

Lo Spazio che si affolla Space Situation Awareness e Space Surveillance and Tracking (SSA/SST)

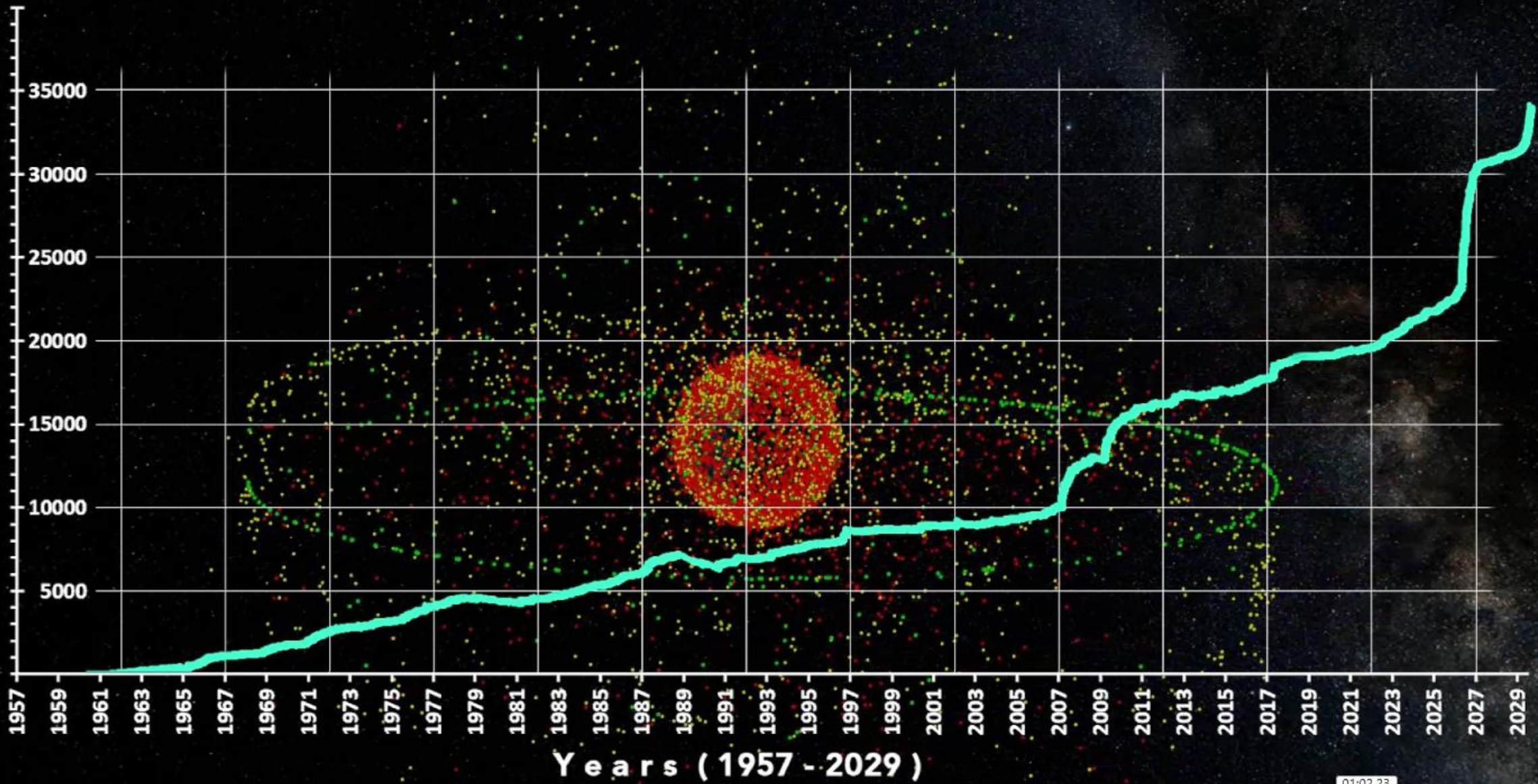
22 Marzo 2022 – Roma, Casa dell'Aviatore

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<http://www.gmspazio.com>

Active Inactive Debris

Objects Orbiting the Earth



01:02,23

01:02,57

THOUSANDS
OF NEW ACTIVE
SATELLITES

PREDICT COLLISIONS?

HAZARDOUS DEBRIS

CONSTELLATIONS

TRACK OBJECTS
ACCURATELY?

FOR THOUSANDS OF YEARS TO COME

BETTER STEWARDS
OF SPACE

RESPONSIBLY USE SPACE OR LOSE IT FOREVER

CUBE SATS

MAPPING

WEATHER

GLOBAL INTERNET

01:29,55



01:29,90

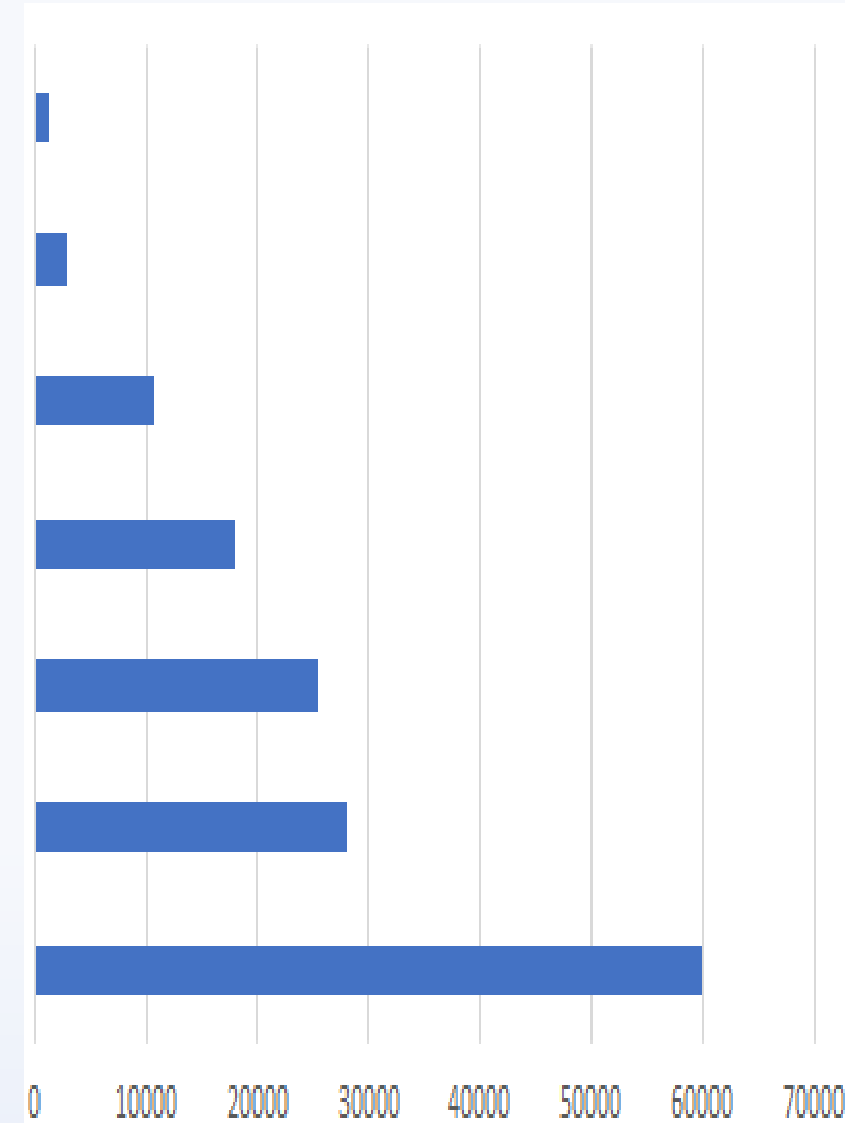


➤ Orbite https://www.esa.int/Enabling_Support/Space_Transportation/Types_of_orbits

- Geostationary orbit (GEO)
- Low Earth orbit (LEO)
- Medium Earth orbit (MEO)
- Polar orbit and Sun-synchronous orbit (SSO)
- Transfer orbits and geostationary transfer orbit (GTO)
- Lagrange points (L-points)
- *Last but not least NEO (Near Earth Orbits)*

➤ Le velocità in gioco

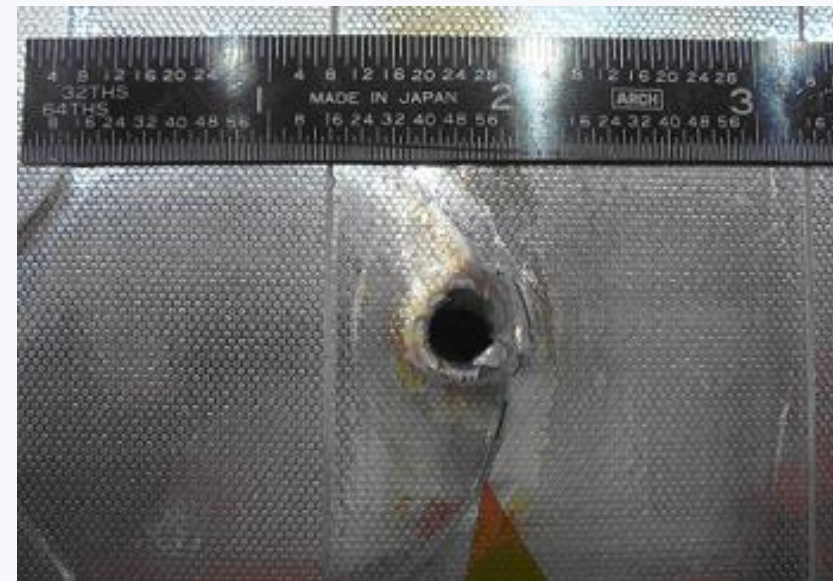
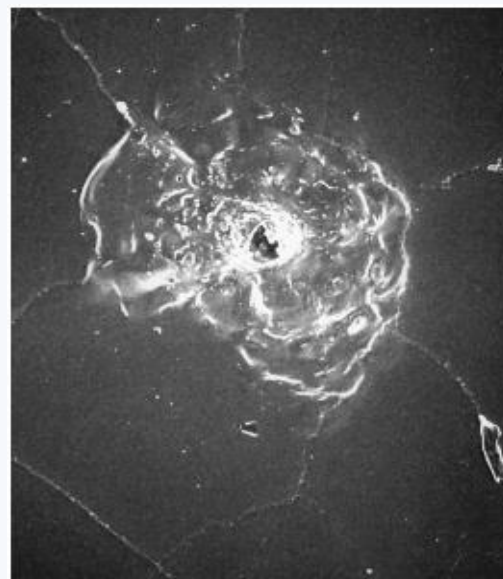
- Velocità del suono : 343 m/s $\approx$ 1,234 km/s
- Remington 221 : 810 m/s $\approx$ 2,916 km/s
 - (oppure la 363 Mauser : 560 m/s)
- Satelliti GEO : 3.000 m/s $\approx$ 11.000 km/h
- Satelliti MEO : 5.000 m/s $\approx$ 18.000 km/h
- Satelliti LEO : 7.000 m/s $\approx$ 27.400 km/h
- ISS : 7.669 m/s $\approx$ 28.000 km/h
- NEO : 15.000 ÷ 20.000 m/s $\approx$ 54.000 ÷ 72.000 km/h



Le energie in gioco



Ricordando la formula per il calcolo dell'energia cinetica : $K = 0,5 mv^2$, proviamo ad immaginare i danni provocati da una piccola vite delle dimensioni di pochi centimetri e del peso di dieci grammi. L'energia di impatto risulta pari a $\approx 250\text{kJ}$. Una vite siffatta è considerata dalle agenzie spaziali un **oggetto mortale**, perché troppo piccolo per essere monitorato ma capace di provocare danni enormi, potenzialmente drammatici.



Le foto mostrano danneggiamenti vari operati da detriti spaziali delle dimensioni stimate inferiori ai 2 cm su alcuni sistemi operanti nello spazio intorno alla Terra in orbita bassa, nell'ordine da sinistra a destra, foro nel braccio robotico della ISS, urto su un finestrino dello Shuttle (ne sono stati sostituiti in totale 83), sistema di raffreddamento dello Shuttle STS-109.

SSA – Space Situational Awareness

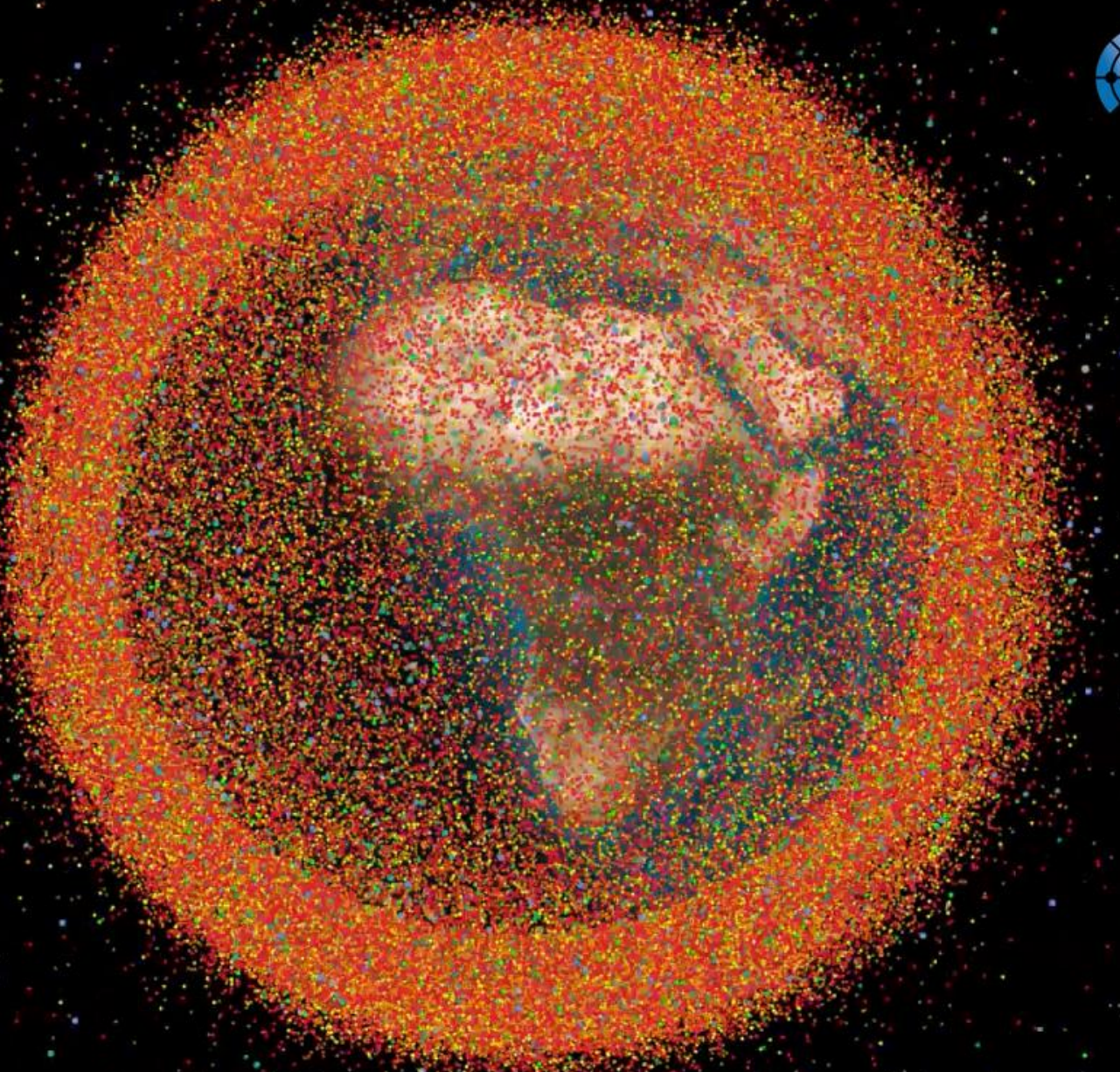
SST – Space Surveillance & Tracking

SDA – Space Domain Awareness



LEO-Crossing Resident Space Objects

152 > 5.0 m.
1193 > 2.5 m.
2793 > 1.0 m.
5980 > 50 cm.
10049 > 25 cm.
16560 > 10 cm.
42561 > 5 cm.
48364 > 4 cm.
79215 > 3 cm.
198490 > 2 cm.



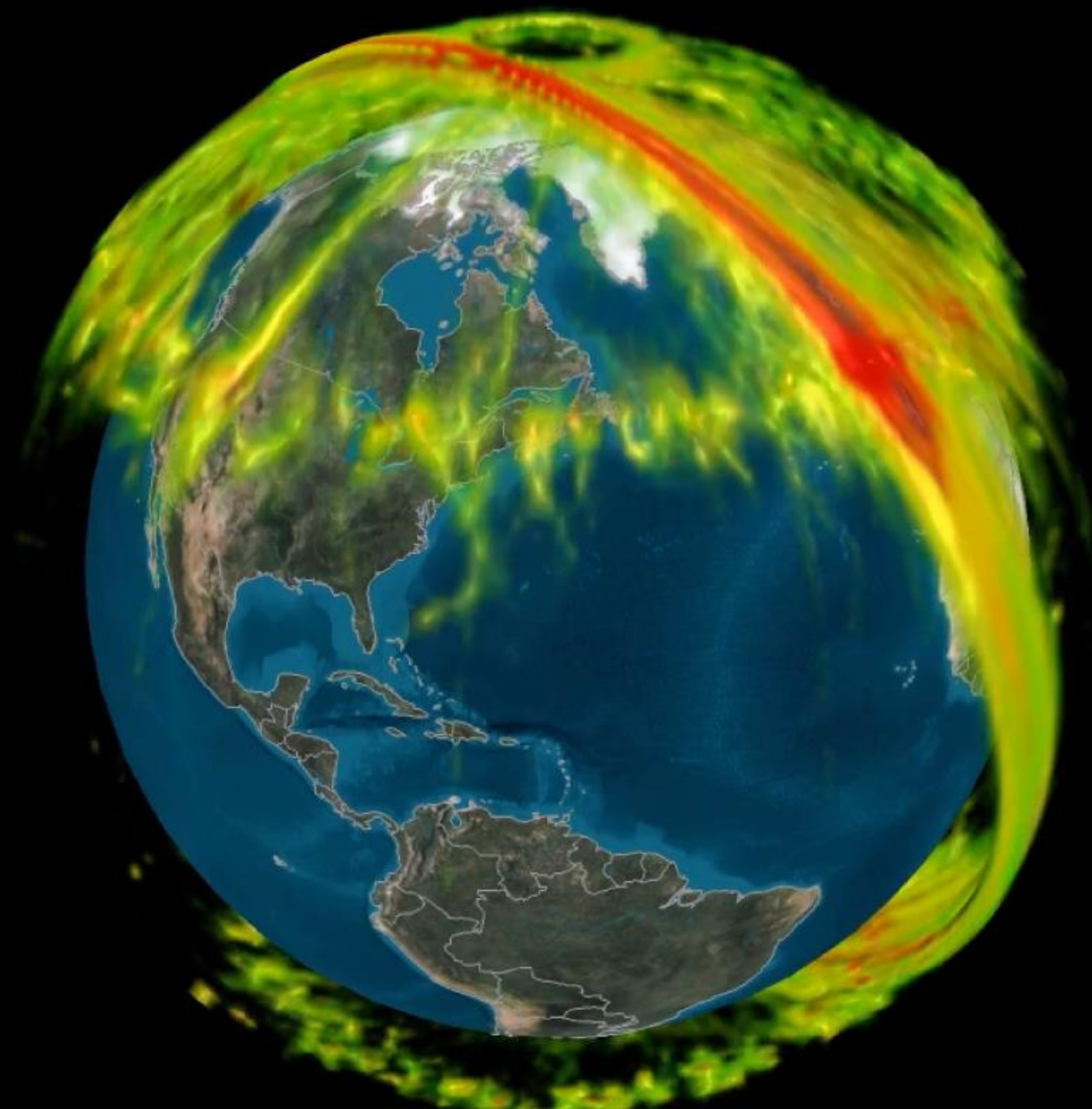
Objects per Million km³



0.01

0.1

1.0



Quali strumenti?



Sensori



Sistemi di Comando e Controllo



Reti di Sistemi Cooperanti

EU-SST
SATCEN

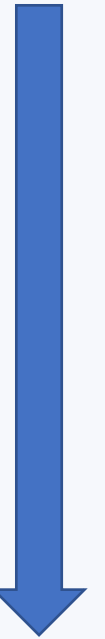


Monitoraggio continuo dello spazio intorno alla Terra

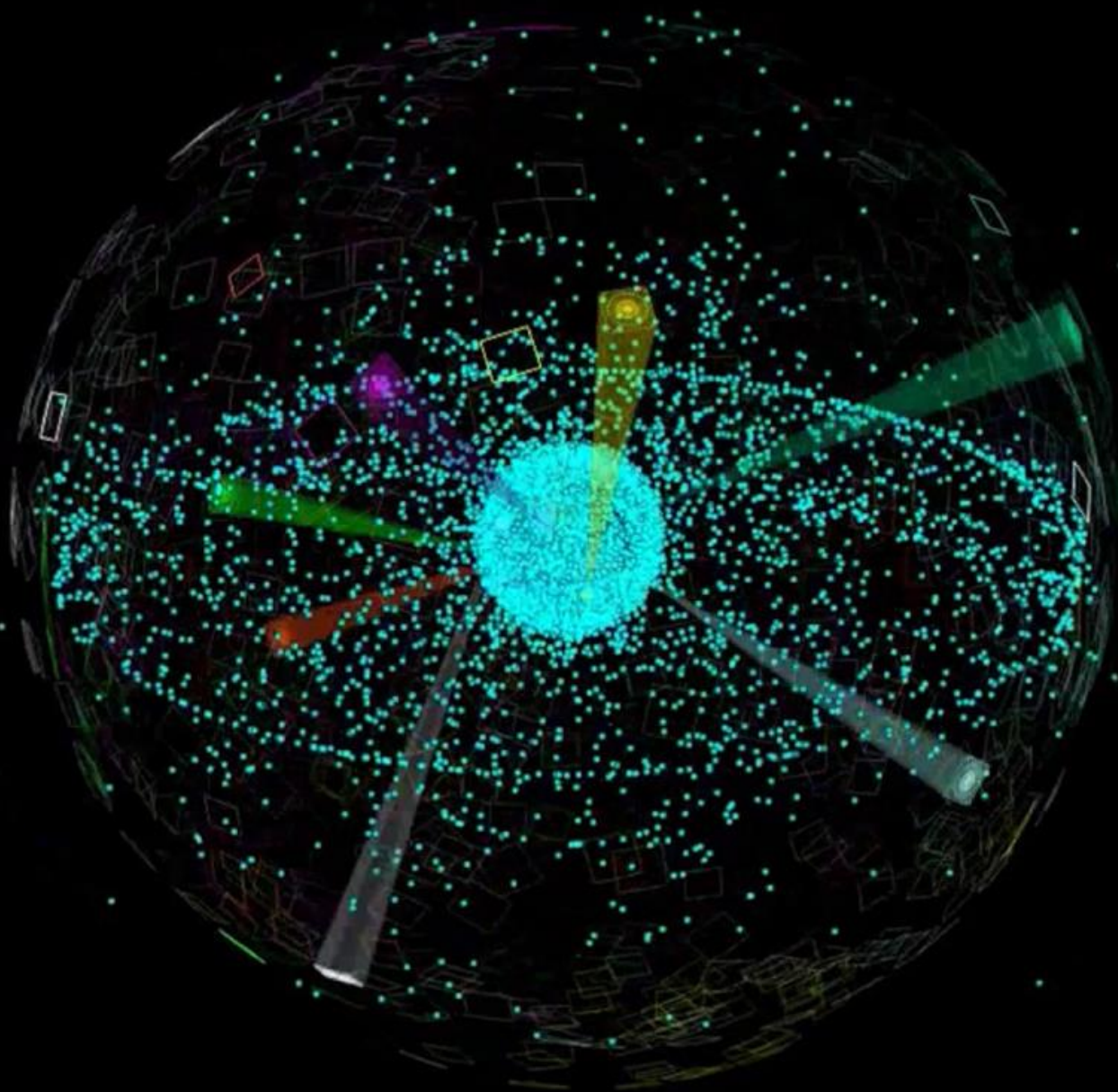
Mitigazione del fenomeno

Pulizia dello Spazio

today



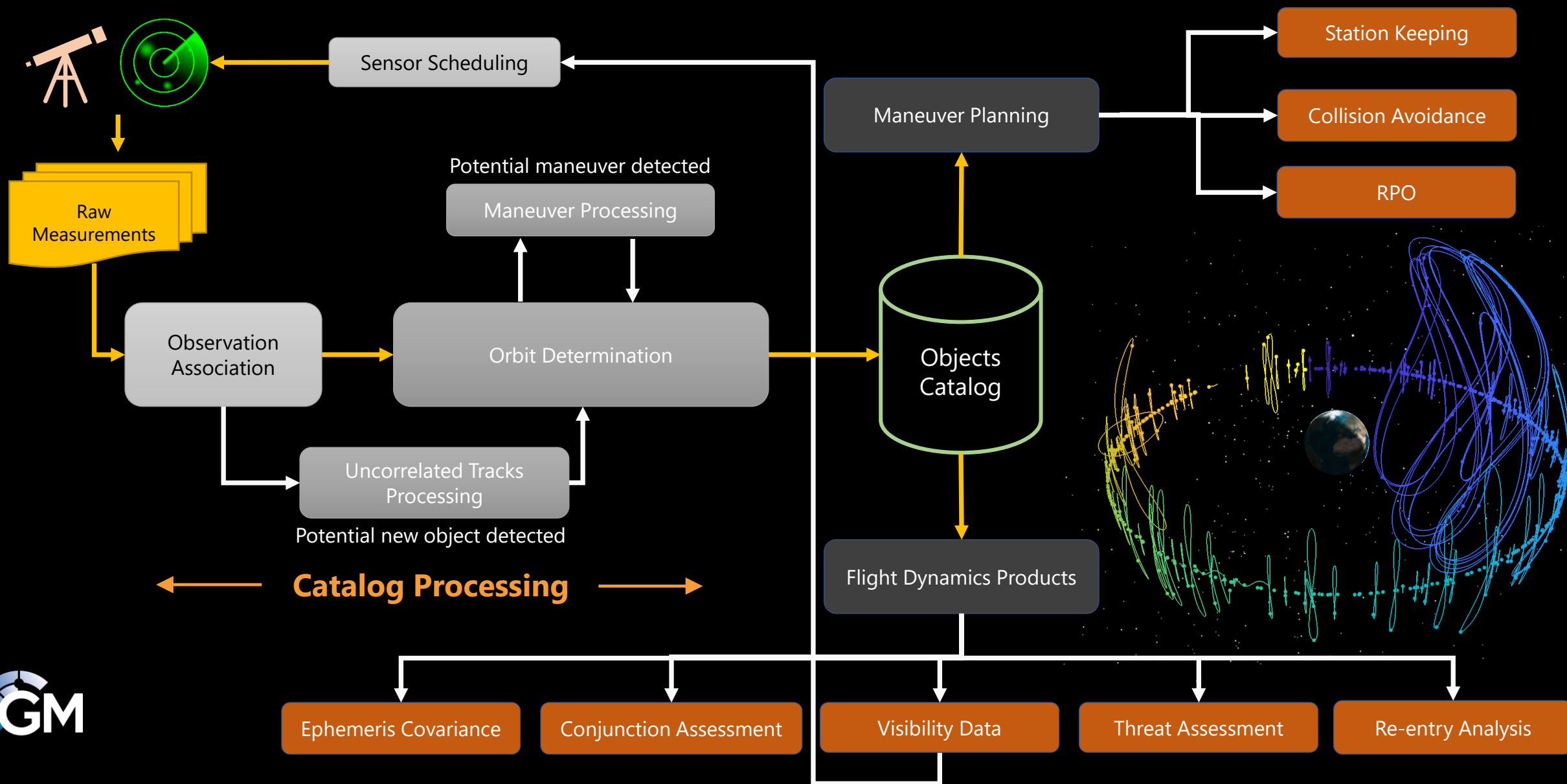
tomorrow



Space Situational Awareness (SSA) / Space Surveillance & Tracking (SST)

- SSA meant for a long time *detecting, tracking, and identifying all objects in orbit* (also known as: Catalog Maintenance).
- Now, SSA has evolved to encompass more than just Catalog Maintenance but having an accurate catalog has enabled different groups to achieve their broader definition of Space Situational Awareness.
 - For militaries: “SSA enables the continuous preparation of the battlespace in order to fight and win a war in space.” (Air Force Space Command)
 - For commercial satellite companies: SSA enables protecting their high value assets from debris or collisions with other satellites.
 - For Intelligence organizations: SSA enables the understanding of capabilities of other actors in space.
 - Many Definitions Exits!

Basic SSA/SST Workflow



La nostra proposta



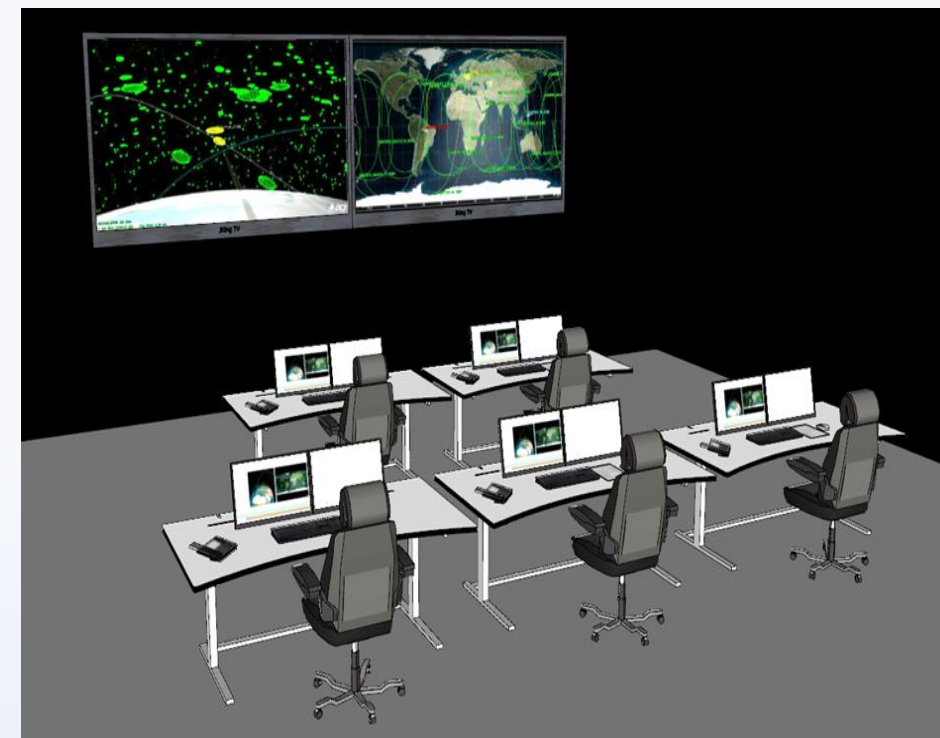
Space Situational Awareness GSAT (2012) Italia

Space Surveillance & Tracking GSTT (2015) Italia

Italian Space Operation Center ISOC (2016) Italia

Polish Space Agency Space Center SNCO (2020) Polonia

work in progress and more to come ... (2022 – 2024)



Thank you very much
for your kind attention!

Q & A