

The ESA Φ sat-2 mission: an AI empowered 6U Cubesat for Earth Observation

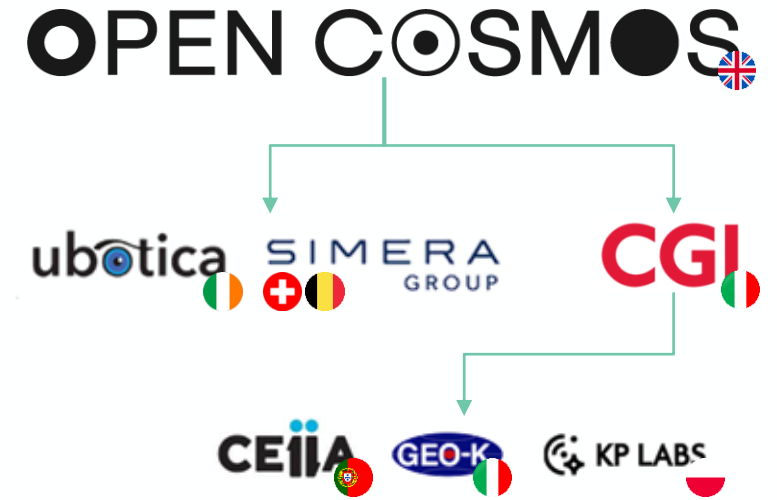
Mirko Albani, Nicola Melega, Nicolas Longepe
(ESA)
WGISS#61, Dehradun (India), 16-20 March 2026

Φsat-2 Mission at a glance

Objectives

- Demonstrate the enabling capabilities of running Artificial Intelligence applications onboard the spacecraft
- Demonstrate their relevance for applicative scenarios and operational missions

- Total Budget: about **3 MEuro** including launch and 1 year of operations
- **Launched on August 16th 2024**
- First Image acquired 4 days after launch
- Operations end expected Q1 2026



Lifecycle





6U CUBESAT PLATFORM

- 3 axis stabilised (4 RW, 1 STR + gyro)
- Deployable SA
- S/X-Band comm
- No propulsion

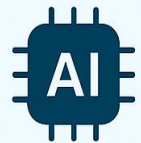


SSO@510 Km
LTDN 11:00



MULTI-SPECTRAL IMAGER

- 7 VIS-NIR + PAN
- 4.8 m GSD
- Dedicated payload computer
- Level 1 Products onboard



6 ONBOARD APPLICATIONS

- upload, update
- chaining



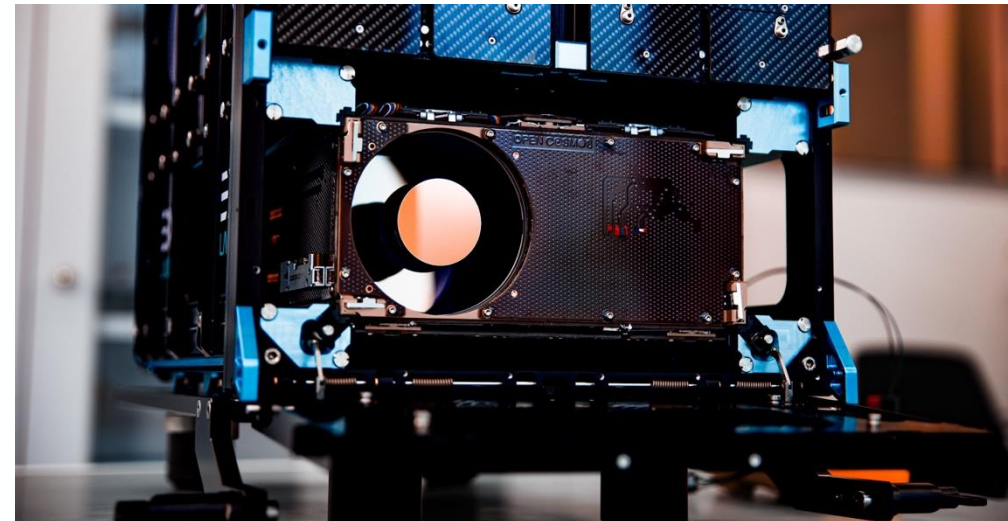
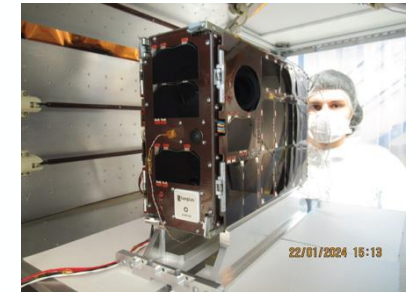
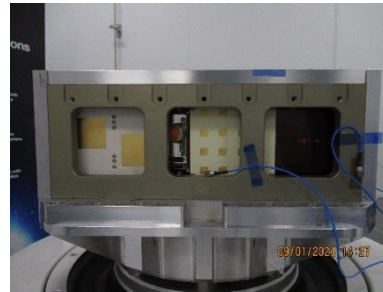
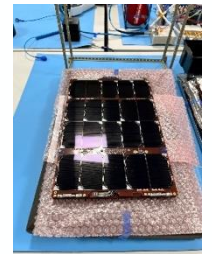
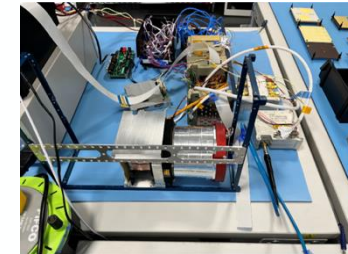
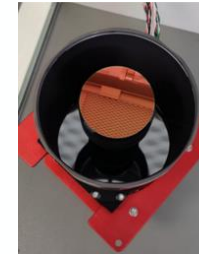
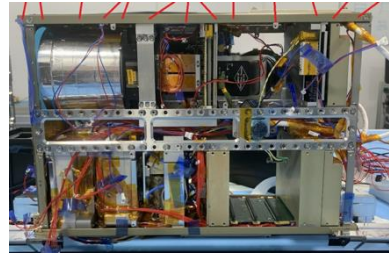
1 year NOMINAL OPERATIONS

- Applications fine tuning
- Nominal Operations



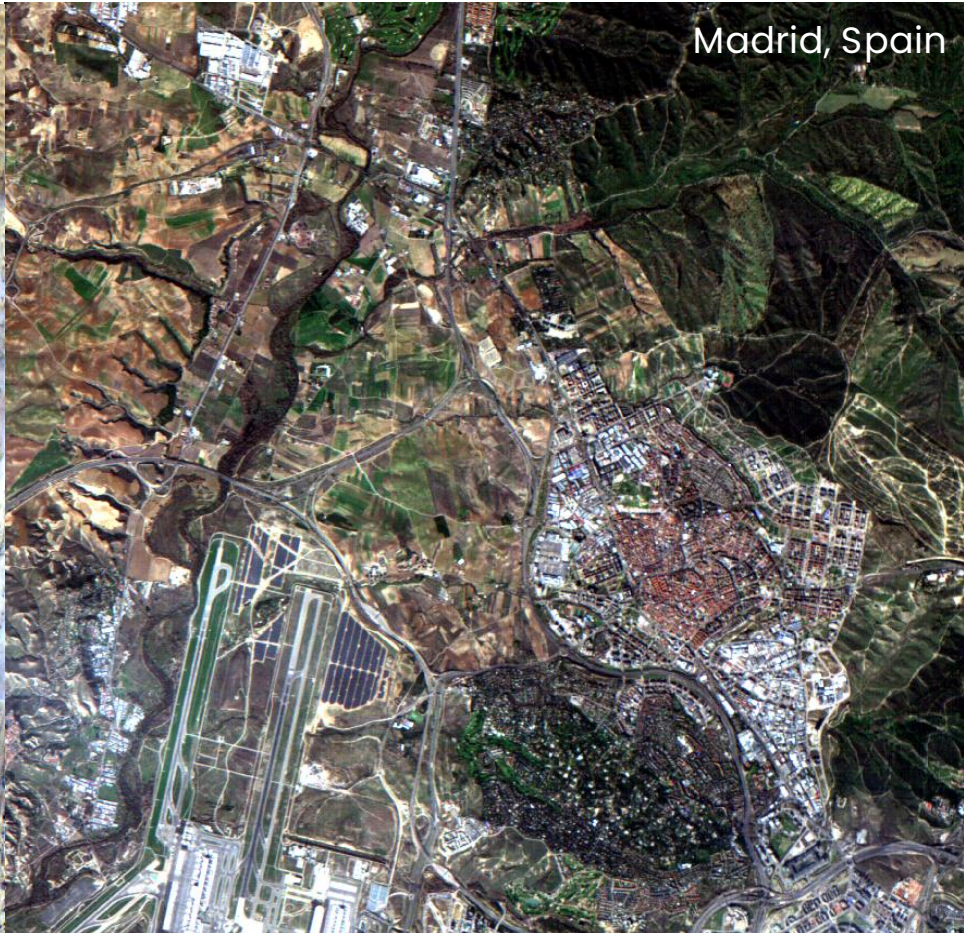
~12 ACQUISITIONS/DAY

- Up to 45 min processing
- Identified AOIs



Onboard Processing (1)

Full Level-1c processing onboard (Relative Radiometric Correction, Cosmetic Filling, Denoising, Absolute Radiometric Correction, Band Co-registration, Geolocation, TOA Radiance to Reflectance conversion).



Onboard Processing (2)

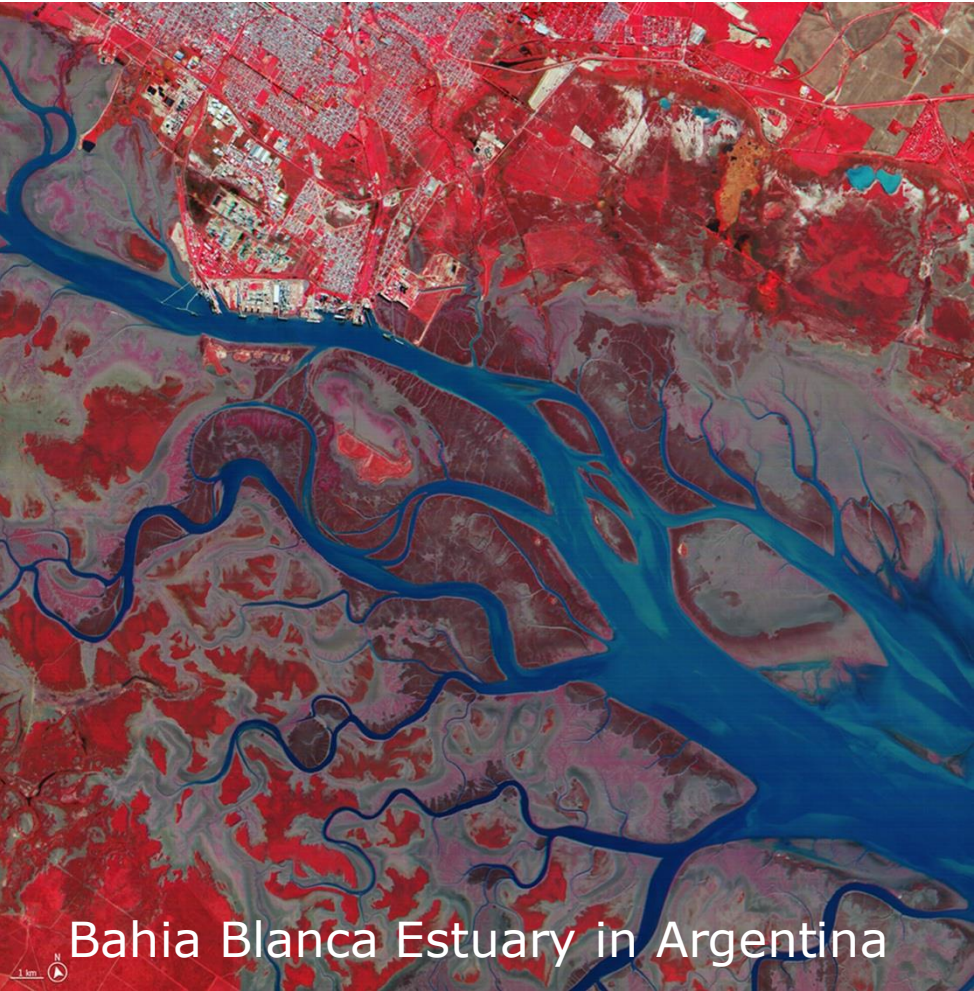


Xico Crater, Mexico City



Ocean Colors

Onboard Processing (3)



Onboard Processing (4)

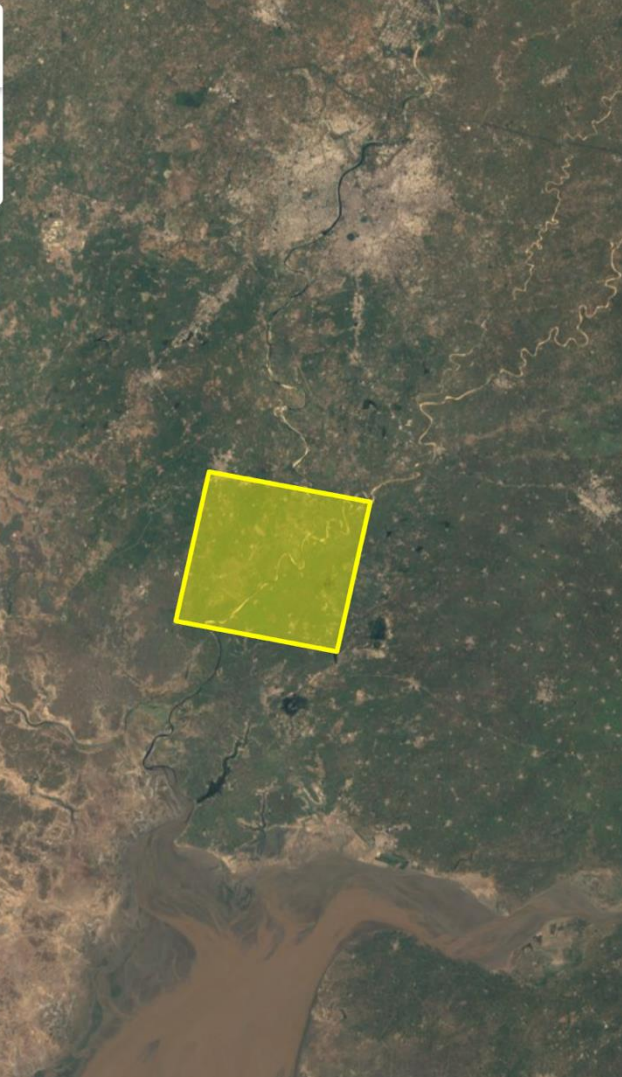
< **Insula Perception**

Map layers ⋮ [+ Add layers](#)

No dataset selected



Palla-Vauta Bridge



Sabarmati River, Vauta-Baroda (India)

Onboard Processing (5)



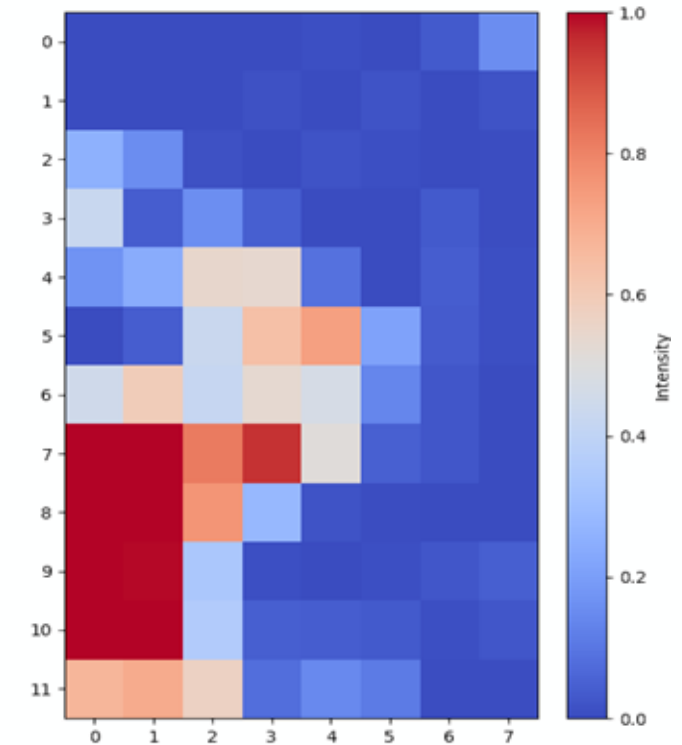
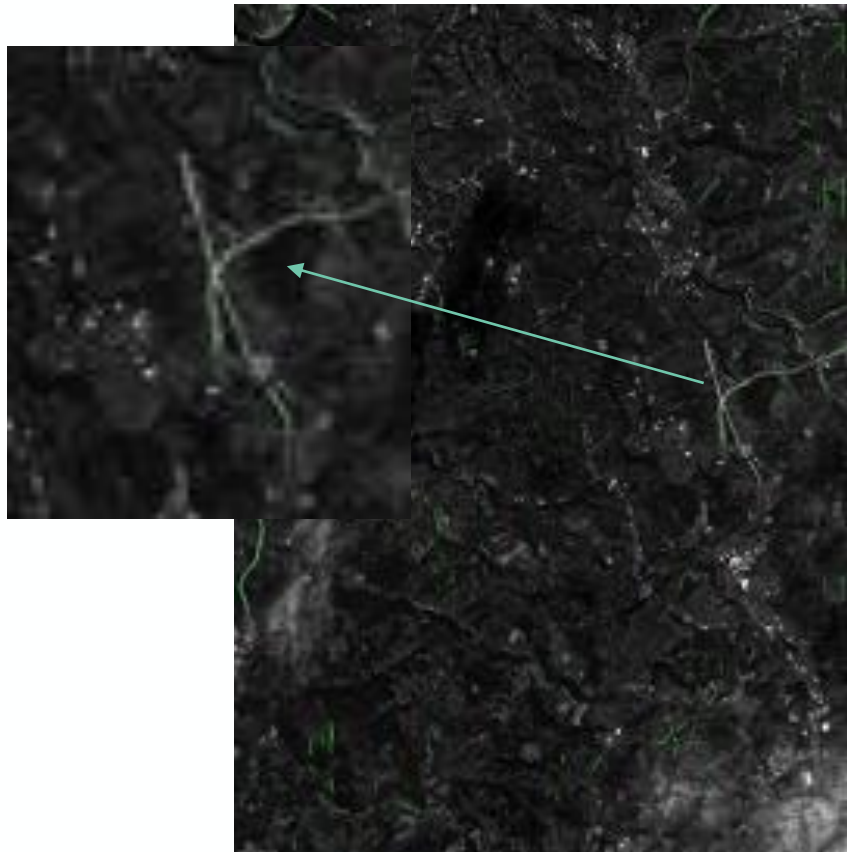
Ahmedabad (India)



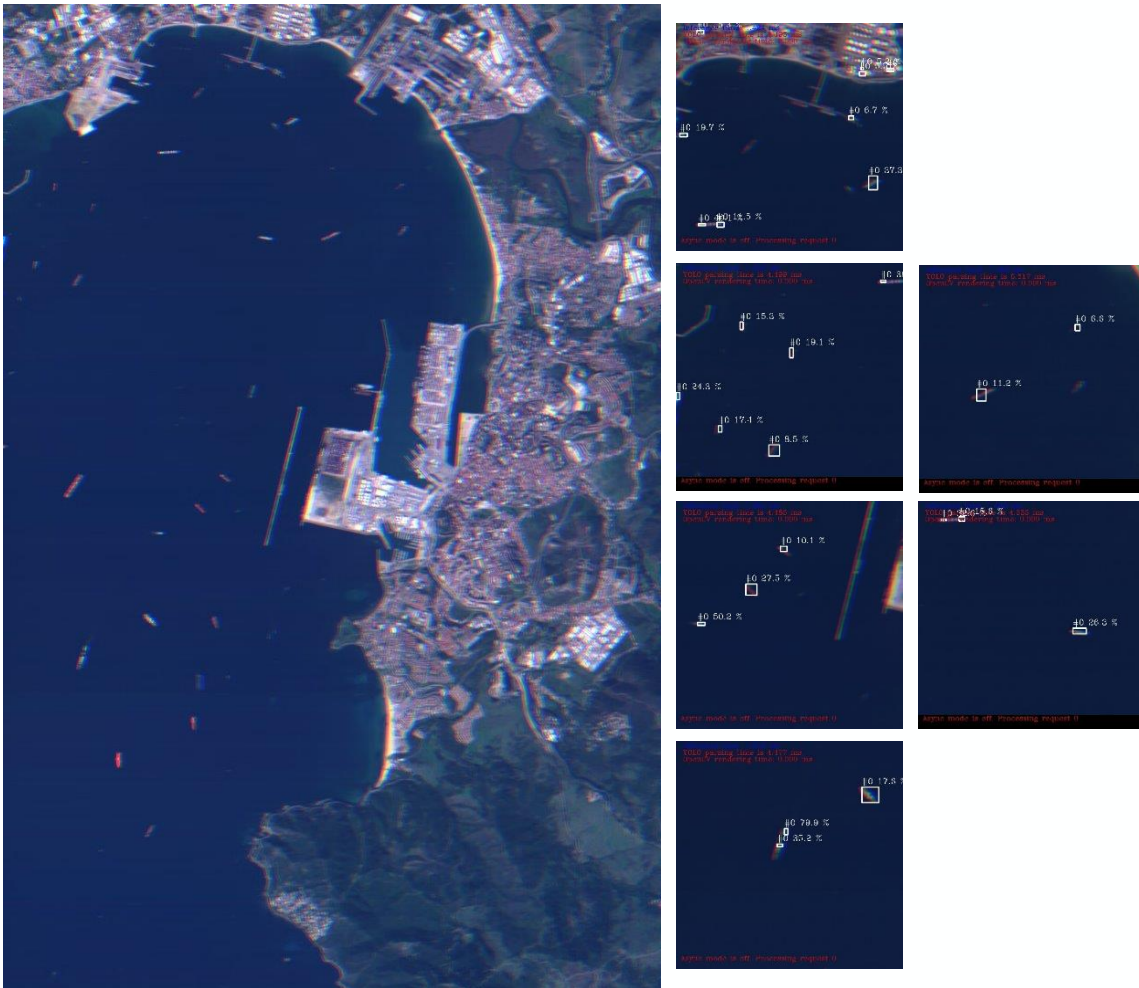
ISRO Research Institute

SAT2MAP: automatically obtain street map information from MSI images using AI.

CLOUD DETECTION: Enable prioritization of data to be downlinked to Ground based on standard cloud coverage and new concentration measure (homogeneous or heterogeneous cloud masks e.g. clouds scattered around the entire scene...); Act as onboard service for other applications to offload them from the tasks of a cloud assessment

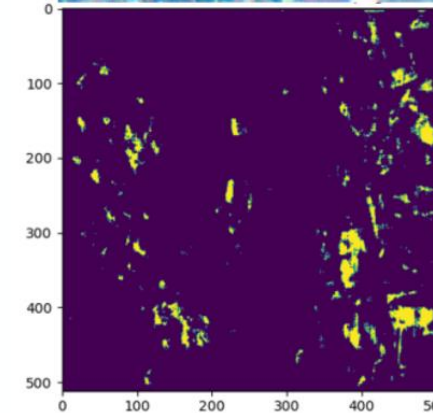


VESSEL DETECTION: autonomously develop awareness about vessels (detect and classify various vessel types) using AI

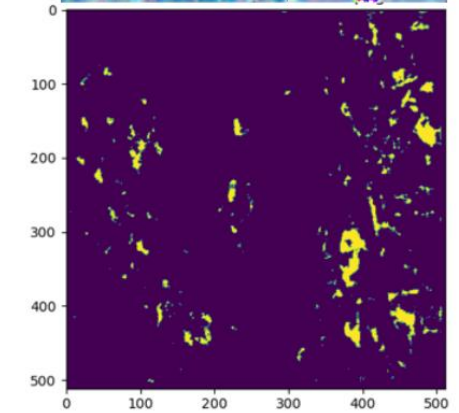
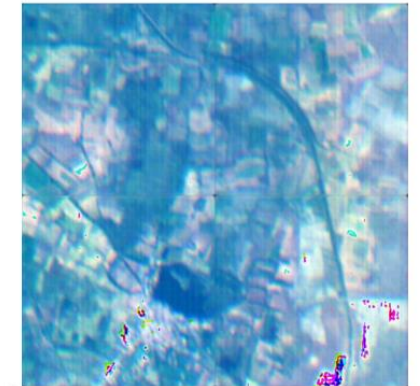


DEEP COMPRESSION: Reduce the amount of data to be sent to the ground with a limited information loss. Compression of the image is performed on-board, Reconstruction on the ground by means of the decoder.

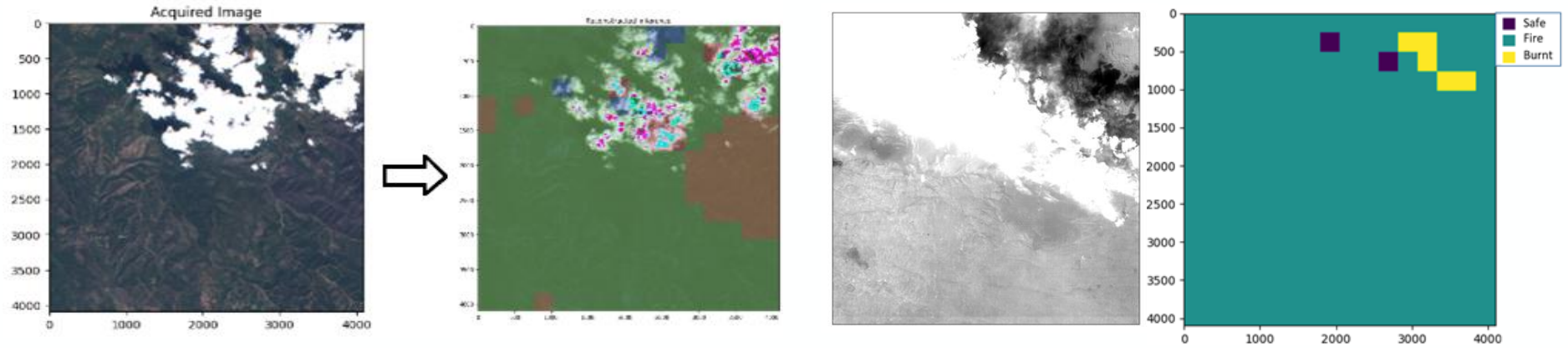
Input image (512x512)



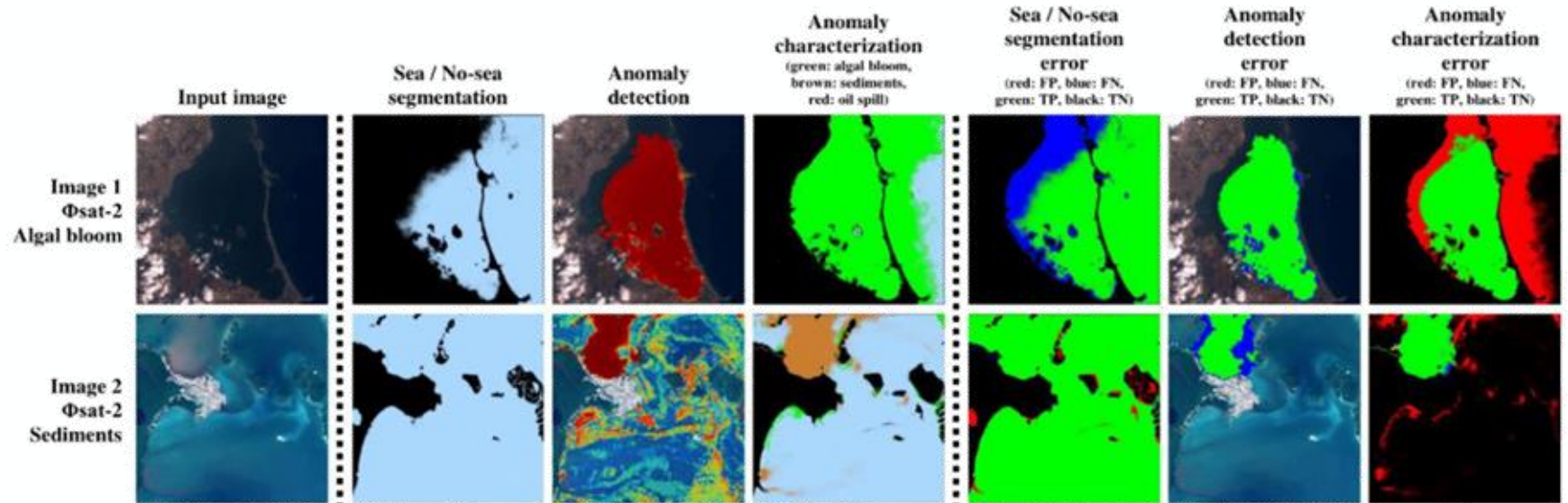
Decompressed image (512x512)



PHIFIRE DETECTION:
Onboard land classification, including burnt areas and plume detection for fire early warning.



MARINE ANOMALIES:
Onboard detection of marine anomalies like oil spills, algal bloom, sediments. It focuses on coastal areas.



Operational Phase (April 2025-March 2026)

LEOP

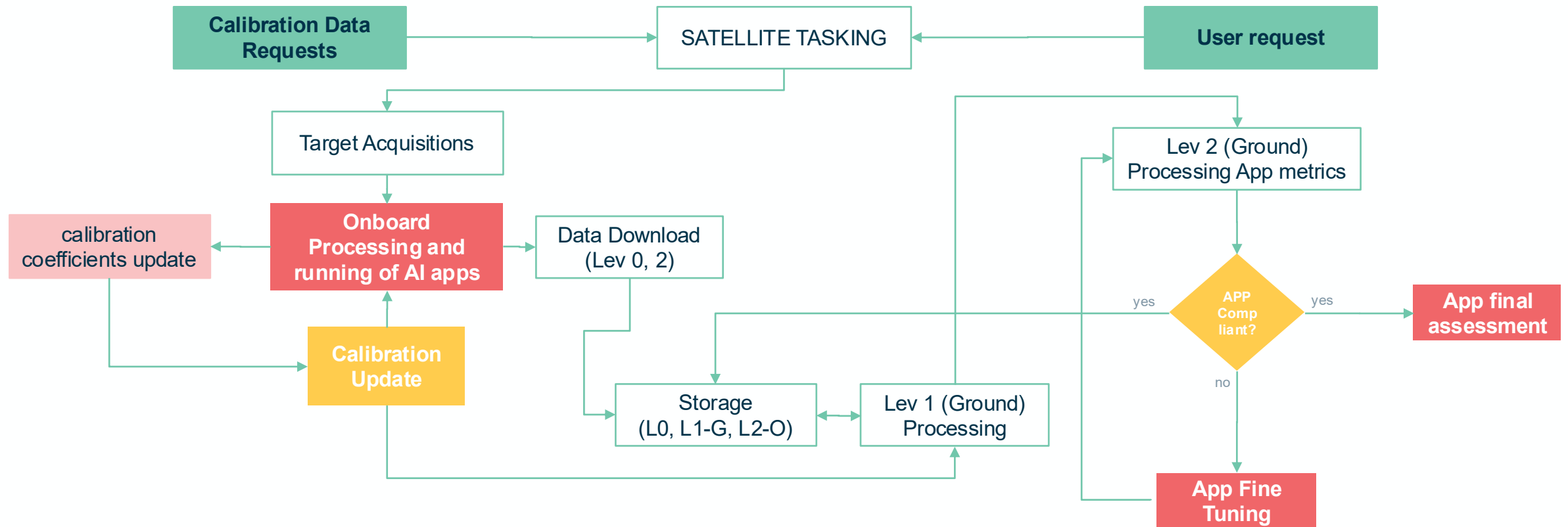
Platform Commissioning

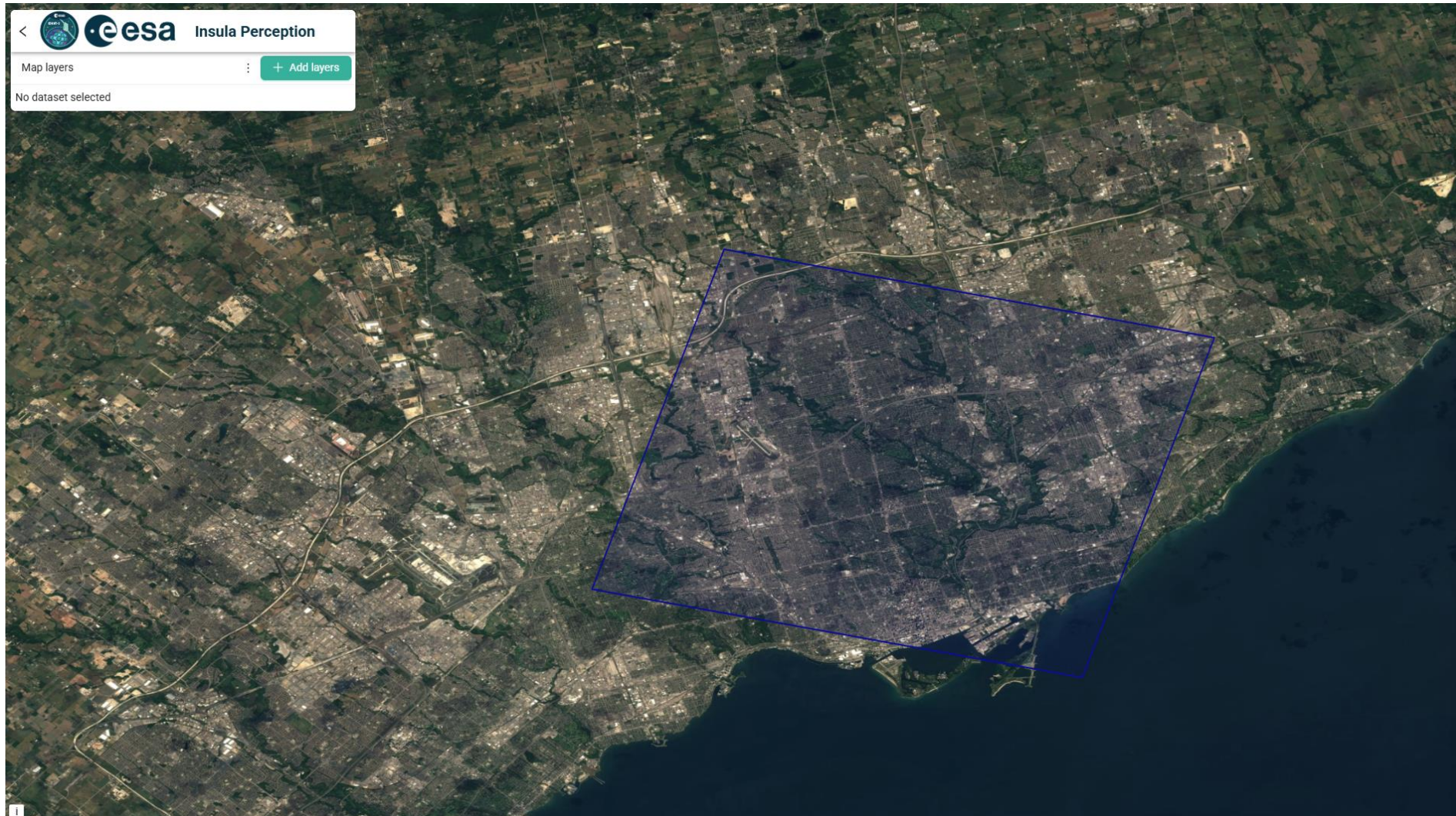
Payload Commissioning and Calibration

AI Apps fine tuning

Routine Operations

De-comissioning





Data discovery

PhiSat-2 Apps PhiSat-2 - L0 PhiSat-2 - L1

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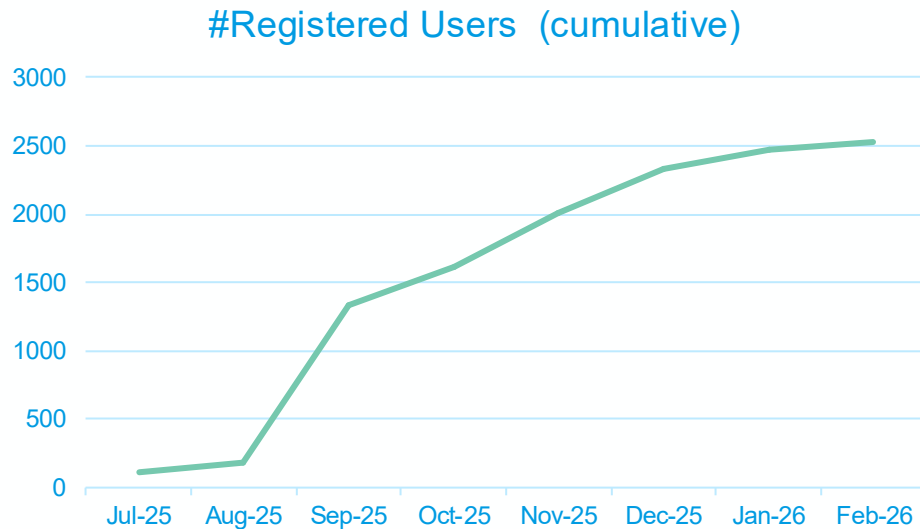
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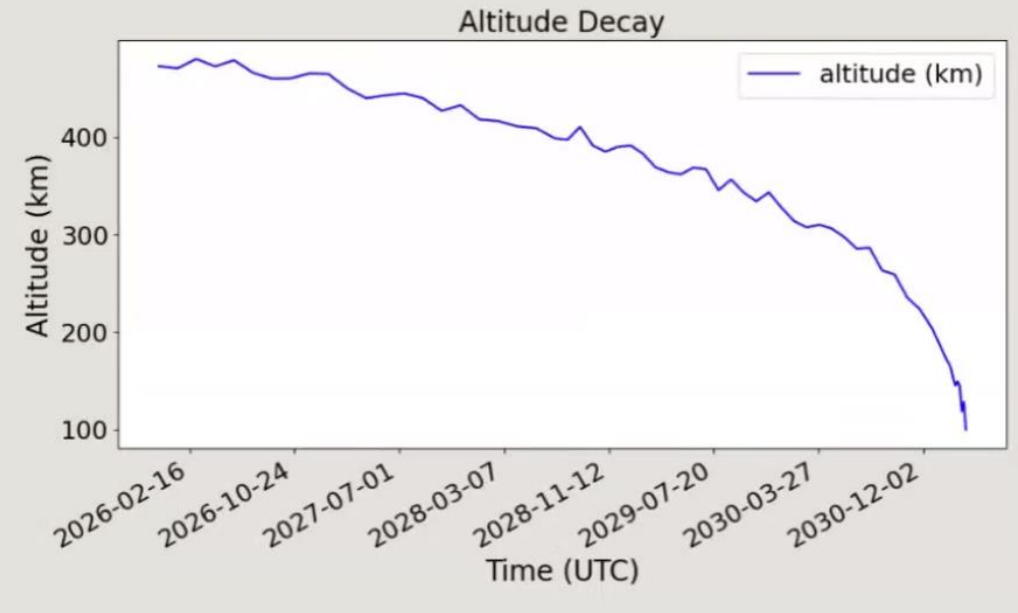
Currently about 3000 images accessible open and free at <https://phisat2.insula.earth/>

Phisat-2 Users and orbital status

	Jul-25	Aug-25	Sep-25	Oct-25	Nov-25	Dec-25	Jan-26	Feb-26
#Registered Users (cumulative)	115	184	1331	1616	2004	2331	2473	2535
#L1 Download (per month)	602	1969	5390	1510	742	702	530	3104



De-orbit prediction: Q1 2031
Current SMA: 483.3km



Considering the very good performances of the satellite and payload, the slow orbital decay and the very high interest expressed from user communities at large, ESA is planning to further extend the mission for an additional year beyond the planned phase E2 which will last until end March 2026.

Thanks for your attention!

