Sustentabilidade Espacial

Erika Rossetto
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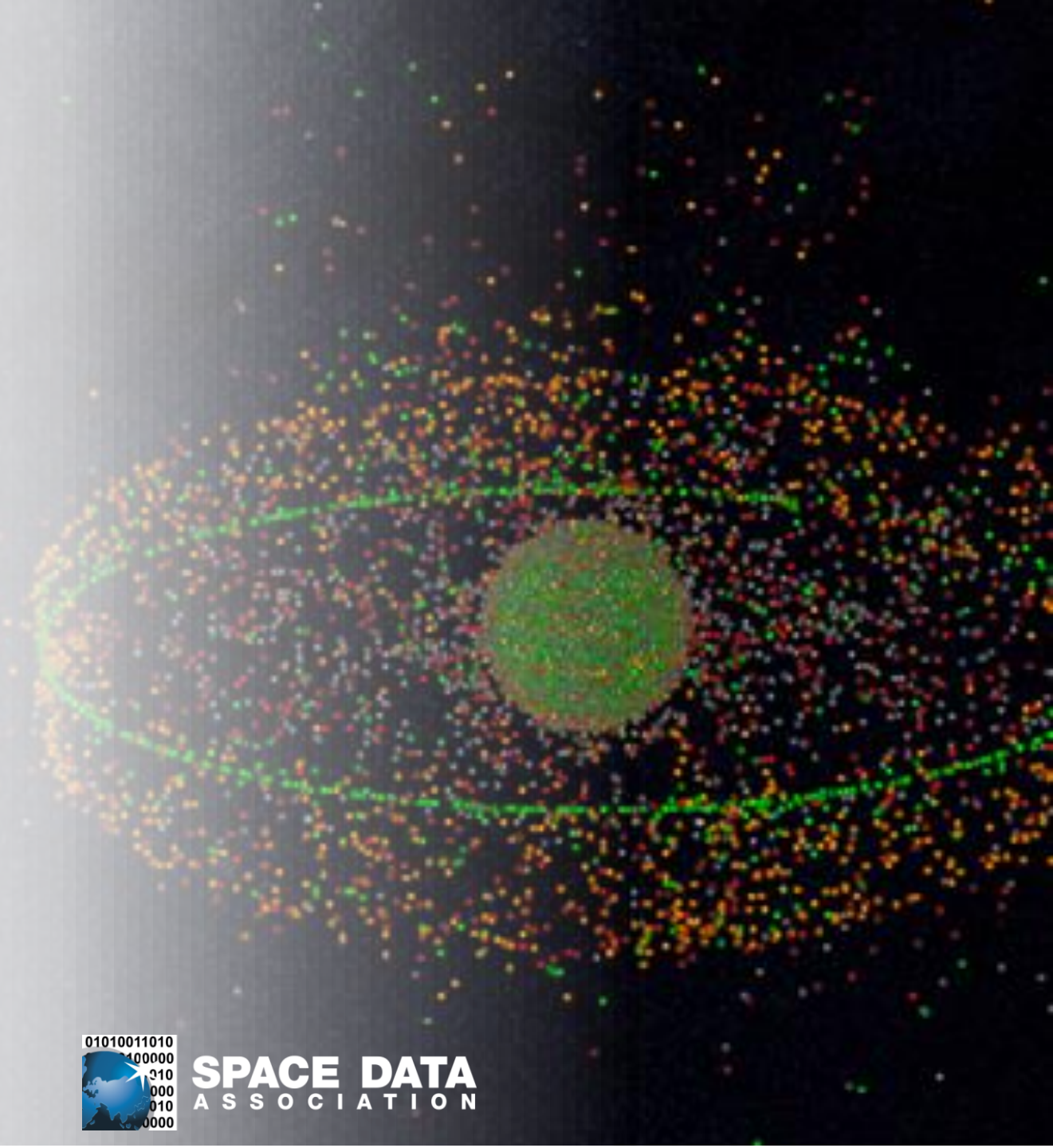
Outubro de 2024

2º FÓRUM DE LOGÍSTICA
AEROESPACIAL E SUSTENTABILIDADE



Embratel star one

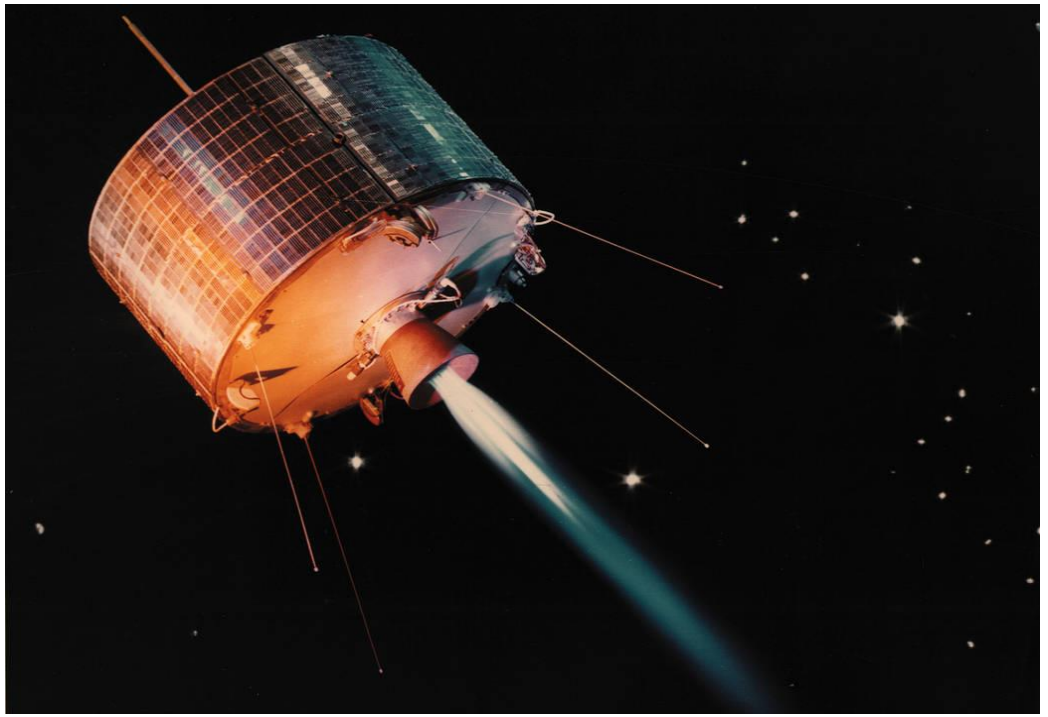
ILA

SPACE DATA ASSOCIATION

Histórico

- Até o lançamento do Telstar havia 340 objetos catalogados, sendo 116 payloads;

- Em 1963 é lançado o primeiro satélite geoestacionário. (527 objetos catalogados, sendo 167 payloads);



Fonte: NASA

Syncom I e II. Primeiros satélites geoestacionários.

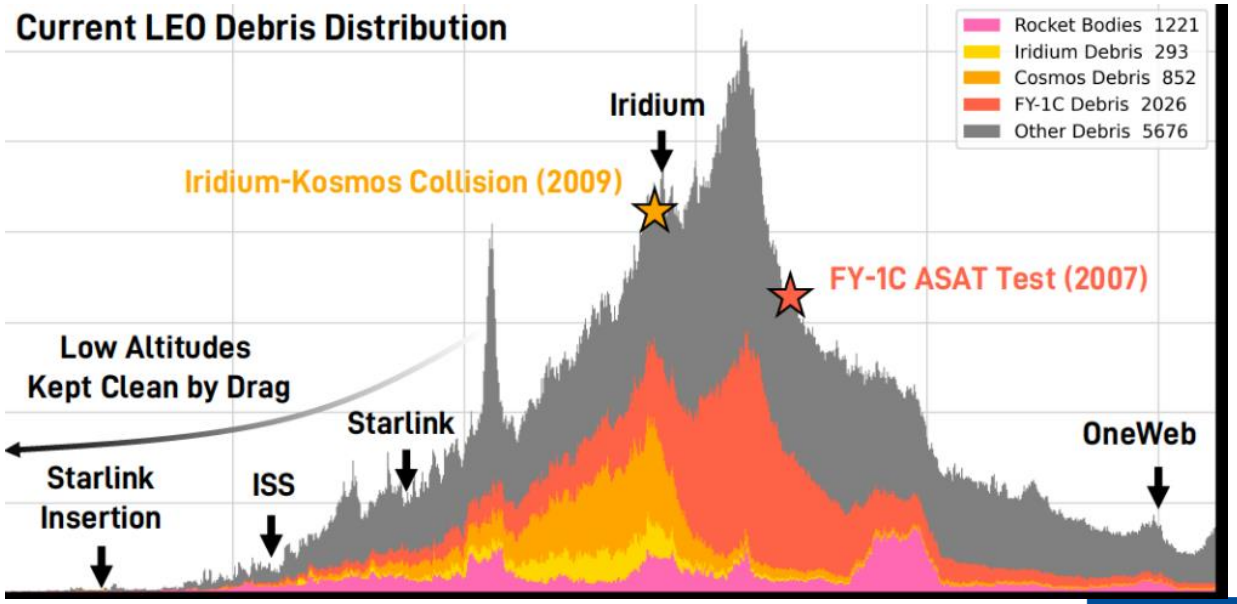
✓ Em 1961, o satélite Transit-4 A explodiu 2 horas após o lançamento, gerando quase 300 detritos rastreáveis.

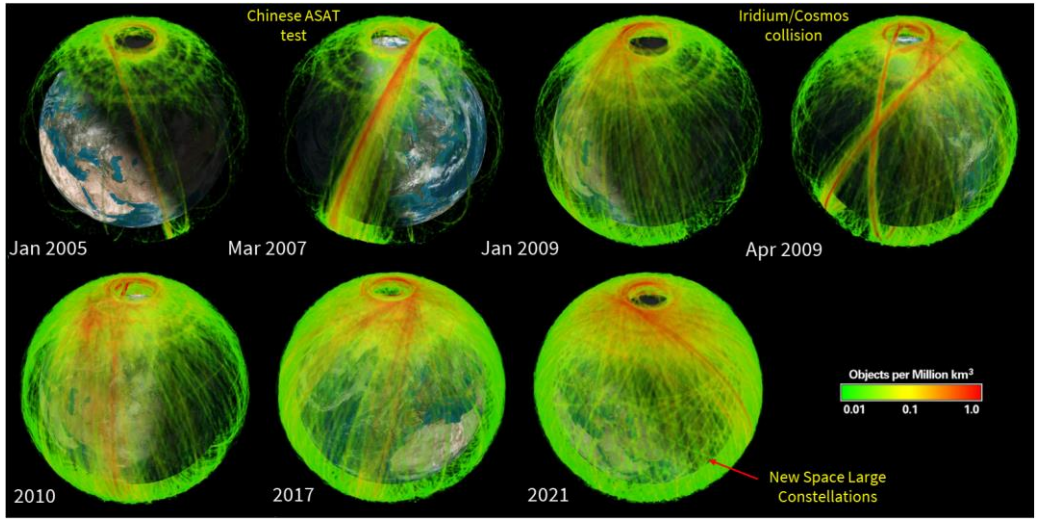
✓ Em 1967 o primeiro acidente fatal espacial é registrado. Morreram 3 astronautas da missão Apolo 1. No mesmo ano, o astrononauta soviético Valdimir Mikhailovich Komarov tornou-se o primeiro homem a morrer no espaço.

✓ Em 1969, 868 objetos haviam sido lançados, porém a população espacial era de 2390 objetos rastreáveis.

✓ Em 1985 um satélite americano é destruído em órbita e milhares de fragmentos foram gerados.

Histórico





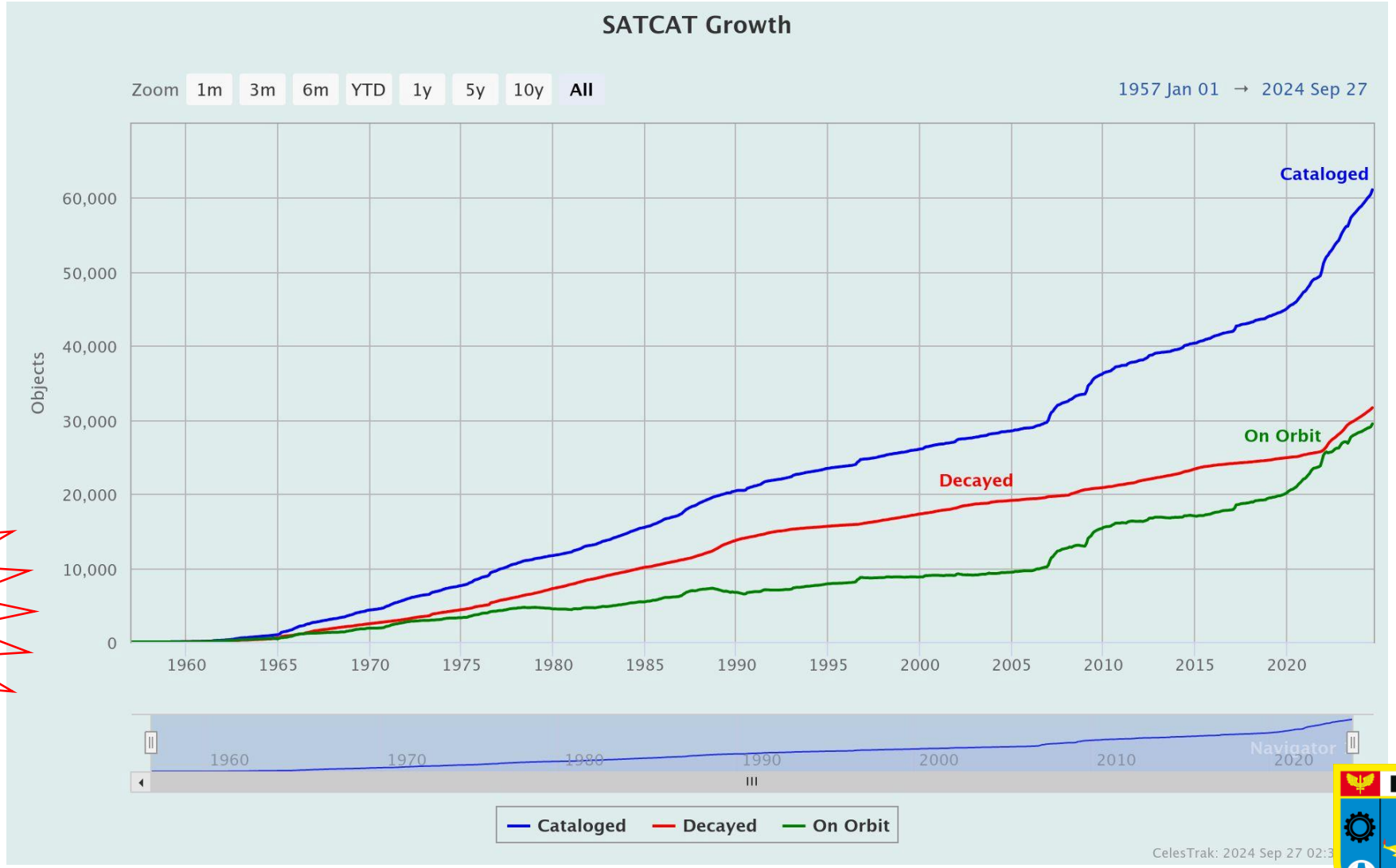
Category	Chinese ASAT	USA 193	Indian ASAT	Russian ASAT	Iridium/Cosmos collision
Date	11 Jan 2007	21 Feb 2008	27 Mar 2019	15 Nov 2021	10 Feb 2009
Altitude (km)	856	246	282	461	769
Velocity (hypervelocity˜ > ≈ 6)	14.8 km/s	8.49 km/s	9.4 km/s	4.6 km/s	11.6 km/s
≈ kJ/kg (catastrophic ≈ >40)	15,000-35,000	1,500 – 2,500	6,000	500 – 1,000	51,500
Debris tracked by SSN	3,532	174	129	1,604 (so far)	2,369
Simulated trackable* debris	3,007	452	936	1,246	2,651
Simulated Lethal Non-Track	34,733	3728	10,439	16,386	7,883
80th percentile lifetime (yrs)	63	0.03	0.05	1.5	56
“RSO-years” (trackable)	130,347	13	65	2,098	108,230
“RSO-years” (LNT)	1,225,972	94	784	16,464	257,442

Histórico

Cenário Atual

Há 29654 objetos catalogados em órbita, sendo 13601 payloads e 16053 debris*.

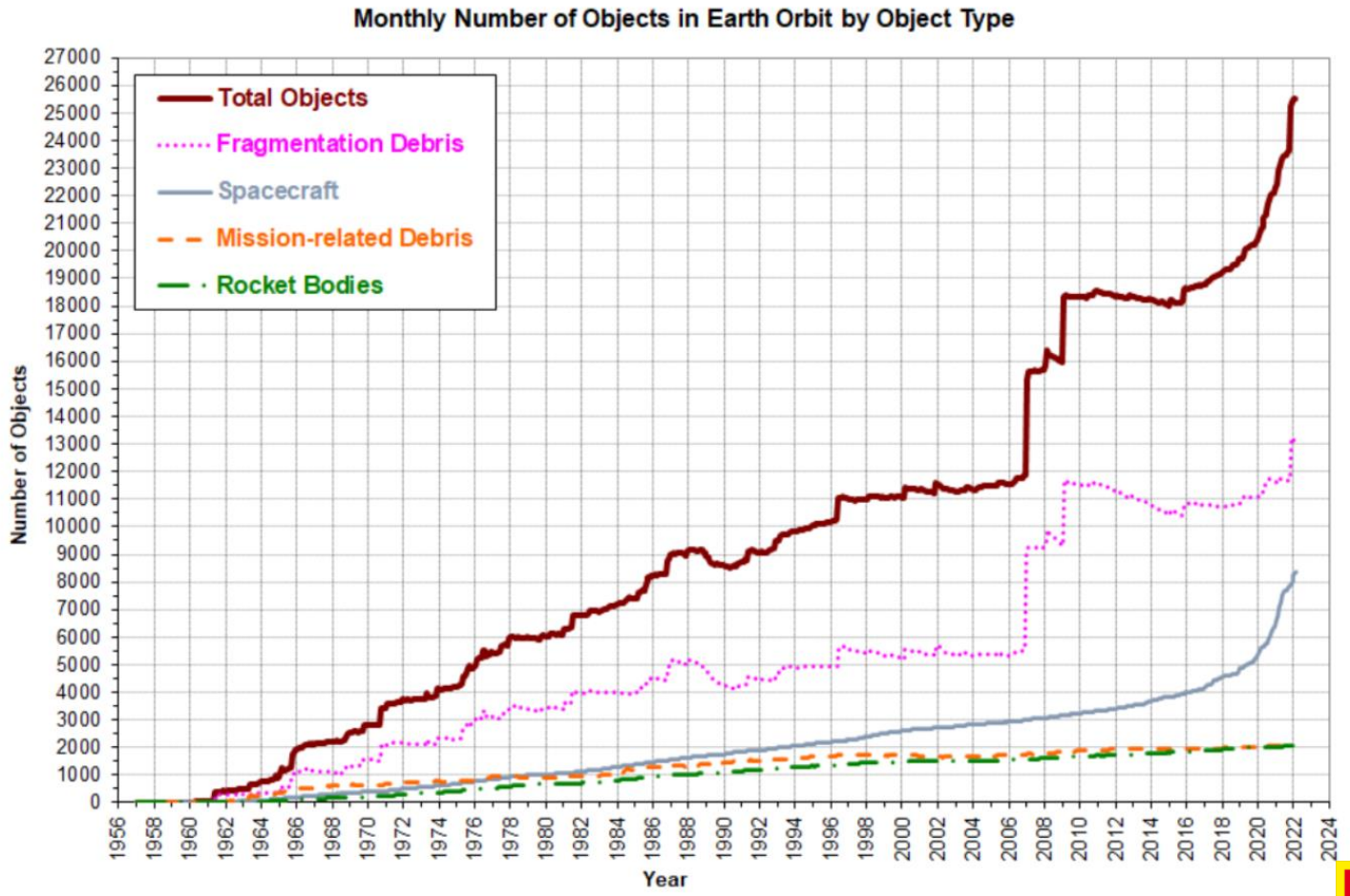
Há entre 300000 e 500000 debris de diâmetro entre 1 a 10 cm não rastreáveis.



*dados de 27/09/2024

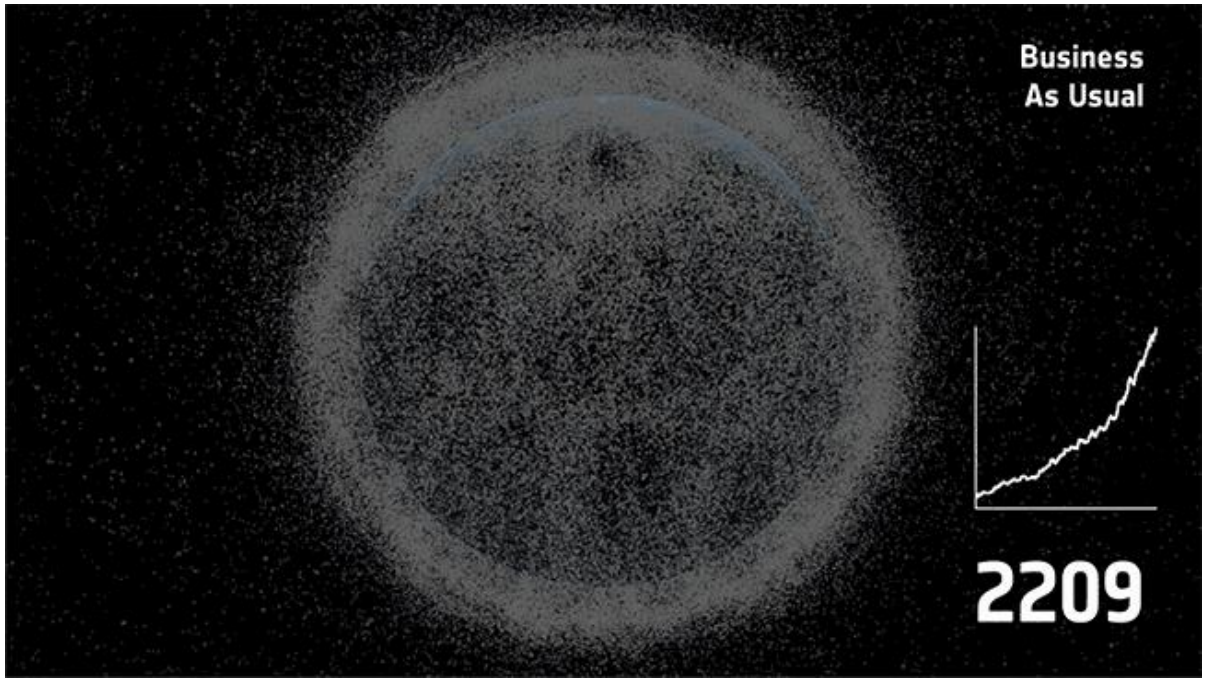
Cenário Atual

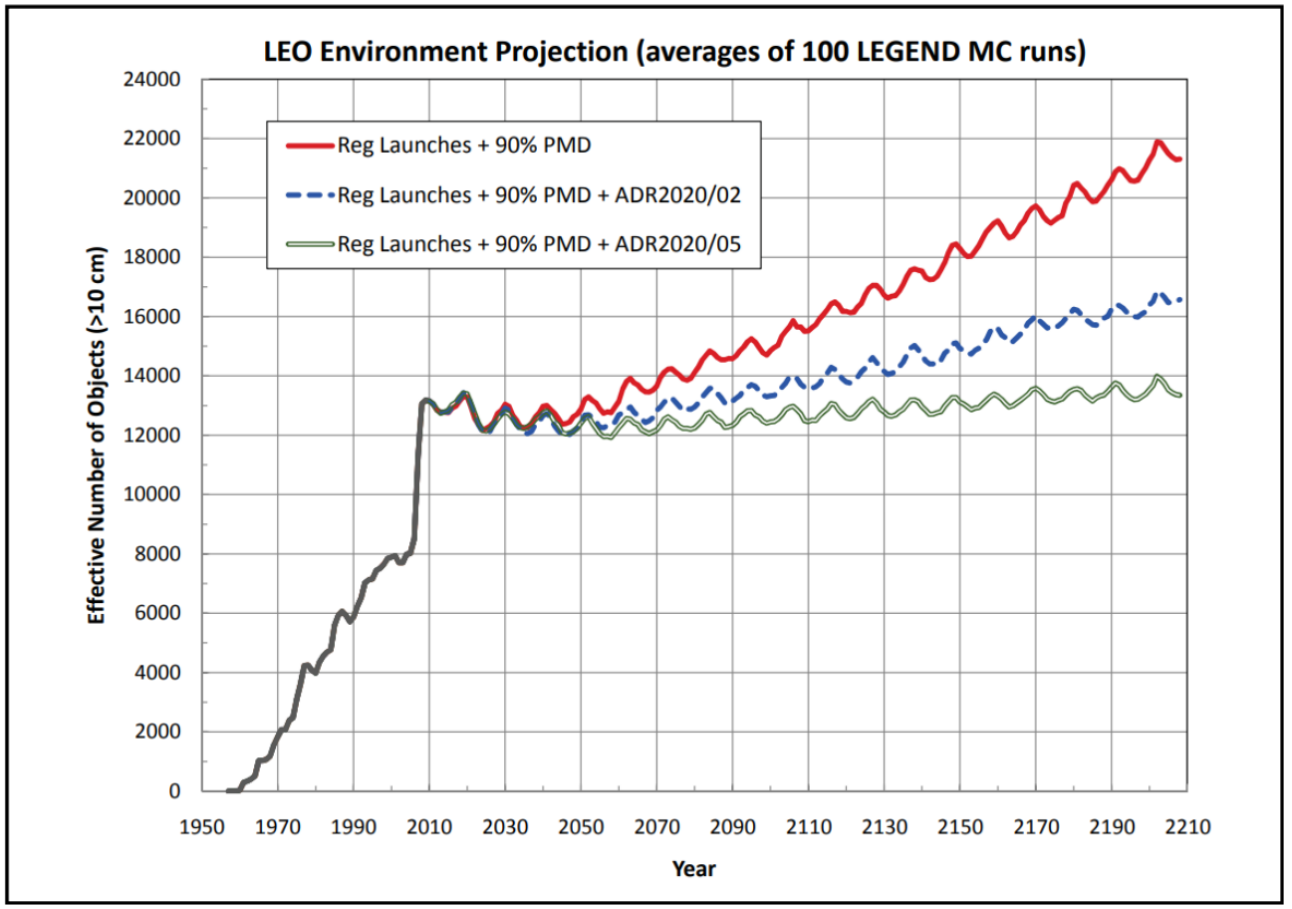
Impacto de uma esfera de 1.2 cm de diâmetro colidindo com um bloco de 10 cm de espessura a 6.8 km/s



Em LEO velocidades relativas de colisão podem chegar a 15 km/s, em GEO 3 km/s

Perspectivas



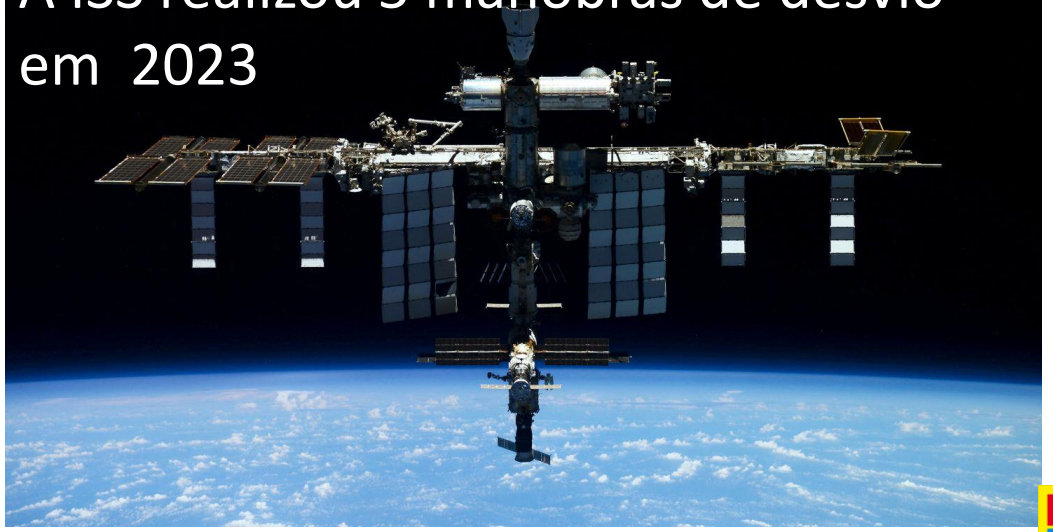


Impactos relevantes

SpaceX reportou quase 50 mil manobras de desvio em 2023, uma media de 6 manobras por satélite.

Em 2021, 2 satélites da One Web receberam avisos de risco de colisão com satélites da Starlink, aproximação de **60 m**!

A ISS realizou 5 manobras de desvio em 2023



Como criar um ambiente espacial mais sustentável?

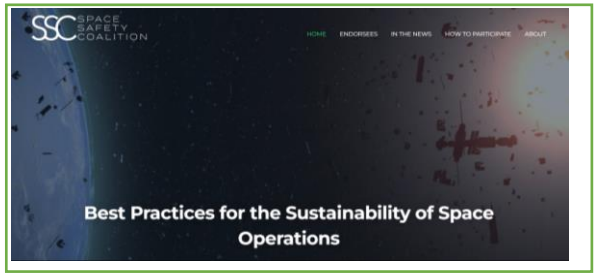
Normas, recomendações, regulação

INTERNATIONAL STANDARD **ISO 24113**

Fourth edition
2023-05

Space systems — Space debris mitigation requirements

Systèmes spatiaux — Exigences de mitigation des débris spatiaux



ESA's guidelines for sustainable space

For this reason, ESA has adopted the "Zero Debris approach", first outlined in Agenda 2025, which aims to significantly limit the production of debris in Earth and lunar orbits by 2030 for all of the Agency's future missions, programmes and activities.

5.3.2 **Objects Passing Through the LEO Region**

Spacecraft or orbital stages that are terminating their operational phases in orbits that pass through the LEO region, or have the potential to interfere with the LEO region, should be de-orbited (direct re-entry is preferred) or where appropriate manoeuvred into an orbit with an expected residual orbital lifetime of 25 years or shorter. The probability of success of the disposal should be at least 90%. For specific operations such as large constellations, a shorter residual orbital lifetime and/or a higher probability of success may be necessary. Retrieval is also a disposal option.

IADC-02-01
Revision 2
Mar 2020

Inter–Agency Space Debris Coordination Committee

Senate passes orbital debris bill

The Senate passed by unanimous consent Oct. 31 S. 447, the Orbital Sustainability, or ORBITS, Act of 2023. The bill previously passed the Senate Commerce Committee in July.

The central part of the bill would direct NASA to establish an active debris removal program. Tnat includes creating "a demonstration project to make competitive awards for the research, development, and demonstration of technologies leading to the remediation of selected orbital debris." It would also require NASA to enter into a partnership to fly a demonstration mission to remove debris.

GLOBAL SATELLITE OPERATORS ASSOCIATION RELEASES CODE OF CONDUCT ON SPACE SUSTAINABILITY

Brussels, Belgium, 13th November 2023 – The Global Satellite Operators Association (GSOA) today released its Code of Conduct on Space Sustainability, calling on operators to implement responsible practices that mitigate the risk of in-orbit collision, minimize the threat of non-trackable debris, protect humans in space and limit effects on optical astronomy.

Embratel star one

Como criar um ambiente espacial mais sustentável?

Novas iniciativas

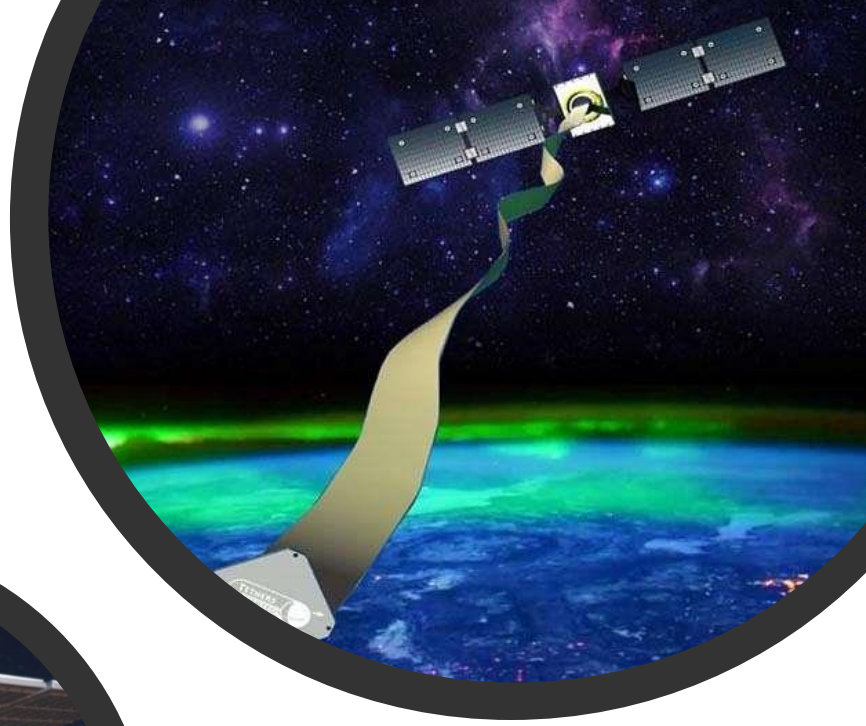
Global Space Debris Monitoring and Removal Market Overview

Space Debris Monitoring and Removal Market Size Valued at USD 1.5277 Billion, market Grow at a CAGR Of 8.32% by 2020 -2030

Space debris is space objects no longer used by humankind but still revolve around the Earth's Orbit. Space debris can be any space objects like the one out-of-mission spacecraft, launch vehicle parts, and other released tools, which are of no use. The Space Debris Monitoring and Removal Companies have noticed a huge demand due to the rise of various space organizations and agencies. The NASA Orbital Debris Program began in 1979 in the Space Sciences Branch in Houston, Texas. The program looked for ways to create fewer orbital debris and designed equipment to track and remove the debris already in space

Organização	País	Cobertura	Tipo
SDA	UK	LEO/MEO/GEO	Privada Sem fins lucrativos
18Spc	USA	LEO/MEO/GEO	pública sem fins lucrativos
ESA	EU	LEO/MEO/GEO	pública sem fins lucrativos
Lockheed Martin	USA	LEO	privada
INDRA	Spain	LEO	privada
AGI	USA	LEO/MEO/GEO	privada
Deimos Space	Spain	LEO/MEO/GEO	privada
GMV	Spain	LEO/MEO/GEO	privada
L3 – ADS	USA	LEO	privada
Centauri	USA		privada
EOS	Australia	LEO/GEO	privada
Etamax Space	Germany		privada
ExoAnalytics	USA	GEO	privada
Gauss SRL	Italy	LEO/GEO	privada
Launchspace Technologies	USA		privada
LEO LABS	USA	LEO	privada
Northstar	Canada		privada
Numerica Corporation	USA	GEO	privada
Orbit Logic	USA	GEO	privada
Polaris Alpha	USA		privada
Schafer	USA		privada
SpaceNav	USA		privada
Vision Engineering	USA	LEO/GEO	privada
Share My Space	França	LEO/GEO	privada
Kayhan	USA	LEO/GEO	privada
Neuraspace	Por	LEO/GEO	privada

Como criar um ambiente espacial mais sustentável?



- Várias iniciativas foram criadas para remoção do lixo especial: Airbus Defense, Altius Space Machines (USA), Astroscale (Japão), Clearspace (Suiça-ESA), Exodus Space Systems (Australia), KMI (USA), OrbitGuardians (USA), Orbit Recycling (Alemannha), Origin Space (China), Ortum Stellar (USA),Scout Aerospace, Shanghai ASES Spaceflight Technology (China), Share My Space (France), Starfish Space (USA), Start Rocket (Russia), and Tethers Unlimited (USA).

Como criar um ambiente espacial mais sustentável?

Novas iniciativas

Lançamento previsto para 2026;

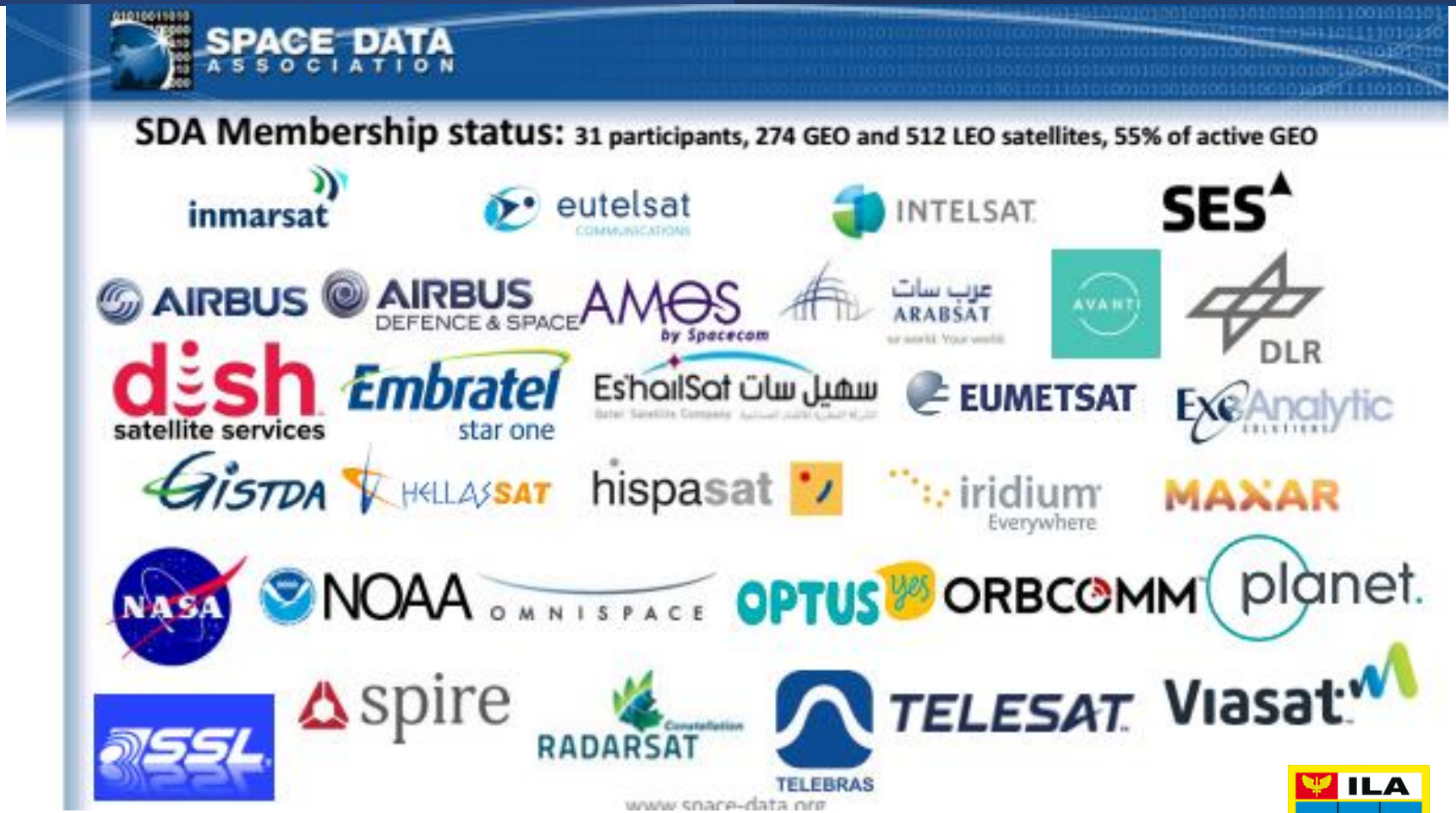
Alvo: Estágio superior da Vespa (112 kg)

Altitude: 664 - 801 km

Como criar um ambiente espacial mais sustentável?

Colaboração

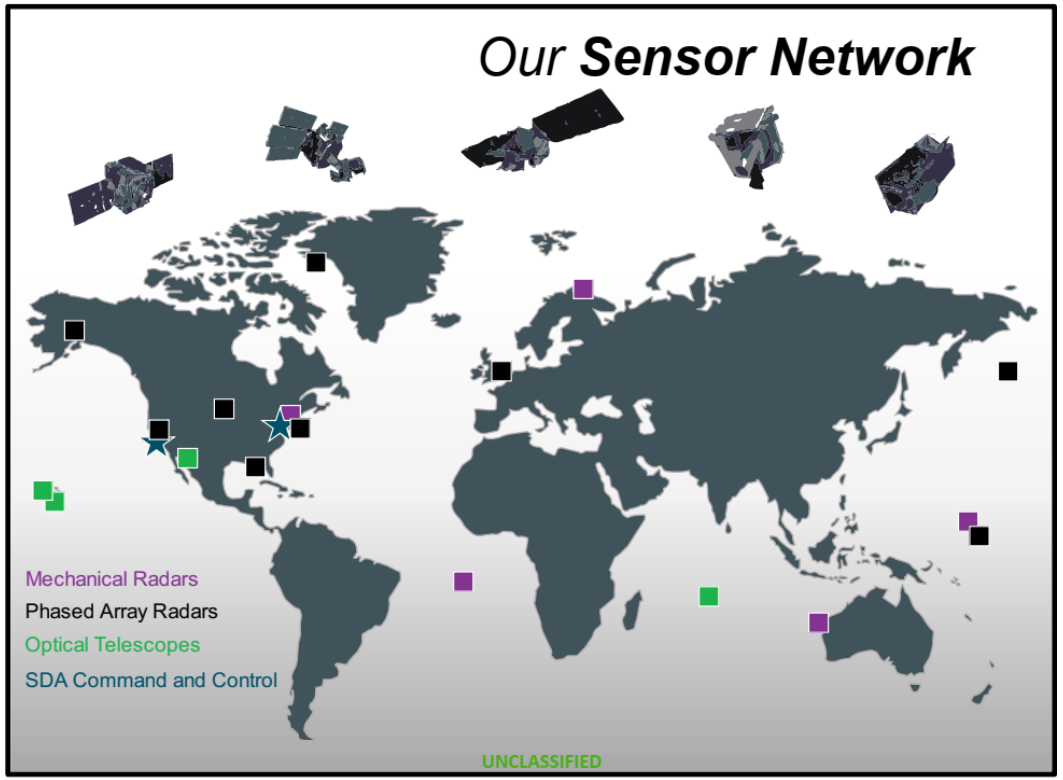
- SDA conta mais de 30 operadores associados;
- Possui um sistema dedicado a prevenção de colisão, suporte operacional e integração entre os associados;
- Colaboração com outras iniciativas.



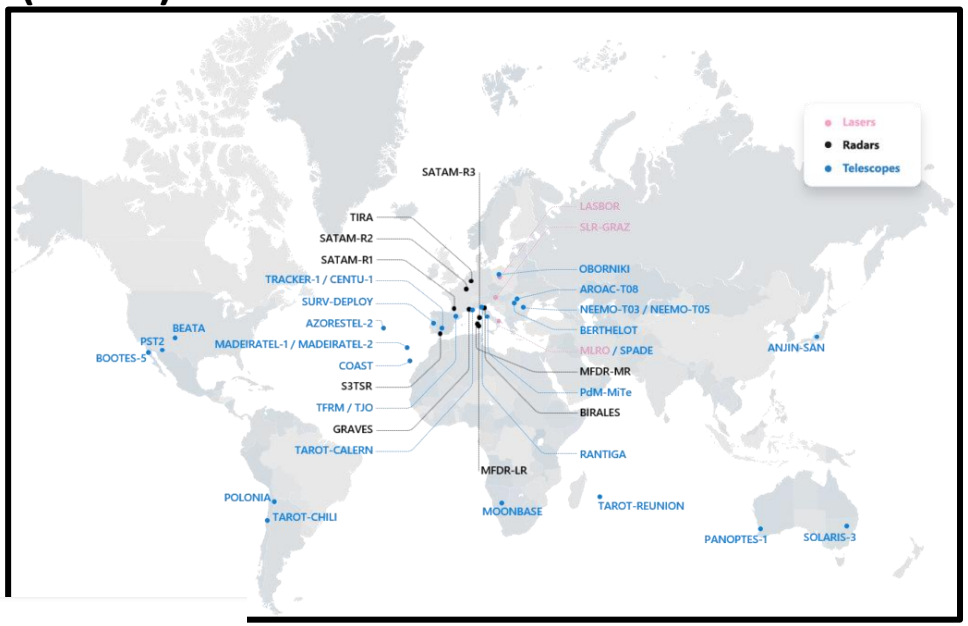
Como criar um ambiente espacial mais sustentável?

Monitoração

Rede americana de sensores para monitoramento espacial (USSPACECOM)



Rede européia de sensores para monitoramento espacial (EUSST)




航空 航天
CHINA AEROSPACE STUDIES INSTITUTE

China's Space Situational Awareness Capabilities For Beyond GEO[i]

Kristin Burke

This paper reviews the publicly available information on China's existing and planned ground and space-based systems for its beyond geosynchronous Earth orbit (GEO) missions. This paper assumes that the PRC, like the U.S., has not needed a well optimized system for discovering, tracking, and cataloging multiple objects between GEO and the Moon, but might, like the U.S., consider how to leverage existing capabilities in anticipation of multiple actors operating beyond GEO.[1]

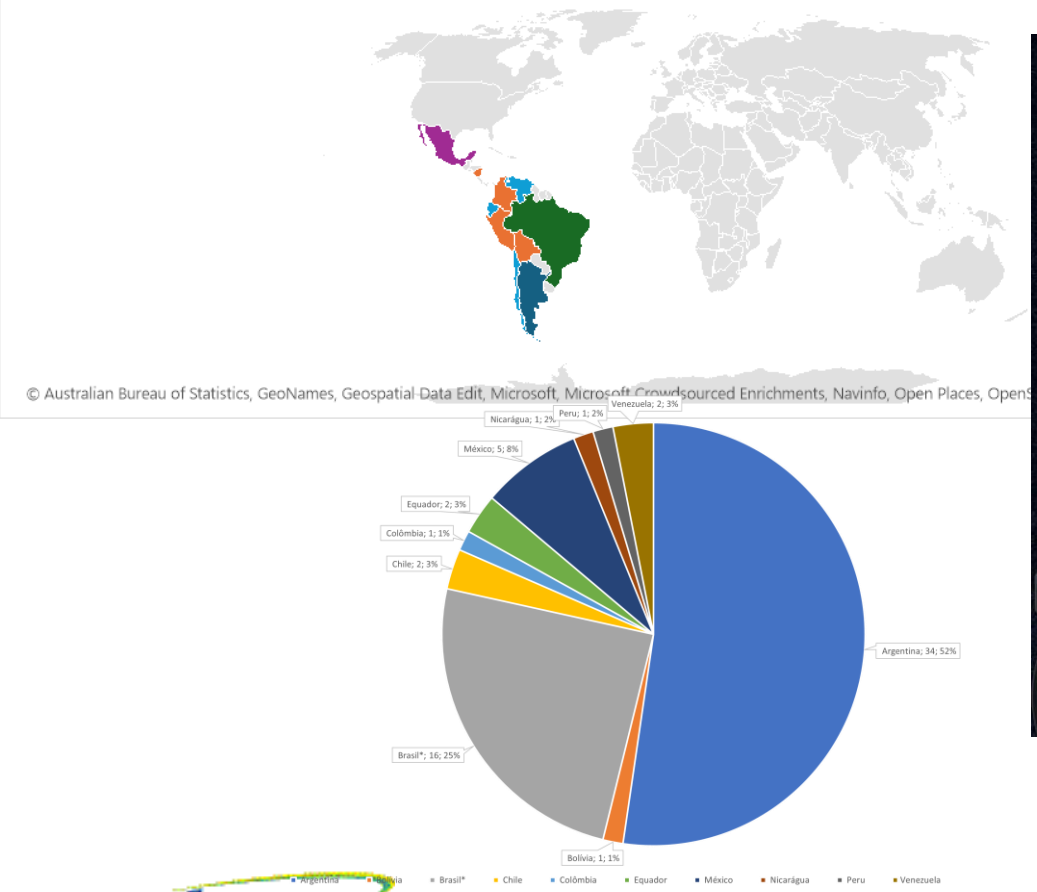
The PRC has many sensors to support its Lunar and Martian exploration programs but does not currently have any publicly known dedicated ground or space-based sensors capable of scanning the volume of space between the Earth and the Moon to discover unknown objects. The PRC is taking steps to increase its capabilities over the next 5-10 years. China has only recently begun to expand its systems for planetary defense, which could enable beyond-GEO scanning for unannounced spacecraft. Even if the Chang'e 5 orbiter is still at the Lunar Distant Retrograde Orbit (DRO), its updated camera, as discussed below, seems more tuned for close

Planos para os próximos anos

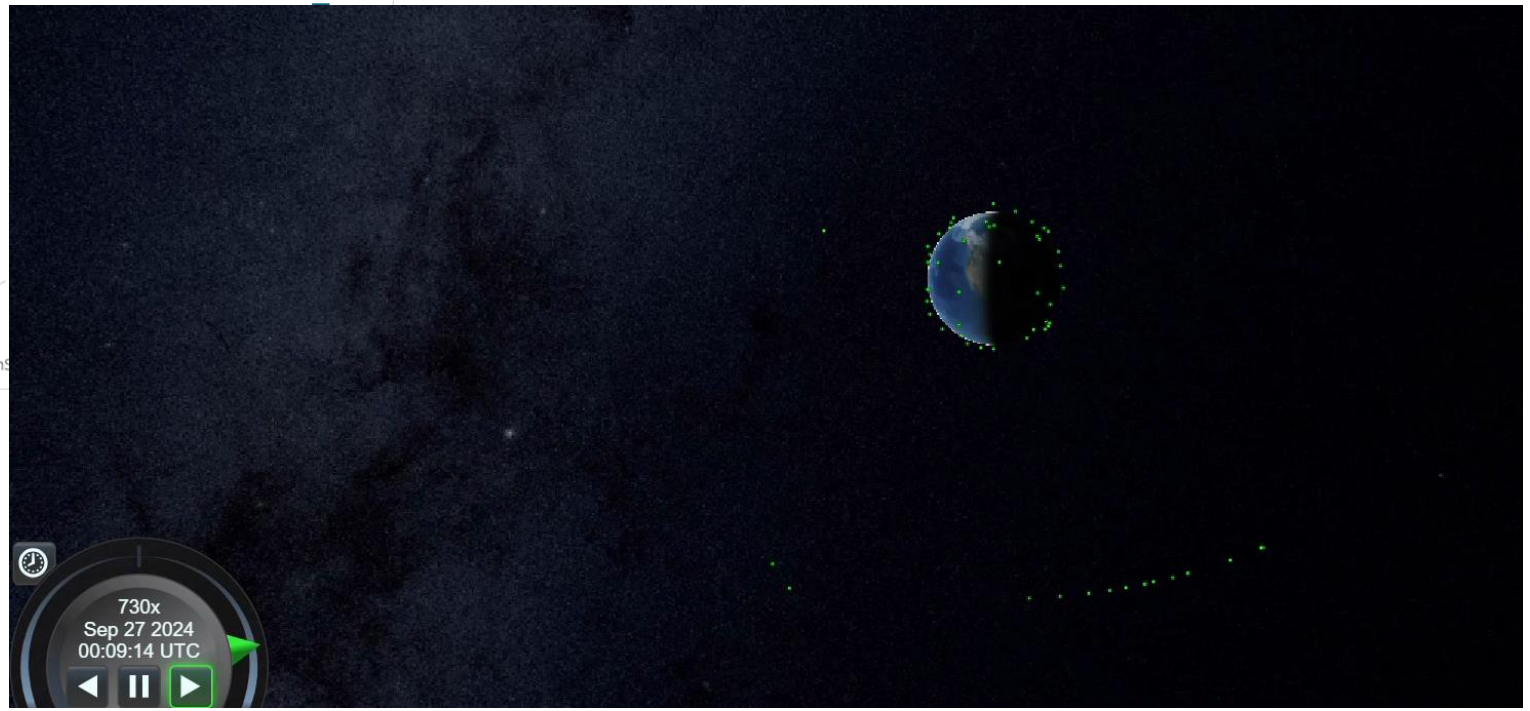
Como criar um ambiente espacial mais sustentável?

Cenário Local

Satélites Ativos latino-americanos registrados no Space-track



América Latina



104 satélites latino-americanos; **65** ativos.

Nenhum Sistema de Vigilância Espacial.

Embratel star one

Conclusões

Ainda temos desafios para continuar usando o espaço de forma sustentável;

Muitas iniciativas e projetos estão surgindo;

É de extrema importância trabalhar em conjunto para criar um Sistema realmente sustentável.

EUA e UE são os mais atuantes para sustentabilidade especial.

A cooperação entre órgãos governamentais, indústria e institutos de pesquisa é eficaz par o avanço da sustentabilidade especial.

A América Latina deve buscar autonomia para vigilância especial?