Symposium Introduction

OVERVIEW OF SMALL SATELLITE INITIATIVES AT THE BRAZILIAN SPACE AGENCY

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@ United Nations/Brazil Symposium on Basic Space Technology
Creating Novel Opportunities with Small Satellite Space Missions
Natal, September 2018

OUTLINE

1) Summary of Brazilian past small satellite missions

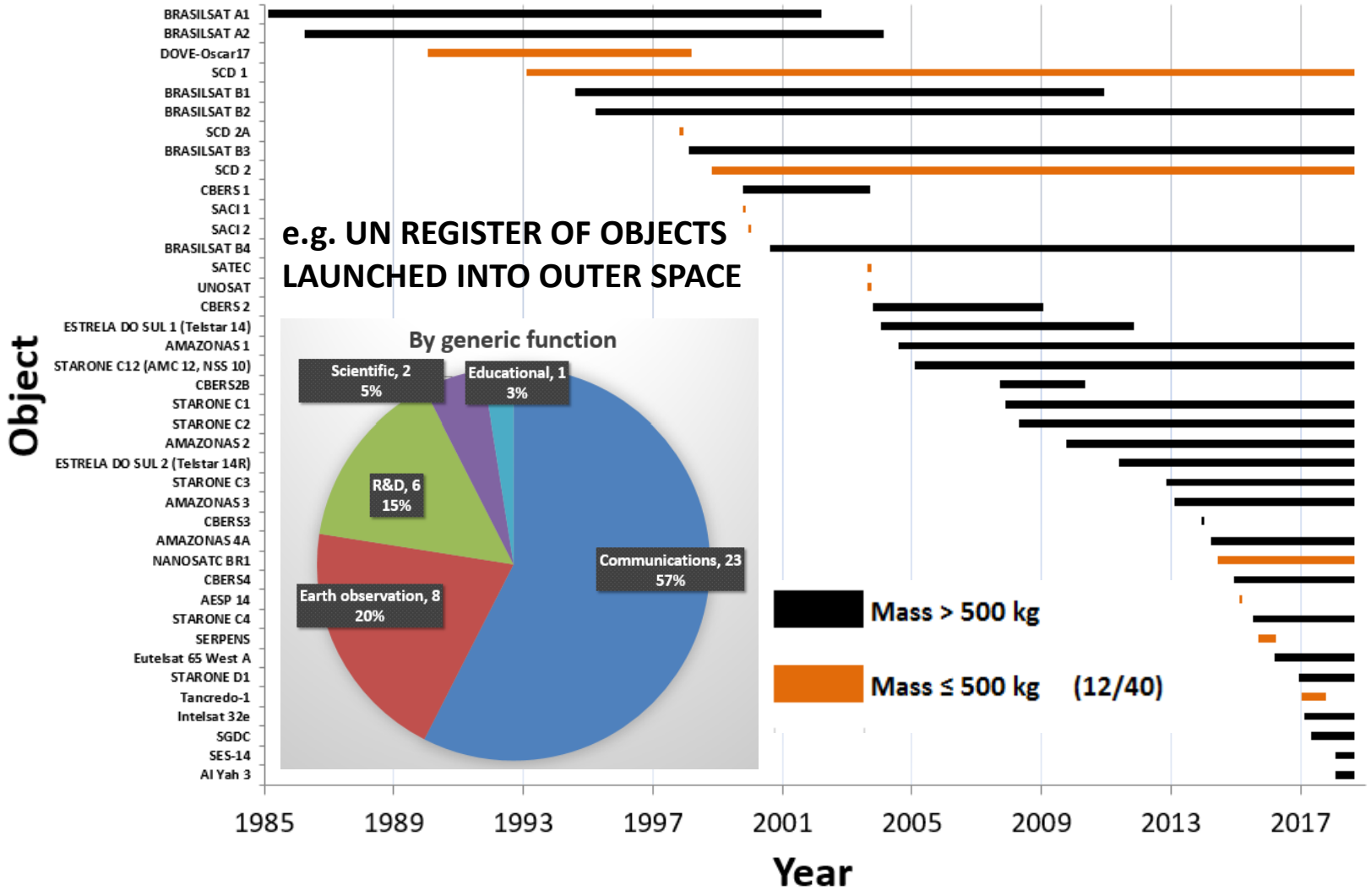
2) Small satellite initiatives (by mass category):
   i. Mini ~500kg
   ii. Micro ~100kg
   iii. Nano ~1-10kg

3) Brazilian community & Stakeholders

4) STEM & Community/Public Outreach

5) Final remarks

SUMMARY OF BRAZILIAN SMALL SATELLITE MISSIONS



SUMMARY OF BRAZILIAN SMALL SATELLITE MISSIONS

AEB
AGÊNCIA ESPACIAL BRASILEIRA

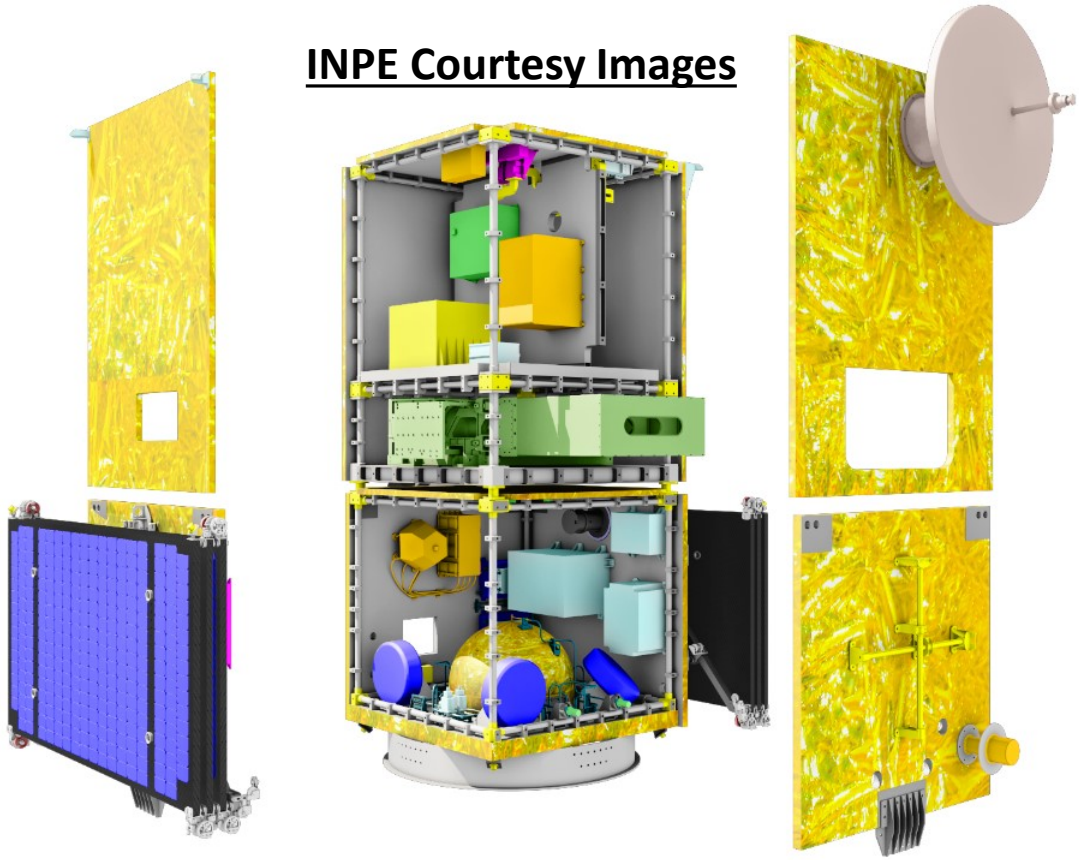
Brazilian objects under 500kg

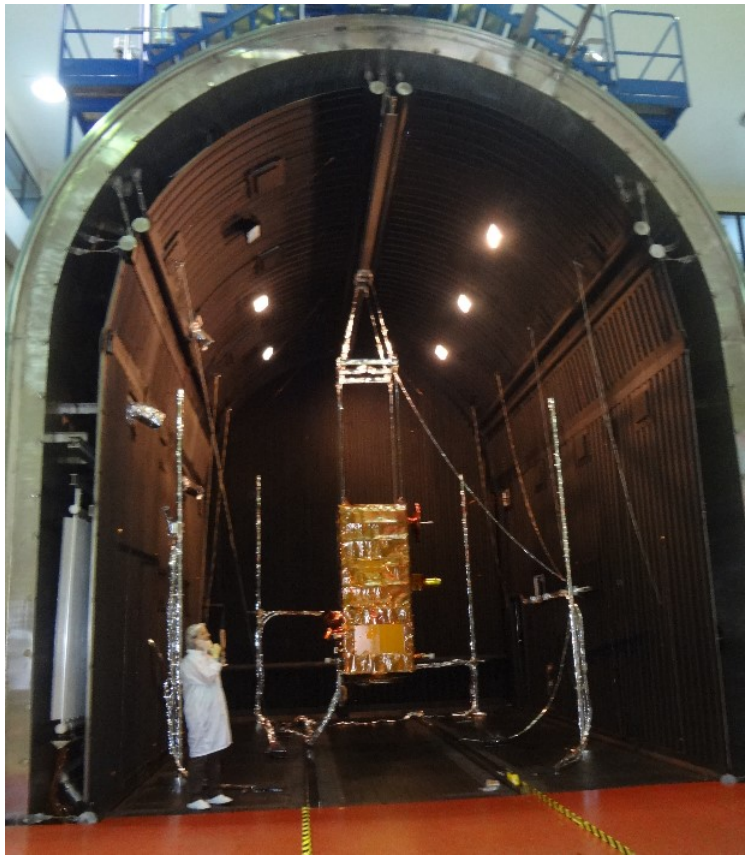
Object	Year	Launch vehicle	Status	Organization	Mass (kg)
Tancredo-1	2017	H-2B	End of operation	Escola Tancredo Neves / AEB	0.7
SERPENS	2015	H-2B	End of operation	UnB / AEB	4
AESP 14	2015	Falcon 9	Satellite failure	ITA / INPE / AEB	1
NANOSATC BR1	2014	Dnepr	Operational	INPE / UFSM / AEB	1
UNOSAT	2003	VLS	Launch failure	UNOPAR	9
SATEC	2003	VLS	Launch failure	INPE	65
SACI 2	1999	VLS	Launch failure	INPE	80
SACI 1	1999	Long March	Satellite failure	INPE	60
SCD 2	1998	Pegasus	Operational	INPE	117
SCD 2A	1997	VLS	Launch failure	INPE	115
SCD 1	1993	Pegasus	Operational	INPE	115
DOVE-Oscar17	1990	Ariane	End of operation	Eng. Torres de Castro	13

AEB SMALL SATELLITES INITIATIVES: MASS CATEGORY ~500kg

Brazilian Multi Mission Platform (PMM) for small (and medium-sized) satellites

INPE Courtesy Images



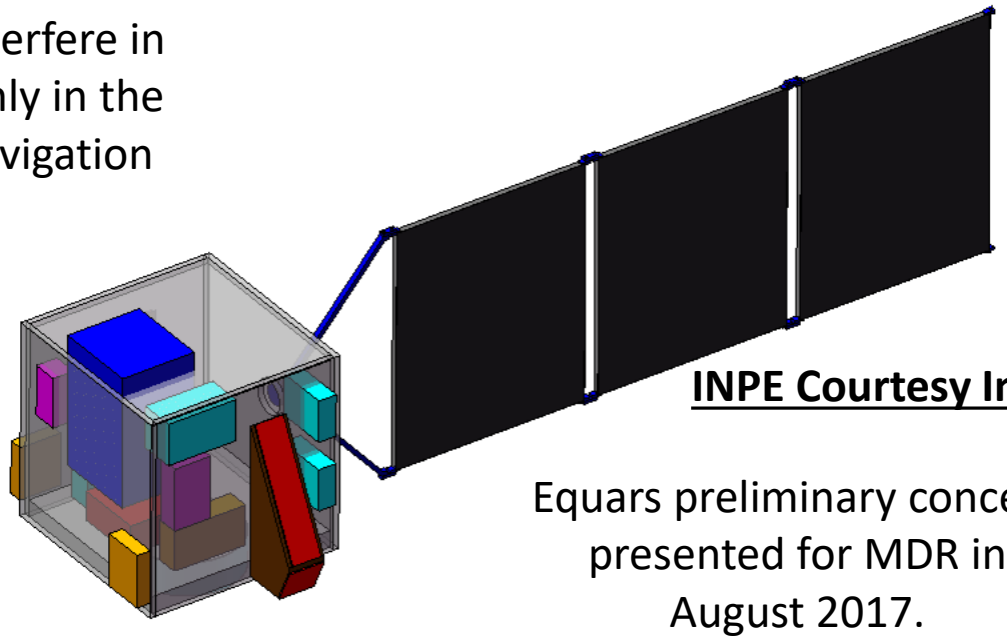


Amazon-1 satellite: multi-mission Platform (service module, bottom) and payload module (top). The closing panels are separated to illustrate the internal layout of equipment and subsystems. The solar panel is shown in its launch configuration.

AEB SMALL SATELLITES INITIATIVES: MASS CATEGORY ~100kg

EQUARS (EQUatorial Atmosphere Research Satellite)

Investigate the formation of ionosphere bubbles, a phenomenon that can interfere in various technological activities, mainly in the areas of telecommunications and navigation by satellites.



INPE Courtesy Image

Five scientific payloads:

- *Airglow photometer*
- *Electrostatic Energy Analyzer*
- *Monitor of Alpha, Proton and ElectronfluXes*
- *GPS Radio Occultation Measurement*
- *Ionospheric sensor set*

Equars preliminary concept presented for MDR in August 2017.

PPR review planned for late 2018

LAUNCHED CUBESATS: LATIN AMERICA & THE CARIBBEAN

Puerto Rico
QBUS 4, uni, 2U, 2017

Costa Rica
Irazu, civ, 1U, 2018

Colômbia
Libertad 1, uni, 1U,2007

Equador
NEE 01, civ, 1U, 2013
NEE 02, civ, 1U, 2013
*UTE-UESOR, uni, 1U, 2017

Peru
PUCP-SAT 1, uni, 1U, 2013
UAPSat, uni, 1U, 2014
Chasqui 1, uni, 1U, 2014

Brasil
NanosatC-BR1, civ, 1U, 2014
AESP-14, uni, 1U, 2015
Serpens, civ, 3U, 2015

Uruguai
ANTELSAT, uni, 2U, 2014

Chile
SUCHAI, uni, 1U, 2017

Argentina
CubeBug-1, civ, 2U, 2013
CubeBug-2, civ, 2U, 2013

16 objects
Last updated: August 2018

Members of the Committee on the Peaceful Uses of Outer Space

*Ecuador/Russia, UTE-YuZGU

AEB SMALL SATELLITES INITIATIVES: MASS CATEGORY ~1-10kg

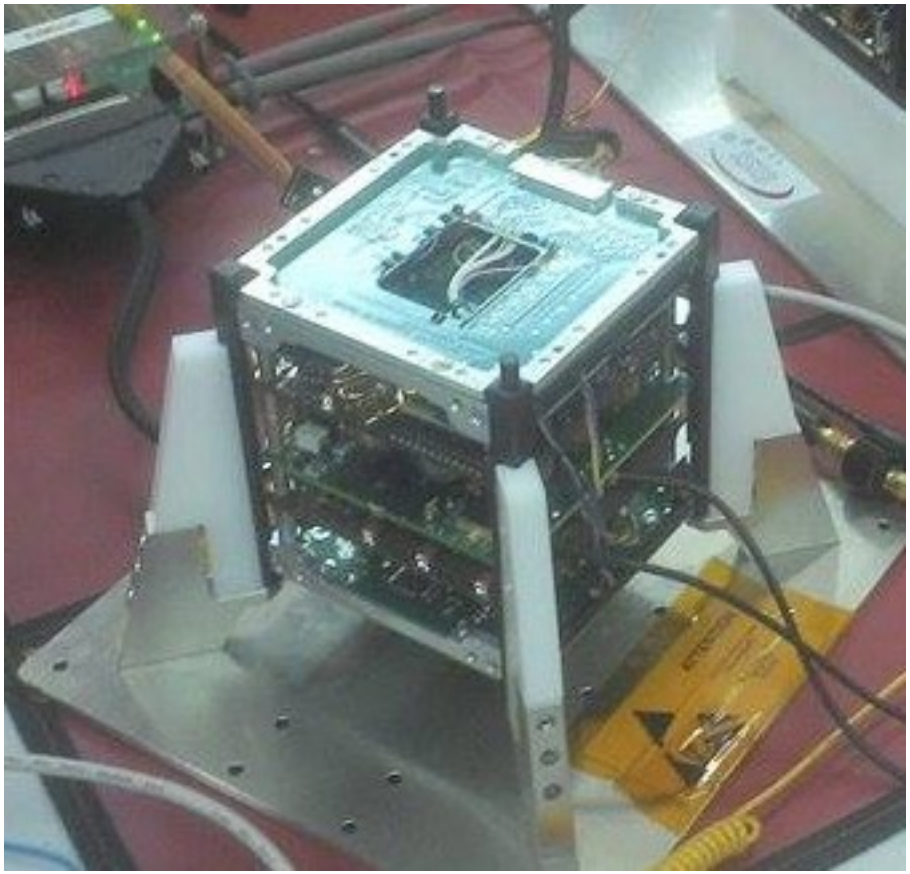
NanosatC-BR1 is the 1st Brazilian CubeSat launched. Developed by INPE in collaboration with UFSM and AEB support.

Launched on June, 2014 By DNEPR from Russia (as a tertiary payload by ISIS)

The payload instruments of the NanosatC-Br 1 consists of magnetometer to measure the intensity of the Earth Magnetic Field at the South Atlantic Magnetic Anomaly (SAMA) region and on the Brazilian sector of the Ionosphere Equatorial Electrojet (EEJ) A particle precipitation chip dosimeter

CURRENT STATUS

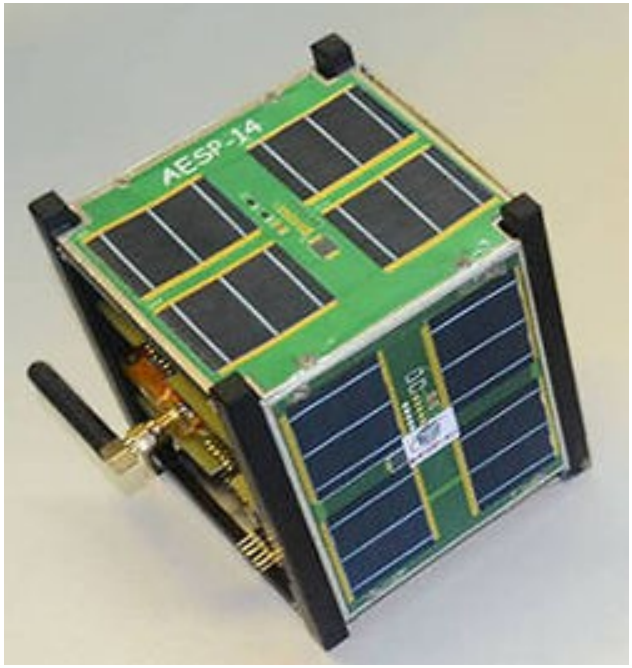
Today, the NANOSATC-BR1 can transmit only when it is in sight of the Sun (The battery can no longer hold electric charge because it was damaged by magnetic solar storms in September-October 2014). The World Amateur Radio Network is currently providing NCBR1 data.



UFSM Courtesy Image

AEB SMALL SATELLITES INITIATIVES: MASS CATEGORY ~1-10kg

AESP-14



ITA Courtesy Image

The main objective of the mission was to validate in space a namosat developed by students.

Did't work as it shoud due to a problem with a transmission antenna.

AEB SMALL SATELLITES INITIATIVES: MASS CATEGORY ~1-10kg

Human Resources training: Focused on system engineering at undergraduate level. There is no technology development on each mission the focus is on the hands on experience of satellite and mission design.

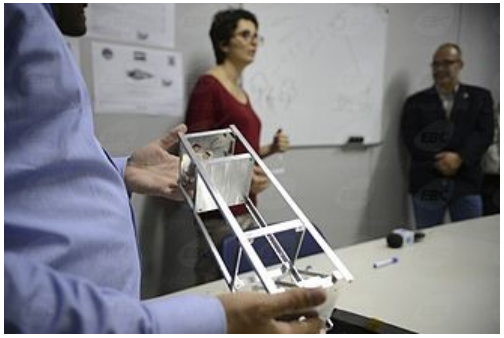
Flight opportunity for technology and scientific payloads: The SERPENS satellite offer the flight opportunity for scientific and technological payloads that are available during the mission time provided that mission team agrees in including the payload.

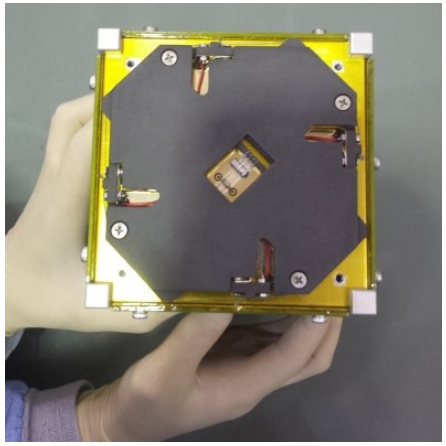
University autonomy: Each SERPENS mission is coordinated by one of the Brazilian Aerospace universities. The students and professors compose the core acting as the mission's prime contractor and design organization. Nonetheless other institutions can be involved provided the coordinating university so desires.

Serpens 1: Data Collection tech demonstrator.

Spinoffs and Technology: NanoRaven, Antenna Deployment System, Brazilian 3U structure.

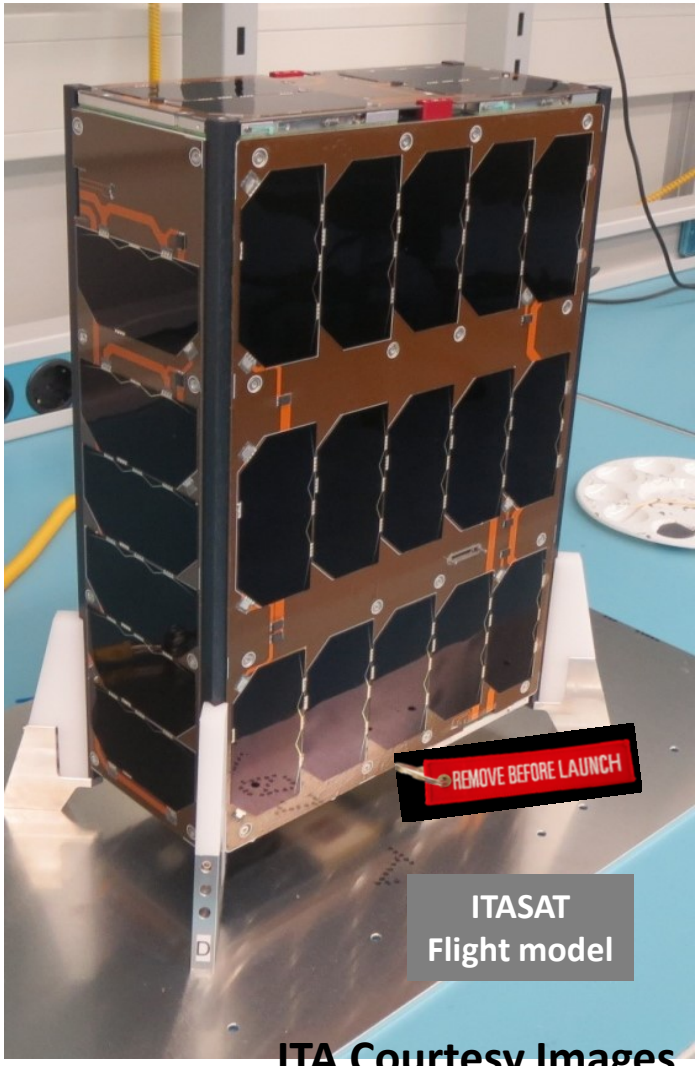
Serpens (Space System for NanoSatellites Research and Experiments)





AEB Courtesy Images

AEB SMALL SATELLITES INITIATIVES: MASS CATEGORY ~1-10kg



ITASAT
Flight model

ITASAT, a 6U Cubesat ready for launch

Payload: Camera, GPS, transponder for data collection, radio amateur

ITASAT team at ISIS/Delft Flight preparation

ITA Courtesy Images

AEB SMALL SATELLITES INITIATIVES: MASS CATEGORY ~1-10kg

The NanoSatC-Br2 is a 2U cubesat aiming to target capacity building and science and R&D.

The platform flight software was developed in Brazil, by Researchers and Engineers from CRS/CCR/INPE/MCTIC and LACESM/CT – UFSM, already working in this area (Determination & Attitude Control and Data Management).

The Control Law for the control software has also been developed in Brazil.

The Project received support from AEB to hire the launch and future operation of NCBR2 in orbit.

Now the NCBR2 is planned to be launched early 2019.

UFSM Courtesy Image

AEB SMALL SATELLITES INITIATIVES: MASS CATEGORY ~1-10kg

- Ongoing effort to sign an Implementing Arrangement between NASA, AEB, INPE and ITA to establish the cooperation terms for the SPORT mission. SPORT is a cubesat that will study the preconditions leading to equatorial plasma bubbles in the ionosphere.

- Discussing with UFSC the upcoming Serpens 2.

- Discussing with China scenarios for launching Brazilian cubesats as a secondary payload on Long March.

- Supporting academic research and development on plasma propulsion technology for nanosatellites.

- Following third party initiatives (e.g. VCub1 Visiona/Senai/Embrapii, FloripaSat UFSC, Conasat INPE, Garatéa-L Consortium, Cubesat Grupo Criar, CGEE prospective studies, INPE Cubesat for X-ray astronomy, Air Force Carponis proposal, PLUS a few more projects).

- Engaging in high level space related committee (CDPEB).

ACCESS TO SPACE

IAE Courtesy Image

Strategic importance of small satellites for Brazil

AEB Courtesy Image

BRAZILIAN COMMUNITY & STAKEHOLDERS

AGÊNCIA ESPACIAL BRASILEIRA

Brazilian Cubesat/Nanosat Network: 253 professionals @ CNPq Lattes

(50% PhD, 24% Master, 23% Grad Student, 3% Undergrad)

Universities, Institutes, Government, Private Sector

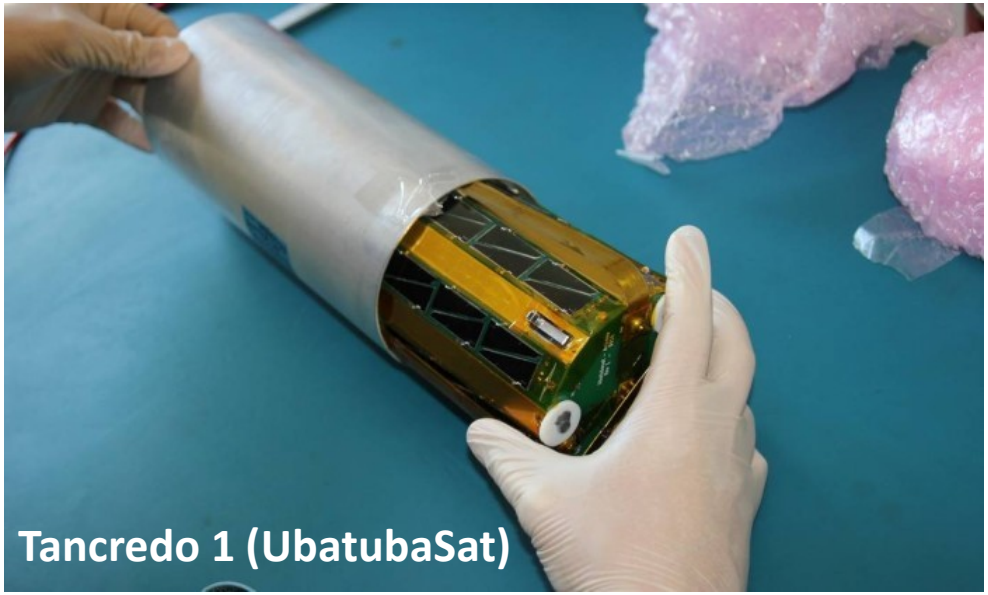
Word cloud of community work and production

cgee insightNet Browser

STEM & COMMUNITY/PUBLIC OUTREACH

AEB is offering space related curriculum choices to schools and students to improve competitiveness in Science, Technology, Engineering, and Mathematics (STEM) disciplines.

AEB Courtesy Image



Tancredo PicoSat Team Courtesy Image

CVT-E
Brazilian Space-Tech Vocational Center, CLBI, Natal
Gonçalves & Gurgel Veras, 54th AIAA Aerospace Sciences Meeting, 2016

STEM & PUBLIC/COMMUNITY OUTREACH

AEB
AGÊNCIA ESPACIAL BRASILEIRA

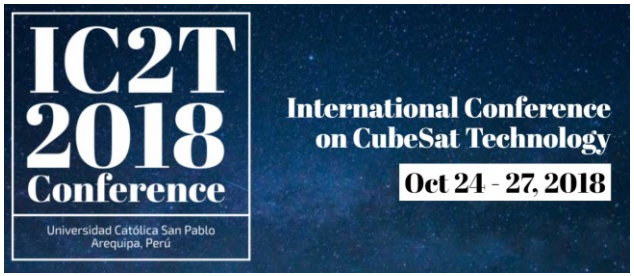
OBA
OLIMPÍADA BRASILEIRA DE ASTRONOMIA E ASTRONÁUTICA

United Nations/Brazil Symposium on Basic Space Technology
"Creating Novel Opportunities with Small Satellite Space Missions"

E2T

NATAL, BRAZIL, 11 - 14 SEPTEMBER 2018

Co-organized by the United Nations Office for Outer Space Affairs and the Government of Brazil



UNNATI (UNispace Nanosatellite Assembly & Training by ISRO)

NASA International Internship (NASA I²) Program

I IAA LATIN AMERICAN CUBESAT WORKSHOP

Teatro Municipal de Ubatuba - Ubatuba, SP

03 de dezembro de 2018, 07h - 07 de dezembro de 2018, 18h

ICAB
Congresso Aeroespacial Brasileiro

1º Encontro da Sociedade Brasileira de Astrobiologia
11 e 12 de Julho de 2018
São Paulo-SP

THE GLOBE PROGRAM

Regional Centre for Space Science and Technology Education for Latin America and the Caribbean (CRECTEALC)

FINAL REMARKS

- Consolidate in Brazil the small satellite segment
    - ~500kg
    - ~100kg
    - ~1-10kg
- Identify small missions to attend qualified demands
- Promote synergies with Brazilian launch vehicle development effort
- Continuous human resources training
- Welcome new stakeholders (industry, startup, think-thank, etc)
- Incentivate sustainable bussines model for the segment (services, applications, innovation)
- Promote international partnerships

THANK YOU FOR YOUR ATTENTION

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