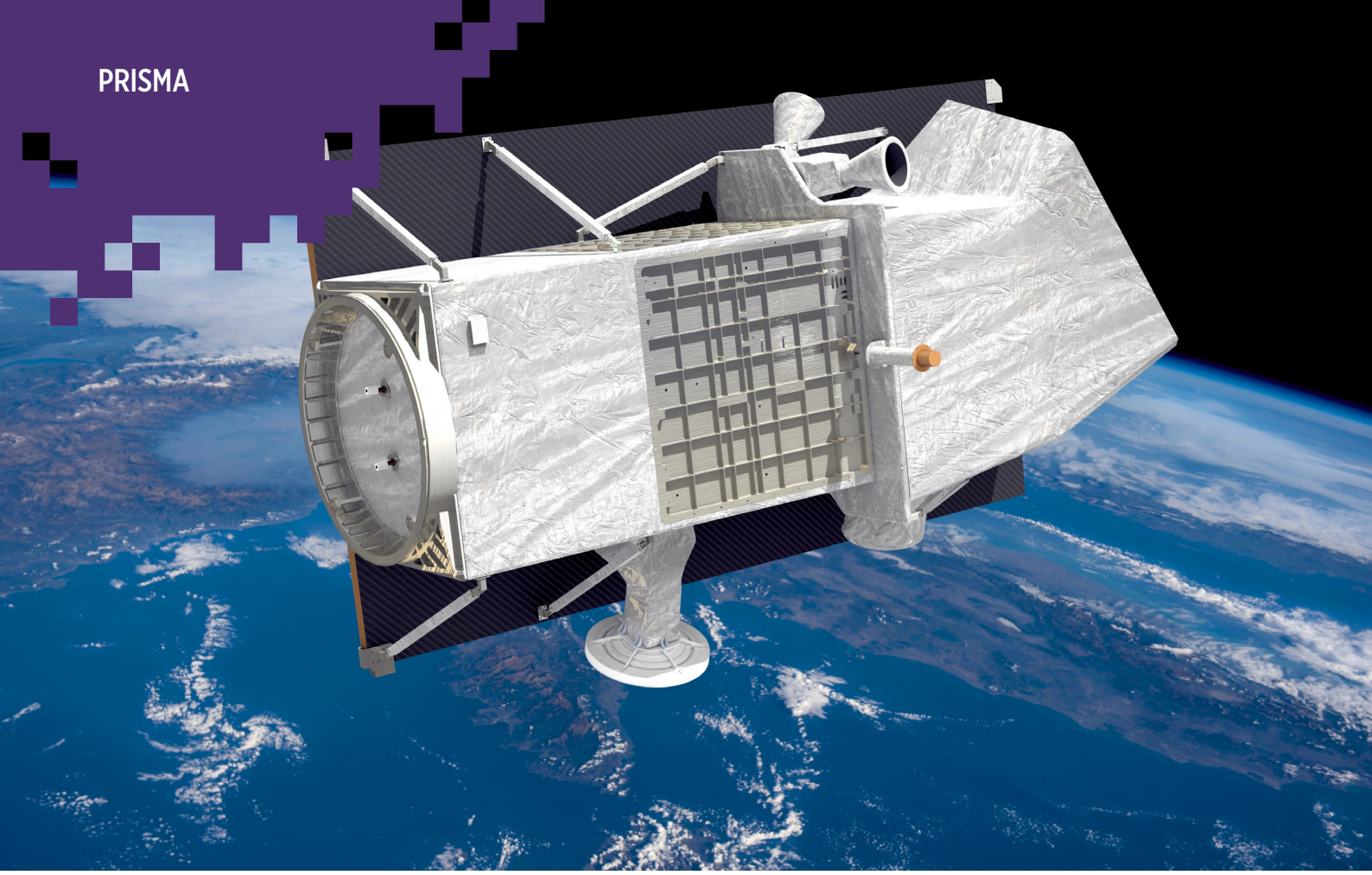
PRISMA



PRISMA (“PRecursore IperSpettrale della Missione Applicativa”) is a hyperspectral electro-optical sensor developed for the Italian Space Agency (ASI) in the frame of the PRISMA – a pre-operative small Italian hyperspectral mission-, to qualify the technology, develop applications and provide products to scientists for environmental observation and risk management .

The PRISMA mission has been conceived for in orbit demonstration and qualification of an Italian state-of-the-art hyperspectral imager, as well as for the validation of end-to-end data processing and the development of new applications for Earth observation based on high spectral resolution images.

Leonardo has a crucial role in PRISMA since the company is in charge of the hyperspectral imager, the star trackers, the solar array and the Power Control and Distributed Unit (PCDU).

THE MISSION

Launched in 2019, PRISMA acquires areas with a swath width of 30 km with a GROUND SAMPLING DISTANCE (GSD) of 30 m, from a sun-synchronous orbit at about 615 km altitude, covering the wavelength range from 400 nm to 2500 nm with two partially overlapped spectrometer channels dedicated to VNIR and SWIR. Simultaneously, a panchromatic camera acquires the same area with a spatial resolution of 5 m.

Spatial resolution	
Hyperspectral:	30 m
PAN:	5 m
VNIR:	400 - 1010 nm (66 spectral bands)
SWIR:	920 - 2505 nm (174 spectral bands)

The PRISMA satellite downloads data to the two ground stations located in Italy. Once the hyperspectral images are received by the ground station, they are archived and processed up to level 2 products.

The distinctive feature of PRISMA is the capability to acquire images of the same scene simultaneously with a panchromatic (PAN) and a hyperspectral (HSI) sensor. This allows the generation of pansharpended hyperspectral images.

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THE PAYLOAD

The PRISMA Payload consists of 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, operating with a pushbroom scanning mode.

The hyperspectral technique is based on the acquisition through the PRISMA electro-optical sensor of a "spectral cube" containing both spatial and spectral information of the target area. This advanced technology makes it possible to acquire more than two hundred spectral images (66 VNIR + 176 SWIR) of the observational scene in a single acquisition.

To achieve the very demanding mission image quality requirements, the optical head comprises a foreoptics telescope in TMA (Three Mirrors Anastigmatic) configuration. This is common to the patented double band spectrometer, operating in VNIR and SWIR bands and to the panchromatic camera able to gather spatially coregistered images in order to derive higher resolution images with hyperspectral characteristics by postprocessing data fusion algorithms.
The increased spectral and spatial resolution of these hyperspectral images allow for detailed examination of surfaces and different materials present in the observed area, previously not possible.

APPLICATIONS

With respect to previous generations instruments, PRISMA allows to obtain a more accurate estimation of physical, biophysical and chemical processes linked with agricultural management and its environmental impact. Therefore, it opens the way to the monitoring of key variables in space and time and several fields could benefit from the scientific use of the PRISMA images.

- **agriculture** and forest - the mapping of vegetation cover and the monitoring of its health conditions are critical tasks to drive sustainable policies. PRISMA high resolution images can allow high-accuracy estimations of canopy stress or degradation, linked to sustained water deficit, to soil compaction and to erosion and salinization.

- **geology** - the use of spectral absorption features that can be retrieved from data of PRISMA is suitable to many geologic applications such as the mapping of the composition of the Earth surface in terms of mineralogy and lithology, or the quantification of rock, the chemistry of soil.

- **urban areas** - hyperspectral VNIR-SWIR (Visible-Near InfraRed / Short-Wavelength InfraRed) imaging spectrometers identify and discriminate different urban materials (higher spectral separability) that pertain to pervious and impervious surfaces. PRISMA demonstrates good potential for mapping complex urban landscapes because it combines spatial and spectral resolution with high spectral accuracy, also in combination with high spatial resolution PAN imagery.

- **water resources** - PRISMA can provide a wide range of products and applications enabling a better understanding of the aquatic ecosystems and coastal processes, for a better management of natural resources and for disaster recovery. Moreover, these products could potentially help the planning of in situ sampling, by indicating the spatial extent of an event observed in images.

- **environmental monitoring** and natural hazards - the use of hyperspectral images develops indices for assessing damages to vegetation caused by fires or by other disastrous events (floods, volcanic eruptions, landslides, oil spills, weather events, etc.). This involves using post-event hyperspectral images to evaluate the impact on vegetation, namely the loss of biomass products.

Leonardo contributes to PRISMA Mission with enabling technologies both in terms of payload for mission accomplishment as well as for attitude determination, power generation and management.

LEONARDO ELECTRONICS

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