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FACSAT PROGRAM: Iniciative for development of Colombian Space capabilities

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INTEGRIDAD - SEGURIDAD - HONOR - VALOR - COMPROMISO

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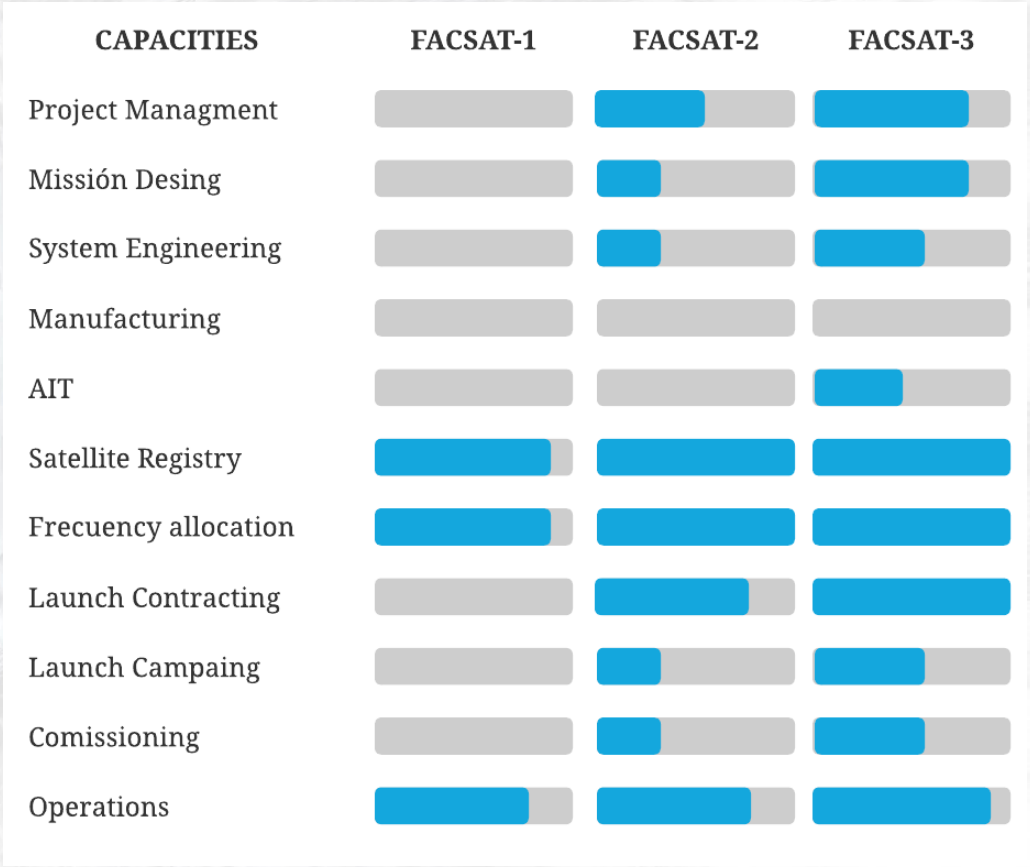
FACSAT Program objectives

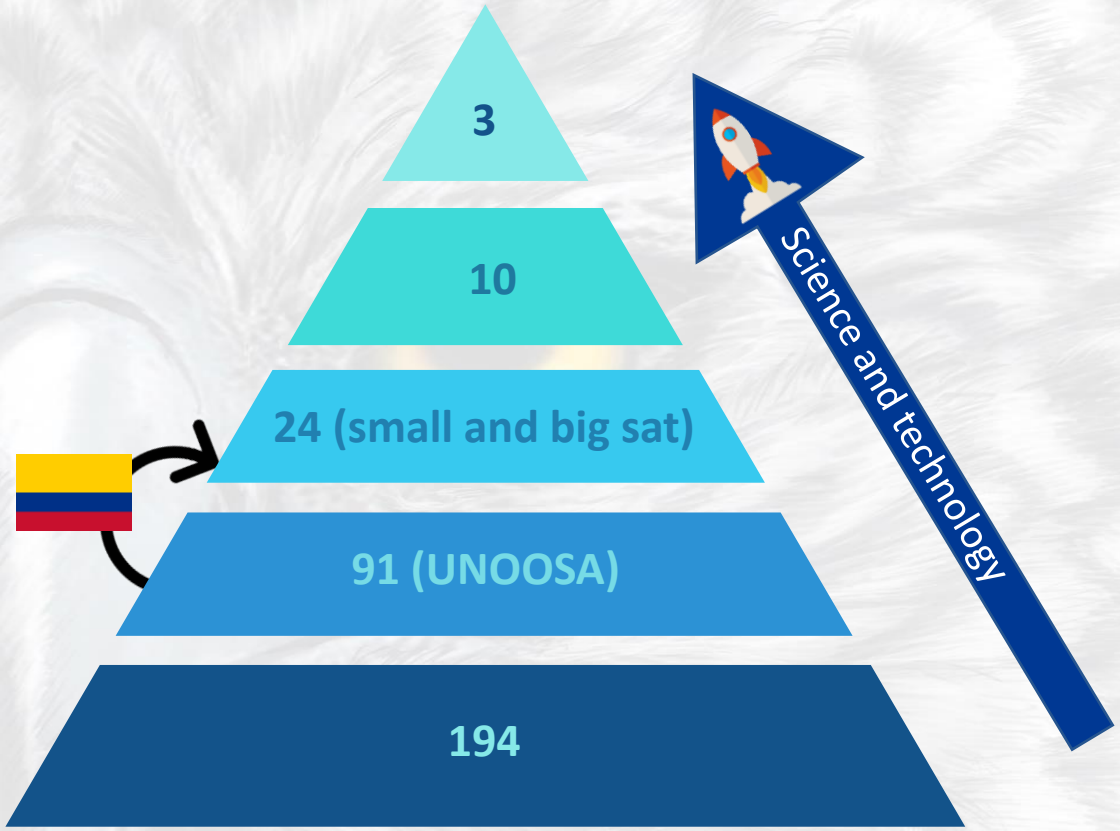
The FACSAT program is the first effort to **maximize the use of space** technologies in Colombia.

1. Develop an **in-house satellite manufacturing capability** to promote the national industry and increase inter-institutional cooperation in Colombia.
2. Increase awareness of "**Space Culture**" to keep the program current over time.
3. Strengthen **international cooperation** related to space development.



Overview FACSAT Program

- Countries with manned space flight
- Launching States
- Satellite manufactures
- Space system operator countries
- Countries users of the space industry



Space technology pyramid
Source: Leloglu and Kocaoglan (2008)

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COLAF Strategy

LEGAL

- National Regulations and CONPES
- COLAF Strategy 2042
- ECSS Standards

INFRASTRUCTURE

- CITAE ISO-8 Lab
- SpOC
- Laboratorios AIT (≤ 100 Kg)

HUMAN CAPITAL

- ToK
- University agreements
- Young Researchers
- Masters and PhD internships

R&D

- Design of Space Platforms
- Satellite Operations and Communications
- Software development
- Artificial Intelligence applied to space systems

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Space Ecosystem

COLAF SPACE STRATEGY

CIVIL SOCIETY — *Engineers, physicists, communicators, political scientists.*

ACADEMY

GOVERNMENT

PRIVATE SECTOR

DEFENSE

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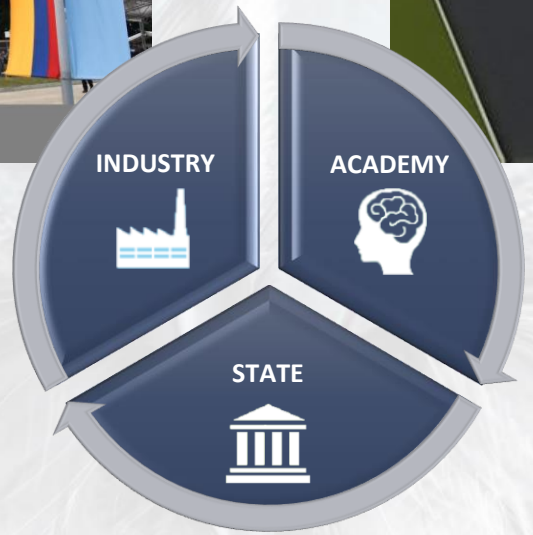
Space Complex



Space Operation Center SpOc

- Multidomain : "Horus", "Kairos" and Big Data process.
- S-X Band communication.

AIT LAB

- Microsatellites up to 100 kg.
- ISO 8 class & ISO 7 class laboratories, IT center, SW Lab, and prototyping Labs.

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Space Ecosystem Achieves

Building space ecosystem by engaging and capacitating the stakeholders and other partners through training.

On-the-job training

GOMSPACE

How to apropiate knowledge?

Papers generation

>400 people

Undergraduate projects

Associated Master´s and doctoral thesis

Creates Value in Space culture

>40 Internships

>80 Researchers

>30 Professionals, > 20 local companies are suppliers

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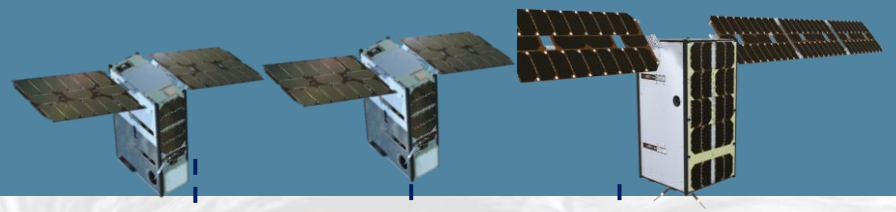
FACSAT R&D Timeline

Constellation

Increasing Technology Apropiation Level

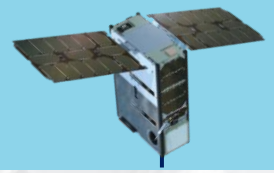
FACSAT-3A | FACSAT-3B | FACSAT-3C



CubeSats

FACSAT-1

FACSAT-2 Chiribiquete



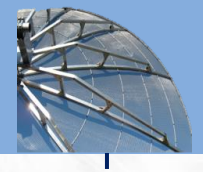
Facilities

Antartic Temporal Station

SpOC

AIT labs

GS Antartic Permanent



2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030

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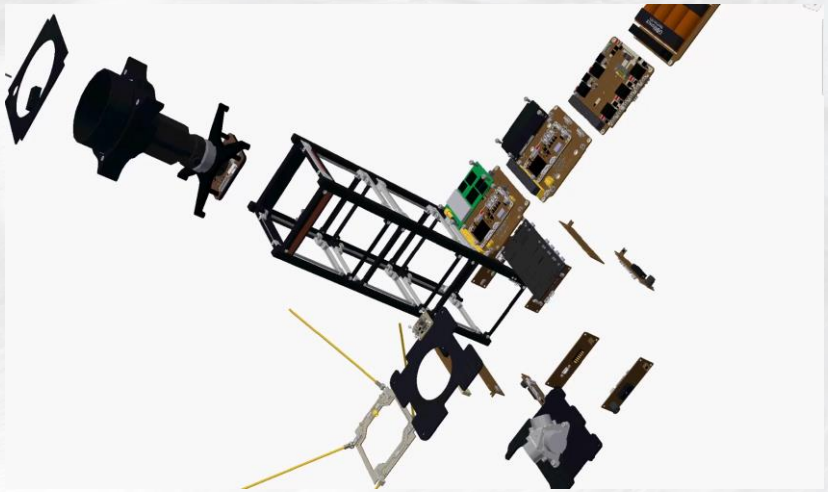
FACSAT-1 Mission



Type	Earth Observation (EO)
Class	Nanosatellite
Mass	4 kg
Orbit	LEO (SSO, 450 km @2023)
Launch	November 28, 2018 via PSLV C-29 rocket from SDSC, INDIA
Payloads	NanoCam 30 meters per pixel
Lifetime	3-5 years
Operation	**3555 acquired images** 151 downloaded images 187,200 km2 Cover area (≈**16,39%** Colombia territory)

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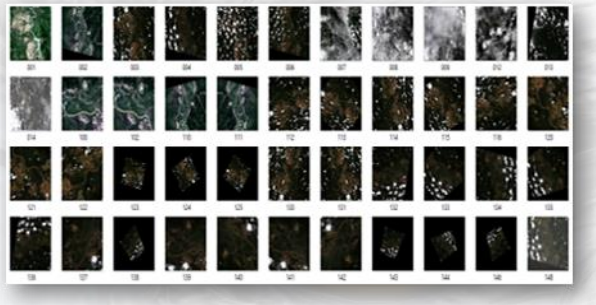
Artificial Intelligence for data Post-processing

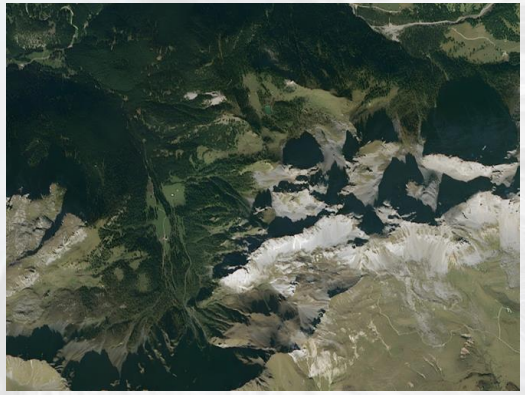
Software GEOMASK

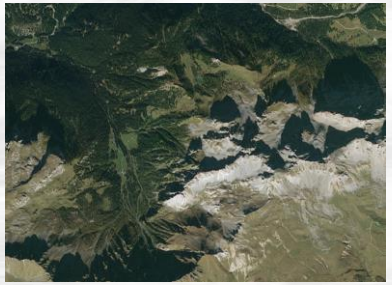
- Functional prototype by deploying and integrating computer vision algorithms for detecting open mining, heavy equipment, and ground remotion.

- Data Aumentation



- Super resolution





1024 x 768 pixeles

13584 x 2688 pixeles

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FACSAT-2 Mission
Chiribiquete

Type	Earth Observation (EO) + GHG Analysis
Class	Nanosatellite
Mass	7.49 kg
Orbit	LEO (SSO, 500 km)
Launch	April 2023 Transporter 7 Falcon 9 block 5 VSFB Vanderberg, USA
Payloads	Simera Multiscape cis 100 4.7 meters per pixel Argus 2000 Spectrometer 1,000 to 1,700 nm
Lifetime	3-5 years
Operation	Performe since Space Operation Center SpOC located in Cali, Colombia

ecopetrol

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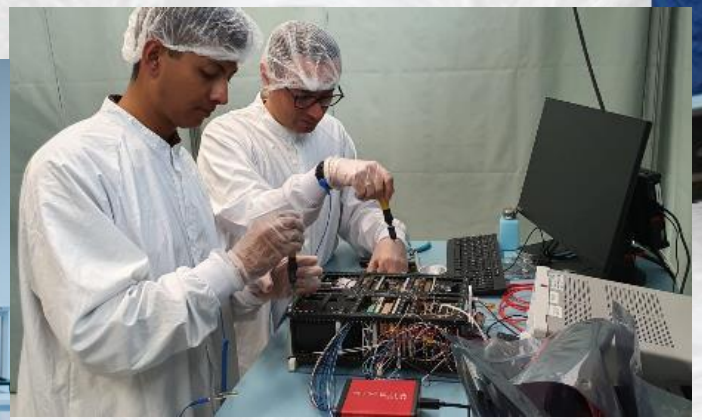
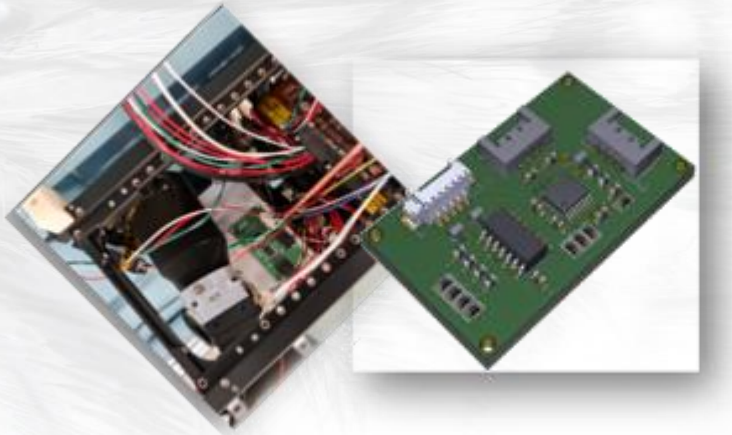
Co-design & Co-development

- On-the-Job Training: Roles of Project manager, System engineer, OBC, ADCS, Mechanical, Payload.
- Own developments: System Interface, SW.



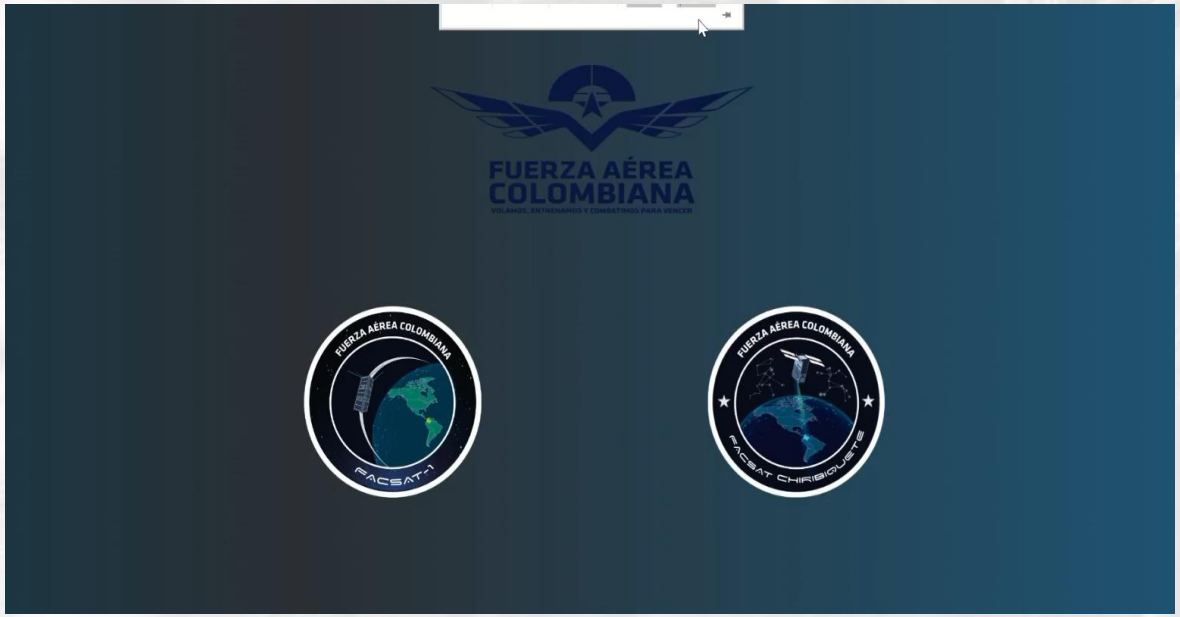
PCB (Space qualification)

- Thermal Cycling test
- Thermal Stress test
- Irradiation test



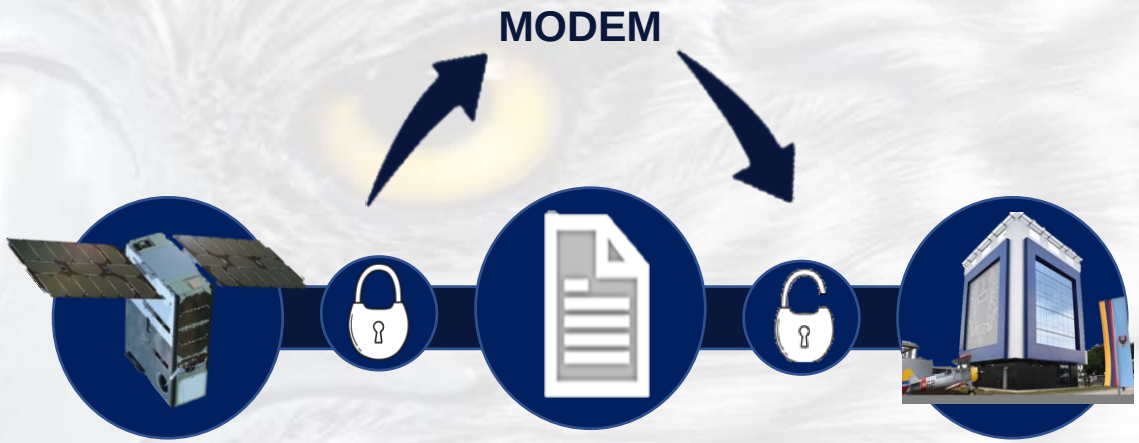
Achievements FACSAT-2

GROUND SEGMENT SOFTWARE



KAIROS: FACSAT Program Mission Control Software

SPACE SEGMENT SOFTWARE



Información Cargas Útiles + TMTC

Información Cargas Útiles + TMTC

Payload data encryption software

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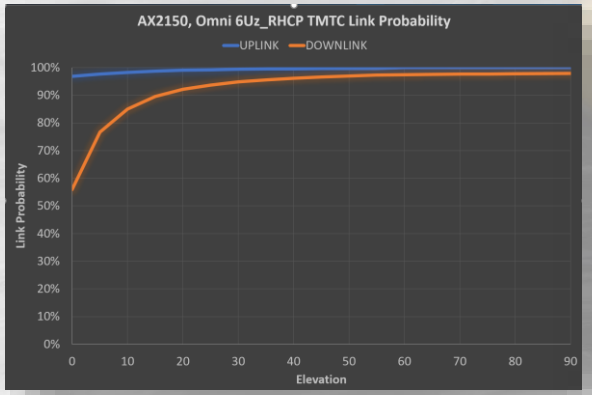
Antenna selection and GS Arquitecture

Link budget Calculation and antenna selection

X-BAND antenna instalation over SpOC

E2E tests between EM & Ground segment



DOWNLINK 50000kbit/s 500km RCB GS Tracking	
Elevation [°]	Link Margin [dB]
0	-3.2
2	-2.4
4	-1.7
6	-0.9
8	-0.2
10	0.5
12	1.1
14	1.8
16	2.4
18	3.0
20	3.5
22	4.0
24	4.5
26	5.0
30	5.9
35	6.8
40	7.6
45	8.4
50	9.0
55	9.5
60	9.9
65	10.3
70	10.6
75	10.8
80	10.9
85	11.0
90	11.1

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Summary

Colombia has reached substantial progress in the space race, as an operator and designer.

The scientific activities carried out by COLAF with the allies contribute to building autonomous capabilities.

Colombia grows up in a space ecosystem to create competitiveness and bring future developments and innovations.

CONTACT INFORMATION

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Thank you for your attention!

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