

# SABIA-Mar

## Mission Status Update



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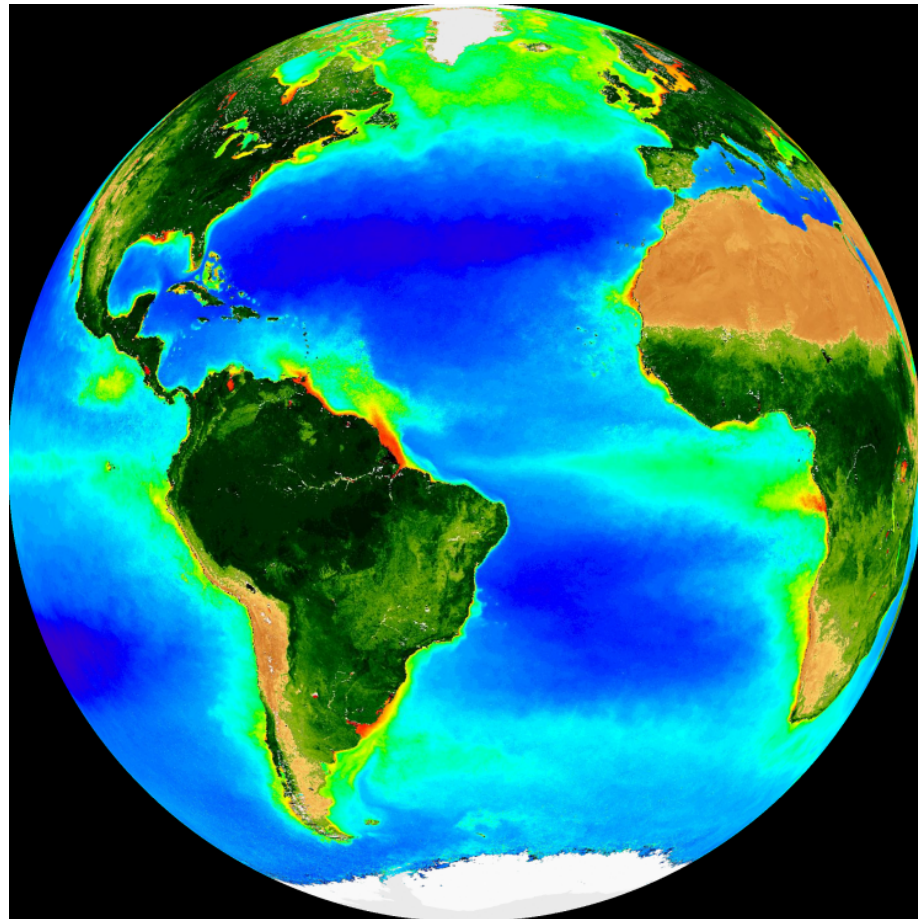
**January 2017**



# Driver Requirements

- The SABIA-Mar Mission is foremost intended for:
  - Global and coastal (South America) chlorophyll-a concentration determination.
  - Global and coastal water related parameters variability monitoring.
- Primary: Ocean Color Mission (2 days revisit)
  - Regional/Coastal Scenario
    - 200 meters for the measurement bands
    - 400 meters for the atmospheric correction bands
  - Global Scenario
    - 800 meters (imaging with 200 m – 4x4 pixels aggregated to decrease the on-board accumulated data)
- Secondary: Sea Surface Temperature (2 days revisit)
  - 400 meters in both scenarios

# Products



- **Normalized Water leaving radiance maps** 5% uncertainty (0.5% in blue for open ocean)
- **Chlorophyll-*a* concentration Maps** 30% uncertainty for open ocean with concentration in the range 0.01-10 mg/m<sup>3</sup>
- **Diffuse Attenuation coefficient K<sub>d</sub> (490)** 25% uncertainty on a daily time scale
- **Photosynthetic Available Radiation** 20%, 15%, 10% on a daily-weekly-monthly time scales
- **Turbidity** 35% uncertainty
- **Sea Surface Temperature** 0.7°C

# Bands – Ocean Color

Band	Wave length [nm]	GSD [m] Regional	GSD [m] Global	L typical [ $\text{Wm}^2\text{sr}^{-1}\mu\text{m}^{-1}$ ]	L max [ $\text{Wm}^2\text{sr}^{-1}\mu\text{m}^{-1}$ ]	S/N @ Ltyp GSD: 1000m
B0	412 ± 5	200	800	79	602	1000
B1	443 ± 5	200	800	68	664	1000
B2	490 ± 5	200	800	52	686	1000
B3	510 ± 5	200	800	45	663	1000
B4	555 ± 5	200	800	34	643	1000
B5	620 ± 5	200	800	21	570	1000
B6	665 ± 5	200	800	16	536	1000
B7	680 ± 3.75	200	800	15	517	1500
B8	710 ± 5	200	800	12	489	1000
B9	750 ± 5	200	800	10	447	600
B10	765 ± 5	400	---	7.8	430	600
B11	865 ± 10	200	800	5.9	333	400
B12	1044 ± 10	400	---	3.7	236	400
B13	1240 ± 10	400	---	0.88	158	250
B14	1610 ± 30	400	---	0.29	82	250

# Spectral Coverage

Band	Center Wavelength [nm]
B0	412
B1	443
B2	490
B3	510
B4	555
B5	620
B6	665
B7	680
B8	710
B9	750
B10	765
B11	865
B12	1044
B13	1240
B14	1640
B15	10800
B16	11800

Camera  
**VIS-NIR**  
11 bands  
11 lines

Camera  
**TIR**  
2 bands  
2 lines

Camera  
**MAC**

Panchr	HSC
B2	MODULE
B4	MODULE
B8	POL (x3)
B11	POL (x3)

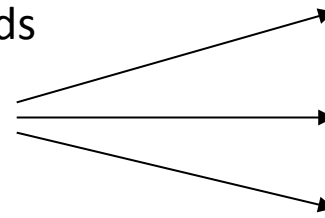
Camera  
**NIR-SWIR**  
6 bands  
15 lines



# Payload Module - Instruments

Three instruments required to cover 17 bands

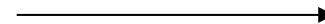
- Optical design
- Detector availability
- No saturation over clouds & land



- VIS-NIR
- NIR-SWIR
- TIR

Alternative to NIR-SWIR for atmospheric corrections

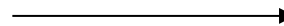
- Redundancy for some VIS-NIR bands



- MAC

Swath  $\approx 1500$  km

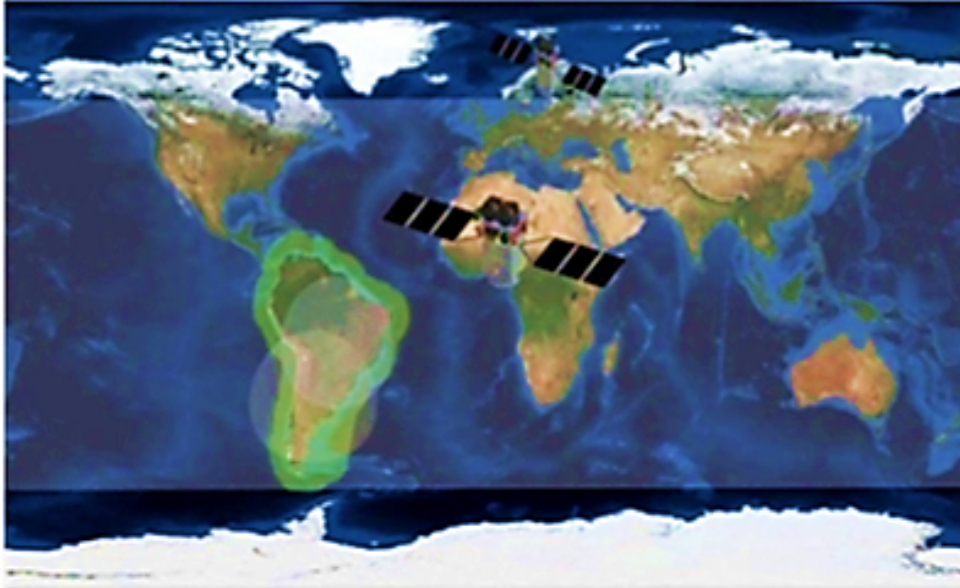
FOV  $\approx 90^\circ$



- VIS-NIR & NIR-SWIR
  - 3 inclined identical optical modules
  - Two different integration times to avoid saturation at  $L_{\max}$
- MAC
  - 1 optical module
- TIR
  - 6 inclined identical optical modules

Two other instruments on board SABIA-Mar 1 Satellite: LIULIN (ASI) & DCS (UNLP – Arg.)

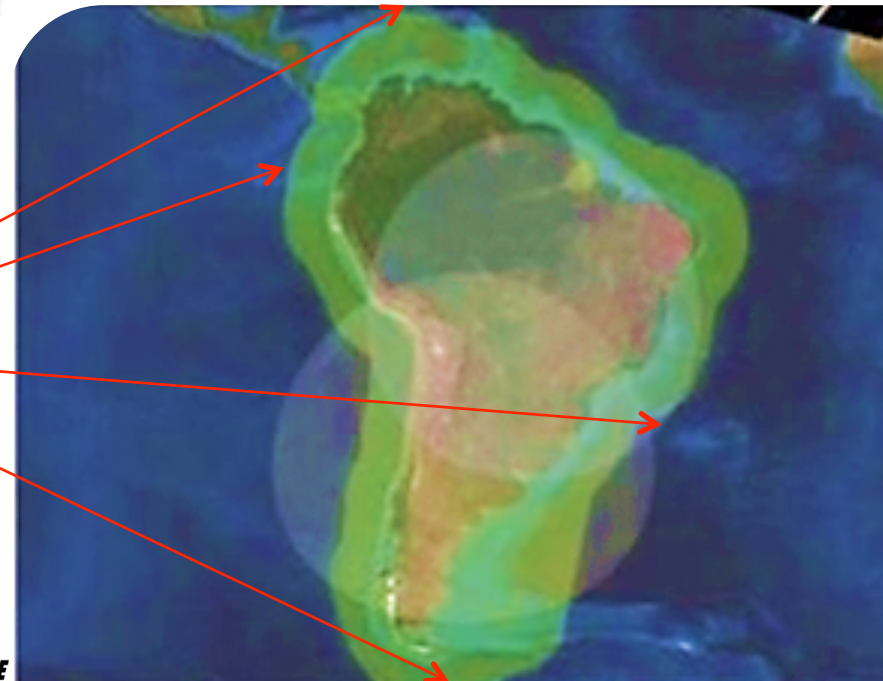
# Mission Scenarios



**Global** scenario  
VIS-NIR imaging during sunlight

## Coastal-Regional scenario

- **VIS-NIR / NIR-SWIR / MAC** imaging during sunlight
- **TIR** imaging during day & night
- **MAC** (panchromatic) imaging during night



# Mission Scenario enhancement

The mission design allows, with minor impacts, the enhancement of the current considered imaging scenarios. Current limitation is to account with only one Ground Station to download payload generated data.

SABIA-Mar 1 could offer ocean color (200 meters) and thermal infrared images (400 meters) during daily passes over other regions, besides South America, if through the correspondent agreement, the interested Agency/Organization provides X-band downlink capability through a suitable Ground Station during the SABIA-Mar 1 satellite passes, coordinated with the Main Control and Receiving Station located in Córdoba, Argentina.

Enhancement possibilities that were analyzed are:

- Provide globally OC with 200 meters and thermal infrared with 400 meters during some daily passes

or

- Provide OC data with 200 meters and thermal infrared images with 400 meters during all daily passes over selected regions, besides South America and its coast.





# System Configuration

## Space Segment

- SABIA-Mar 1 Satellite

## Ground Segment

- Mission & Control Centers
- Córdoba Ground Station
- Links with other stations

SABIA-Mar 1

## Launch

- Services
- Launch Vehicle
- Launch Base

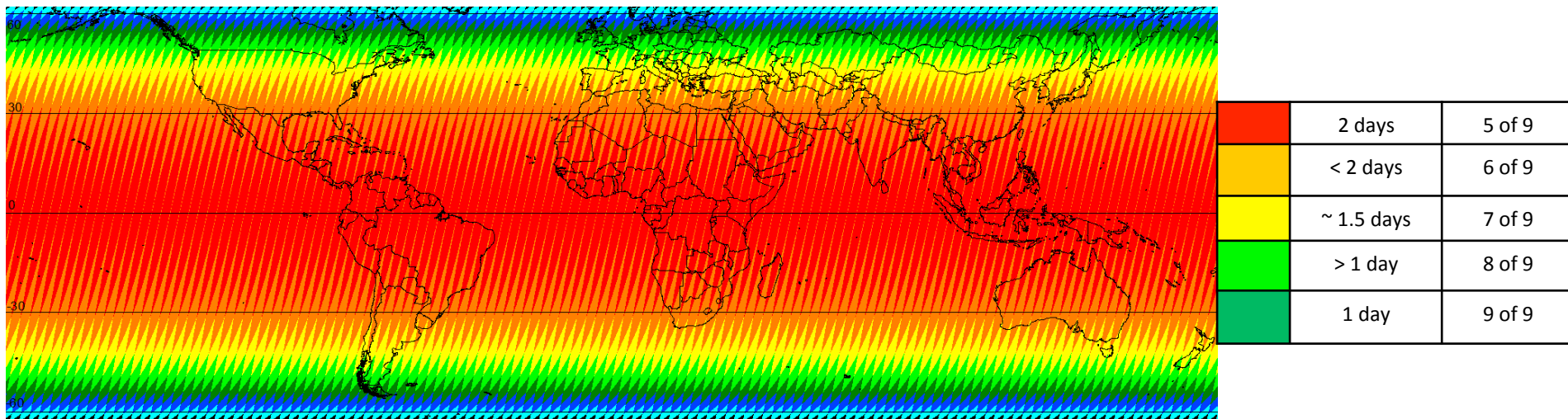
## Applications Segment

- Models, Algorithms
- Cal-Val
- Processing

# Orbit

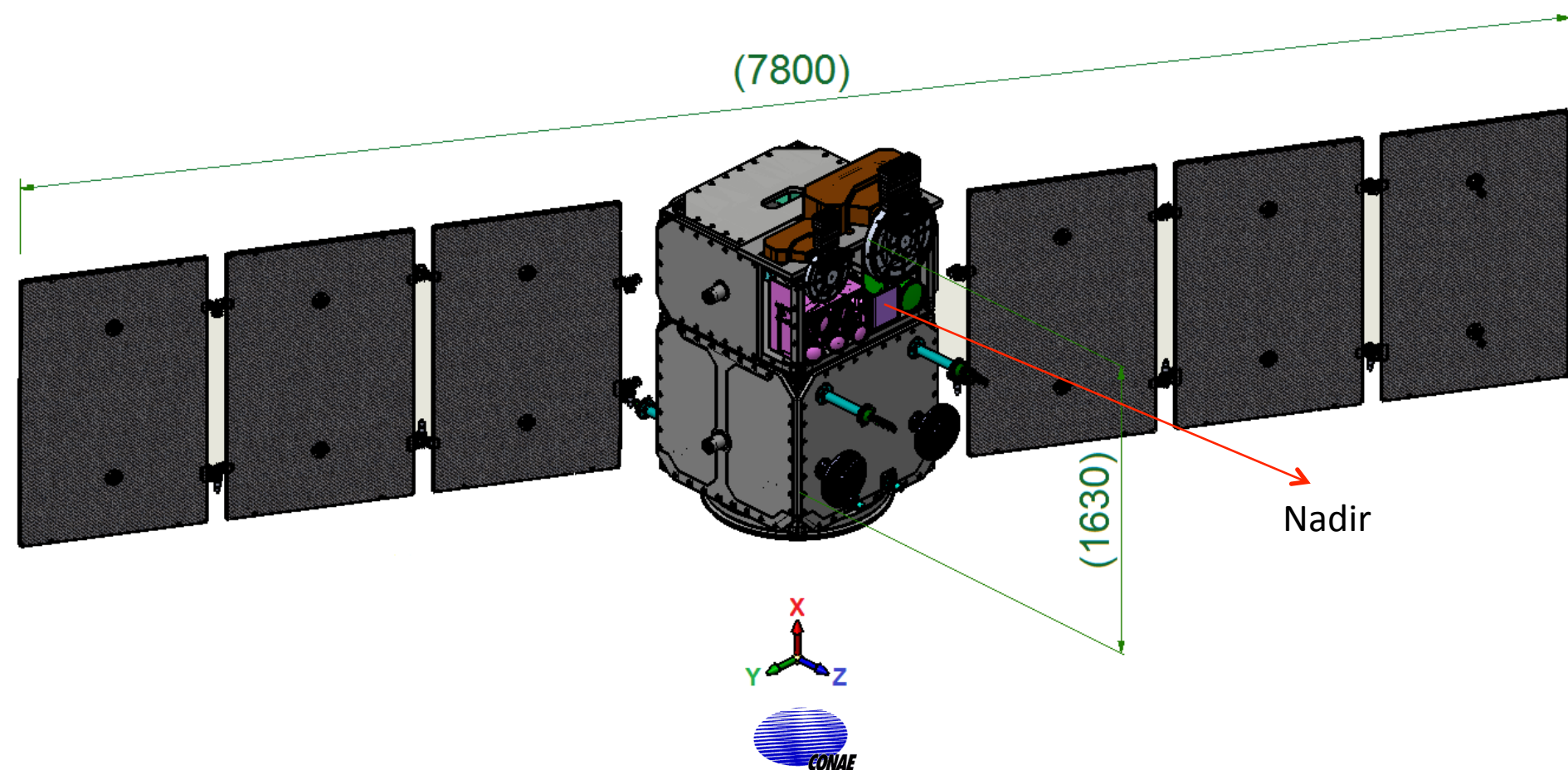
- Drivers:
  - Revisit required for the Argentinean coasts is  $\leq 2$  days
  - Sun-glint effects mitigation
- Selected Orbit:
  - Sun Synchronous                      702 km                      22:20 hs mean local time AN
  - Period: 99.8 minutes              9 days repeat cycle
  - Area affected by glint              pixels on the swath borders

## SABIA-Mar 1 Revisit

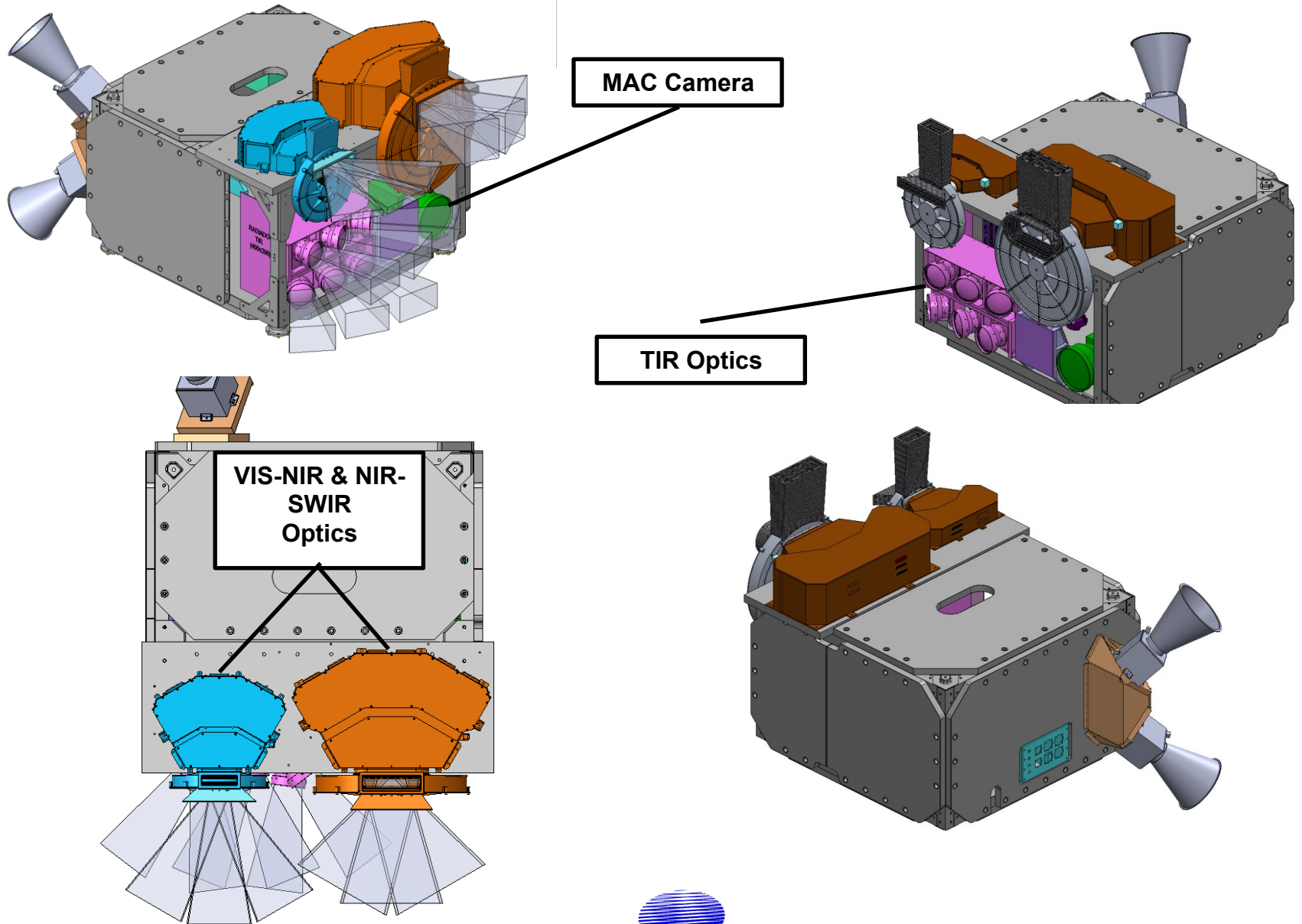


# SABIA-Mar 1 Satellite

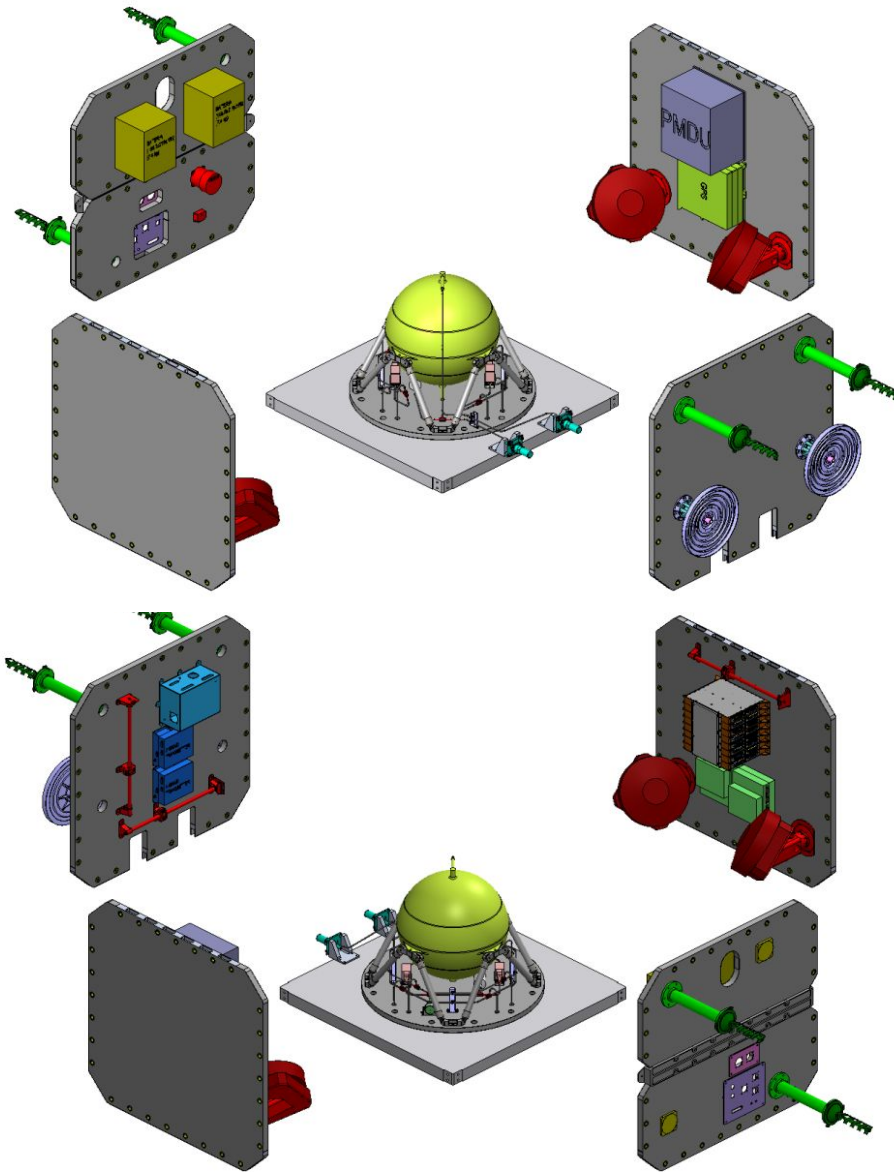
- Weight  $\approx 650$  kg
- Envelope  $\varnothing \approx 2$  meters      Height  $< 2$  meters
- Lifetime 5 years



# SABIA-Mar 1 – Payload Module

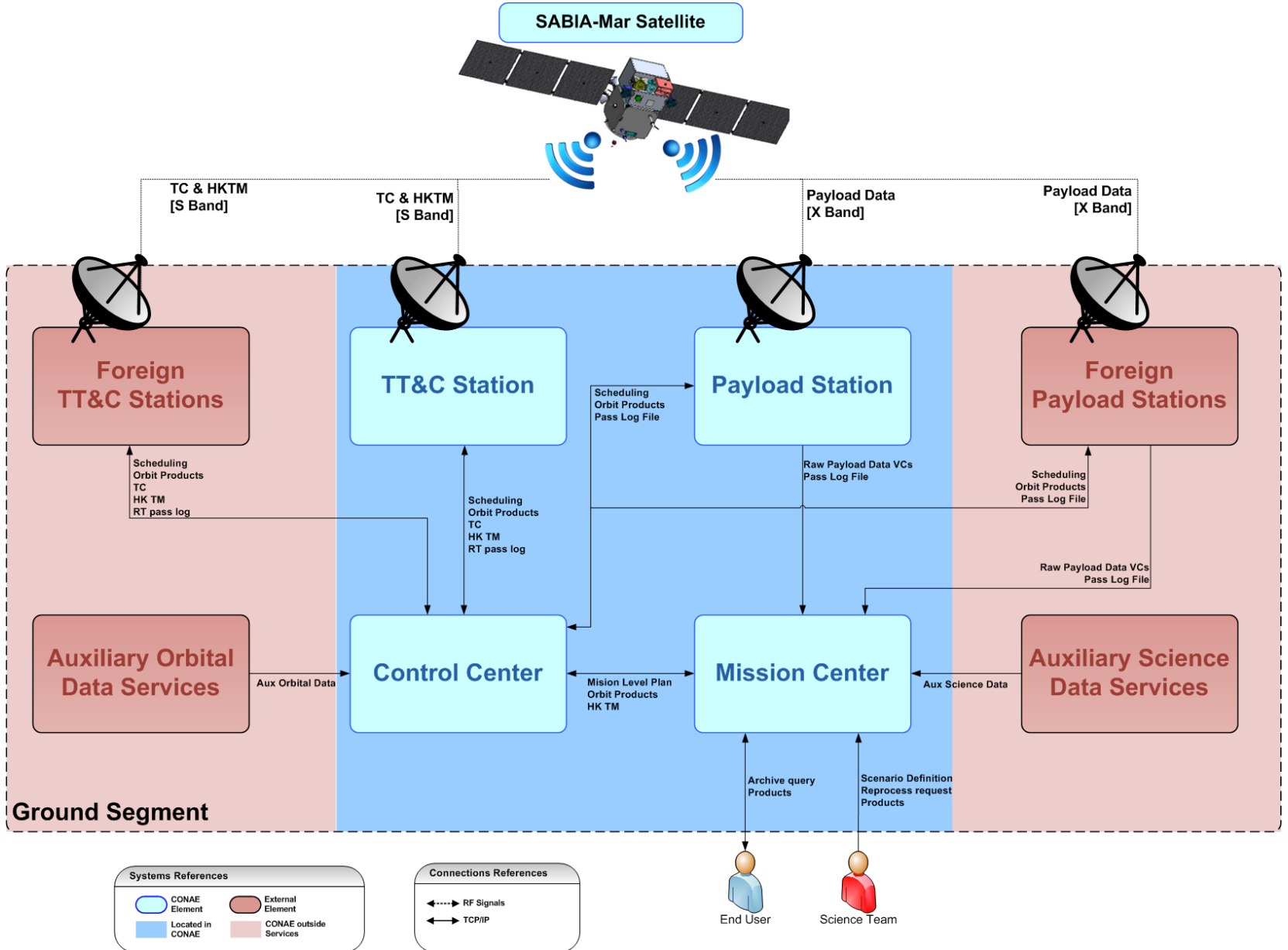


# SABIA-Mar 1 – Service Module



- Solar Array: two deployable wings, 3 panels per wing – 600 watts EOL orbit avg
- Fully redundant Avionics Subsystems
- AOCS Sensors: Star Trackers, Gyros, GPS Receivers, Magnetometers, Coarse Sun Sensors
- Fully redundant S-band TT&C Subsystem
- 96 Ahr Li Ion battery
- Propulsion Subsystem: Pressurized hydrazine 37 kg tank; two redundant branches, 4-1N thrusters each
- Structure & Thermal Control: heritage from other satellite platforms

# Ground Segment



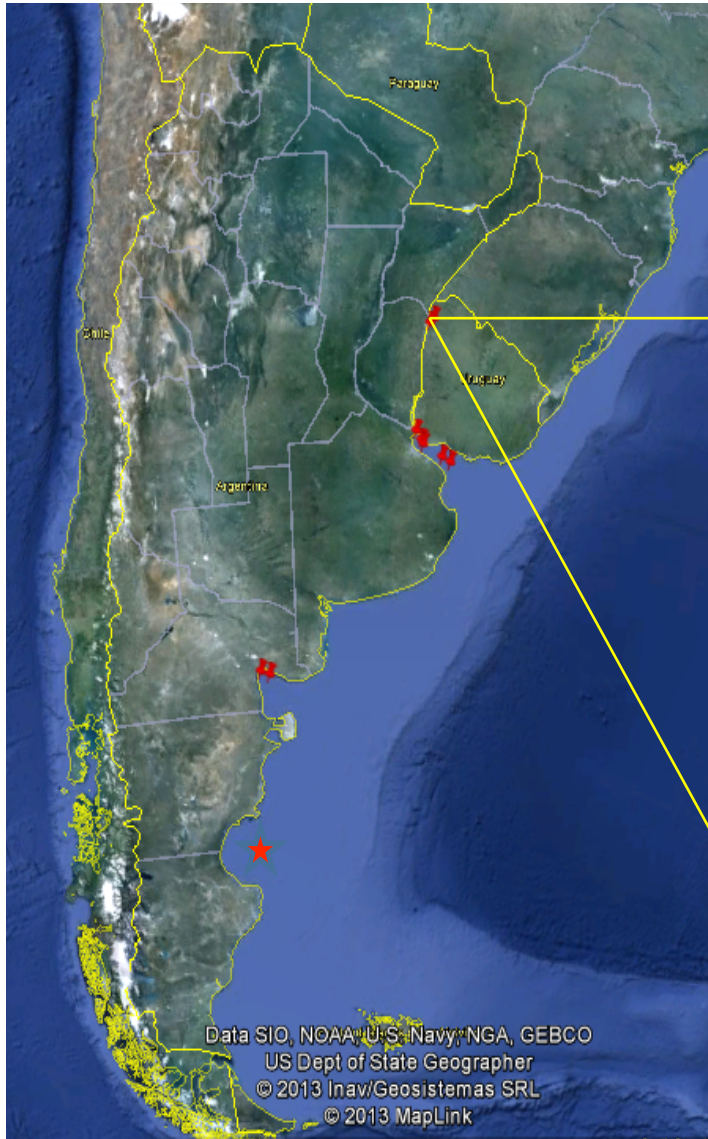


# Launch Segment

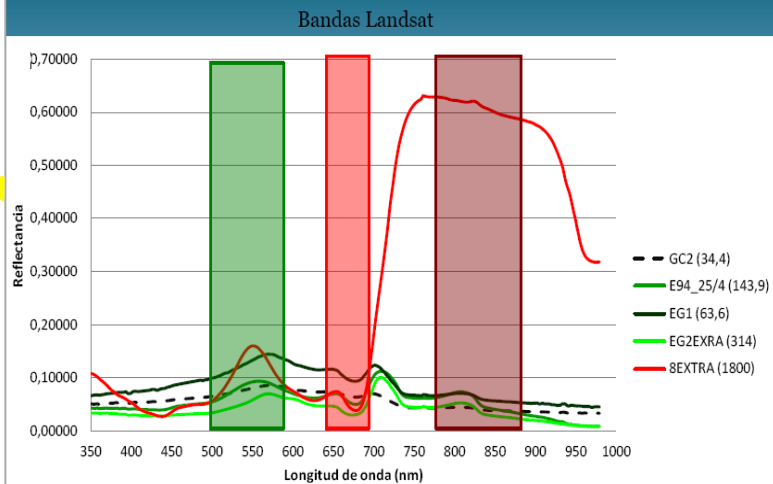
- A Joint (CONAE&AEB) Request for Information [RFI] was released and addressed to all possible providers asking for launch availability, ROM price, fueling services at the launch base, possibility of insurance, etc.
- Until now, 11 proposals were received, 9 of them for a dedicated launch and 2 considering a dual launch, being SABIA-Mar 1 the primary payload. Proposals were received from: Rockot [Eurockot], Dnepr [ISC Kosmotras], Vega [Arianespace], Falcon 9 [Space X], Soyuz [Arianespace], LM-2C/2D [CGWIC], Soyuz [JSC Glavkosmos], Minotaur C [OSC], Tsyklon 4 [ACS Alcantara]. Another proposal, from Antrix, expected to be received during 1<sup>st</sup> quarter this year.
- The Phase 1 of the Proposals Evaluation is completed (Antrix response to be added)
- Phase 2 of the Proposals Evaluation (interchanges with possible providers, environments and interfaces clarification, statement of work generation, etc.) going on.
- International Bid Tender release foreseen by Mission CDR time frame

# In situ radiometric measurements in progress

With National & International Cooperation



Respuesta espectral del sitio con una concentración de clorofila de 1800 mg/m<sup>3</sup>





# Development Status

- The SABIA-Mar 1 Project completed its Preliminary Design Phase (Phase B) in March 2016, with a Mission PDR held in Bariloche, Argentina, in April 6-8, 2016.
- According to the main two recommendations of the Mission PDR Review Board, two other peer reviews were held during 2016:
  - Mission Drivers Requirements peer review, held in Buenos Aires, Argentina, in July 26-28, 2016
  - Main Cameras [Ocean Color // VIS-NIR & NIR-SWIR Cameras] peer review, held in Bariloche in November 9-10, 2016
- The development is undergoing the Detailed Design Phase (Phase C), with a Flight Segment Critical Design Review [CDR] foreseen beginning 2018; and Ground Segment, Applications Segment & Mission CDR by third quarter 2018.
- SABIA-Mar 1 satellite launch is planned by September 2021, with SABIA-Mar 1 entering its operational phase at 2022 start.



*Thank you*

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# BACKUP



# L1 Requirements

ID	Title	L1 Description
	Information	<p>Level 1 Requirements contain the science objectives, questions, and applications that the SABIA-Mar Mission is to address and responds to.</p> <p>The SABIA-Mar Mission is foremost intended for:</p> <ul style="list-style-type: none"> <li>- Global and coastal chlorophyll-a concentration estimation.</li> <li>- Global and coastal water related parameters variability monitoring.</li> <li>- South America Coastal Zones and Estuaries Studies and Management</li> </ul>
L1-MIS-001	Mission Objective	<p>The SABIA-Mar Mission main objective is to measure ocean color in open ocean (<b>global coverage</b>), and coastal zones of South America (<b>regional coverage</b>), providing two days revisit of the Argentinean coastal areas, in order to provide information and value-added products for studies related to: Primary productivity of the sea; Ocean and coastal ecosystems; The carbon cycle; Marine habitats and biodiversity assessment; Management of fishery resources and water quality of coastal waters and estuaries.</p>
L1-MIS-002	SABIA-Mar 1 Satellite Payload Module	<p>The SABIA-Mar 1 Payload Module shall provide as much as possible electrical, mechanical and thermal interfaces compatible with the Service Module as per the Multi Mission Platform developed by AEB/INPE</p>
L1-MIS-003	Spatial Resolution	<p>SABIA-Mar Mission Nadir spatial resolution for ocean color measurements shall be: 800 meters for global coverage and 200 meters for regional coverage (South America)</p>
L1-MIS-004	Products	<p>To accomplish with L1-MIS-001 the SABIA-Mar Satellite main instruments shall measure Top Of Atmosphere (TOA) radiance, in order to estimate:</p> <ol style="list-style-type: none"> <li>1. Normalized Water leaving Radiance</li> <li>2. Chlorophyll-a concentration (Chl-a)</li> <li>3. Diffuse Attenuation Coefficient (Kd490)</li> <li>4. Photosynthetically Available Radiation (PAR)</li> <li>5. Turbidity</li> </ol>
L1-MIS-005	Scientific Mission	<p>SABIA-Mar shall be a scientific mission. Generated data &amp; products will be available for Argentineans, Brazilians and the International community free of charge.</p>
L1-MIS-006	Operational Mission	<p>SABIA-Mar shall be an operational mission for Argentinean and Brazilian users. The generated data &amp; products will be available to them 1 day after acquisition. Specific products of the South America Regional Coverage will be available to them no later than 6 hours after acquisition.</p>
L1-MIS-007	SABIA-Mar 1 Satellite	<p>The SABIA-Mar 1 Satellite life time shall be 5 years.</p>

# L2A Science Requirements

ID	Title	L2A - Description	Parent ID
L2A-SCI-001	Product	Spectral bands shall be covered by the mission with the corresponding wavelength and bandwidth per Table 1	L1-MIS-004
L2A-SCI-002	Global Scenario	Global scenario: The System shall be designed taking into account the nominal extension of the geographical coverage in latitude shall be 120 degrees with seasonal varying, as per Figure 1	L1-MIS-001
L2A-SCI-003	Regional Scenario	Regional scenario: the coverage shall include the coastal zone of South America, coming to about 650 km offshore. For regional studies and monitoring of Vitória-Trinidad Ridge and Malvinas Islands regions at 1000km coverage is requested. See Figure 2	L1-MIS-001
L2A-SCI-004	Spatial	The spatial resolution requested for the spectral bands are given in Table 1.	L1-MIS-003
L2A-SCI-005	Spatial	Band-to-band registration knowledge (in lab) between bands of the same camera shall be better than 10% of the pixel size	L1-MIS-004
L2A-SCI-006	Spatial	Band-to-band registration knowledge among bands from different cameras (i.e. bands of the VIS-NIR to bands of the NIR-SWIR cameras) shall be better than 0,5 miliradian.	L1-MIS-004
L2A-SCI-007	Radiometry	Signal to noise ratio requested for the spectral bands at nadir are given in Table 1. (for Ocean Color) Note: Verification of the required SNR values for 1000 m GSD shall be performed through analyses. The relationship between the required value for 1000 m GSD and the SNR @ others GSD is the following: $\frac{SNR@GSD}{SNR@1000} = \frac{GSD}{1000}$	L1-MIS-004
L2A-SCI-008	Radiometry	The instruments VIS-NIR & NIR-SWIR shall be able to measure, without saturation, at TOA radiance up to the values given in Lmax per Table 1	L1-MIS-004
L2A-SCI-009	Radiometry	For bands B0-B1-B2-B3-B4, (see Table 1), the accuracy of TOA radiance shall be determined with 0.5%. This precision on the determination shall be obtained after Vicarious calibration is applied	L1-MIS-004 L2A-SCI-025 (Ch-a uncertainty)
L2A-SCI-010	Radiometry	The polarization sensitivity of each band of the Primary Instruments on board SABIA-Mar 1 (Ocean Color) shall be measured and known during their ground processing with $\leq 0,2\%$ of the signal.	L1-MIS-004

# Project Schedule

