

Space Debris Mitigation Activities at ESA in 2017

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ESA Launches and Mitigation Efforts in 2017 (1/2)



Sentinel-2B (with EC)

- Launch: March 7th, 2017 from CSG/Kourou (VEGA), 790km x 788km @ 100.6°
- Mission: Multispectral optical imagery
- The VEGA/AVUM upper-stage performed a controlled re-entry



Sentinel-5p (with EC)

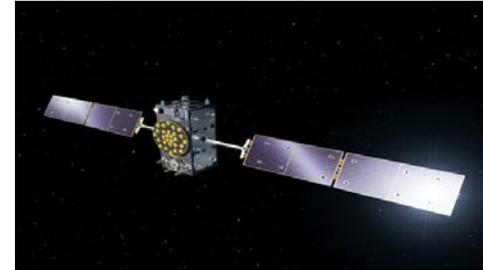
- Launch: October 13th, 2017 from Plesetsk (Rokot)
- 828km x 826km @ 98.7°
- Mission: Atmospheric monitoring (precursor to S5)
- The Briz-KM stage lowered its orbit to 400km x 800km



Debris Mitigation Efforts by ESA in 2017 (2/2)

Galileo 19, 20, 21, 22 (with EC)

- Launches: Dec 12th, 2017 Kourou (Ariane 5)
- 23235km x 23212km @57deg
- Ariane 5 EPS stages injected into graveyard orbit below constellation, the 4 satellites raised to their operational altitude



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SPACE DEBRIS USER PORTAL > HOME

This portal addresses the user community of ESA's Space Debris Software. It serves as entry gate for software license applications and for the retrieval of the software. Registered users may retrieve updated data and software patches and may raise support requests.

THE FOLLOWING ESA SPACE DEBRIS TOOLS CAN BE REQUESTED:

MASTER

MASTER (Meteoroid and Space Debris Terrestrial Environment Reference) allows to assess the debris or meteoroid flux imparted on a spacecraft on an arbitrary earth orbit. MASTER also provides the necessary computational and data reference for DRAMA and needs to be installed before DRAMA is installed.



<https://sdup.esoc.esa.int>

DRAMA

DRAMA (Debris Risk Assessment and Mitigation Analysis) is a comprehensive tool for the compliance analysis of a space mission with space debris mitigation standards. For a given space mission, DRAMA allows analysis of:

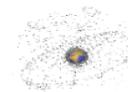
- Debris and meteoroid impact flux levels (at user-defined size regimes)
- Collision avoidance manoeuvre frequencies for a given spacecraft and a project-specific accepted risk level
- Re-orbit and de-orbit fuel requirements for a given initial orbit and disposal scenario
- Geometric cross-section computations
- Re-entry survival predictions for a given object of user-defined components
- The associated risk on ground for at the resulting impact ground swath



Please beware that the installation of MASTER is a necessary pre-condition for the successful operation of the DRAMA suite. MASTER provides the necessary computational and data reference for DRAMA and needs to be installed before DRAMA is installed.

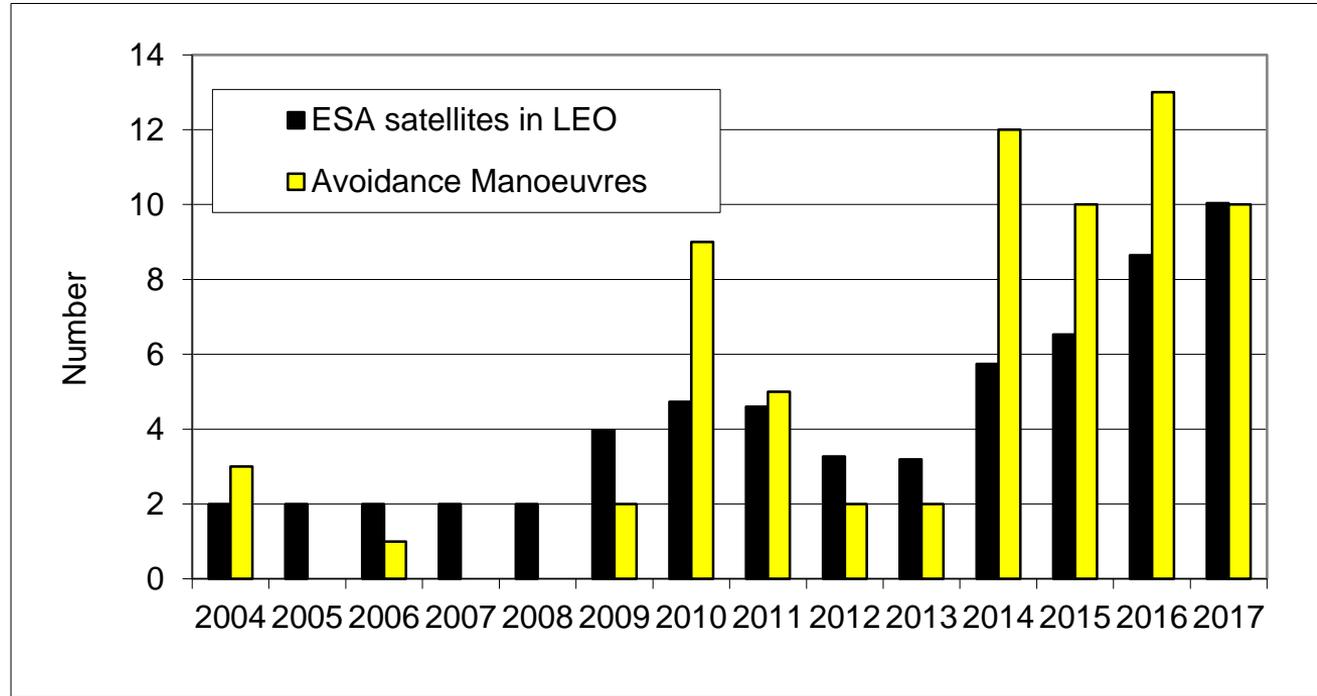
DISCOSWEB

DISCOS (Database and Information System Characterising Objects in Space) serves as a single-source reference for launch information, object registration details, launch vehicle descriptions, spacecraft information (e.g. size, mass, shape, mission objectives, owner), as well as orbital data histories for all trackable, unclassified objects which sum up to more than 40000 objects. Today, DISCOS not only plays an essential role in the various daily activities at the ESA's Space Debris Office, and it is the basis for operational processes in collision avoidance, re-entry analyses, and for contingency support. DISCOS also provides input to numerous and very differently scoped engineering activities, within ESA and throughout academia and industry. DISCOS-based routine activities also comprise the maintenance of a Re-entry Events Database to



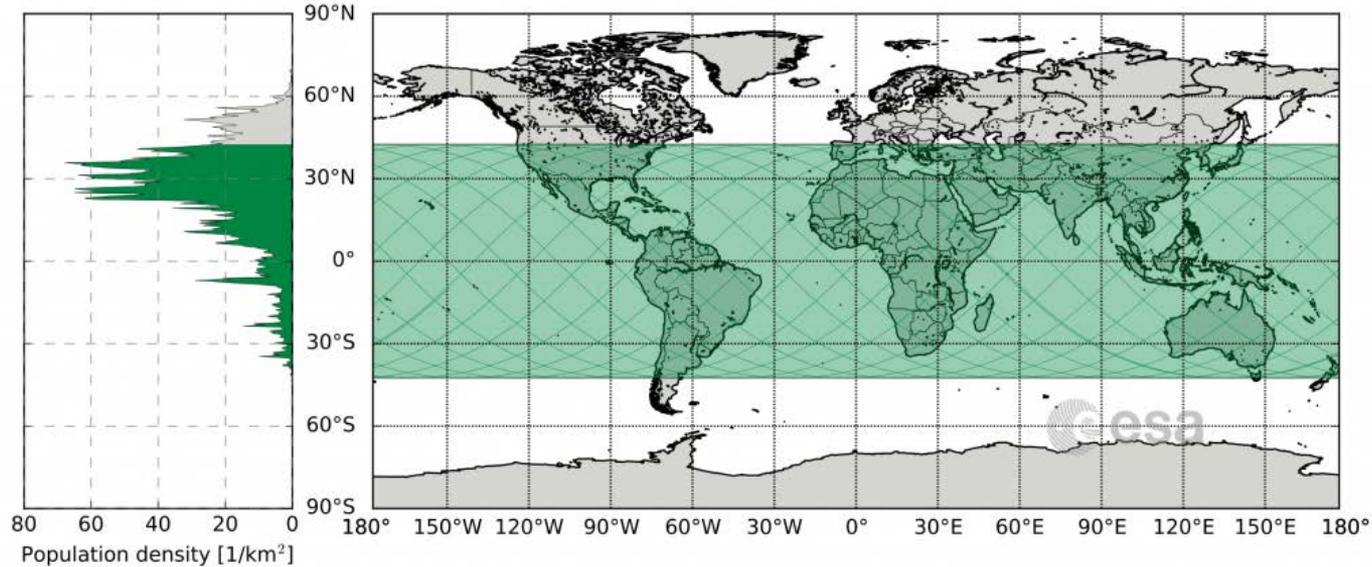
Collision Avoidance in LEO

- 10 maneuverable spacecraft in LEO



Tiangong-1 Re-entry – Re-entry Area

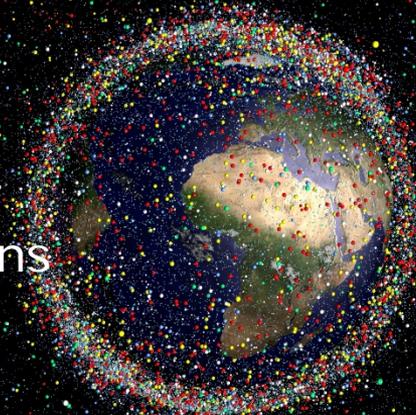
Tiangong-1 Potential Re-entry Area



- Organise and expert workshop on re-entry prediction and atmospheric break-up
 - ESOC, Feb 28th - Mar 1st (<https://reentry.esoc.esa.int>)
- Frequently asked questions:
 - <http://blogs.esa.int/rocketscience/2018/01/16/tiangong-1-frequently-asked-questions-2/>

7th European Conference on Space Debris

440 registrations
350 participants
260 papers
24 Technical Sessions
21 Nations
10 Exhibitors



ESOC, Darmstadt/Germany
18 - 21 April 2017

7th European Conference on Space Debris



http://www.esa.int/spaceinvideos/Sets/Space_debris_playlist



http://www.esa.int/Education/ESA_Academy/Applications_now_open_for_the_Space_Debris_Training_Course

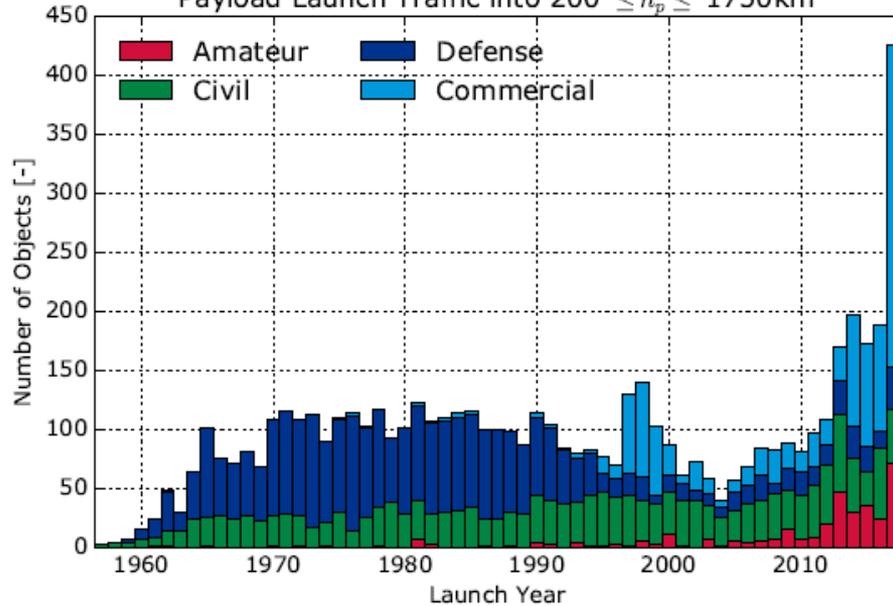
- April 16-20, ESEC, Redu
- Application:
 - Citizens of ESA member states
 - Age 18-32
 - MSc/PhD students of engineering disciplines



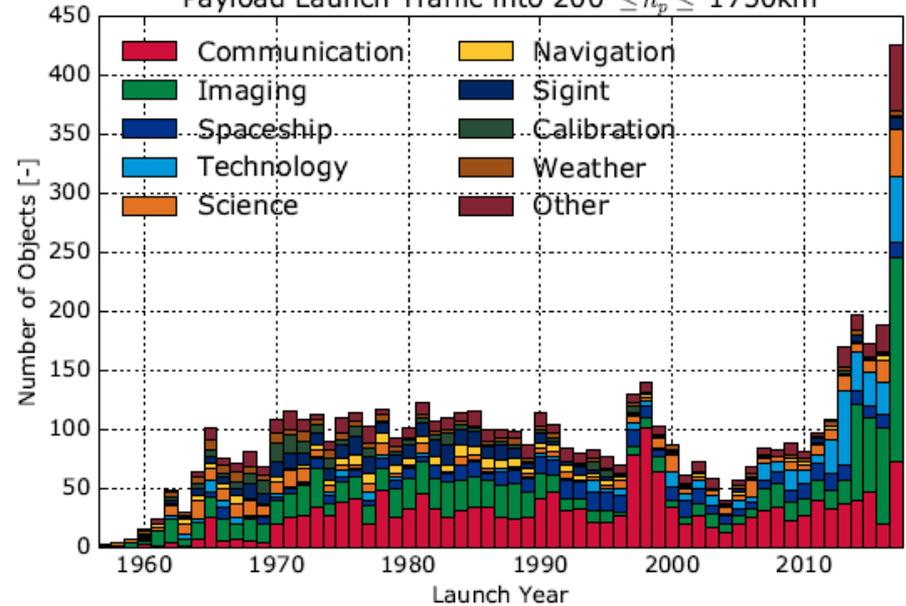
Day 1: The Environment	Introduction Space Debris Environment Legal Environment
Day 2: Mitigation	Mitigations Principles and Guidelines Forces acting on a space object Assessment Methods Mitigation Technology
Day 3: Operations	Space Surveillance Collision Avoidance Operations in the Space Debris Environment Protection and Shielding
Day 4: Re-entry	Aerothermodynamics Atmospheric Break-up On-ground Risks
Day 5: The Future	The Future of the Environment Active Removal

Launches into LEO

Payload Launch Traffic into $200 \leq h_p \leq 1750$ km

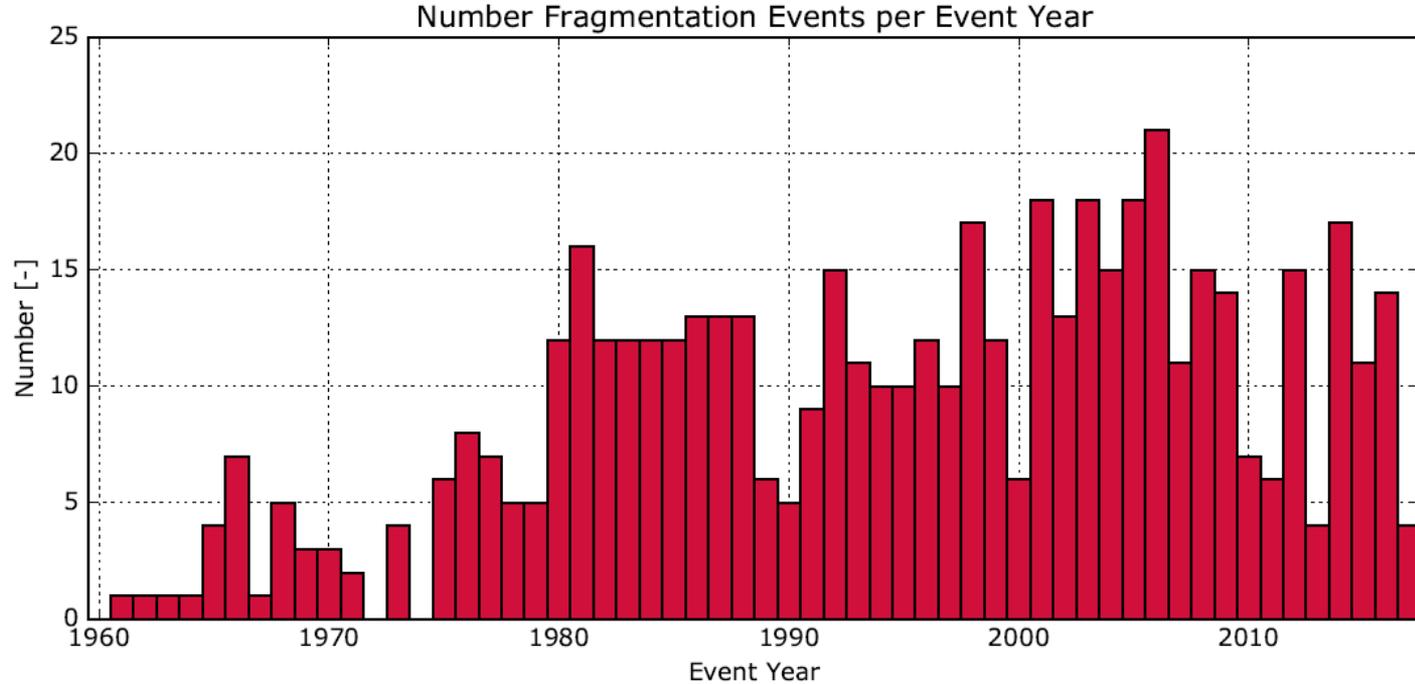


Payload Launch Traffic into $200 \leq h_p \leq 1750$ km

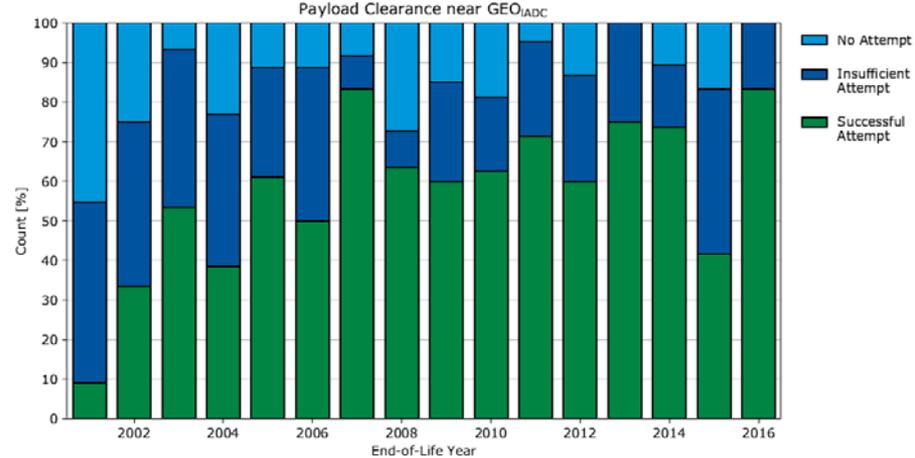
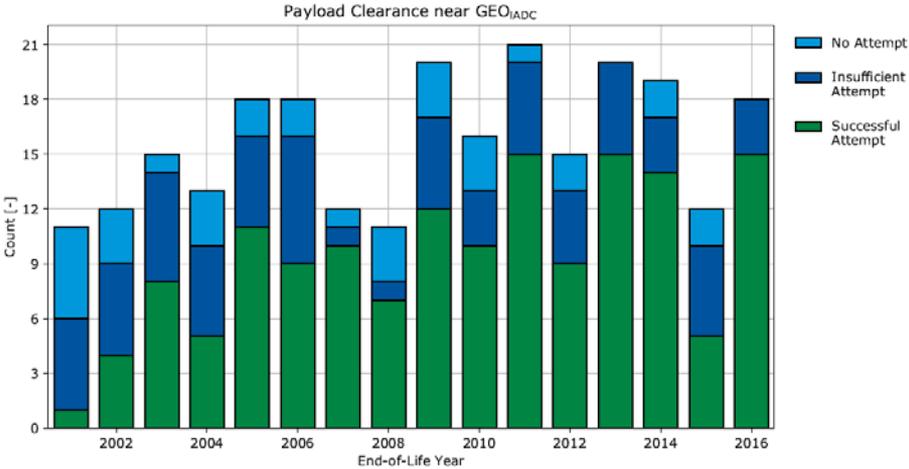


[https://www.sdo.esoc.esa.int/environment_report]

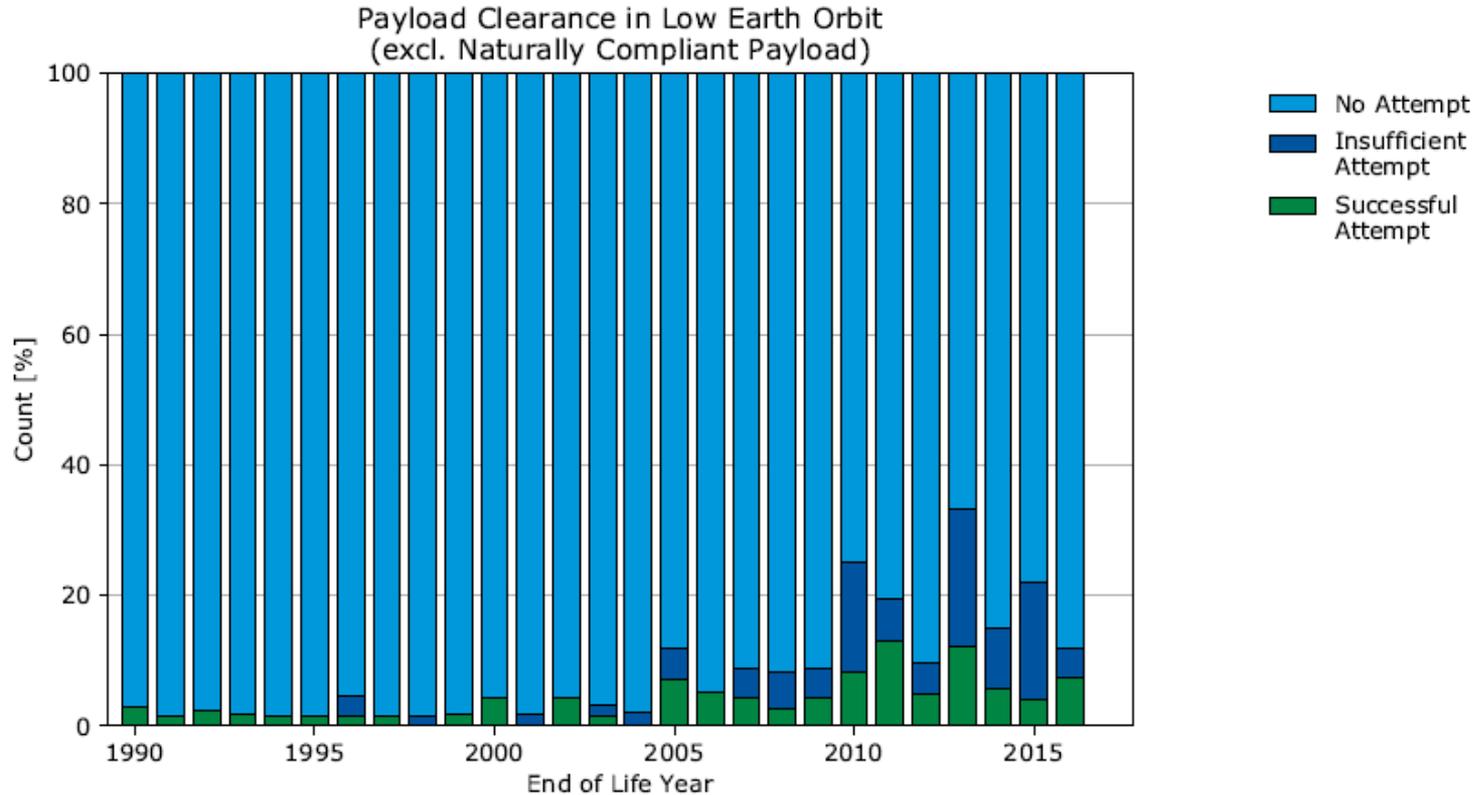
Annual Mitigation Compliance Review – On-Orbit Fragmentations



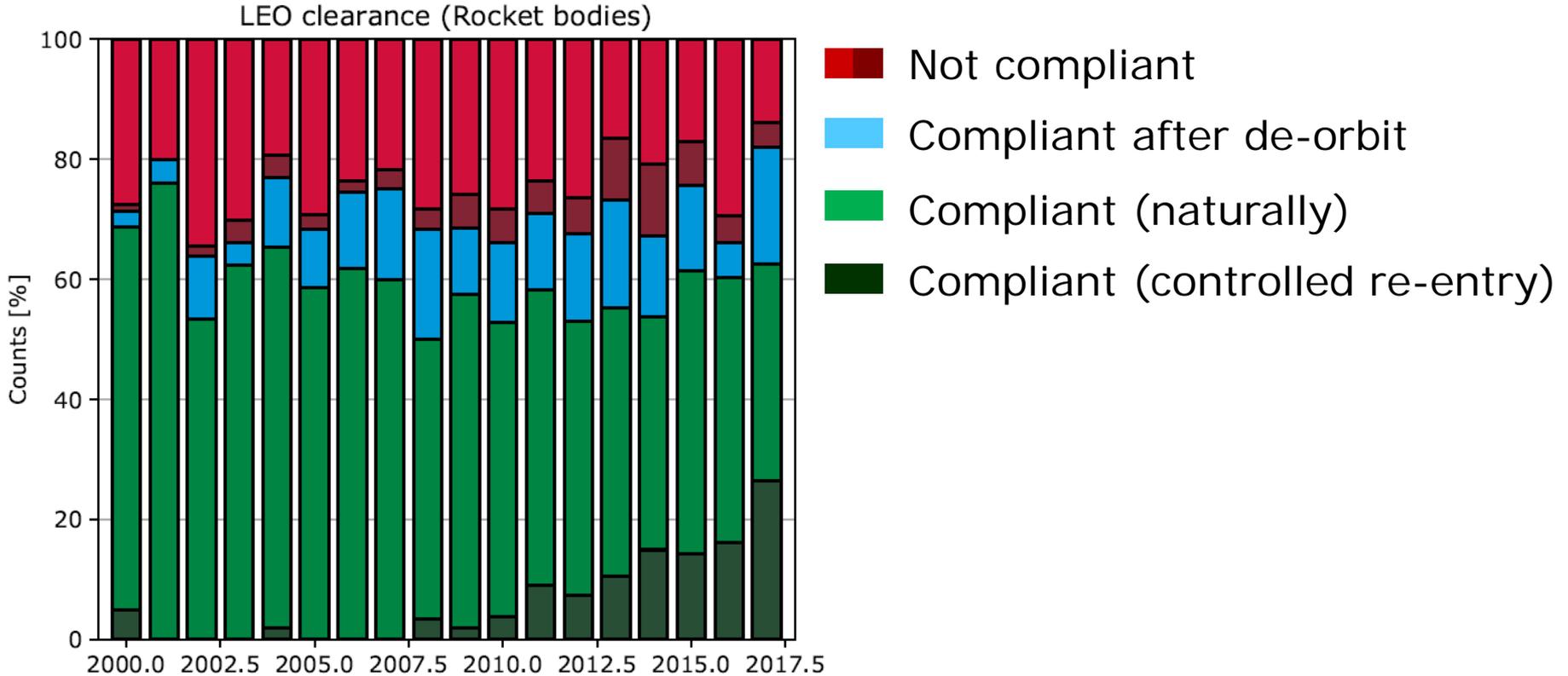
Post Mission Disposal in GEO (thru 2016)



Post Mission Disposal in LEO - Spacecraft



Post Mission Disposal in LEO – Upper-Stages



Summary



- ESA has launched 6 spacecraft in 2017 in compliance to UN guidelines
- ESA follows the re-entry of the Tiangong-1 station
- The 7th European Conference on Space Debris (April 18-21, 2017) saw an all-time high in participation
- ESA has its annual environment report online
- Global performance in mitigating debris still very poor for spacecraft in LEO

