Il Programma di Osservazione della Terra dell'Agenzia Spaziale Italiana:

Missioni attuali e future per un pianeta che cambia.

Francesco Longo

ASI Earth Observation at glance: *for our planet, for our future…*

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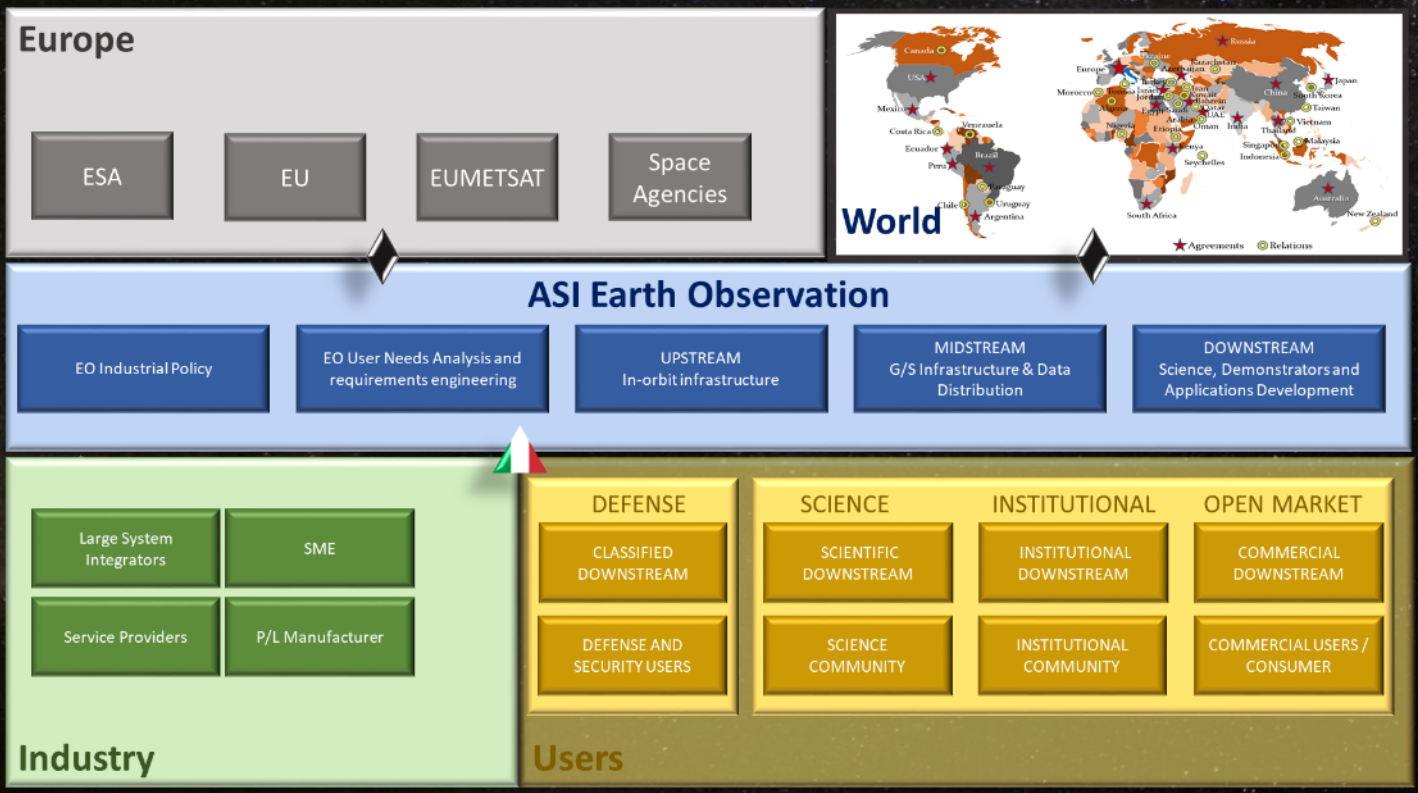
…ensure the understanding, monitoring and protection of our planet guaranteeing the maximum benefit for science, applications, society and economic growth of Italy…

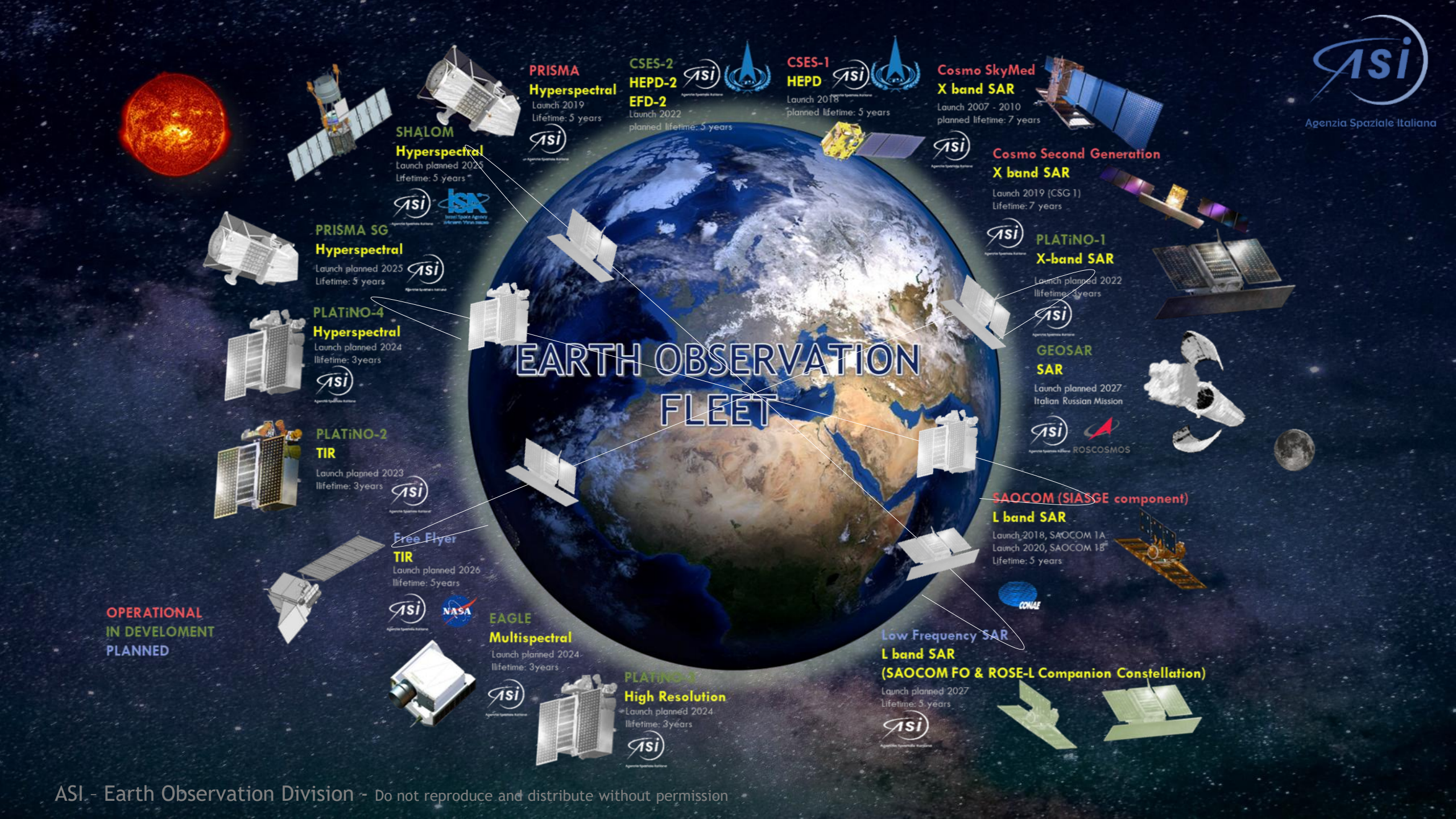
ASI implements this vision through its Earth observation programs developed in Italy, in Europe (ESA, EU, EUMETSAT) and within the widest international framework.

ASI plays an architect role in the definition, development, procurement, exploitation and evolution of the space assets through its National industry and science and application community, contributing actively to the major European infrastructures.



Our 8 major objectives in Earth Observation

I.Sustain the Future of Synthetic Aperture Radar	•New instruments and constellations (X/L/P Bands) •Developments for large reflectors/deployable antennas •SAR Technology Roadmap
Secure the leadership in Hyperspectral payload	•Hyperspectral Next Generation •Miniaturized Hyperspectral Mission (PLATiNO) •Hyperspectral Technology Roadmap
Strengthen developments in Thermal Infrared	•TIR Mission based on minisatellite (PLT-2) •ASI-NASA TIR mission •TIR hyperspectral / TIR Technology Roadmap;
Achieve autonomy in HR systems	•HR Mission based on minisatellite (Feasibility study) •Optical Technology Roadmap
Consolidating the Lidar capability	•Lidar mission (Feasibility study) •Lidar Technology Roadmap
Sustain development of new instruments	•Radiometers, Quantum Gravimetry, etc •Technology roadmap
Strengthen Earth science and applications	•Scientific and application projects 1) to understand earth system and interaction between process and 2) to deliver information to enhance quality of life and strengthen our economy
Pull users towards our applications and services layers	•Demonstrators •Application Services Start-Up



THE MICROWAVES:

SAR in P, L, (C) and X Band

Focus on:

- COSMO-SkyMed: First, Second and Next Generations
- SAOCOM, L-Band
- GEOSAR, a GEOSYNCRONOUS SAR MISSION
- PLATiNO-1: MONO/BI STATIC X-BAND SAR MISSION
- P-Band, SAR and Sounder

COSMO-SkyMed: The First and the Second Generation

COSMO-SkyMed Second Generation (CSG) will:

- Ensure operational continuity to the currently operating constellation
- Achieve a step ahead in terms of functionality, performances and system services for the Earth Observation users

The 4 CSG Satellites will have an operational lifetime of at least 7 years.

COSMO-SkyMed is the Italian end-to-end System for Earth Observation, funded by:

CSG Image Products improvement w.r.t. CSK

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Narrow Field Image

Very High Resolution
VHR *(sub-metric)*
Governmental Use

Resolution: 1 m
Single Polarization
Size 10 km x 10 km
Civilian and Defence use

Ultra-High Resolution (UHR)
Governmental Use

Spot-2
VHR and Dual Pol. (**)
Sp-2A res. ≤ 0.35 x 0.55 m
Swath ≥ 3.1 x 7.3 Km
Sp-2B res. ≤ 0.63 x 0.63 m
Swath ≥ 10 x 10 Km
Sp-2C res. ≤ 0.80 x 0.80 m
Swath ≥ 5 x 10 Km
Civilian and Defence Use

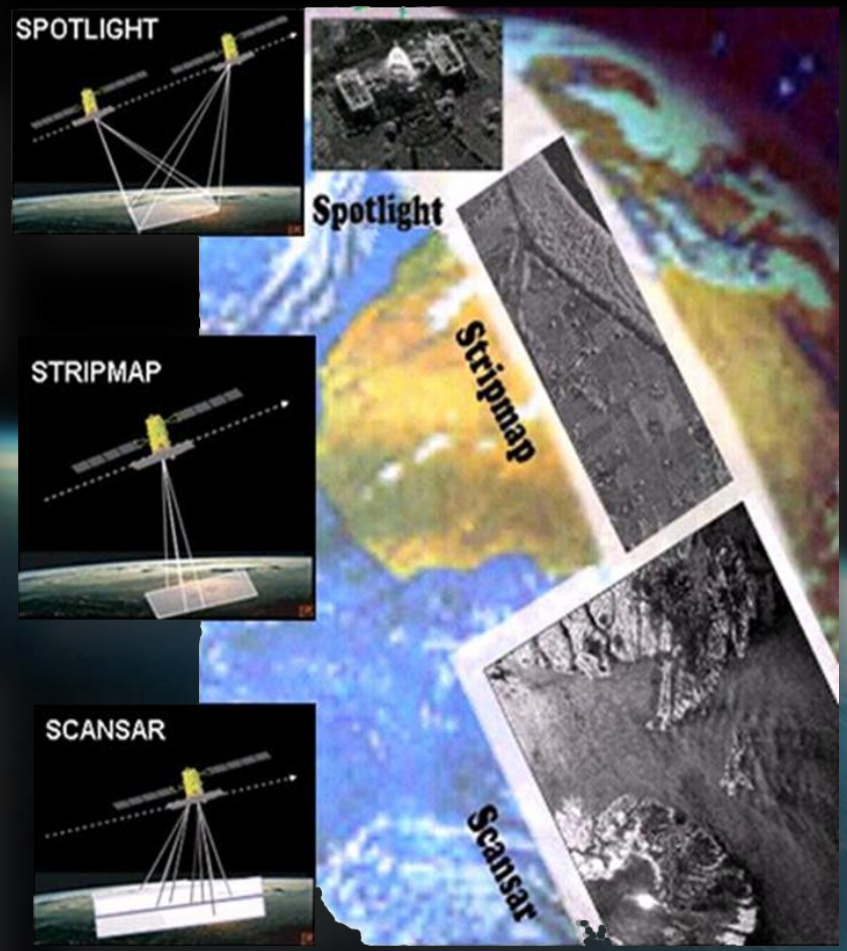
Wide Field Image

Resolution: 3 m
Single Polarization
Swath Size 40 km
Civilian and Defence use

Resolution : 3m x 3m
Swath Size Dual Pol 40 km
Swath Size QUADPOL 15 km
Civilian and Defence use

Resolution: 30 m
Single Polarization
Swath Size: 100 km
or
Resolution : 100 m
Single Polarization
Swath Size: 200 Km
Civilian and Defence use

Resolution : 4 x 20 m
Double Polarization
Swath Size : 100 km
or
Resolution : 6 x 40 m
Double Polarization
Swath Size: 200 Km
Civilian and Defence use



(**) in azimut and range

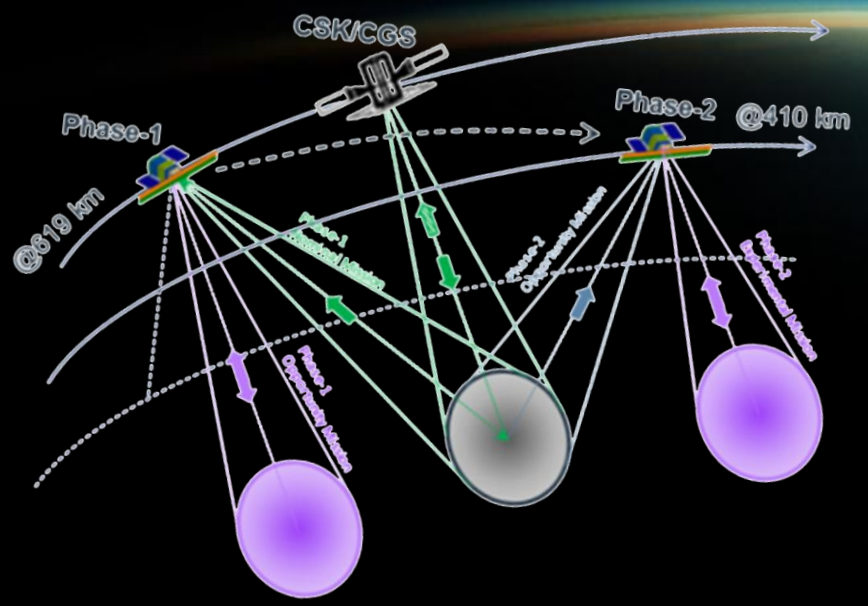
PLATiNO-1 – SAR Mission

Mission Phases are:

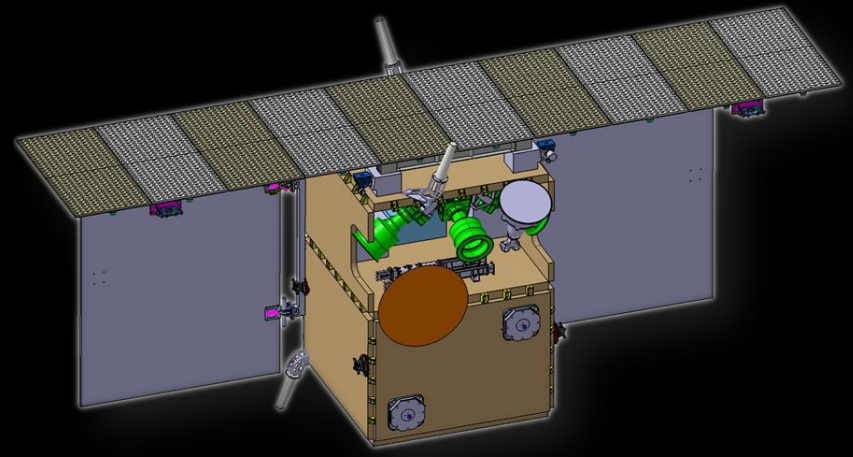
- Commissioning (LEOP and Commissioning) 3 months;
- Phase-1 (@619 km, formation flying with CSK/CSG) 1 year;
- Re-orbit phase (orbit transfer with HET) 6 months;
- Phase-2 (@410 km, monostatic acquisition) 1.5 years;
- De-orbiting phase 6 months.

Selectable Formation-Flying configurations:

- Leader-Follower
- Pendulum
- Cartwheel
- Helixmonths



PLT-1 shall be sized to provide the capacity to acquire, downlink and archive images totaling **20000 km2 daily**.



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During Phase-1 PLT-1 will mainly work as a receiver acquiring from Earth the signal generated by CSK/CSG

Bistatic performances (Phase-1)	
Altitude	619 km
Swath	40 km
Resolution	3 m
Target Experimental Resolution	1 m
Imaging mode	CSK/CSG Stripmap
Continuous stripmap	Up to 1000 km

Monostatic performances (Phase -2)	
Altitude	410 km
Swath	15 km
Resolution	3 m
Target Experimental Resolution	1 m
Imaging Mode	Stripmap
Continuous stripmap	Up to 800km

GEOSAR – GEOSYNCRONOUS SAR MISSION

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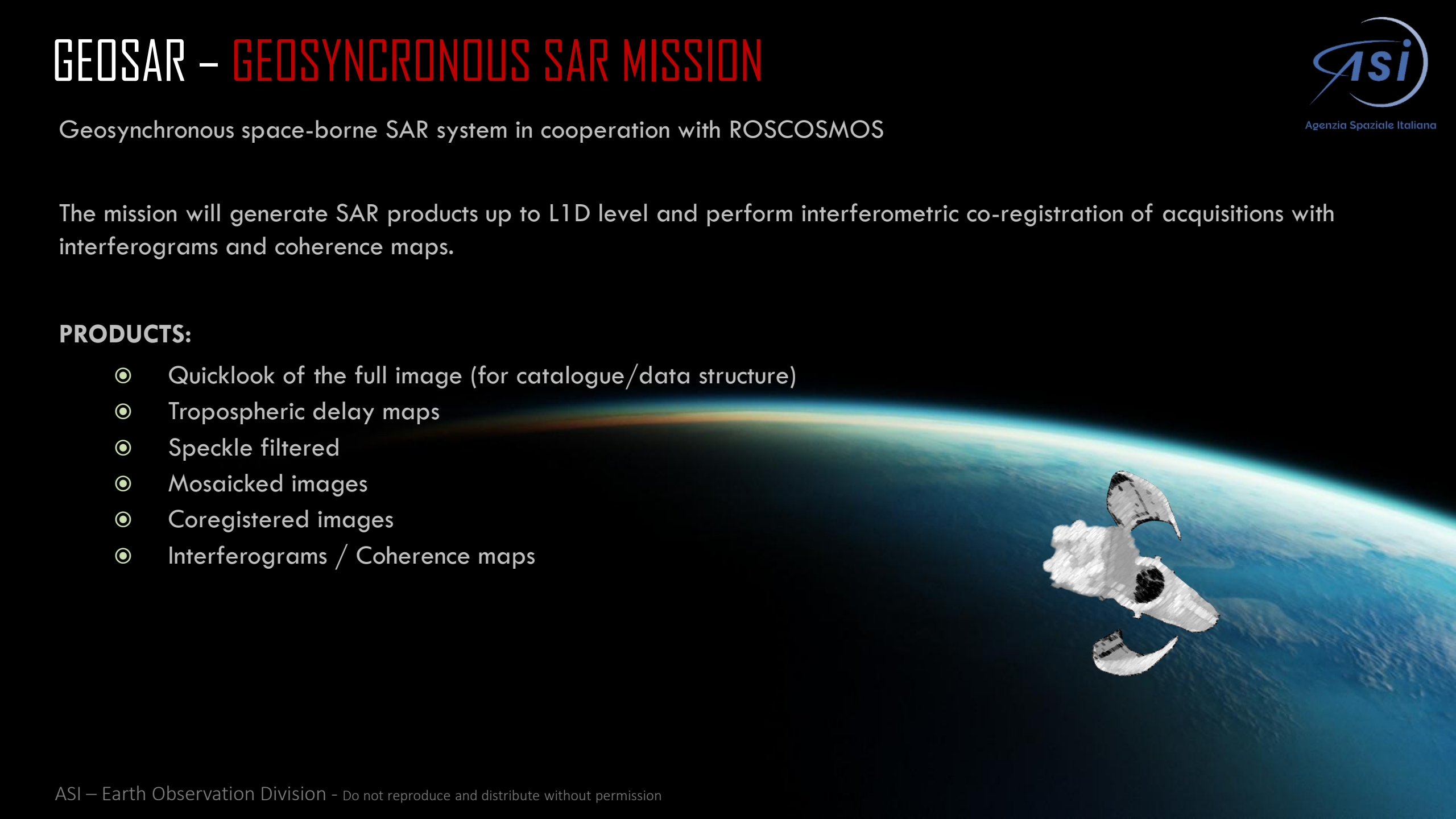
Geosynchronous space-borne SAR system in cooperation with ROSCOSMOS

The mission will generate SAR products up to L1D level and perform interferometric co-registration of acquisitions with interferograms and coherence maps.

PRODUCTS:

- Quicklook of the full image (for catalogue/data structure)
- Tropospheric delay maps
- Speckle filtered
- Mosaicked images
- Coregistered images
- Interferograms / Coherence maps



SAOCOM – in the frame of SIASGE

2 Argentinian SAOCOM satellites (1A and 1B) with an **L-Band SAR** sensor onboard.

Same orbit of COSMO-SkyMed satellites.

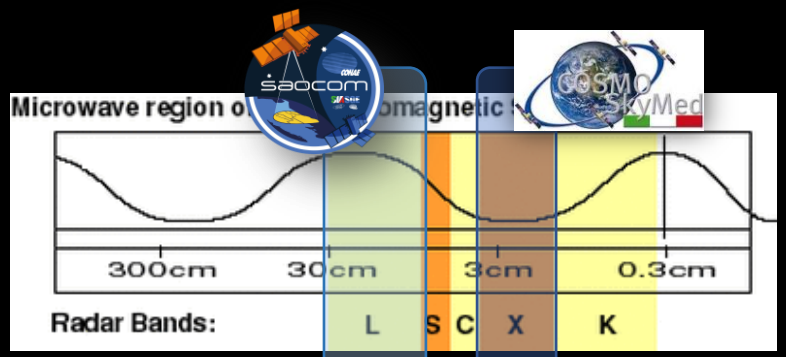
ASI has full utilization rights on its **Area of Exclusivity AoE (approximately all the Europe territory).**

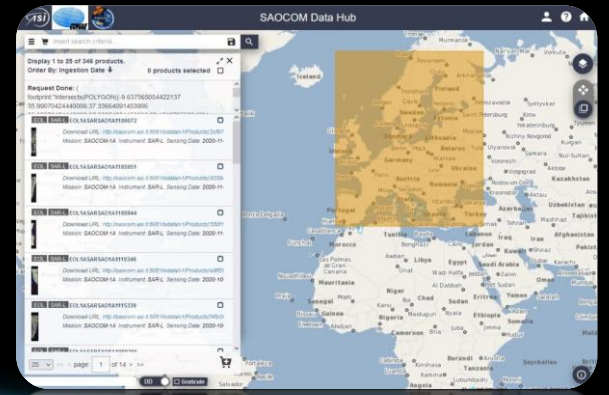
Users:

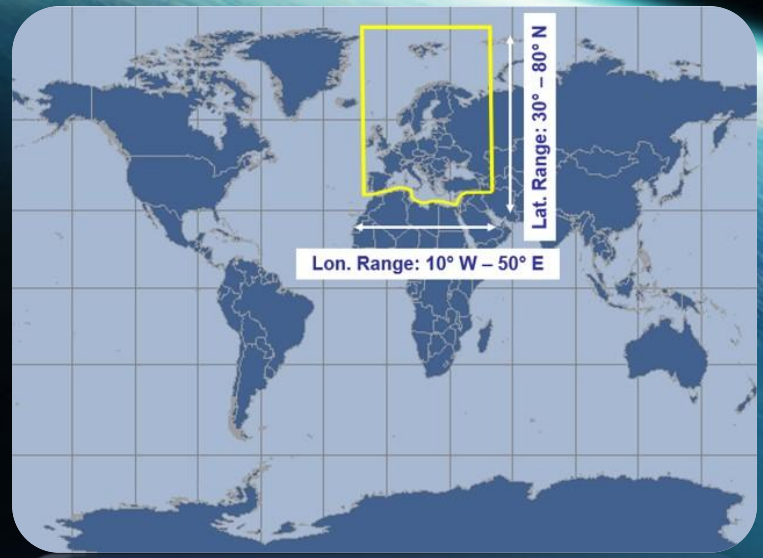
- ✓ Scientific, institutional and commercial
- ✓ Italian and International
- ✓ **only for non-commercial purposes**

Access to data on ASI AoE:

1. Registration following the instruction at: https://www.asi.it/en/earth-science/saocom/
2. Access through the ASI SAOCOM Portal http://saocom.asi.it:8081







P-Band – Sounder / SAR

Aerial radar multi-operating/multi-frequency modality in the UHF and VHF bands: the radar system operates at different carrier frequencies as Sounder and Synthetic Aperture Radar (SAR):

- Sounder operates at 165 MHz,
- SAR operates at
  - 450 MHz (SAR-Low mode)
  - 860 MHz (SAR-High mode).

Several Helicopter-Borne Campaign: 2 in Southern Italy and 1 in Morocco Desert

Low Frequency RADAR Mission

Objective:
To Explore, at national level, the feasibility of a SAR mission in P (below 1 Ghz) and L bands.

The initiative capitalizes:

- the SAOCOM experience;
- the know-how matured in the P-Band experimental activities.

THE REFLECTIVE/EMISSIVE BANDS:

VIS-NIR-SWIR-TIR

Focus on:

- Hyperspectral imagery in the visible and shortwave infrared;
- Multi / hyperspectral imagery in the thermal IR.

PRISMA - Hyperspectral

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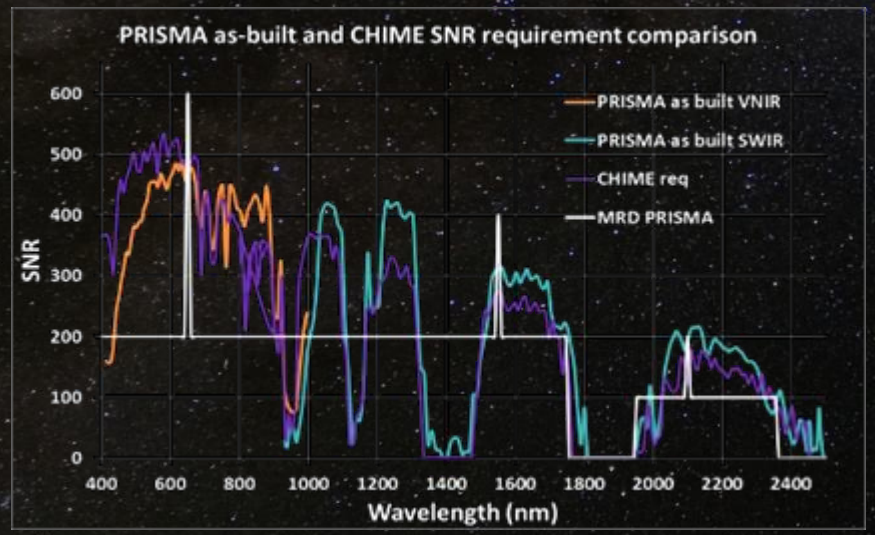
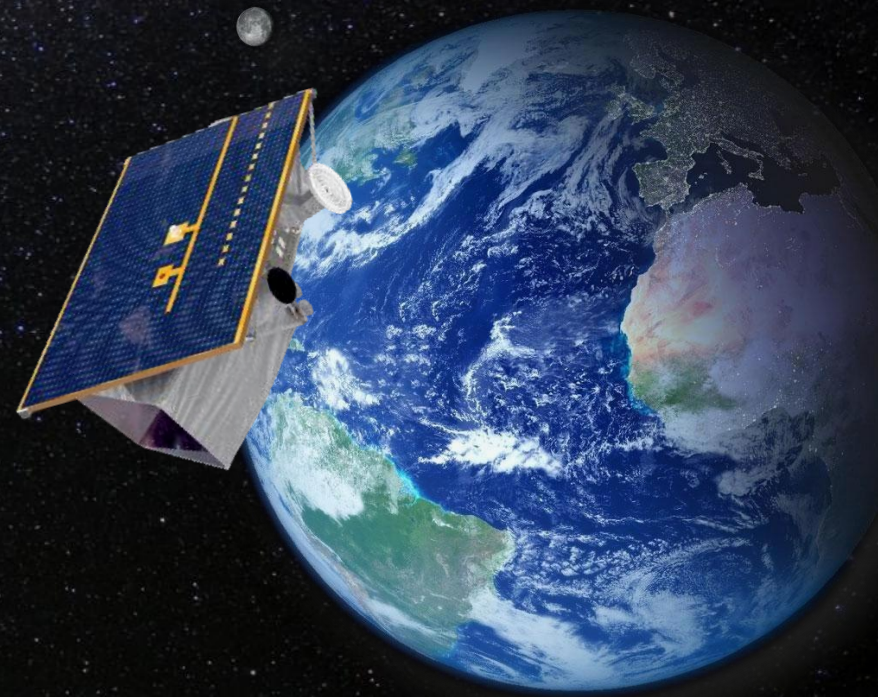
Fully funded by the Italian Space Agency (ASI): in-orbit Earth Observation system that simultaneous combines data of a hyperspectral sensor and a panchromatic camera from the same scene.

- 240 total bands in VNIR (#66, 400–1010 nm) & SWIR (#174, 920–2505 nm) at a spatial resolution of 30 m on a swath of 30 km
- Mean spectral resolution of 10 nm in a spectral range of 400-2500 nm
- Pan (Panchromatic) imagery is provided at a spatial resolution of 5 m
- Simultaneous acquisition of images in the VNIR, SWIR and PAN on the same scene!





PRISMA 2nd Generation

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PRISMA Second Generation is the future Hyperspectral Italian Mission, to be launched in 2025.

- Entirely Funded by the Italian Space Agency
- Hyperspectral data continuity currently available by the PRISMA system.

SPECS:

- SWATH and SNR: on demand techniques of SWATH enlargement and SNR enhancement on a single pass using the platform agility.
- Acquisition modes: STRIPMAP and SPOTLIGHT.
  I. STRIPMAP image: VNIR/SWIR GSD ≤ 30 m and PAN GSD ≤5 m, swath ≥30 km and indefinite length with a Daily STRIPMAP Imaging Capacity (acquire, downlink and archive) more than 2.000.000 km2.
  II. SPOTLIGHT image (on-demand): VNIR/SWIR GSD ≤10 m and PAN GSD ≤2,5 m, swath ≥30 km and length up to 210 km with a Daily SPOTLIGHT Imaging Capacity (acquire, downlink and archive) more than 200.000 km2.
- Low revisit time (72 h with a maximum off-nadir angle of ± 30°)

SHALOM: Spaceborne Hyperspectral Applicative Land And Ocean Mission

Joint program between ASI and ISA based on the "Implementation Arrangement On Cooperation in a Joint Definition Phase of a Spaceborne Hyperspectral Applicative Land And Ocean Mission - Shalom".

Italy is responsible of the overall hyperspectral instrument and is the Ground Segment Authority.

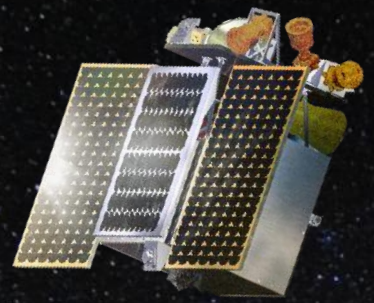
Israel is responsible for the satellite platform, the telescope and the panchromatic camera and is the Space Segment Authority.

The mission will acquire:

- Hyperspectral measurements of the Earth radiation reflection and absorption in the VIS-NIR-SWIR spectral range (400-2500nm)
- Panchromatic images of the Earth (simultaneous with the hyperspectral measurements)

Parameter	Specification
Orbit	SSO 640 km
Repeat Cycle	4 days
Daily Imaging	Up to 200.000 km^2
Swath Width	≥ 10 km
HYP P/L GSD	≤ 10m
PAN P/L GSD	≤ 5m
Op Lifetime	5 years

PLATiNO – 3



PLATiNO-4

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High Resolution Mission

	Planned Launch date 2024
band	VIS
Altitude [km]	400
Orbital duty cycle [s]	180 to 300
Swath [km]	4
FOV [deg]	1.27
Aperture [mm]	420
GSD [m]	0.5 x 0.5
Spectral Range (nm)	470-840
VIS SNR	100-120:1
MTF	0.2-0.3 (over RGB bands)
# spectral bands	4 (RGB-NIR)

Hyperspectral Mission

	Planned Launch date 2025
band	VNIR - SWIR
Altitude [km]	619
Orbital duty cycle [s]	65
Swath [km]	30
FOV [deg]	2.77
Aperture [mm]	210
GSD [m]	30
Spectral Range (nm)	VNIR: 400 – 1010 / SWIR: 920 – 2505
Spectral Resolution (nm)	10
VNIR SNR	> 200:1
SWIR SNR	> 100:1
MTF	VNIR/SWIR along track > 0.18 / VNIR/SWIR across track > 0.34 / PAN along track > 0.10 /PAN across track >0.20
# spectral bands	>230(VNIR-SWIR)

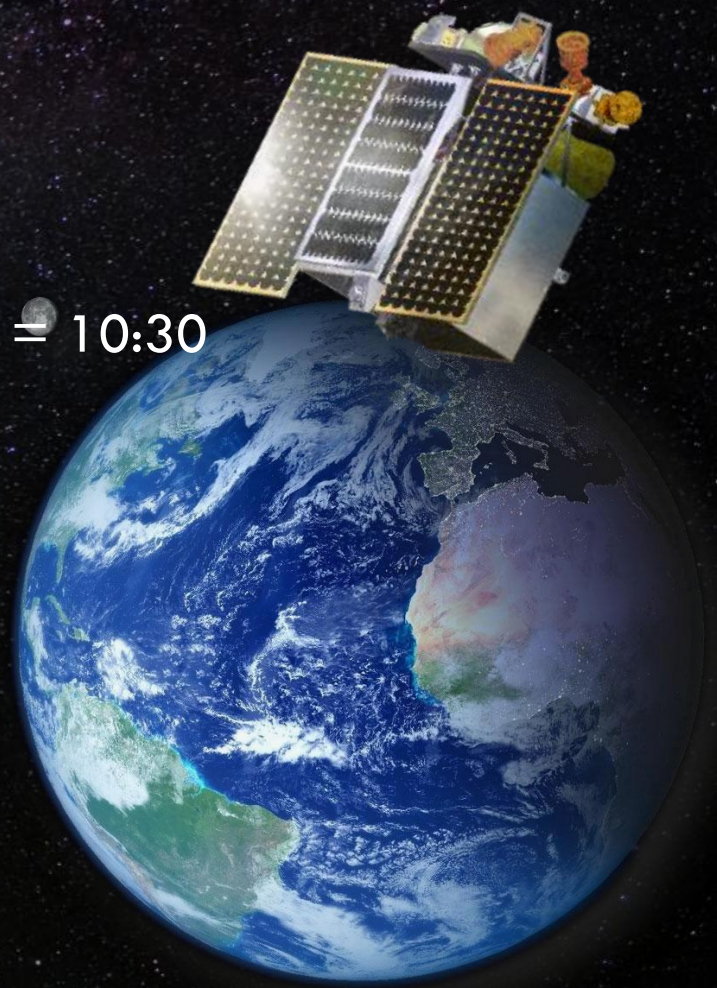
PLATiNO – 2: TIR/Multispectral Mission

- Spectral Range 8-12 micron
- Spectral Channels : 8.6, 9.1, 10.3, 11.5 micron
- Channel bandwidth: 1 micron

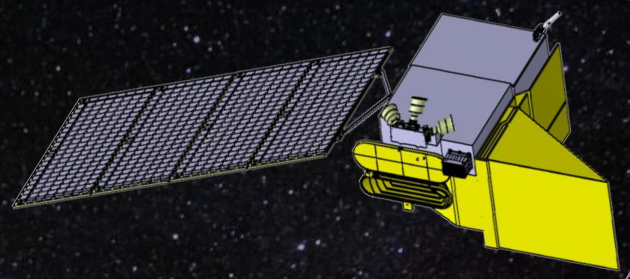
- Spatial resolution: 40m
- Accuracy <1.5 ° K
- Swath = 40 km
- Strip = up to170 km
- Daily coverage 170.000 km2

- Secondary P/L:
  - VNIR camera
  - Early Warning system

- Orbital parameters:
- SSO Frozen
- Local time of ascending node = 10:30
- Altitude = 393 km
- Inclination = 96 deg
- Repeat Cycle = 52 days



ASI-NASA/JPL: TIR-Multispectral Mission



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ASI-JPL FreeFlyer mission is a TIR-VNIR Mission aimed at acquiring images of the Earth 24/7

TIR instrument: 8-band radiometer

TIR Performance	SPECS	Note
Thermal IR Bands	8.28 µm / 8.63 µm / 9.07 µm / 11.33 µm / 12.05 µm	
mid-IR bands	3.98 µm / 4.80 µm	
short-wave IR	1.60 µm	
NETD	0.2 °K @ 300 °K	
GSD	60m	
Swath width	935 km	
Coverage	Global	
Data quantization	16 bit	
Data Production	248.8 Mbps peak *(108.17 Mbps compressed)*	Daytime and Coastal Land (42%)
Data compression	> 2:1	*2.3:1 used*
Data Latentcy	< 24h	

VNIR camera: a two-channel instrument to calculate NDVI values

VNIR Performance	SPECS	Note
Visible Bands center	655 nm	
Visible Bands bandwidth	80 nm	
NIR Bands center	835 nm	
NIR Bands bandwidth	80 nm	
SNR	100	For both bands
GSD	<35 m	
Swath width	935 km	
Coverage	Global	
Data quantization	12 bit	
Data Production	133.8 Mbps peak (44.6 Mbps compressed)	Daytime only /Coastal Land (42%)
Data compression	3:1	2.3:1 used

ASI EO future mission

- EO constellation with high temporal resolution.
- Mono and Bi-Static SAR X/L/P band, including COSMO-SkyMed Next Generations, Small-sat and Geosyncronous;
- Hyperspectral (VNIR/SWIR/TIR);
- LIDAR
- Optical HR
- New instruments: Radiometers, Quantum Gravimetry, Radar sounder etc

Supporting Earth science and applications and pulling Users towards our services layers


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THANK YOU FOR YOUR ATTENTION