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 7\textsuperscript{th}, 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 13\textsuperscript{th}, 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 12\textsuperscript{th}, 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
ESA Space Debris Tools

**ESA Space Debris User Portal**

The portal addresses the user community of ESA's Space Debris Software. It serves as an 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 impacted 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.

**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 the resulting impact ground swath

Please ensure 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

https://sdup.esoc.esa.int
Collision Avoidance in LEO

- 10 maneuverable spacecraft in LEO
Tiangong-1 Re-entry – 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
ESA Academy – Space Debris Course

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

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Launches into LEO

[https://www.sdo.esoc.esa.int/environment_report]
Annual Mitigation Compliance Review – On-Orbit Fragmentations

Number Fragmentation Events per Event Year

Event Year

Number [-]

Post Mission Disposal in GEO (thru 2016)
Payload Clearance in Low Earth Orbit (excl. Naturally Compliant Payload)
Post Mission Disposal in LEO – Upper-Stages

LEO clearance (Rocket bodies)

Counts [%]

Not compliant
Compliant after de-orbit
Compliant (naturally)
Compliant (controlled re-entry)
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