



EO activities at the Italian Space Agency and PRISMA mission



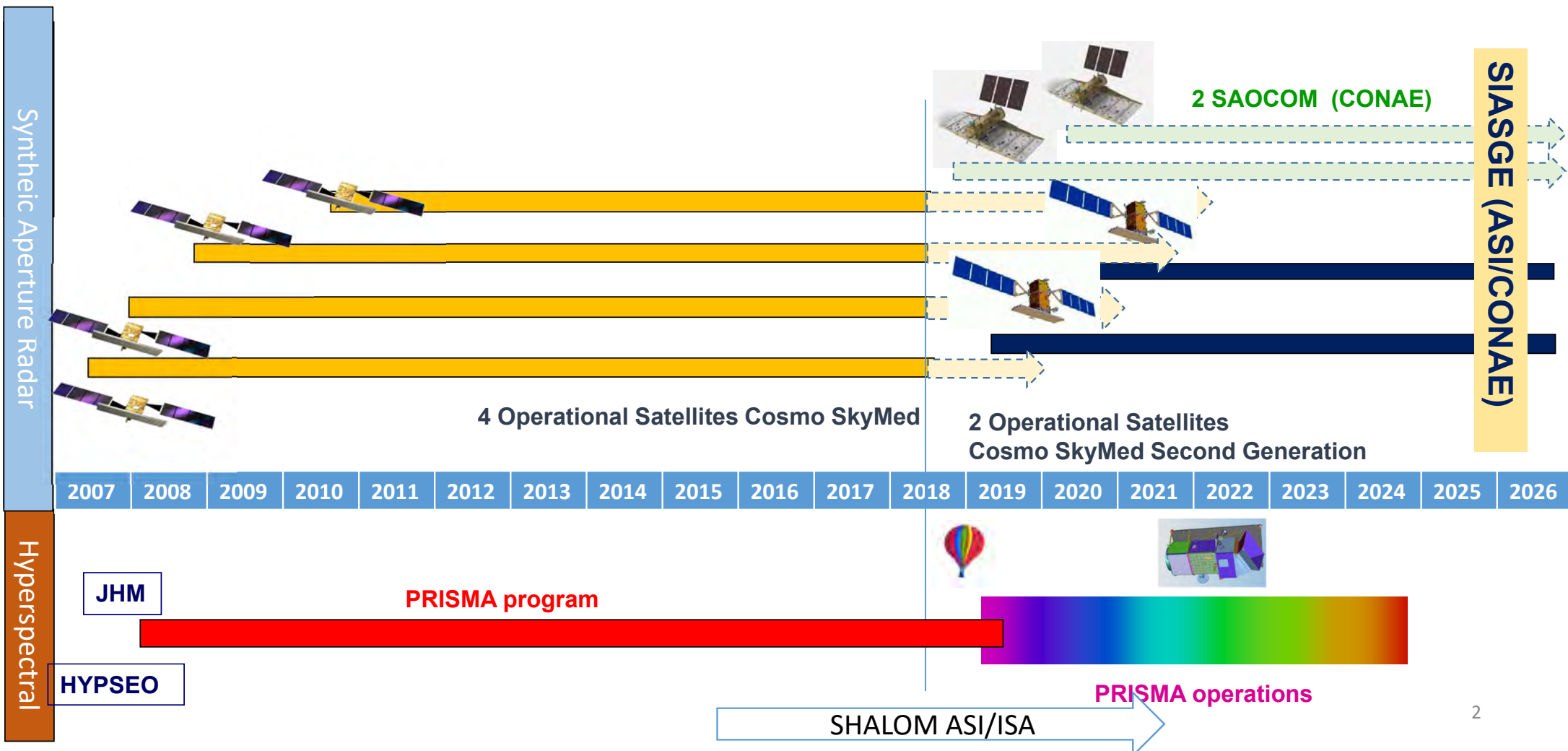
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PRISMA Mission Manager

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IOCCG-23 Committee Meeting, Roma 6 Marzo 2018

ASI Earth Observation Programs



ASI Ground Segment



- 2 X-BAND Antennas
- IMSS (Italian Multimission System-of-Systems) including facilities to process and archive the multi-mission image products and to provide data to Users via Internet.
- IMSS will provide a coordinated-multimission national capability compatible and in line with DIAS, encompassing the Collaborative Ground Segment (direct take off of Sentinel data, QRT/NRT, x-band antennas & EDRS), the SAOCOM SAR-L capabilities in the frame of SIASGE multi-mission system (Italian-Argentinean cooperation) and the other national missions (COSMO-SkyMed, PRISMA).
- IMSS includes dissemination to users allowing to grow the services capabilities and the business opportunities.

PRISMA Mission Overview

PRISMA: PRecursores IperSpettrale della Missione Applicativa

National EO hyperspectral Mission fully funded by ASI.

Mission conceived as:

- ☐ 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 - Contract signed between ASI and an Italian Industries Consortium

Single contract for all the ECSS B2/C/D/E1 phases

Phase D in Progress



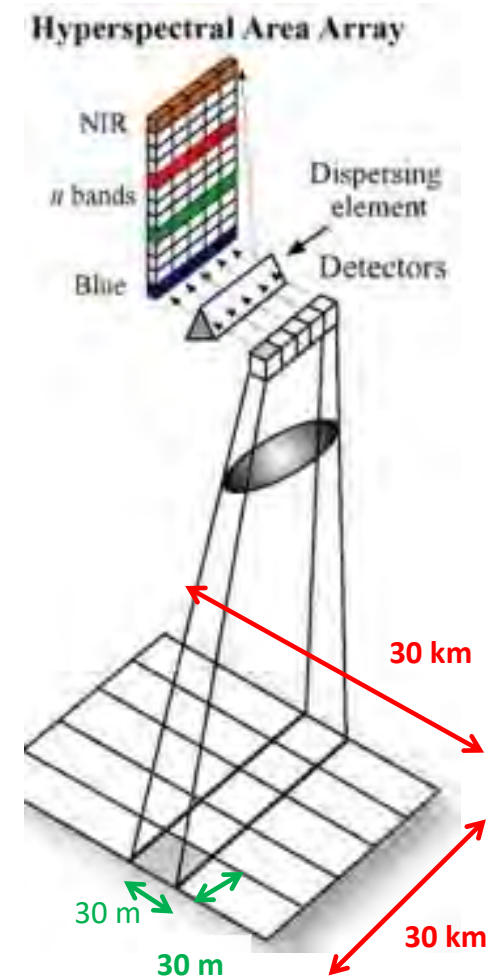
PRISMA launch is scheduled by the end of 2018 with VEGA launcher.

Mission Highlight

PRISMA instrument is a hyperspectral payload consisting of a high spectral resolution spectrometer optically integrated with a medium resolution panchromatic camera - Pushbroom acquisition concept

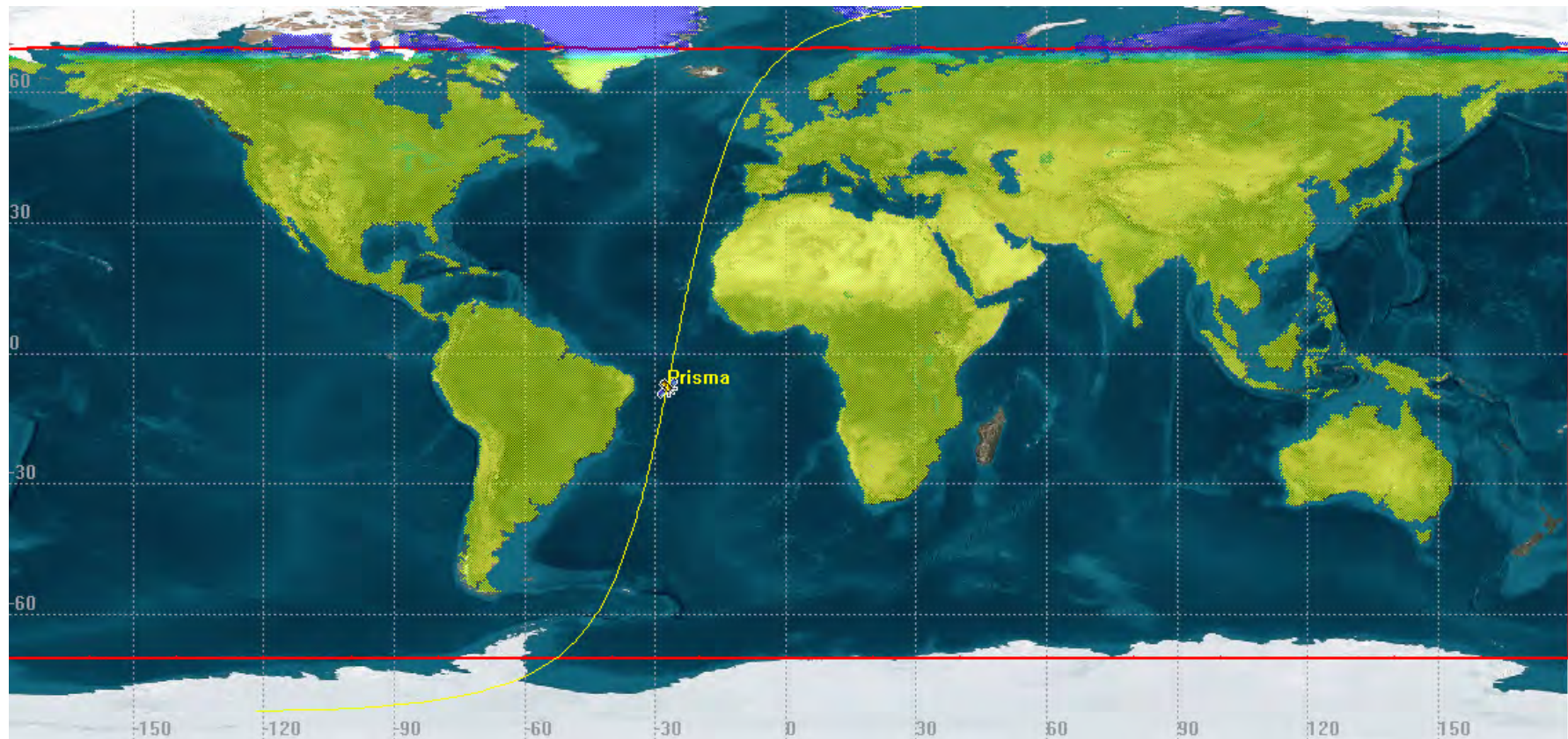
- Payload designed to acquire all available bands in the spectral range 400-2500nm.
- One earth pointing session per orbit
- Acquisition Frame= 30m x 30km (GSD x Swath) = 4,31msec
- Single Image (Minimum Image Length) = 30km x 30km = 1000x4,31msec = 4,31 sec
- Uninterrupted acquisition up to 1800km (258 sec)
- Selectable compression algorithm:
 - Lossless (baseline)
 - Near-lossless with quantization factor of 1-2-3
- Acquired Bands from Payload: 66 VNIR, 173 SWIR (each frame) (all spectral range)

The combined PAN/Hyperspectral data acquisition allows to perform both the observation of the **geometric** characteristics and of the **chemical-physical** characteristics of the targets of interest.



Mission Highlight

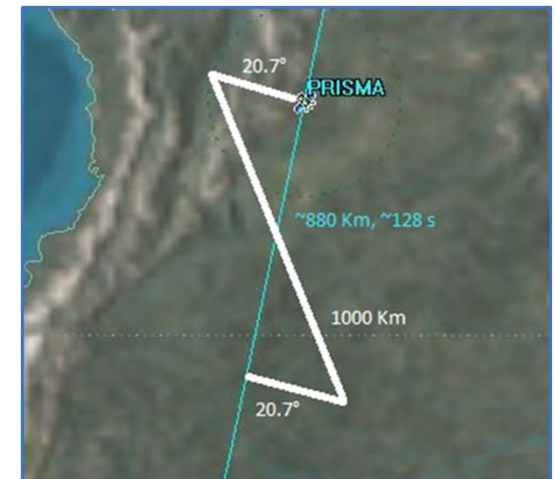
PRISMA PRIMARY AREA OF INTEREST



Longitude 180°W ÷ 180°E Latitude 70°S ÷ 70°N

Mission Highlight

Orbit	SSO 615 km 10:30 LTDN
Lifetime	5 ys
Relook time	<7 days
Onboard Data Storage	448 Gbit
Downlink data rate	310 Mbps
Imaging capacity	200.000 km ² /day
	Pushbroom, strip \leq 1800km
Pointing accuracy	< 1 km
Response time	< 14 days
	Acquisition latency < 9.5 days
	Processing latency < 4.5 days
Target access opportunities over the P-Aol	number of orbits/day: 15/15 duration/day: 240 minutes
Mass P/L + P/F	~ 830 kg (including contingency and balance masses)
Repeat cycle	29 days (430 orbits)
Average eclipse [minutes]	~ 34

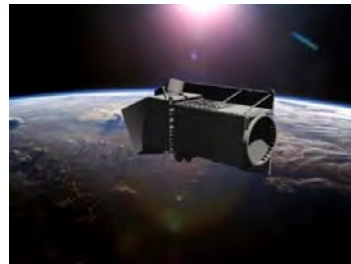


PRISMA satellite shall be able to manoeuvre in order to capture two images at a maximum distance of 1000 km in a single pass (from worst case left to right side looking and viceversa).

PRISMA System

Space Segment

- One small Satellite



Ground Segment

- Fucino: MCC (Mission Control Center) / SCC (Satellite Control Center)
- Matera: IDHS (Image Data Handling System)



Launch Segment: VEGA



The Space Segment

- **Platform**
- **Payload**, consisting in a Hyperspectral / Panchromatic instrument (derived from HypSEO mission)
- Payload Data Handling and Transmission unit (**PDHT**)



PRISMA Structural Model

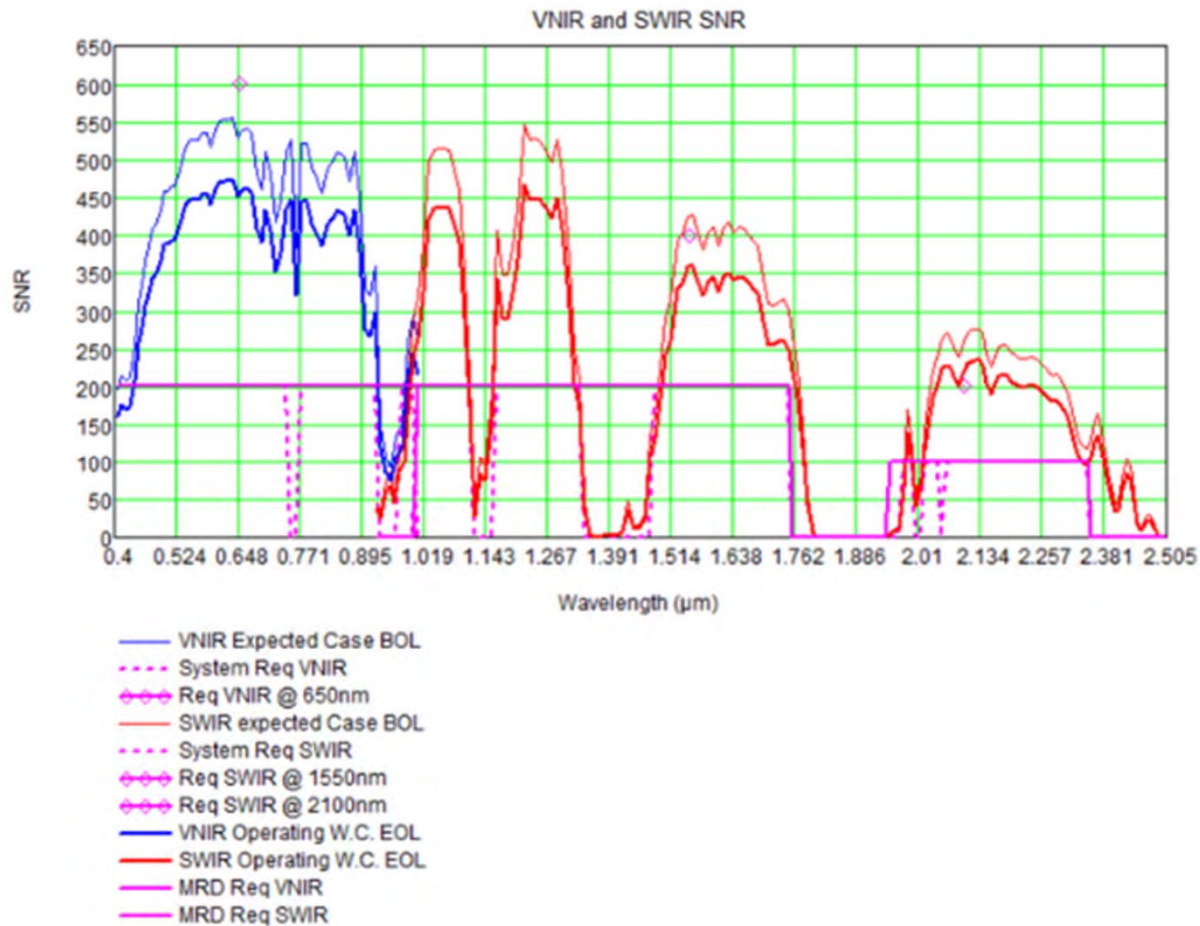
Main Instrument Characteristics

Swath / FOV / IFOV	30 km / 2.77° / 48 μ rad
Ground Sampling Distance (GSD)	Hyperspectral: 30 m / PAN: 5 m
Spectral Range	VNIR: 400 – 1010 nm (66 spectral bands) SWIR: 920 – 2505 nm (173 spectral bands) PAN : 400 – 700 nm
Spectral Width (FWHM)	≤ 12 nm
Radiometric Quantization	12 bits
VNIR SNR	> 200:1
SWIR SNR	> 100:1
PAN SNR	> 240:1
Absolute Radiometric Accuracy	5%
MTF@ Nyquist freq.	VNIR/SWIR along track > 0.18 VNIR/SWIR across track > 0.34 PAN along track > 0.10 / PAN across track > 0.20
Co-registration (Keystone, Smile)	≤ 0.1 pixel
Thermal Control System	Double stage passive radiator (1 for each channel) + stabilization heater
Mass	Optical Head: 175kg Thermal Shield: 25kg Main Electronics: 11kg
Power Consumption	Earth Observation /calibration: 90W Idle: 80W

Payload flexibility :

- ✓ Select Spectral band to be acquired
- ✓ Apply spatial grouping strategy (to increase GSD)
- ✓ Apply spectral binning strategy (to increase in SNR)

PRISMA SNR

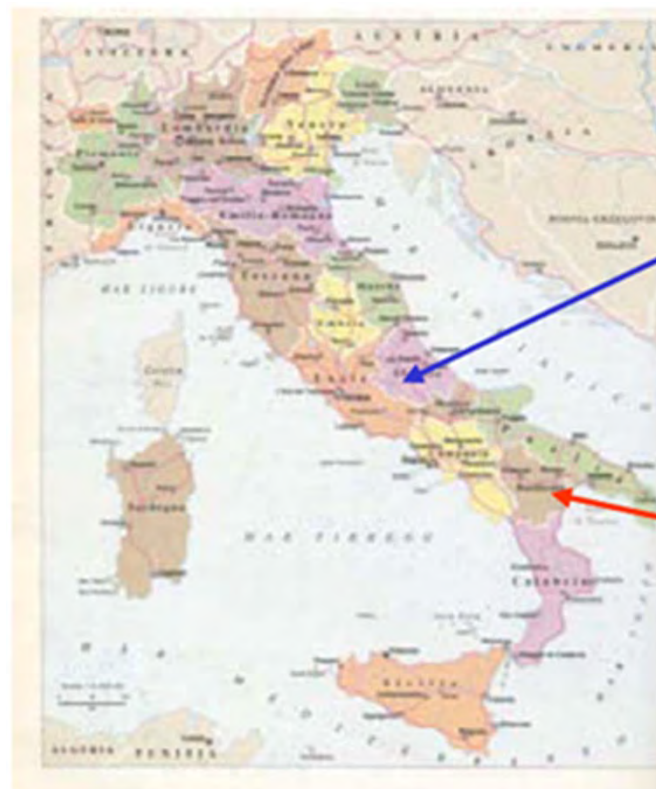


Ground Segment

The PRISMA Ground Segment is geographically distributed in Italy, between the Fucino station and the ASI Matera Space Geodesy Centre.

G/S main basic functions are:

- User Services Management
- Mission Programming
- Satellite Control & Monitoring
- Mission Exploitation in terms of data acquisition, archiving and processing



S-Band Fucino



X-Band Matera

Mission Access

PRISMA mission portal is a web based services access for:

- ☐ User registration
- ☐ Product request (from catalogue/archive)
- ☐ New Image Acquisition Request

- User can select some image acquisition parameters*
- ☐ SZA
 - ☐ off nadir angle
 - ☐ Validity time window (within one repeating cycle; 29 days)
 - ☐ Spot (1 single 30x30sqkm) or Strip (up to 7 consecutive spot)
 - ☐ Maximum cloud coverage
 - ☐ Image geographic coordinates
 - ☐ Spot: image center coordinates
 - ☐ Strip: coordinates of a point of the strip and strip the length before and after that point

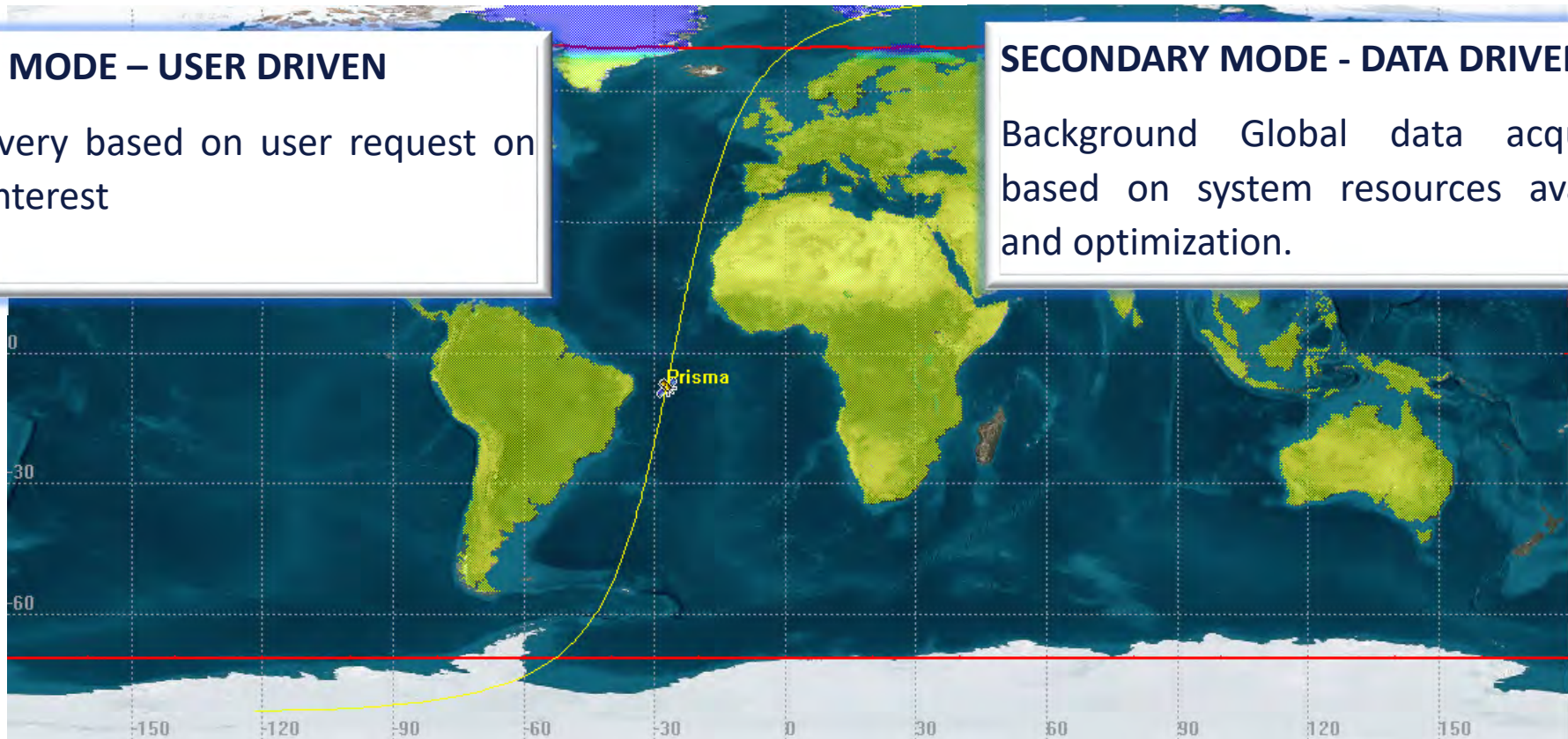
Mission Highlight

PRIMARY MODE – USER DRIVEN

Data Delivery based on user request on areas of interest

SECONDARY MODE - DATA DRIVEN

Background Global data acquisition based on system resources availability and optimization.



Level 0 (Hyperspectral / PAN) - formatted data product with appended metadata, including ancillary data and file formatting information (Archived data).

Level 1 (Hyperspectral / PAN) - radiometrically corrected and calibrated radiance data in physical units. This product provides:

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

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

Level 2c Geolocated At-surface Reflectance Product (Hyperspectral / PAN). This product includes:

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

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

PRISMA Applications

The PRISMA hyperspectral products will provide useful information for science investigation and applications in the fields of Earth Observation for terrestrial and aquatic ecosystems, or for natural resource monitoring and management support.

PRISMA data will be important for supporting the following key applications:

- *Agriculture and Forests*
- *Land use*
- *Inland and Coastal water*
- *Risk Management (es. volcanic, fires, oil spill, hydrology etc...)*
- *Atmosphere and Climate*
- *Geology*
- *Soil*
- *Urban Areas*
- *...*

PRISMA for aquatic ecosystems

Hyperspectral data can provide useful information to assess water quality conditions of many water aquatic ecosystems.

PRISMA can offer a great opportunity for the observation of coastal, inland and estuarine waters providing hyperspectral data at spatial and temporal scales not available with traditional field measurements or ocean color satellites.

Some applications:

- *Chlorophyll analysis*
- *Analysis of optically active parameters*
- *Detection of suspended matter*
- *Investigations of water quality*
- *Monitoring coastal erosion*
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Thank you

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PRISMA web-site
<http://www.prisma-i.it/>