The ASI Prisma Mission Status and Perspectives

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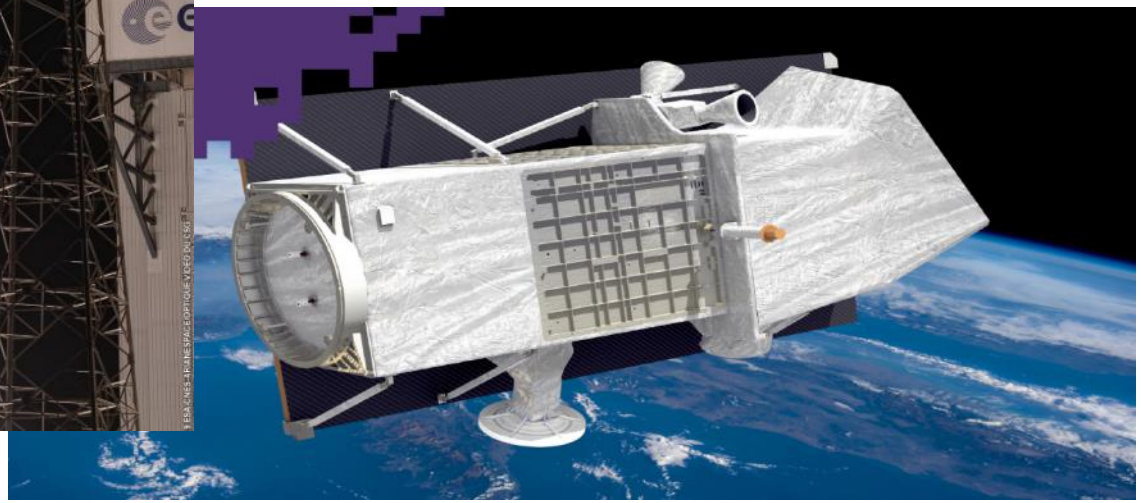
Outline

The PRISMA mission

- status
- project description
- mission overview, key performances, products
- data policy, data exploitation
- international collaborations
- GS, user access
- first results

PRISMA Launch

22nd March 2019
02:50 CET



Verification status

Payload first telemetries

24th March 2019 10:28 UTC
Temperatures and other data confirmed nominal behaviour.

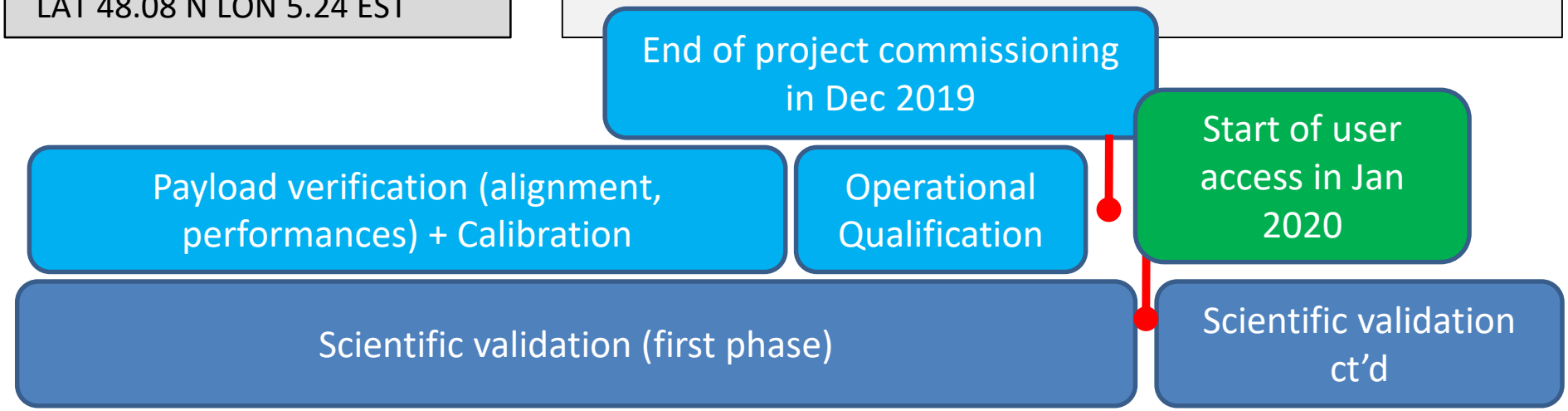
Payload "first light"

9th April 2019 10:44 UTC
pointing near Perrogney - Les Fontaines, Haute-Marne, France.
LAT 48.08 N LON 5.24 EST

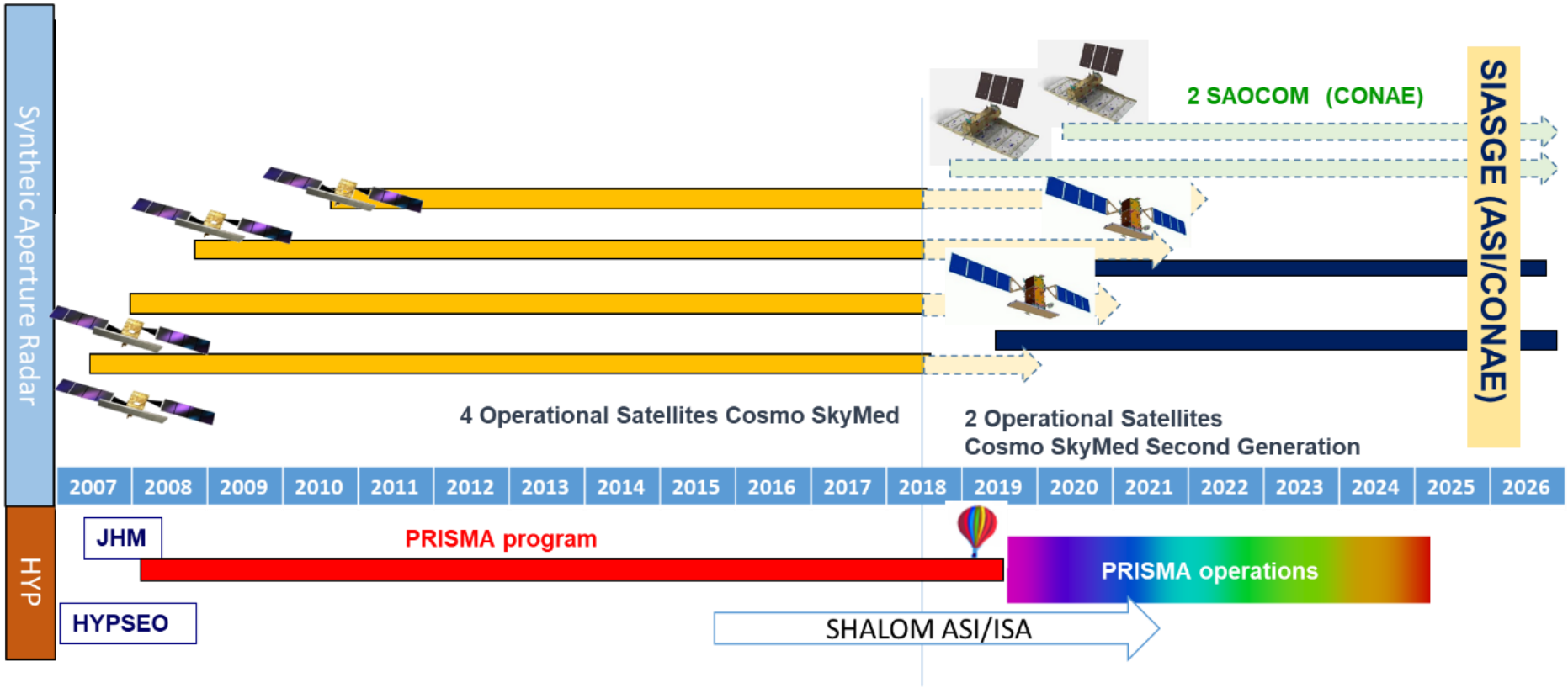
In-flight Commissioning status

Satellite & Payload verification completed, with sensor performances demonstrated using in flight data

Operational qualification of GS near to start



ASI sensors synergy

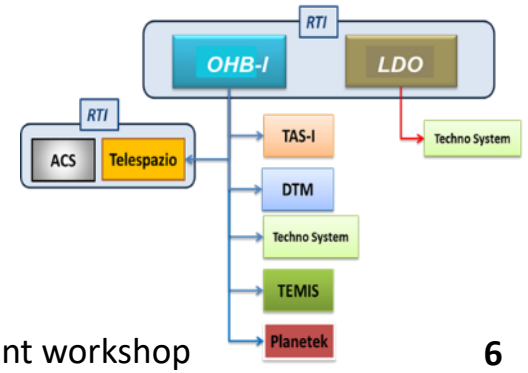


The PRISMA project

The PRISMA Payload is an electro-optical instrument for **Hyperspectral Earth observation**, composed of a high spectral resolution spectrometer optically integrated with a panchromatic camera.

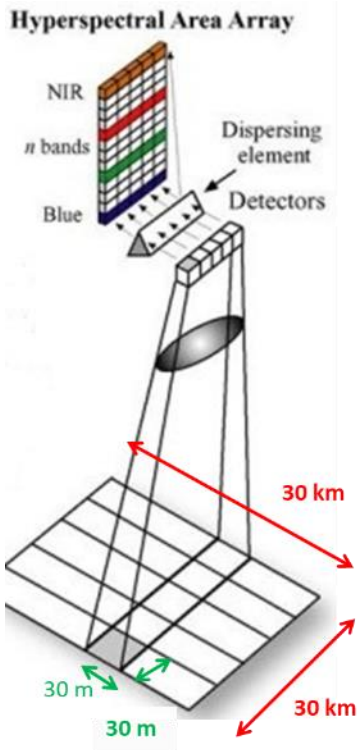
The Payload has been designed and manufactured by Leonardo, as part of a consortium including OHB-I and operating under the authority of the Agenzia Spaziale Italiana

Entire System has been designed by OHB Italia while Ground segment development has been in charge of Telespazio. Satellite Payload Data Handling system by Thales Alenia Space Italia and many important components realized by a large set of subcontractors (italian SMEs)



Mission Overview

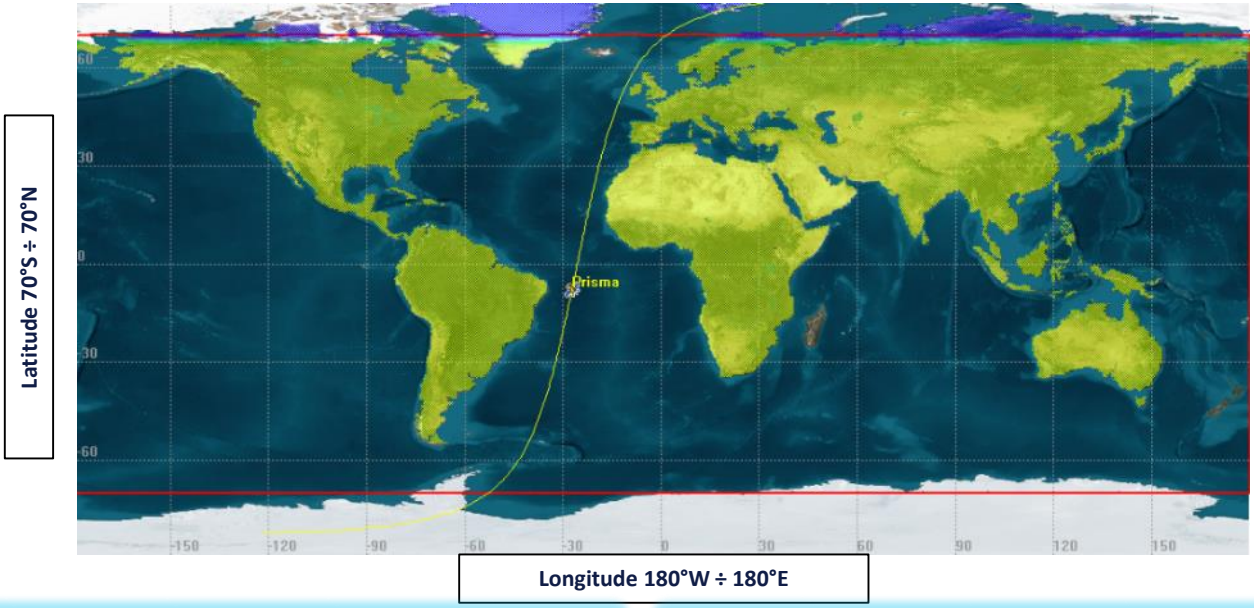
PRISMA: PRecursore IperSpettrale della Missione Applicativa



- National EO hyperspectral Mission fully funded by ASI.
- PRISMA - Contract signed between ASI and an Italian Industries Consortium led by OHB Italia and Leonardo
- Mission conceived as a
  - Pre-operational and technology demonstrator
  - Focus on
    - Space qualification of PAN/HYP payload
    - Development and production of PAN/HYP products up to Level 2d

- PRISMA P/L operates with a Pushbroom scanning concept.
- It records the radiation reflected from the Earth surface (spectral cubes) in 400nm – 2505nm spectral window
  - PAN range
  - 240 bands in VNIR / SWIR (partial overlap)
  - High spectral Resolution (much better of 14 nm)

Mission access



PRIMARY MODE – USER DRIVEN

Data Delivery based on user requests on areas of interest

❑ **Very urgent requests**

- Submitted by 'special users' and direct managed by the mission manager

❑ **Primary requests**

- CALVAL sites
- Nominal requests from all registered users
- Subject to quota and priority level

❑ **Background requests**

- Generated to fill system resources still available after planning of users requests

Performances

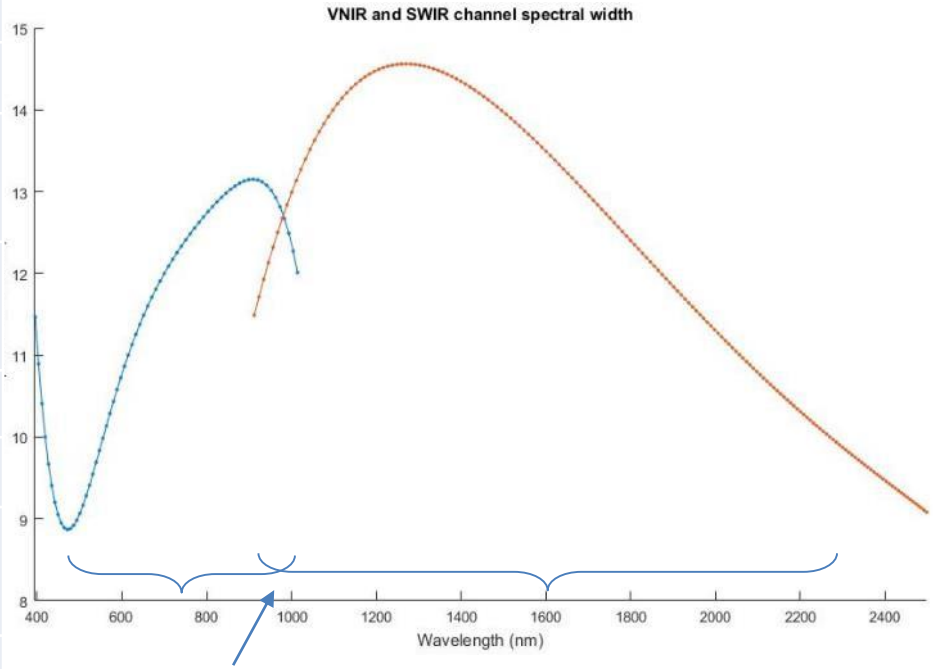
MISSION	
Orbit	LEO SSO, 620km, 10.30 LTDN
Lifetime	5 years
Coverage	Worldwide
Primary Mission mode	User driven (on-demand)
SYSTEM CAPACITY	
Swath	30 km, GSD: 30 m HYP, 5 m PAN
Data volume	daily > 200.000 km2 on all the 430/29 orbits/day
Daily products generation	daily processing of 200 hyperspectral scenes (30 km x 30 km) up to level 2d product.
SYSTEM LATENCIES	
Revisit time	< 29 days
Re-look time	< 7 days
Response time	< 14 days

Performances

SPACE SEGMENT	Single Satellite
Mass (Dry)	827 kg (202.5 kg Payload mass included)
Geometric Dimensions	Height, about 3 m
	Width x depth. about 1.9 m x 1.1 m
GROUND SEGMENT	
MCC/SCC	Mission & Satellite Control Centre: Fucino
IDHS	Image Data Handling Segment: Matera IDHS includes: Centro Nazionale Multimissione (CNM) L0/L1/L2 Processing Hyper-spectral Image Simulator (HSIS)
LAUNCH SEGMENT	
VEGA	Dedicated launch

Performances

Swath	30 Km
GSD	Hyperspectral: 30 m / PAN: 5 m
Spectral Range	VNIR: 400 – 1010 nm (66 spectral bands)
	SWIR: 920 – 2505 nm (174 spectral bands)
	PAN : 400 – 700 nm
SNR	VNIR: > 160:1 (>450:1 at 650nm)
	SWIR: > 100:1 (>360:1 at 1550nm)
	PAN: > 240:1
Spectral Width	≤ 14.5 nm



Performances

Specification	Design Value
Absolute geolocation	<200 m CE90
Geolocation with GCPs.	<0.5 HYP GSD CE90
PAN MTF at Nyquist	>0.2 (Payload>0.53)
VNIR MTF at Nyquist	>0.3 (Payload>0.65)
SWIR MTF at Nyquist	>0.3 (Payload>0.65)
HYP bands coregistration	<0.1 pixels

Specification	Design Value
accuracy of SWIR calibrated TOA radiance for unpolarized light	< 5%
accuracy of VNIR calibrated TOA radiance for unpolarized light	< 5%
Accuracy of the At-surface Reflectance	$\frac{\Delta\rho}{\rho} < 5\%$

Performances

- The system, when fully exploiting its resources, allows planning acquisition and download of 223 spot (30x30 Km) images per day, corresponding to 200.000 Km^2 , using all Hyperspectral/Panchromatic channels.
- The system allows processing 223 spot images per day up to level0 and generating corresponding quicklooks
- The system allows processing at least 200 Hyperspectral scenes (30x30 Km) up to level 2D per day starting from archived L0 products
- The system allows archiving products (downloaded data, L0 products and support data) for a minimum of 10 years

Products

Level 0 (Hyperspectral / PAN)

- formatted data product with appended metadata, including ancillary data and file formatting information (Archived data) in proprietary format

Level 1 (Hyperspectral / PAN) radiometrically corrected and calibrated radiance data in physical units

- Top-of-Atmosphere Spectral Radiance
- Cloud mask
- Sun-glint Mask
- Calibration and characterization data
- Classification Mask

Level 2b Geolocated at Ground Spectral Radiance Product (Hyperspectral / PAN)

Level 2c Geolocated At-surface Reflectance Product (Hyperspectral / PAN)

- Aerosol Characterization Product (VNIR)
- Water Vapour Map Product (Hyperspectral)
- Cloud Characterization

Level 2d Geocoded version of the level 2c products (Hyperspectral / PAN)

L1 and L2 product are disseminated in HD5 EOS format

PRISMA Data Policy

High level DATA POLICY (ASI-MoD)
for all the National and Public
Civil & Dual EO missions

PRISMA Mission Data Policy

Technical and legal principles to regulate access to mission products, in accordance with foreign policy and domestic security:

- Data policy principles
- Licence to use (terms and conditions of the service)

PRISMA Data Policy

- A simple policy is close to approval by ASI: Free of charge & quasi-Open data to all
- It will enter into force for a period of 1 year (renewable) starting with the opening of the access
- This will allow
  - to lower the PRISMA data access barriers (to new acquisitions and archived data too)
  - to expand the PRISMA user community
  - to simplify the data exploitation
  - to build customer loyalty to PRISMA data
  - to gather a feedback from users, unbiased by external factors like user nationality, data price, etc

PRISMA Data Policy

- A «quasi-Open» policy
  - Full support to National security needs
  - User Registration and Licence explicit acceptance is required
  - Each User will be allowed to use only a portion of the system resources, through Priority and Quota mechanisms
  - Products use is allowed for scientific research, R&D of new applications, prototype services, but NOT for commercial purposes
  - Products are costless for the users

Data Exploitation Strategy

- Science and User Community deeply involved
  - CAL/VAL activities for independent verification of data quality
  - PRISMA Advisory Group for data Exploitation supporting the definition/updating of the mission exploitation scenario
    - Mission performances monitoring
    - Background mission update
    - R&D activities for data exploitation algorithms and pre-operational products
    - Data Policy update (user groups, priorities, new licencesing schemes,…)
    - Support to collaborations with other bodies on HYP themes
- Development of a PRISMA Mission Exploitation Platform / PRISMA Toolbox
- Training & Outreach (Workshops, Education events,…)

Scientific Validation

After the end of the commissioning phase it is foreseen a structured three years CAL/VAL activity, which will be performed on instrumented sites distributed in Italy in support to:

- the performance characterization of the instrument;
- the verification and maintenance of mission performance over time;
- the effective use of data.

A systematic validation process is foreseen both during the commissioning phase and during the operational phase.

The Validation involves the assessment of the accuracy of data and products, over the relevant spatial, temporal and spectral domains.

Thematic areas	**Site**
Coastal Water	Lampedusa, Venezia
Snow	Torgnon, Plateau Rosa
Inland water	Lago Trasimeno, Lago di Garda
Agricultural areas	Grosseto, Basilicata, Tavoliere delle Puglie, Ferrara
Forests	Lavarone

International collaborations

ASI is fully open to define agreements with international bodies, in order to develop joint research projects, use the PRISMA system capacity, collaborate on CALVAL of the PRISMA sensor + products and in general exploit potential synergies between respective EO assets

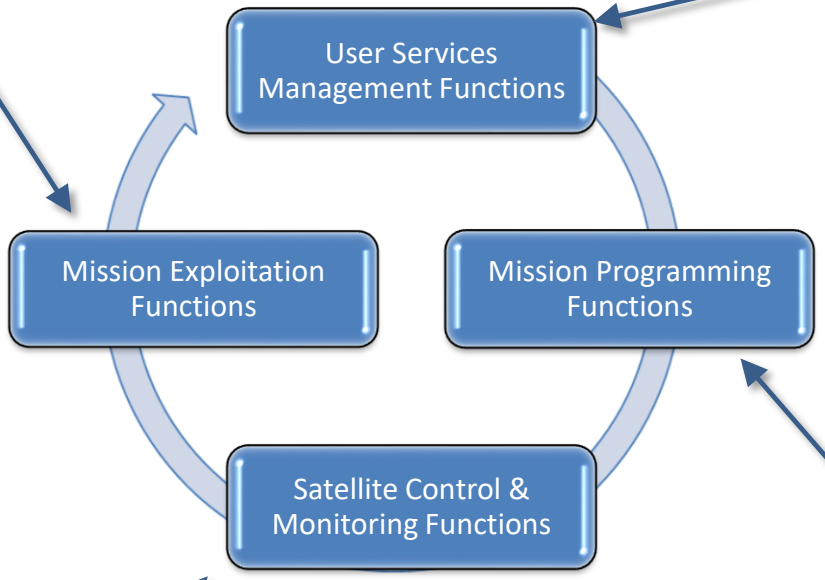
We are currently pursueing agreements with:

- CNES
  - ✓ Exchange of technical and scientific data over calibration sites managed by CNES and over CEOS-PICS (Pseudo Invariant calibration Sites)
  - ✓ Support to CALVAL activities
- DLR
  - ✓ Support to CAL/VAL by sharing test sites data, strategies, methodologies, results
  - ✓ Visibility about activities and results (thematic EO applications, L3/L4 product developments, etc)
  - ✓ Mission exploitation platforms/Toolboxes
  - ✓ Coordination of data acquisitions in support of joint scientific objectives
- ESA: CALVAL, joint acquisitions with CHRIS-PROBA-1, participation to joint scientific events

Ground Segment

- **Data acquisition**
  - XBand Satellite acquisition
  - RAW Image Data Reception
- **Data ingestion**
- **Data archiving**
- **Data processing**
  - - Level 0 Dec
  - - Level 0a Quick Look
  - - Level 0a
  - - Level 1
  - - Level 2b
  - - Level 2c
  - - Level 2d
- **Data distribution**

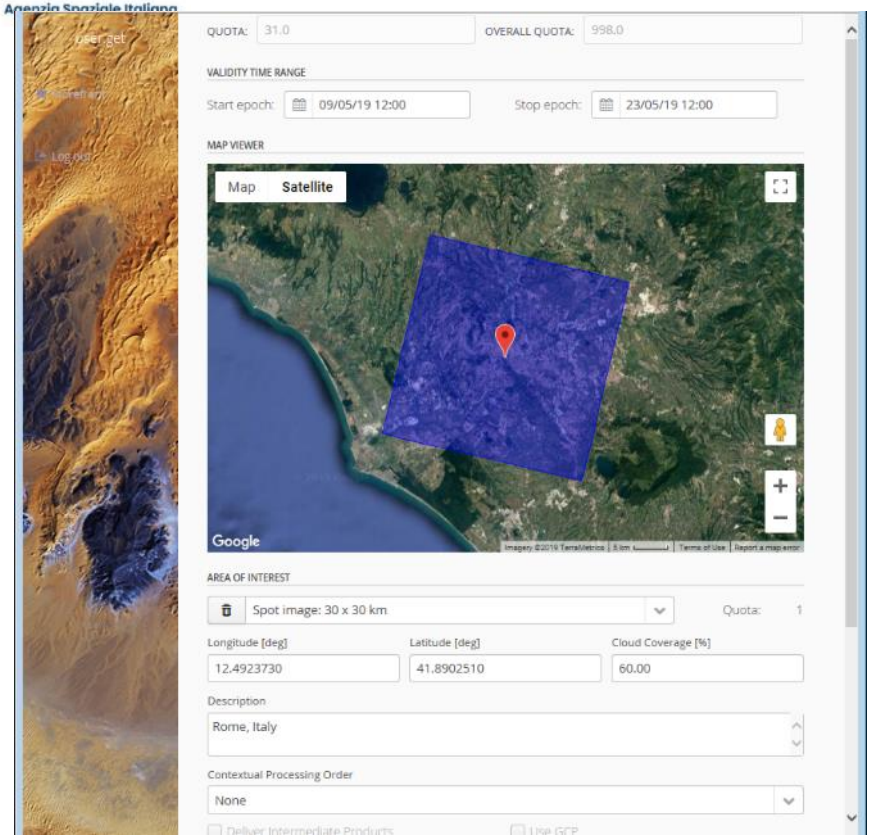
- **Telemetry e Command Handling**
  - Telemetry Acquisition and Telemetry Packets Quality Checking
  - Telemetry Processing
  - Telemetry Parameters Monitoring
  - Mission Database
  - On Board Models
  - Archiving
- **Flight Dynamics**
  - Orbit determination, propagation, Planning products generation
  - Manoeuvres calculation
  - Collision avoidance monitoring
- **Telemetry Tracking & Command**
  - SBand Satellite acquisition
  - TLM Reception
  - TLC Sending



- **User Registration, Management and Authentication**
- **Access and Browsing Catalogue**
- **Order Management for:**
  - new image acquisition
  - image already in archive
- **Request Status monitoring**
- **Help desk**
- **Product Delivery**

- **Acquisition request Ingestion and Verification**
- **Geometrical Feasibility Analysis**
- **Meteo Data Handling function**
- **Planning & Scheduling (conflict resolution)**
- **Short Term (Nominal) Plan generation**
- **Long Term (Contingency/Extended) Plan generation**
- **TC Scheduler generation**
- **Acquisition Plan generation**

User Access – New acquisitions



Validity Time: Time period to achieve a feasible DTO

Point of interest selection alternatives :

- Selection of point of interest on Map Viewer
- Latitude and Longitude editing on entry fields

Area of Interest type alternatives

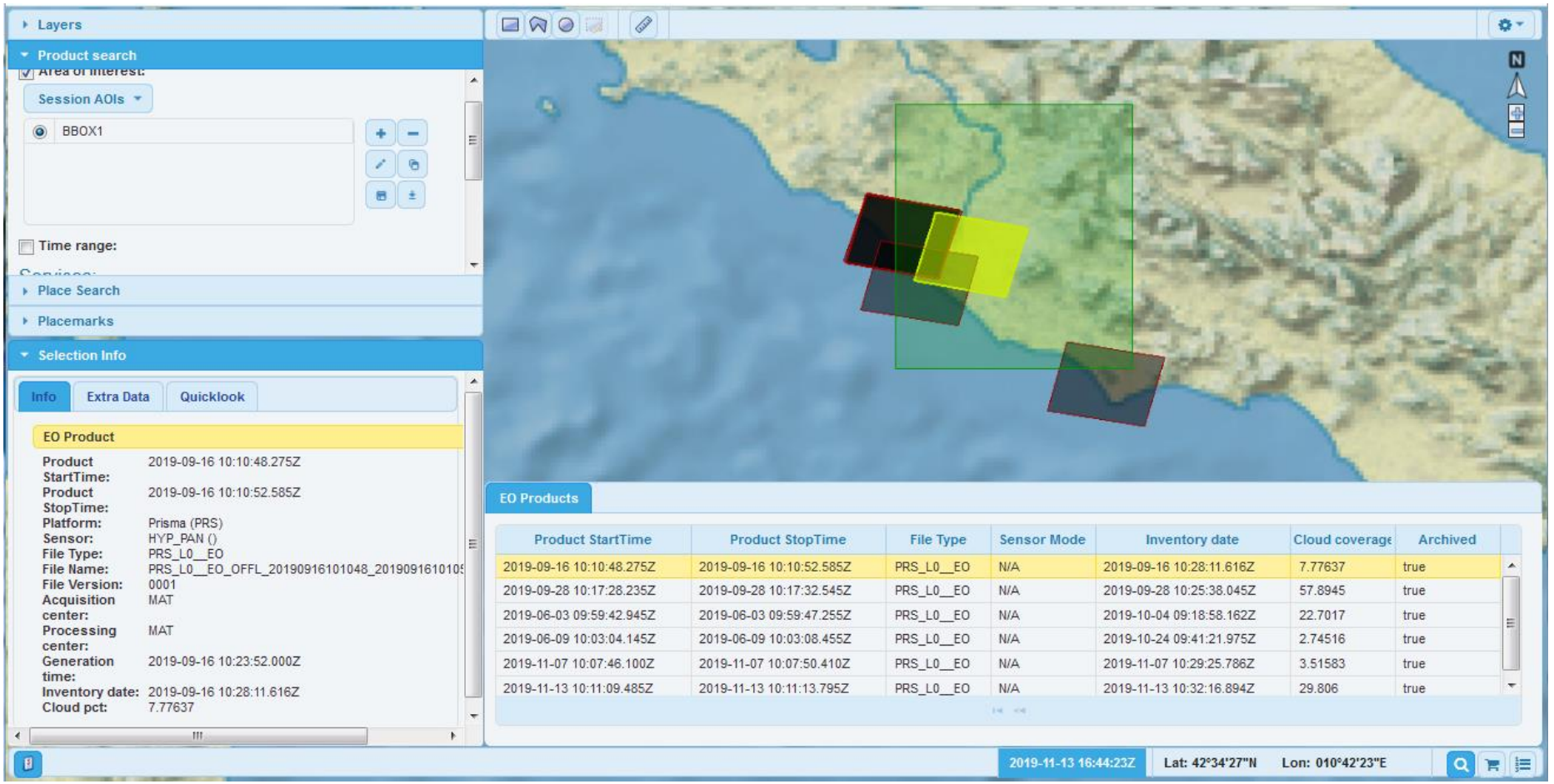
- Spot 30 x 30 km
- Stripmap 30 x 60 km
- Stripmap 30 x 90 km
- Stripmap 30 x 120 km
- Stripmap 30 x 150 km
- Stripmap 30 x 180 km
- Stripmap 30 x … km

Processing level required

- L1
- L2B, L2C, L2D

Multiple programming requests definition is possible

User Access – Archive data

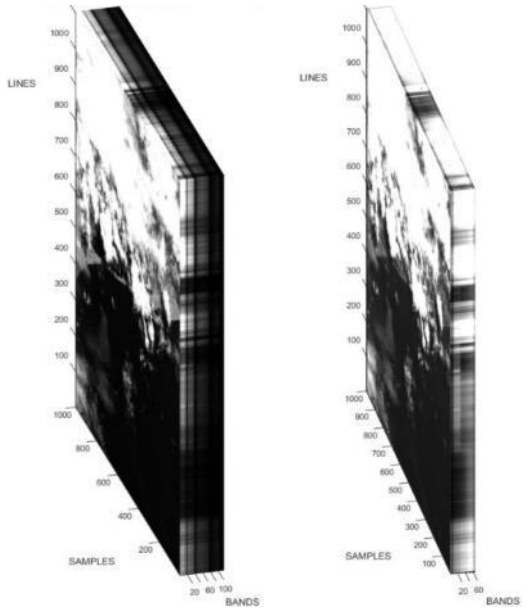


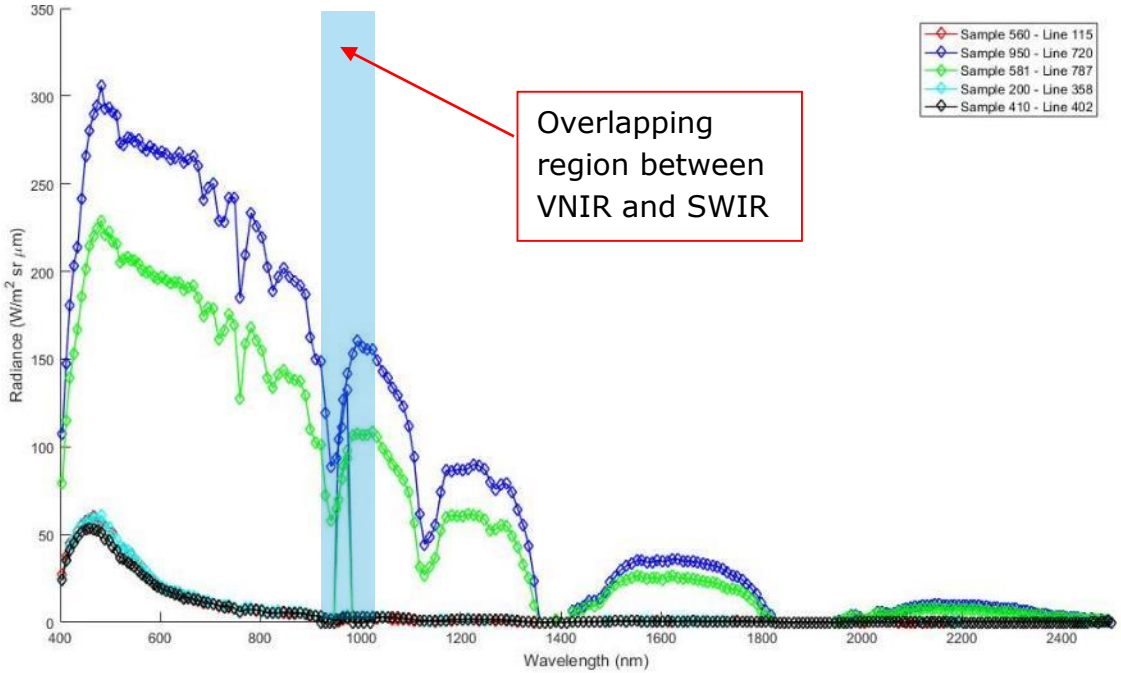
Filtering Panel
- Area of Interest, Time range
- File Type, Cloud Coverage %

Submit (search result)
- Main info in tabular view

Selection Info (details)
- Info & some metadata
- Quicklook

First results

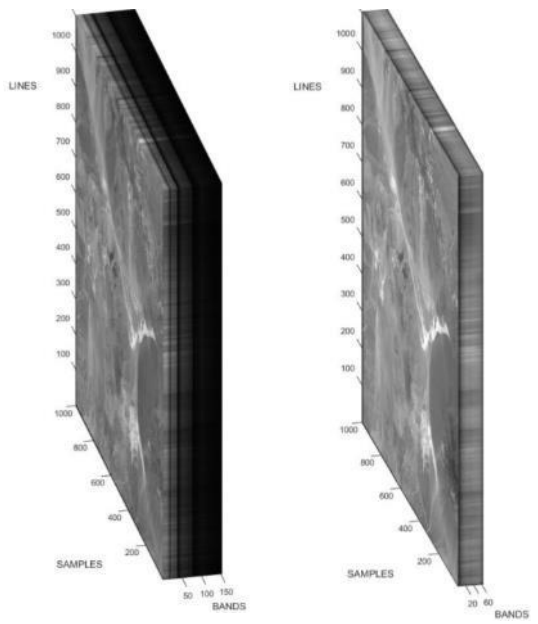


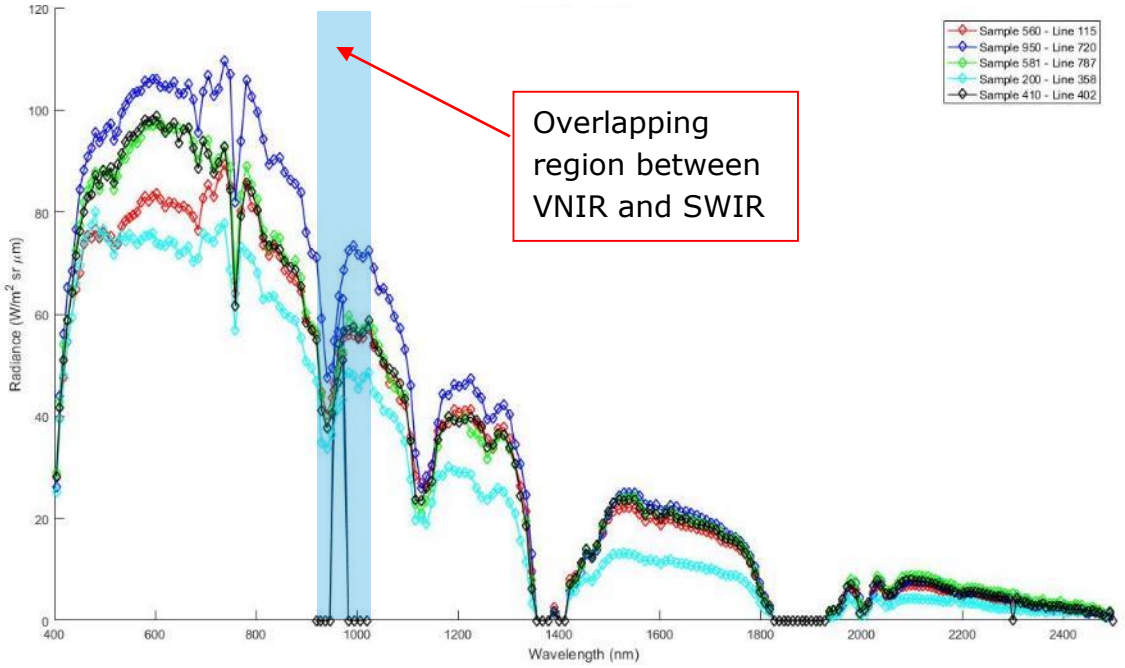


Hyperspectral Cube Image

Spectra over 5 pixel selected in the image

First results





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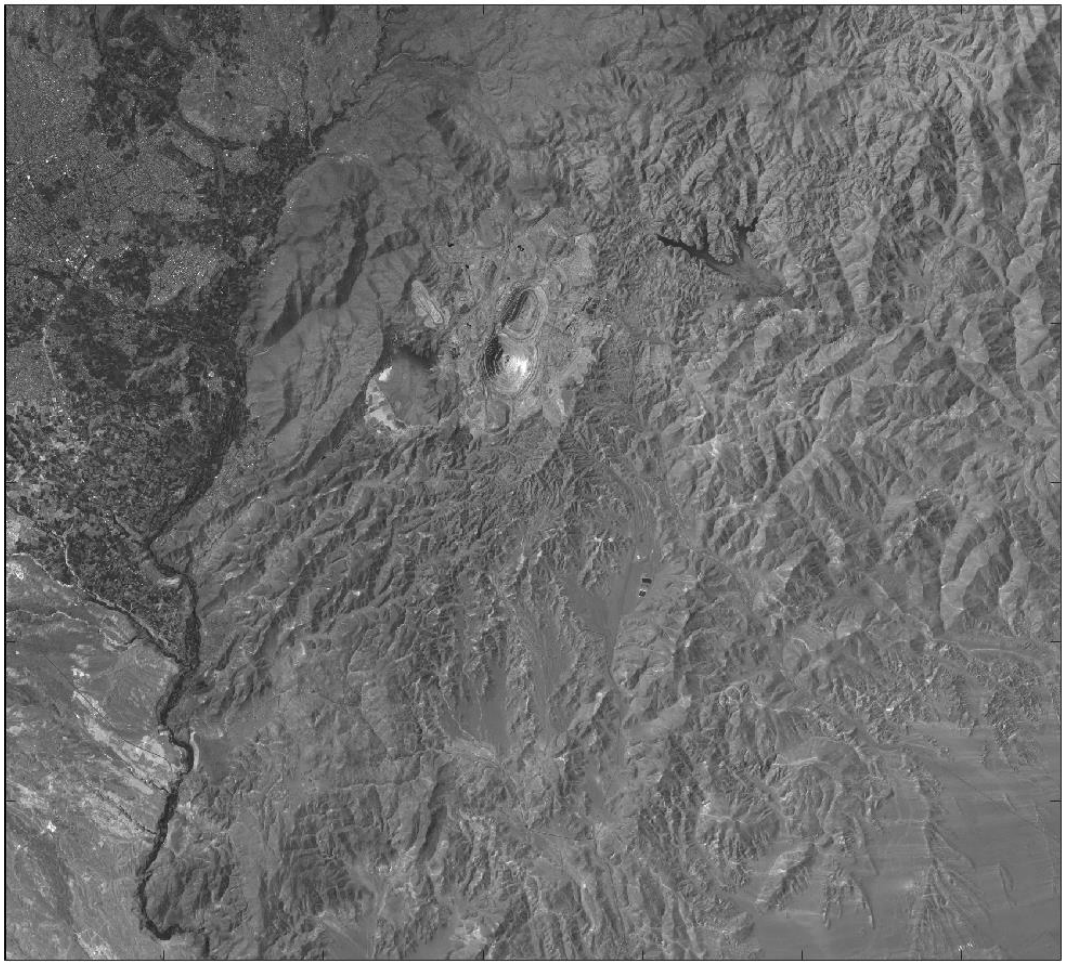


Geographic Area: PERU
(Cerro Verde Mine) Channel: PAN

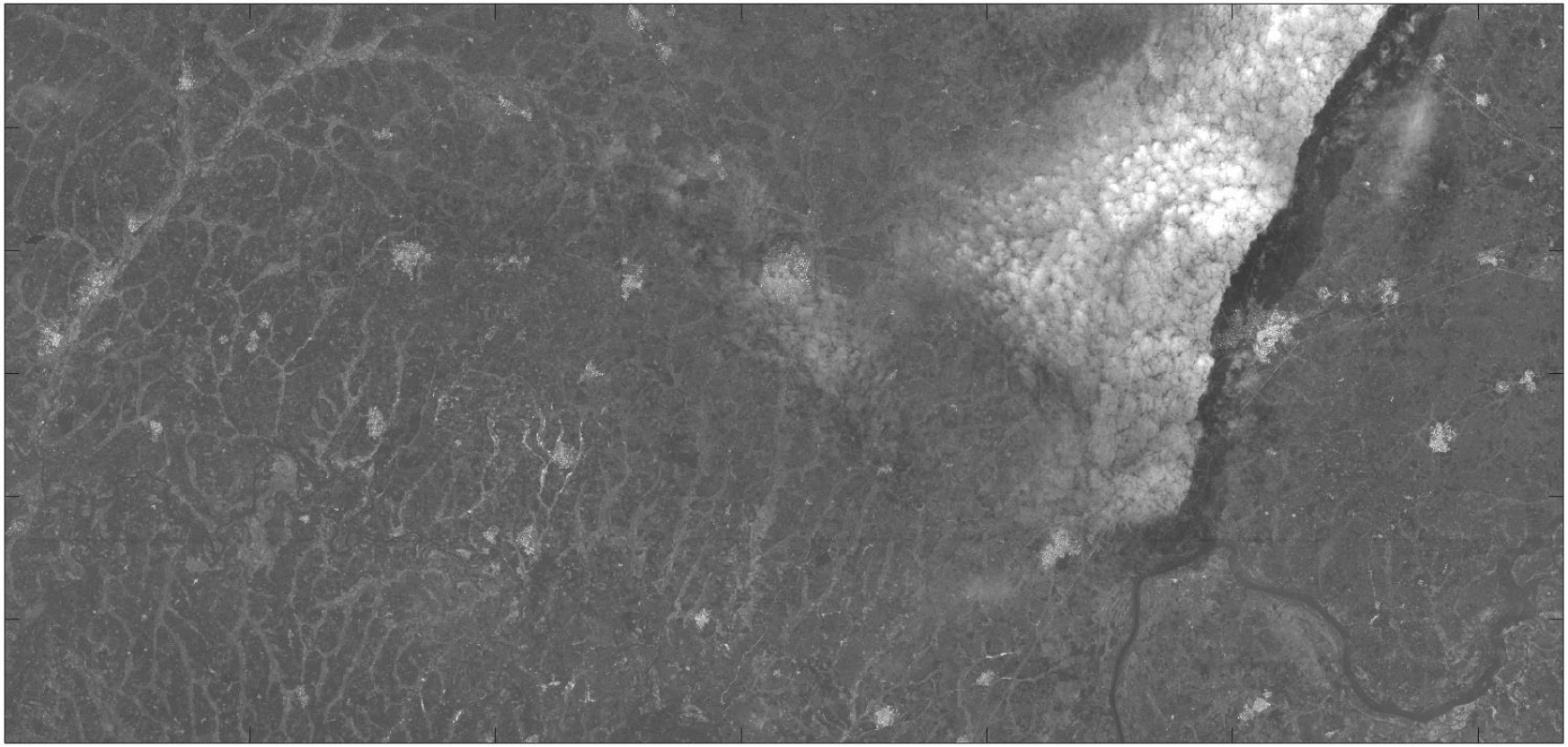
First results

Geographic Area: PERU
(Cerro Verde Mine) Channel: VNIR

First results

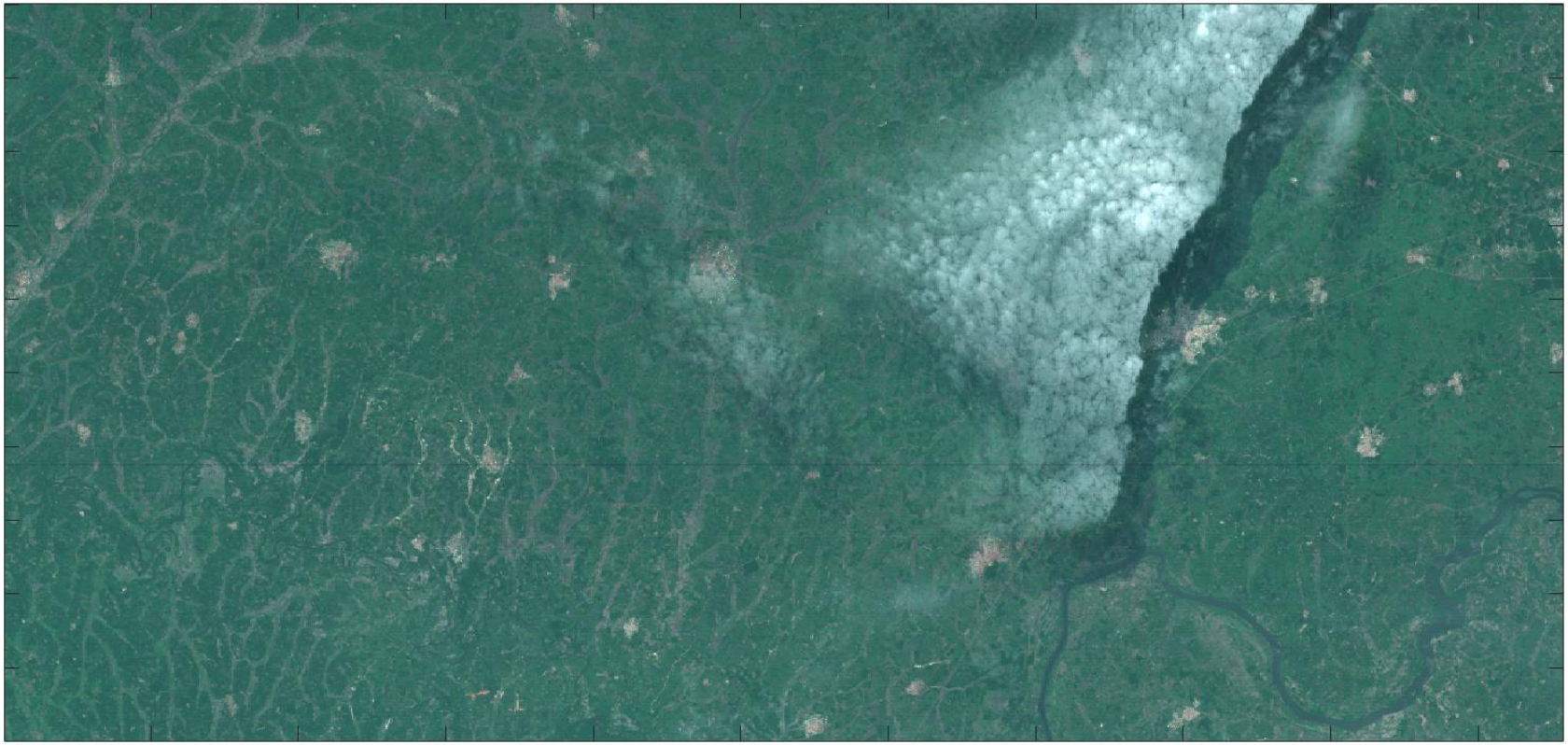
Geographic Area: PERU
(Cerro Verde Mine) Channel: SWIR

First results



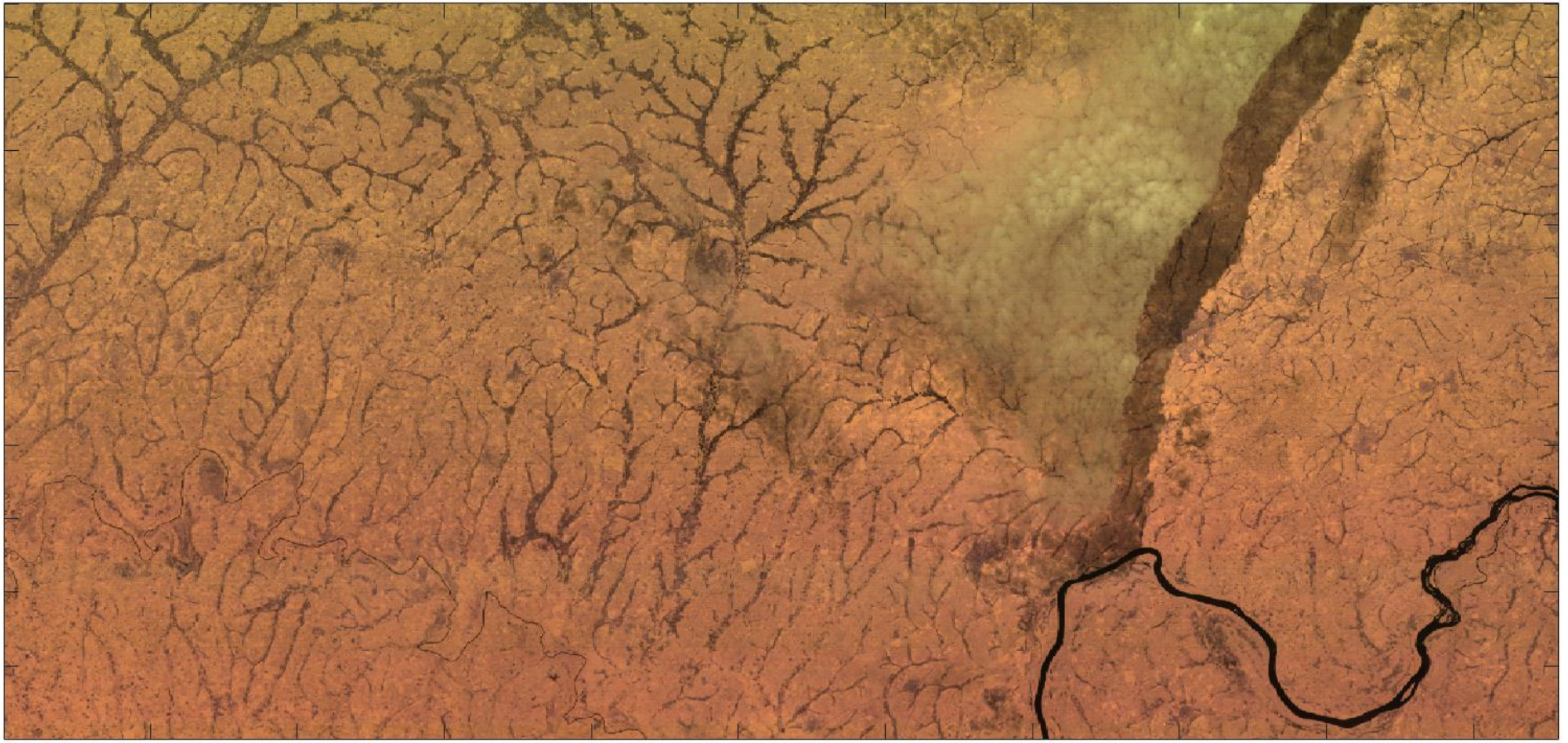
Geographic Area: IVORY COAST
(Yabayo) Channel: PAN

First results



Geographic Area: IVORY COAST
(Yabayo) Channel: VNIR

First results



Geographic Area: IVORY COAST
(Yabayo) Channel: SWIR

Conclusions

- **PRISMA is an innovative Earth Observation Italian Hyperspectral mission**

- **Allows to observe the whole Earth with a**
  - **fast revisit time**
  - **fine spatial and spectral resolutions**

- **Will provide high quality hyperspectral products on specific individual targets requested by the users free of charge and with a quasi-open access**

Agenzia Spaziale Italiana

portal:
https://prisma.asi.it

Many thanks for your interest in PRISMA !!

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