

La missione iperspettrale PRISMA e la sua capacità di rilevare le caratteristiche chimico fisiche degli oggetti sulla Terra

Luca Fasano – ASI

Prepared by: E. Lopinto, P. Sacco, L. Fasano



Mission Overview



PRISMA: PRecursores IperSpettrale della Missione Applicativa

- ❖ **National** EO hyperspectral Mission fully funded by ASI
- ❖ Mission conceived as a **Pre-operational and technology demonstrator**
- ❖ Launch on March 2019

PRISMA Records (pushbroom scanning mode) the radiation reflected from the Earth surface (**spectral cubes**) in **400nm – 2505nm** spectral window

- **240 total bands** in VNIR (#66,) & SWIR (#174, 920–2505 nm), partial spectral overlap
- **High spectral Resolution** (better of 14 nm)
- Medium spatial resolution (30m) and swath (30km)
- **PAN camera** (400–700 nm) offers added capability with 5m spatial resolution



- ❑ **Primary mode – Manage user requests**
 - CALVAL sites (high priority)
 - Nominal requests from registered users
- ❑ **Background mission** to fill-up resources still available after planning the users requests

Products and performances



Absolute HYP **radiometric accuracy** better than **5%** (TOA or BOA)

Geometric localization errors (CE90) better than **200m** (15m with GCPs)

Revisit time is **29 days** at same look angle (orbital cycle) but **<7days** with variable looking

Average response time (from user order to product ready) is **7.5 days** (measured)

System can acquire 223 spot (30x30 Km) images/day (200.000 Km²) and **process 200 images/day up to L2D**

All Product are in **HD5-EOS** format and include HYP data cube + PAN image + masks + metadata

- ❖ **Level 1: Top-of-Atmosphere Radiance** radiometrically corrected and calibrated in physical units (incl. Cloud mask; Sun-glint Mask; Classification Mask; Calibration and characterization data)
- ❖ **Level 2B: Geolocated at Bottom-of-Atmosphere Radiance**
- ❖ **Level 2C: Geolocated at Bottom-of-Atmosphere Reflectance** (incl. Aerosol Characterization Product (VNIR); Water Vapour Map Product (HYP); Cloud Characterization)
- ❖ **Level 2D: Geocoded version of the level 2C products**

PRISMA Data Policy & Exploitation



- ❖ **Free** of charge & **quasi-Open** data to all
- ❖ 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

- ❖ 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 (...changing...)**
 - ❑ Products are **costless** for the users but **cannot be redistributed**

International Collaborations



We are currently pursuing 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: Support to CHIME (2020 and 2021 PRISMA4CHIME project), study of a HYP+HR/VHR CALVAL site, participation to joint scientific events
- Contacts for cooperation agreements with NASA/JPL, NOAA, ASA, NZSA,

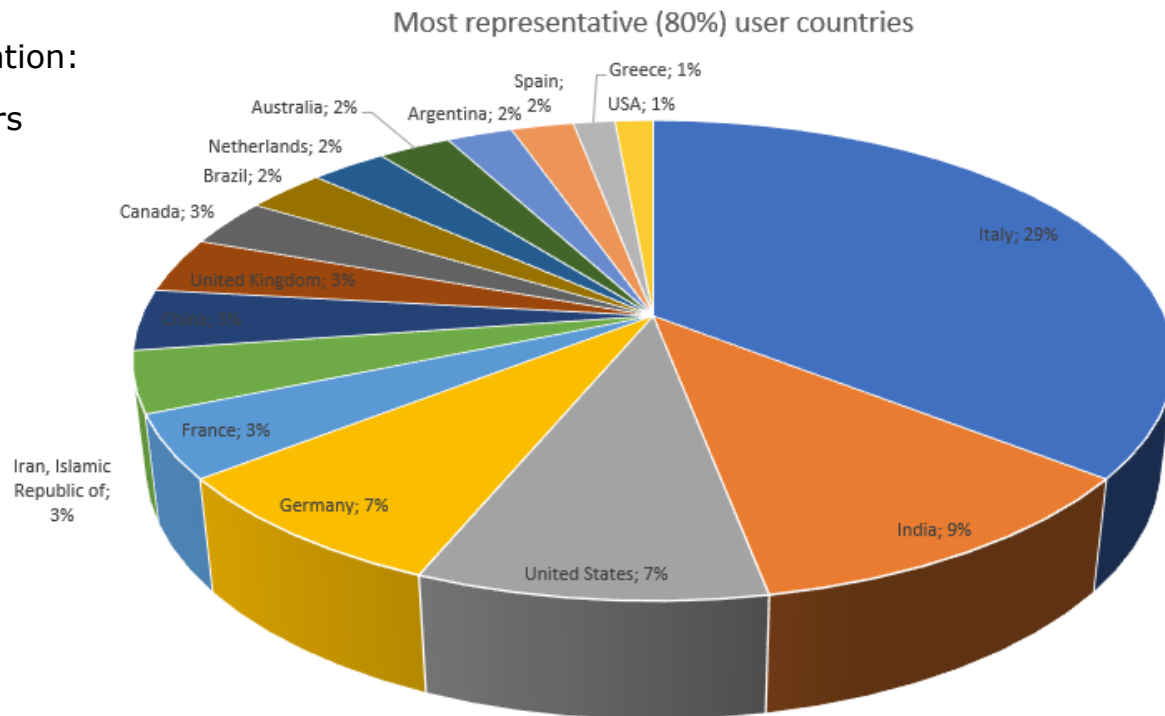
Mission Statistics – User amount & nationality



965 Licenses to Use activated @ 31.08.2021

Limiting to the (statistically) most representative part of the user population:

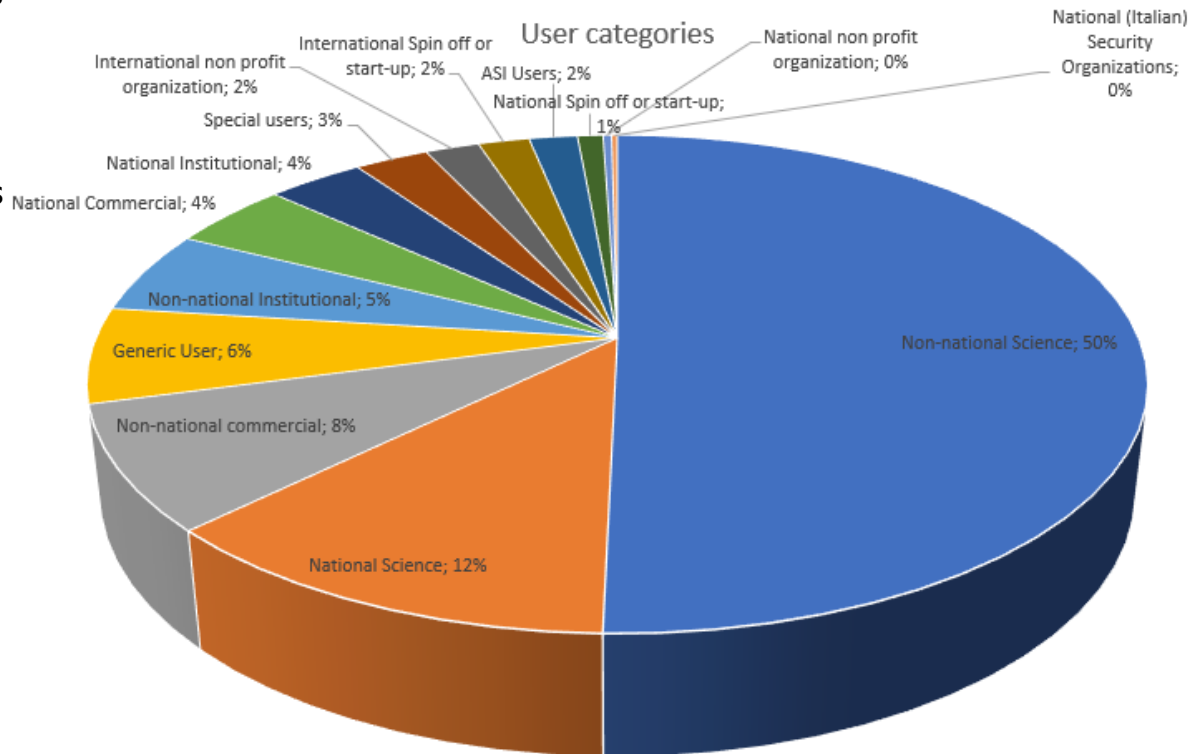
- 16 nations covers **80%** of the users
- the Italian users are **1/3**
- India, USA and Germany together account the **1/4** of the users



Mission Statistics – User category



- **62%** of the total users are **scientists** (**50%** of the users belongs to non-Italian Science and are the largest category)
- Institutional (**9%**) and commercial (**12%**) represents **21%** of total users
- Foreign commercial (**8%**) are two times the Italian commercial (**4%**)
- **6%** of user are still freelance!

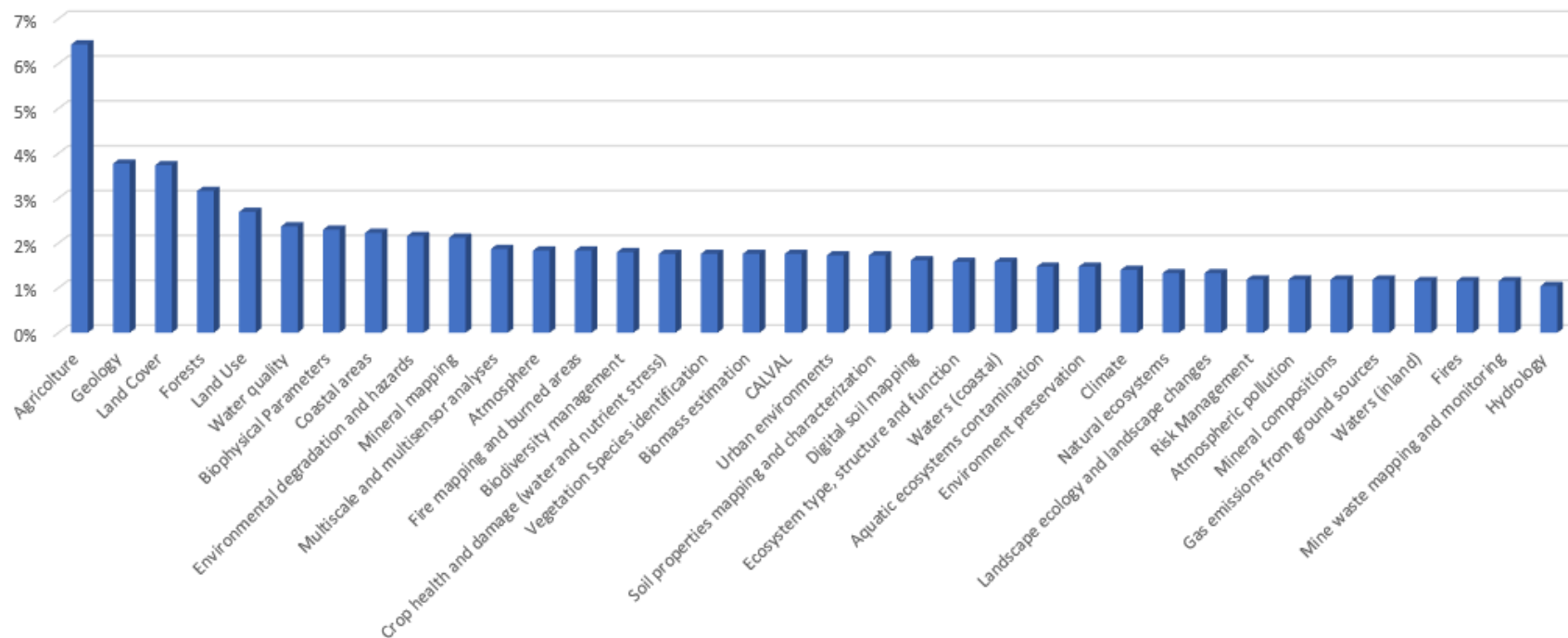


Mission Statistics – Use of data

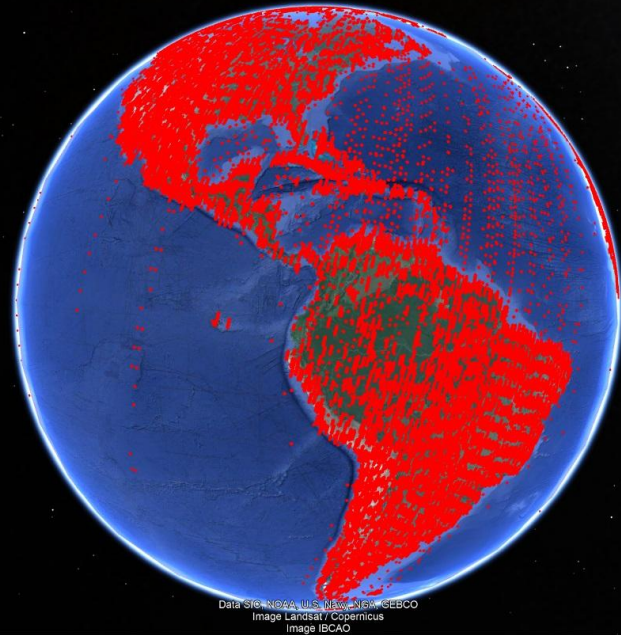
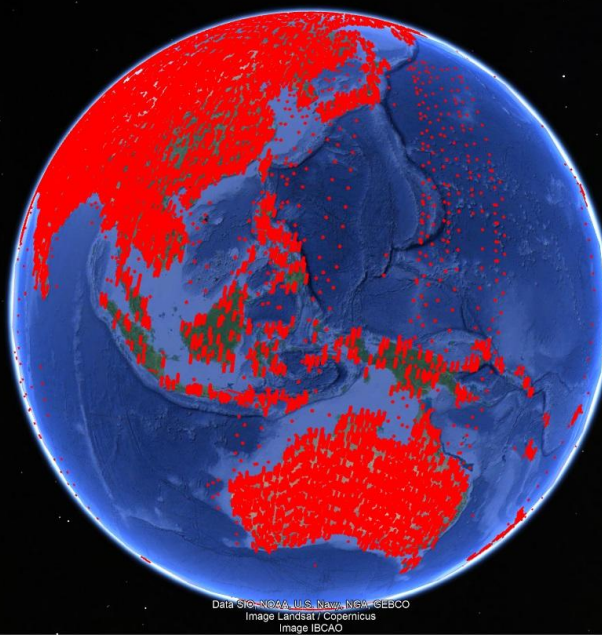
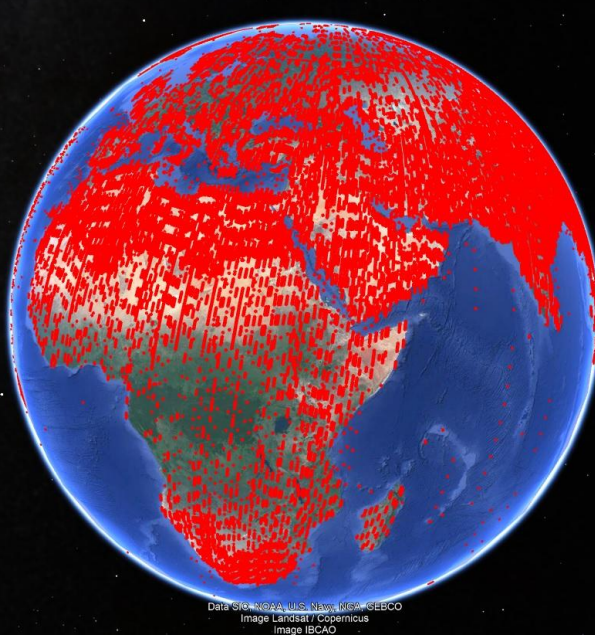


26 thematic areas cover **70%** of all applicative usages

Most frequent (70%) Usages of Data



Mission Statistics

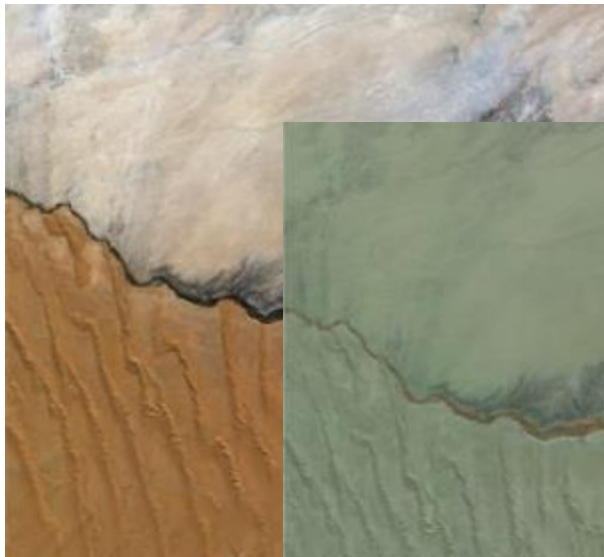


110k images (including those from the background mission) all over the world @31.08.2021; a new approach to background planning is going to be used to improve global land coverage

Some Images



SWIR



VNIR



PAN



PRISMA main CalVal – Gobabeb (Namibia)

Data/Information generated by Leonardo S.p.A. under an ASI License to Use; Original PRISMA Product - © ASI - (2020-2021)

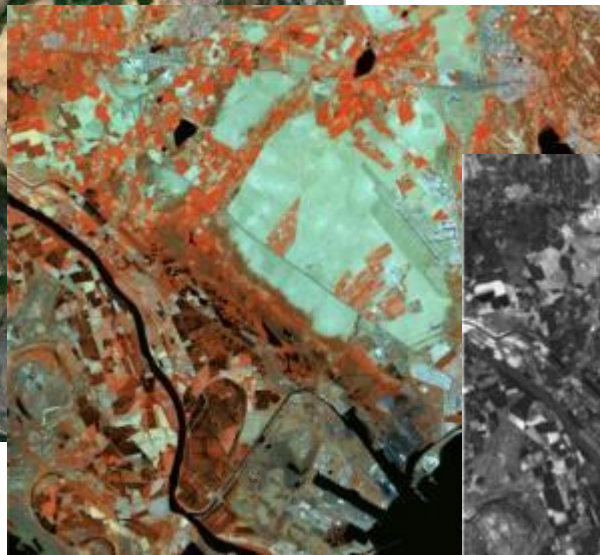
Some Images



SWIR



VNIR



PAN



PRISMA CalVal – LaCrau (France)

Data/Information generated by Leonardo S.p.A. under an ASI License to Use; Original PRISMA Product - © ASI - (2020-2021)

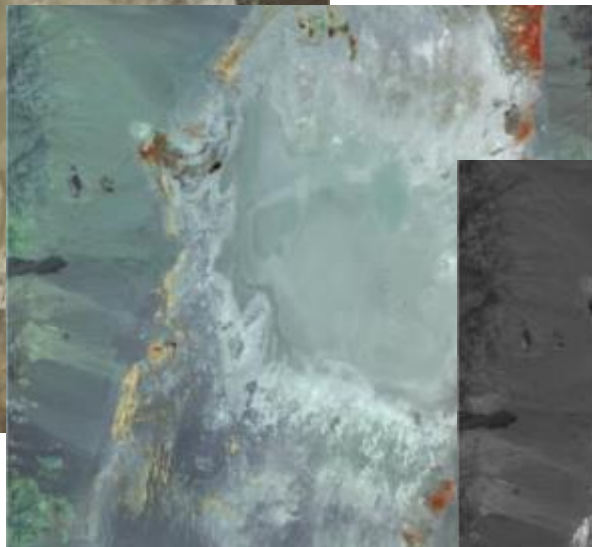
Some Images



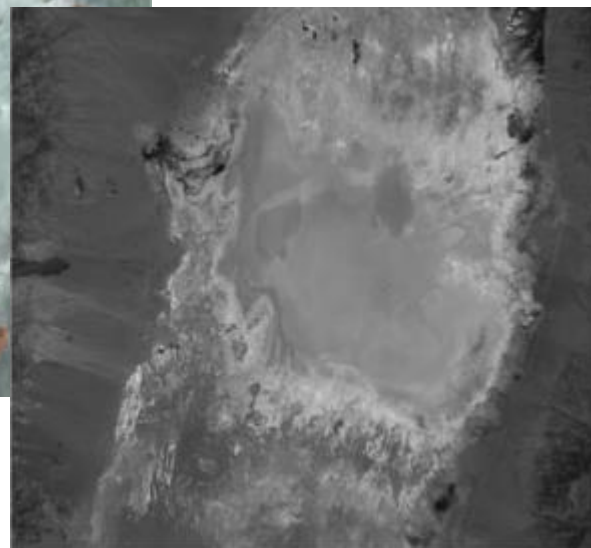
SWIR



VNIR



PAN

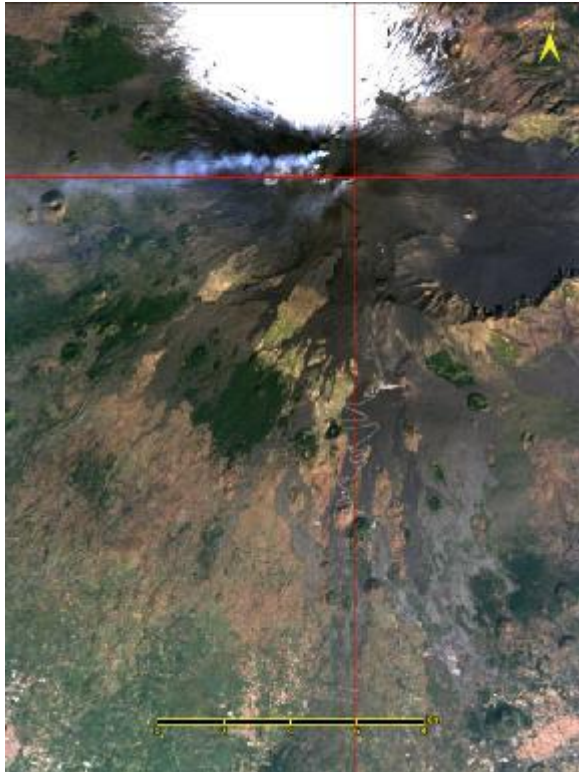


Data/Information generated by Leonardo S.p.A. under an ASI License to Use; Original PRISMA Product - © ASI - (2020-2021)

PRISMA CalVal – Railroad Valley (Arizona)

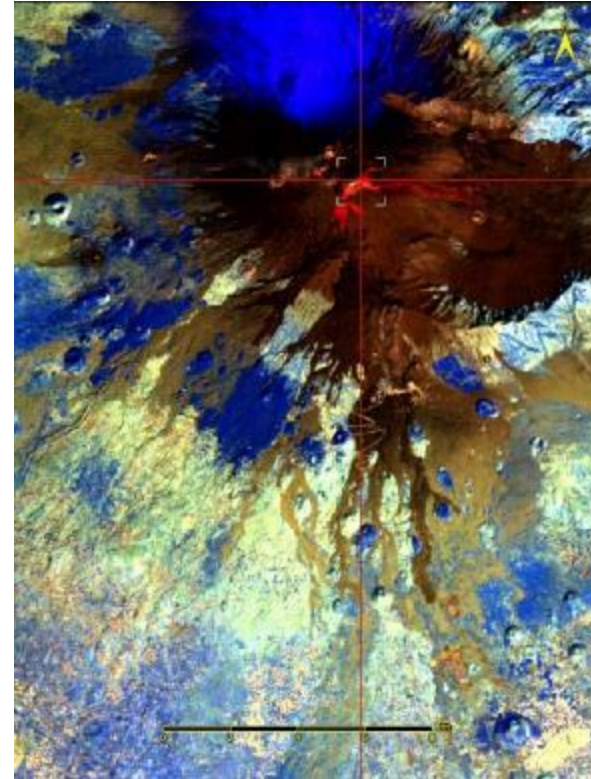
Some Images

Data/Information generated by Leonardo S.p.A. under an ASI License to Use; Original PRISMA Product - © ASI - (2020-2021)



ETNA volcano, Sicily (Italy)

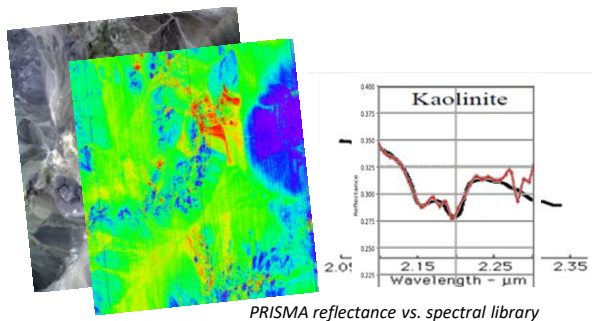
VNIR



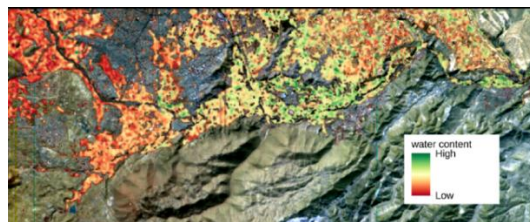
SWIR

PRISMA data usage examples

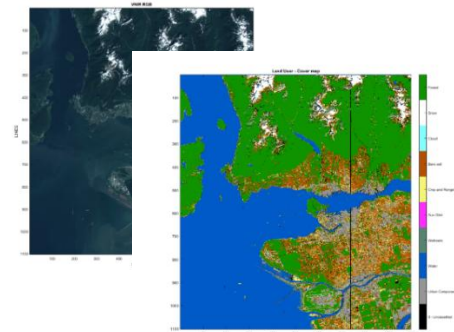
Kaolinite map on Cuprite Hill (US)



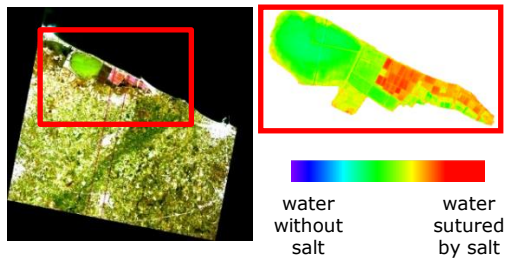
Vegetation Water content map



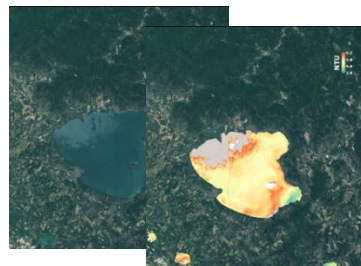
Land cover map



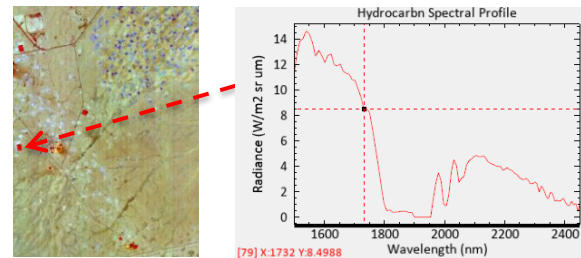
Water properties and salt features on
Margherita di Savoia (IT)



Turbidity map on Lake Trasimeno (IT)



Hydrocarbons map

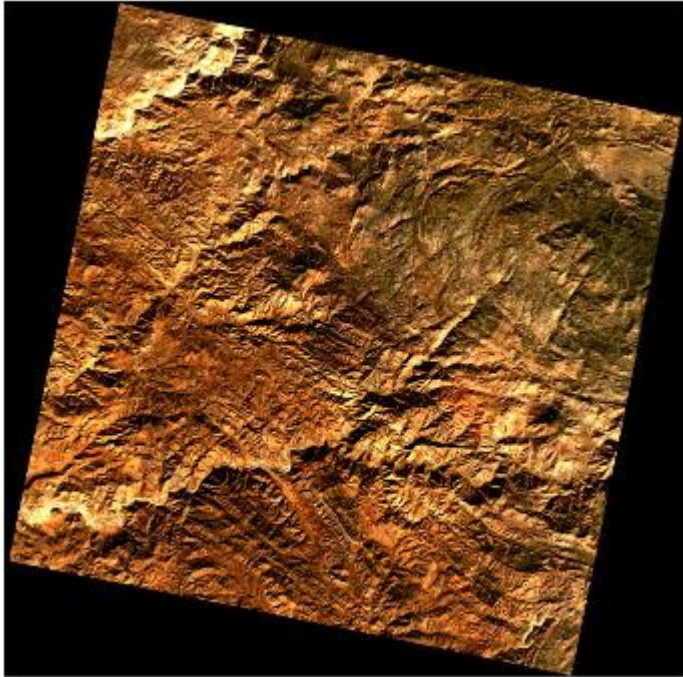




Agenzia Spaziale Italiana

PRISMA Second Generation

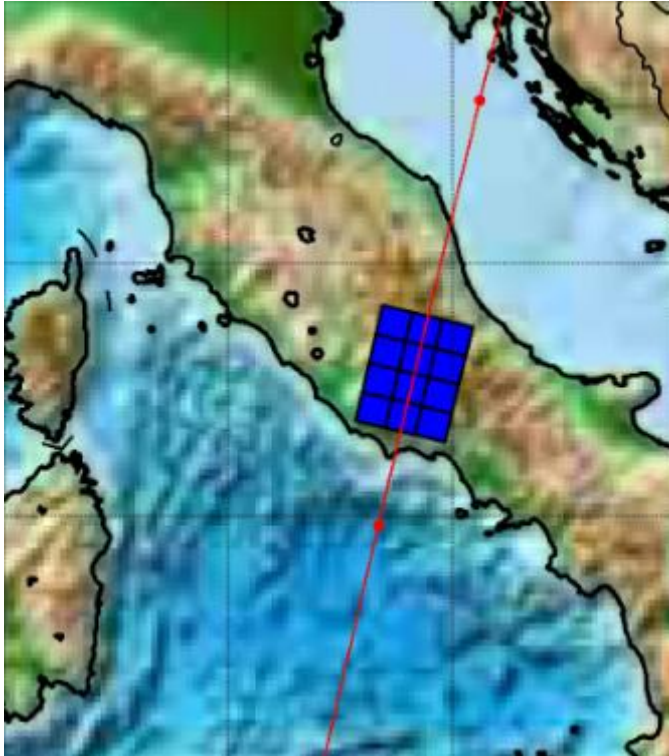




Australia

- **STATUS**
- PRISMA Second Generation will be the future Hyperspectral Italian Mission, to be launched in 2025
- Entirely Funded by the Italian Space Agency
- Increasing interest in hyperspectral remote sensing – towards applicative missions

The PRISMA Follow On Mission: PRISMA Second Generation: stripmap



STRIPMAP image

The PRISMA Second Generation space segment shall acquire images in STRIPMAP mode with **VNIR/SWIR GSD ≤ 30 m** and **PAN GSD ≤ 5 m, swath ≥ 30 km** and indefinite length

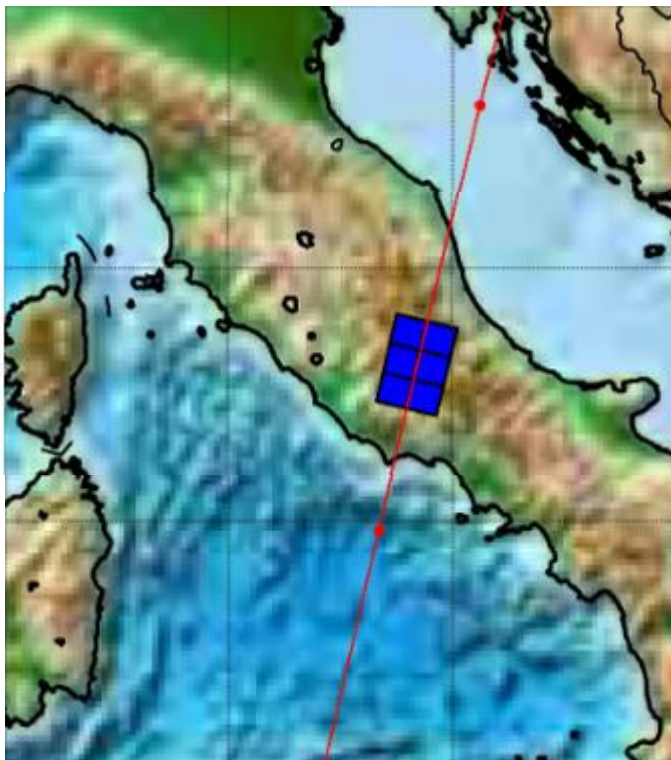
Daily STRIPMAP Imaging Capacity

The PRISMA Second Generation System shall be sized to provide the capacity to acquire, downlink and archive STRIPMAP data totalling 2.000.000 km² daily.

Mosaic STRIPMAP

The PRISMA Second Generation System shall acquire, when requested on demand, **single pass Mosaic** requests in STRIPMAP mode covering with multiple images an area of 90 km across track x 120 km along track of adjacent acquisitions.

The PRISMA Follow On Mission: PRISMA Second Generation: spotlight



SPOTLIGHT image

The PRISMA Second Generation space segment shall acquire images in SPOTLIGHT mode with **VNIR/SWIR GSD ≤ 10 m** and **PAN GSD $\leq 2,5$ m, swath ≥ 30 km** and length up to 210 km.

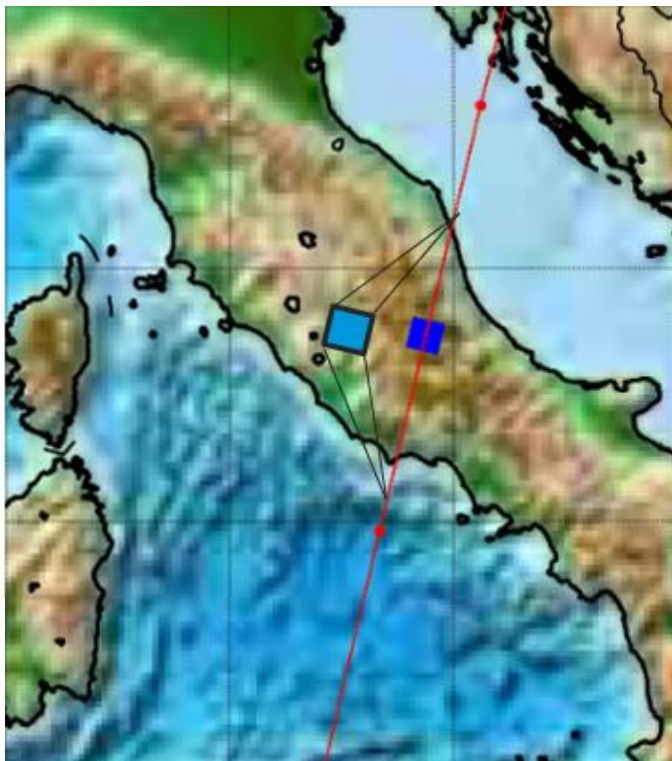
Daily SPOTLIGHT Imaging Capacity

The PRISMA Second Generation System shall be sized to provide the capacity to acquire, downlink and archive SPOTLIGHT data totalling 200.000 km² daily.

Mosaic SPOTLIGHT

The PRISMA Second Generation System shall acquire, when requested on demand, **single pass Mosaic** requests in SPOTLIGHT mode covering with multiple images an area of 60 km across track x 90 km along track of adjacent acquisitions.

The PRISMA Follow On Mission: PRISMA Second Generation: agility



Agility

The PRISMA Second Generation Space Segment shall manoeuvre in order to **capture two different SPOTLIGHT images at the same latitude in a single pass** at a minimum distance of 100 km.

On demand Stereo and tristereo imaging

The PRISMA Second Generation System shall acquire upon user request stereo and tristereo SPOTLIGHT images with on-demand parameters.

The PRISMA Follow On Mission: PRISMA Second Generation: scenario

	In-Orbit	2022	2025	2025	2029
System	PRISMA	EnMAP	SHALOM	PRISMA SG	CHIME
band	VNIR-SWIR-PAN	VNIR-SWIR	VNIR-SWIR-PAN	VNIR-SWIR-PAN	VNIR-SWIR
Swath [km]	30	30	10	30	128
GSD [m]	Hyp: 30 m / PAN: 5 m	Hyp 30 m	Hyp: 10 m / PAN: 2.5 m	Hyp: 30/10 m PAN: 5/2.5 m	30 m
Spectral Range (nm)	VNIR: 400 – 1010 / SWIR: 920 – 2500 / PAN : 400 – 700	VNIR: 420-1000 / SWIR 900 - 2450	VNIR: 400 – 1010 / SWIR: 920 – 2500 / PAN : 430 – 680	VNIR and SWIR: 400 – 2500 / PAN : 400 – 700	400-2500
Spectral Resolution (nm)	avg. 12	≤ 10	≤ 10	≤ 10	≤ 10
# spectral bands	66 (VNIR) 171 (SWIR) 1 (PAN)	230 (VNIR-SWIR)	77 (VNIR) 198, (SWIR) 1 (PAN)	>230(VNIR-SWIR-PAN)	211
Relook time	7 days	4 days	4 days	3 days	20-30 days



Agenzia Spaziale Italiana

portal:

<https://prisma.asi.it>

Info, contacts, inquiries:

prisma_missionmanagement@asi.it

