how the data itself is stored on disk, and other information used by the library to speed up access to the dataset or maintain the file's integrity.

There are four essential classes of information in any header:

- Name
- Datatype
- Dataspace
- Storage layout:

10.1.3.1.1 NAME

A dataset name is a sequence of alphanumeric ASCII characters.

10.1.3.1.2 DATATYPE

HDF5 allows one to define many different kinds of datatypes. There are two categories of datatypes:

- atomic datatypes (which differentiates in system-specific, or NATIVE, and named);
- compound datatypes (which can only be named).

Atomic datatypes include integers and floating-point numbers. Each atomic type belongs to a particular class and has several properties: size, order, precision, and offset. In this introduction, we consider only a few of these properties.

Atomic classes include integer, float, date and time, string, bit field, and opaque.

Properties of integer types include size, order (endian-ness), and signed-ness (signed/unsigned).

Properties of float types include the size and location of the exponent and mantissa, and the location of the sign bit.

The datatypes that are supported in the current implementation are:
- Integer datatypes: 8-bit, 16-bit, 32-bit, and 64-bit integers in both little and big-endian format.
- Floating-point numbers: IEEE 32-bit and 64-bit floating-point numbers in both little and big-endian format.
- References.
- Strings.

Although it is possible to describe nearly any kind of atomic data type, most applications will use predefined datatypes that are supported by their compiler. In HDF5 these are called ***NATIVE datatypes***.
NATIVE datatypes are C-like datatypes that are generally supported by the hardware of the machine on which the library was compiled. In order to be portable, applications should almost always use the NATIVE designation to describe data values in memory.
The NATIVE architecture has base names that do not follow the same rules as the others. Instead, native type names are similar to the C type names.

Compound datatypes are a collection of simple datatypes that are represented as a single unit, similar to a struct in C. The parts of a compound datatype are called members. The members of a compound datatype may be of any datatype, including another compound datatype. It is possible to read members from a compound type without reading the whole type.
Normally each dataset has its own datatype, but sometimes we may want to share a datatype among several datasets. This can be done using a Named datatype. A named data type is stored in the file independently of any dataset, and referenced by all datasets that have that datatype. Named datatypes may have an associated attributes list. See Datatypes in the HDF User's Guide for further information.

10.1.3.1.3 DATASPACE

A dataset dataspace describes the dimensionality of the dataset. The dimensions of a dataset can be fixed (unchanging), or they may be unlimited, which means that they are extendible (i.e. they can grow larger).

Properties of a dataspace consist of the rank (number of dimensions) of the data array, the actual sizes of the dimensions of the array, and the maximum sizes of the dimensions of the array. For a fixed-dimension dataset, the actual size is the same as the maximum size of a dimension. When a dimension is unlimited, the maximum size is set to a value given by the internal variable H5P_UNLIMITED.
HDF5 requires using chunking in order to define extendible datasets. Chunking makes it possible to extend datasets efficiently, without having to reorganize storage excessively (see next section).

The following operations are required in order to write an extendible dataset:
- Declare the dataspace of the dataset to have unlimited dimensions for all dimensions that might be potentially extended.
- Set dataset creation properties to enable chunking and create a dataset.
- Extend the size of the dataset.

A dataspace can also describe portions of a dataset, making it possible to do partial I/O operations on selections.

Given an n-dimensional dataset, there are currently four ways to do partial selection:
- Select a logically contiguous n-dimensional hyperslab.
- Select a non-contiguous hyperslab consisting of elements or blocks of elements (hyperslabs) that are equally spaced.
- Select a union of hyperslabs.
- Select a list of independent points.

Since I/O operations have two end-points, the raw data transfer functions require two dataspace arguments: one describes the application memory dataspace or subset thereof, and the other describes the file dataspace or subset thereof.

10.1.3.1.4 STORAGE LAYOUT

The HDF5 format makes it possible to store data in a variety of ways. The default storage layout format is contiguous, meaning that data is stored in the same linear way that it is organized in memory. Two other storage layout formats are currently defined for HDF5: compact, and chunked.

Compact storage is used when the amount of data is small and can be stored directly in the object header.

Chunked storage involves dividing the dataset into equal-sized "chunks" that are stored separately. Chunking has three important benefits.

- It makes it possible to achieve good performance when accessing subsets of the datasets, even when the subset to be chosen is orthogonal to the normal storage order of the dataset.
- It makes it possible to compress large datasets and still achieve good performance when accessing subsets of the dataset.
- It makes it possible efficiently to extend the dimensions of a dataset in any direction.

10.1.4 HDF5 ATTRIBUTES

An HDF5 attribute is small named datasets that can be attached to one of the following structures:

- primary datasets
- groups
- named datatypes

An HDF5 attribute is a small metadata object describing the nature and/or intended usage of a primary data object. An attribute has two parts

- name
- value

The value part contains one or more data entries of the same datatype.
Attributes are assumed to be very small so they are always stored in the object header of the object they are attached to. HDF5 attributes are therefore managed through a special attributes interface, H5A, which is designed to easily attach attributes to primary data objects as small datasets containing metadata information and to minimize storage requirements. When accessing attributes, they can be identified by name or by an index value. The use of an index value makes it possible to iterate through all of the attributes associated with a given object.

10.2 EXTENSION OF HDF5 TO HDF-EOS5

EOSDIS has defined an extension called HDF-EOS5 that establishes standards for storing EOS data and for applying search services to these data (see [RD-11]). To bridge the gap between the needs of EOS data products and the capabilities of HDF5, four new EOS specific datatypes – point, swath, grid, and zonal average - have been defined. Each of these new datatypes is constructed using conventions for combining standard HDF5 datatypes and is supported by a special application programming interface (API) which aids the data product user or producer in the application of the conventions. The APIs allow data products to be created and manipulated in ways appropriate to each datatype, without regard to the actual HDF5 objects and conventions underlying them. The sum of these new APIs comprises the HDF-EOS5 library.

HDF-EOS5 provides additional features compared with HDF5:

- **A means of storing geolocated data in remote sensing missions.** ECS has defined three new datatypes, composed of standard HDF5 objects:
  - ***Point interface***, designed to support data that has associated geolocation information, but is not organized in any well defined spatial or temporal way.
  - ***Swath interface,*** tailored to support time-ordered data such as satellite swaths (which consist of a time-ordered series of scanlines), or profilers (which consist of a time-ordered series of profiles).
  - ***Grid interface,*** designed to support data that has been stored in a rectilinear array based on a well defined and explicitly supported projection.

- ***Zonal Average interface,*** designed to support data that has not associated with specific geolocation information.

- **A means of providing system wide search services.** Operations software writes special metadata summarizing temporal and spatial coverage of the data, data quality, and production status into the data products. The complete set of metadata is written in the product files in a global attribute as a contiguous block of text. That is, individual fields are not written as individual attributes; rather, the *collection of fields taken together is written as a single attribute.*

- **Four Types of Attributes.** There are four different types of attributes in HDF-EOS5 – global attributes, object attributes, group attributes, and local attributes. A Global Attributes refer to the whole hdf5 files content. An Object Attribute refers to a specific object (such as a Swath). A Group Attribute refers to a single group. A Local Attribute is a field attribute associated with a Data Field.

The last released version of HDF-EOS library is the HDF-EOS5 version 1.13 (August 2010) written in conjunction with HDF5 and which uses HDF5 functionality. The new HDF5-based library will support the same Grid/Point/Swath/Zonal Average functionality and to the extent possible it will be built with the same calling sequences as the original library.

The next section describes the Swath datatype, while Appendix sect.9 describes the availability of common libraries and tools used to support read and write access to these objects.

10.2.1 OVERVIEW OF THE SWATH DATATYPE

The PRISMA instrument acquires images in push-broom modalities that enables the instrument to collect science data in a series of time-ordered scans, as sketched in Figure 10-2. The Swath data type is designed to store data measured in such a fashion, and Level 1 accordingly uses the Swath data type to record science data. This illustrates that scan lines are perpendicular to the direction of motion of the satellite ground track.

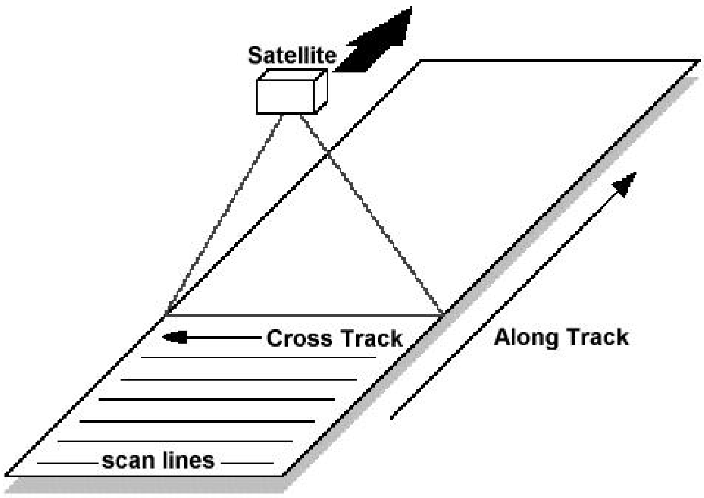


Figure 10-2: Schematic of a PRISMA Observation Swath.

The purpose of the swath is simply to map science data to specific points on the Earth's surface. The swath consists of four parts:

- ***data fields***: Data fields are the main part of a Swath from a science perspective. Data fields usually contain the raw data (often as counts) taken by the sensor or parameters derived from that data on a value-for-value basis. All the other parts of the Swath exist to provide information about the data fields or to support particular types of access to them. Data fields typically are two-dimensional arrays, but can have as few as one dimension or as many as eight, in the current library implementation. They can have any valid C data type.
- ***geolocation fields***: Geolocation fields allow the Swath to be accurately tied to particular points on the Earth's surface. To do this, the Swath interface requires the presence of latitude/longitude field pair

(“Latitude” and “Longitude”). Geolocation fields must be either one- or two-dimensional and can have any data type.

- ***dimensions*.** Dimensions define the axes of the data and geolocation fields by giving them names and sizes. Every axis of every data or geolocation field, then, must have a dimension associated with it.
- ***dimension maps***. Dimension Maps define the relationship between the data fields and the geolocation fields by defining, one-by-one, the relationship of each dimension of each geolocation field with the corresponding dimension in each data field. When the geolocation dimensions have a different size than the data dimension, an offset and an increment define the relation between them. Example of DimensionMap is reported in Figure 10-3.

The Swath chunking is also supported in HDF-EOS5 and it is required in order to define extendible Swaths.

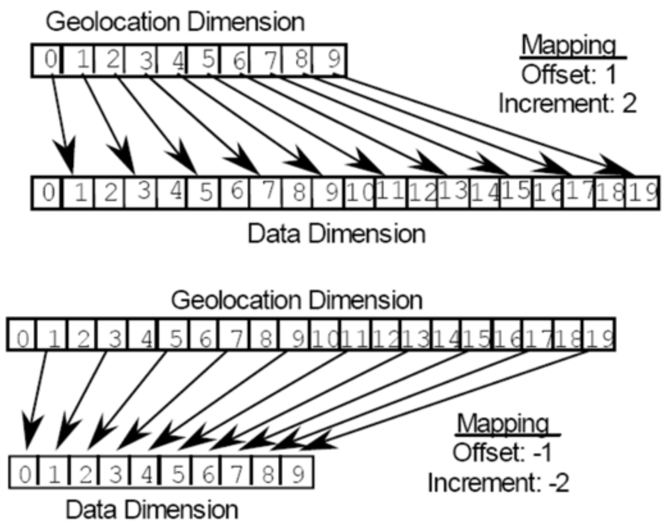


Figure 10-3: Example of Dimension Map. Upper panel: “Forward”; Lower panel “backward”

11. AVAILABILITY OF HDF AND HDF TOOLS

11.1 AVAILABILITY OF HDF5

The currently available release of HDF5 library is 1.8.5-patch-1 (August 2010). The NCSA HDF5 Homepage at http://www.hdfgroup.org/HDF5/ provides product updates and documentation. This homepage also contains a link to User's Guide and Tutorial as well as to programming examples.

11.2 SDP TOOLKIT

The SDP toolkit provides the interface between EOS science data production software and the remainder of the Science Data Production System. It allows portability of science software across approved platforms.

Information on the current release can be found at: http://newsroom.gsfc.nasa.gov/sdptoolkit/toolkit.html.

The SDP Toolkit is available via anonymous ftp from ftp://edhs1.gsfc.nasa.gov/edhs/ (following the instructions reported at http://newsroom.gsfc.nasa.gov/sdptoolkit/mail_tk5217.txt).

11.3 HDF-EOS5

The HDF-EOS5 library is used to write and access HDF-EOS5 data. This library consists of standard HDF5 with ECS conventions for point, grid and swath metadata added; these allow the file contents to be queried by time and geolocation.

The currently available release of HDF-EOS5 library is 1.13 (August 2010). The library, with its documentation, may be downloaded from the HDF-EOS Standards and Tools and Information Center at http://hdfeos.org/software or via anonymous ftp from ftp://edhs1.gsfc.nasa.gov/edhs/ (following the instructions reported at http://newsroom.gsfc.nasa.gov/sdptoolkit/mail_tk5217.txt).

11.4 TOOLS FOR READING, WRITING AND DISPLAYING HDF-EOS5 FILES

11.4.1 HDFVIEW TOOL

HDFView is a visual tool for browsing and editing HDF5 files. The main functionalities of this tool are:

- view a file hierarchy in a tree structure
- create new file, add or delete groups and datasets
- view and modify the content of a dataset
- add, delete and modify attributes
- replace I/O and GUI components such as table view, image view and metadata view

It is freely available for a number of different platforms, including Windows, Solaris, Linux and AIX. Software, User’s Guide and Installation Instructions are avalable at webpage http://www.hdfgroup.org/hdf-java-html/hdfview/.

11.4.2 HDF-EOS5 STANDARDS AND TOOLS AND INFORMATION CENTER

The HDF-EOS5 Standards and Tools and Information Center has a number of tools available for extracting and displaying ECS metadata. The source code for Unix, Win '95 and Macintosh platforms may be downloaded from http://hdfeos.org/software.

11.4.3 EOSVIEW

EOSView is an HDF file verification tool. The contents of HDF files can be displayed and individual objects can be selected for display. Displays include Raster Images, datasets in tables, pseudocolor images of datasets, attributes, and annotations. Simple animations can be performed for a file with multiple raster images. A unique interface has been provided for handling HDF-EOS5 data structures. The Swath/Point/Grid interface uses only HDF-EOS5 library calls. The EOSView user will not see the underlying HDF structures but will be prompted for what parts of the structure they wish to view. Further info can be found here: https://newsroom.gsfc.nasa.gov/sdptoolkit/mailEOSV3_1.txt

11.4.4 HDF-EOS5 PLUG-IN FOR HDFVIEW

HDF-EOS5 plug-in for HDFView extends HDFView functionality for browsing any HDFEOS file
Detailed description: With HDF-EOS plug-in installed the HDFView functionality is extended for browsing any HDFEOS file; starting with a tree view of all top-level objects in an HDF file's hierarchy, such as Grid, Swath and Point data. HDFView with plug-in allows a user to descend through the hierarchy and navigate among the file's geo and data objects. With the extended tool users are also allowed to create, delete, and modify the value of HDF-EOS objects and attributes.Further information about HDF-EOS plugin is available at https://hdfeos.org/software/hdfeos_plugin.php

11.4.5 ENVI

HARRIS ENVI (https://www.harrisgeospatial.com/Software-Technology/ENVI) is a well known commercial image analysis software used by GIS professionals, remote sensing scientists and image analysts to extract meaningful information from imagery. Since version 5.5.3 it is natively capable to import the full range of PRISMA products.

11.4.6 IDL

HARRIS IDl (https://www.harrisgeospatial.com/Software-Technology/IDL) is a scientific programming language used across disciplines to create meaningful visualizations out of complex numerical data.

The IDL function `H5_BROWSER()` is able to read PRISMA products and allow to inspect both the metadata and to get the various layers of image data. Please notice that the IDL variable hosting one of the available PRISMA image layers (obtained using the “Import to IDL” funtion, see the picture below) is arranged as a matrix with indicization (columns, bands, rows). If you want to import such image into ENVI, you should rearrange indices to (columns, rows, bands).

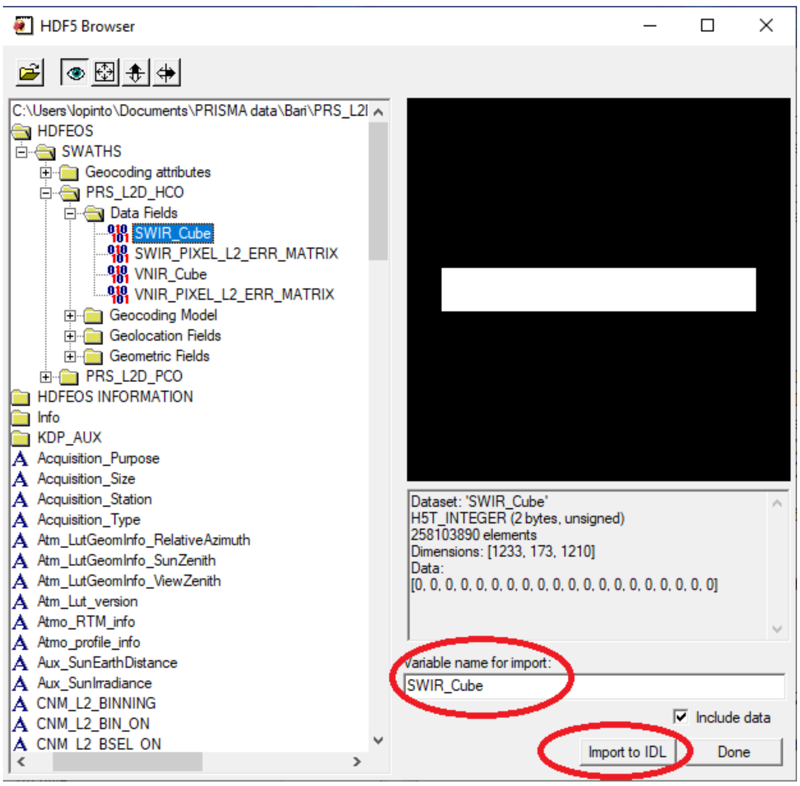


Figure 11-1: H5_BROWSER

11.4.7 PYTHON

Python (https://www.python.org/) is a well known Open Source programming language that lets you work quickly and integrate systems more effectively. It's distributed under a GPL-compatible licensing scheme (https://docs.python.org/3/license.html#history-and-license).

The following few lines of Python 3.x code, demonstrate how to open a PRISMA image, dump metadata and print a bunch of pixel data.

```
# first of all install h5py library from command line with pip install
h5py
# enable h5py
import h5py

# open the PRISMA file
f = h5py.File('PRISMA_image_filename_goes_here.he5', 'r')

# reading name and value for root attributes (metadata contained in HDF5
root)
for attribute in f.attrs:
     print(attribute,f.attrs[attribute])

# reading names for all attributes (metadata) contained in HDF5 Groups
# specific method for reading the values shall be built depending by the
# specific metadata type (a single value, an array, a matrix, etc)
def printname(name):
     print(name)

f.visit(printname)

# reading SWIR & VNIR datacubes; adjust the "PRS_L1_HCO" string portion
depending by the specific PRISMA product type (e.g. for L2D product use
PRS_L2D_HCO)
swir = f['/HDFEOS/SWATHS/PRS_L1_HCO/Data Fields/SWIR_Cube']
vnir = f['/HDFEOS/SWATHS/PRS_L1_HCO/Data Fields/VNIR_Cube']

# list the structure of SWIR data
swir.shape
# list the structure of VNIR data
vnir.shape

# print portions of the SWIR and VNIR bands; Adjust the sizes accordingly
to the specific PRISMA product type (L2 data has not the same 1000 by 1000
size of L1 data)
# band 0
swir[0:9,0,0:9]
vnir[0:9,0,0:9]

# band 170
swir[990:999,170,990:999]
# band 60
vnir[990:999,60,990:999]
```