

# Space Debris Mitigation Activities at ESA in 2018

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# ESA Launches and Mitigation Efforts in 2018 (1/3)



## Sentinel-3B (with EC)

- Launch: April 25<sup>th</sup>, 2018 from Plesetsk (Rokot), 803km x 802km @ 98.6°
- Mission: Oceanography and land-vegetation monitoring
- The Briz-KM upper-stage has been disposed to re-enter within 25 years



## Galileo 23, 24, 25, 26 (with EC)

- Launches: July 25<sup>th</sup>, 2018 Kourou (Ariane 5)
- 23235km x 23212km @57deg
- Ariane 5 EPS stage injected into graveyard orbit below constellation, the 4 satellites raised to their operational altitude



# Debris Mitigation Efforts by ESA in 2018 (2/3)

## Aeolus

- Launch: August 22<sup>nd</sup>, 2018 from CSG/Kourou (Vega)
- 312km x 311km @ 96.7°
- Mission: Atmospheric dynamics monitoring
- The VEGA/AVUM upper-stage performed a controlled re-entry



## BeppiColombo

- Launches: October 20<sup>th</sup>, 2018 Kourou (Ariane 5)
- Interplanetary (Mercury Orbiter)
- Ariane 5 EPS stage on escape trajectory towards heliocentric orbit



# Debris Mitigation Efforts by ESA in 2018 (3/3)

## ESEO

- Launch: December 3<sup>rd</sup>, 2018 Vandenberg (Falcon 9)
- 591km x 571km @97.8 deg
- Drag sail deployment planned
- The Falcon-9 2<sup>nd</sup> stage performed a de-orbit manoeuvre.



HOME

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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.



#### DRAMA

DRAMA (Debris Risk Assessment and Mitigation Analysts) 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:

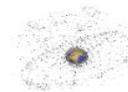
- Debris and meteoroid impact flux levels (at user-defined size regimes)
- Collision avoidance manoeuvre frequencies for a given spacecraft and a project-specific accepted risk level
- Re-orbit and de-orbit fuel requirements for a given initial orbit and disposal scenario
- Geometric cross-section computations
- 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



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



The ESA-ECSL Space Debris Regulation, Standards and Tools Workshop  
19-21st of March 2019, ESA ESOC, Darmstadt, Germany

# ESA's Space Safety Programme

# Dealing with Space Debris Hazards in Space Safety



## Identify



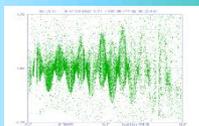
Surveillance radar



Robotic Telescopes



Fly-Eye



Laser Tracking

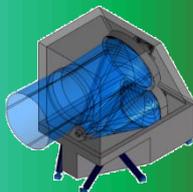
## Analyse



Catalogue correlation technology

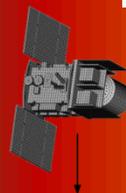


Space Debris Modelling

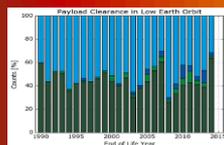


Space-based optical component

## Recognise



On-ground Risk Model



Implementation Control

## Prevent



Automated Collision Avoidance



Cleansat Mitigation Technology

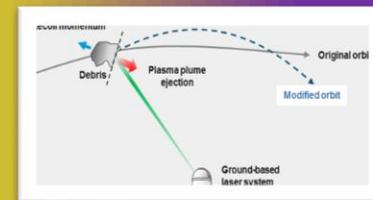


Protection

## Respond



Remediation by active removal



Remediation by ground-based laser

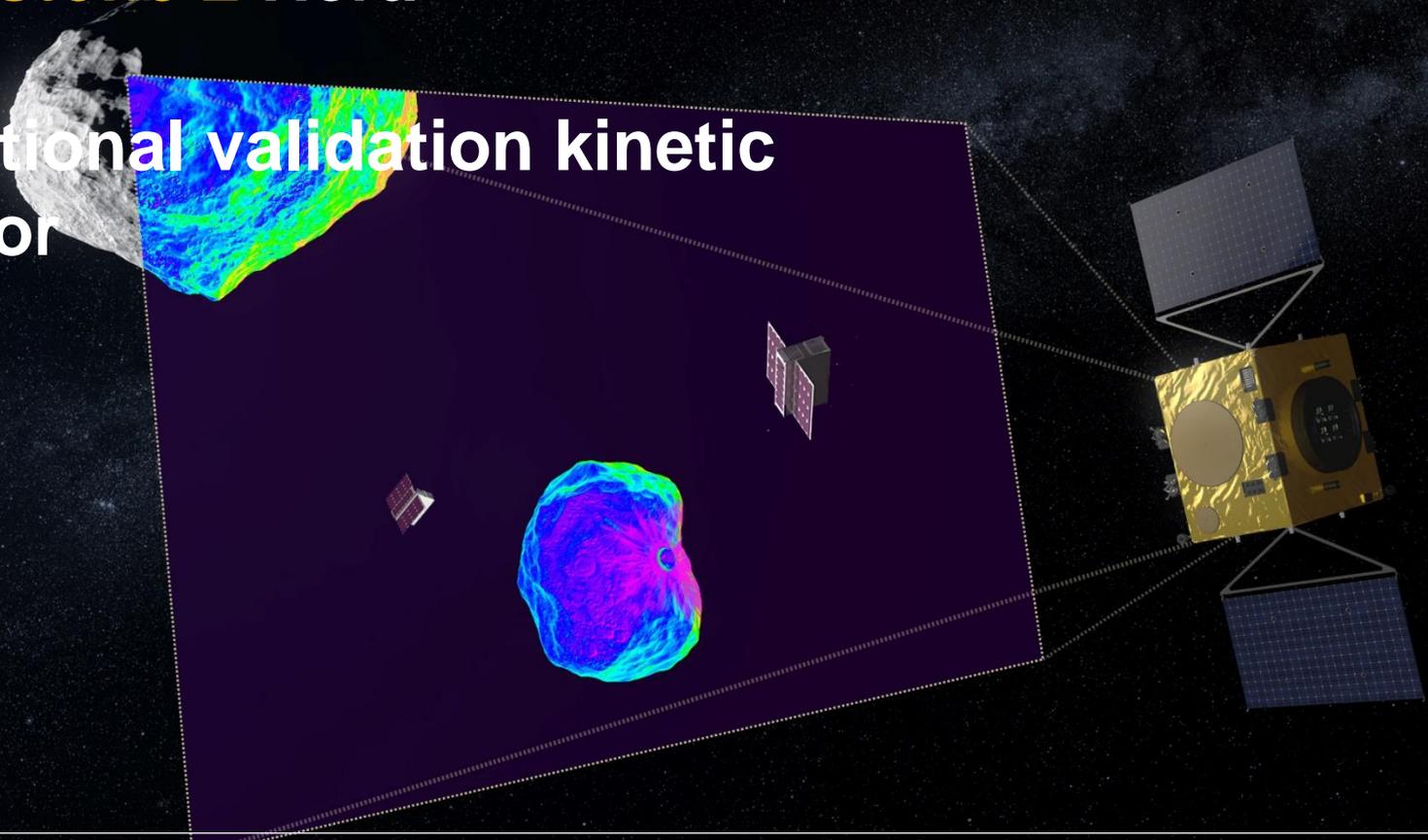


# Cornerstone 1 Lagrange Mission to L5



# Cornerstone 2 Hera

international validation kinetic  
impactor



# Cornerstone 3 Debris Removal

*...for the big*



## Service Offer Request (SoR) for In-Orbit Servicing, Active Debris Removal



# Cornerstone 4 DREAM: Debris Risk Estimation and Automated Mitigation



Encounter Details

MiniCat  
2018-11-04 19:38:20

TCA

**2018-11-04 11:28:21**

<i>Miss distance</i>	<i>Relative Position (RTN):</i>
<b>107 m</b>	<b>69 m, 19 m, -79 m</b>
<i>Probability</i>	
<b>1.158e-7</b>	
<i>Comments</i>	
MAN	

2018-11-04T11:28:21Z

SCARFvis v1.0.0



OBJECT1 Payload

49407 (SATCAT)  
28:22

Sentinel-3B

OBJECT2 Payload Debris

892 (USA)  
28:22

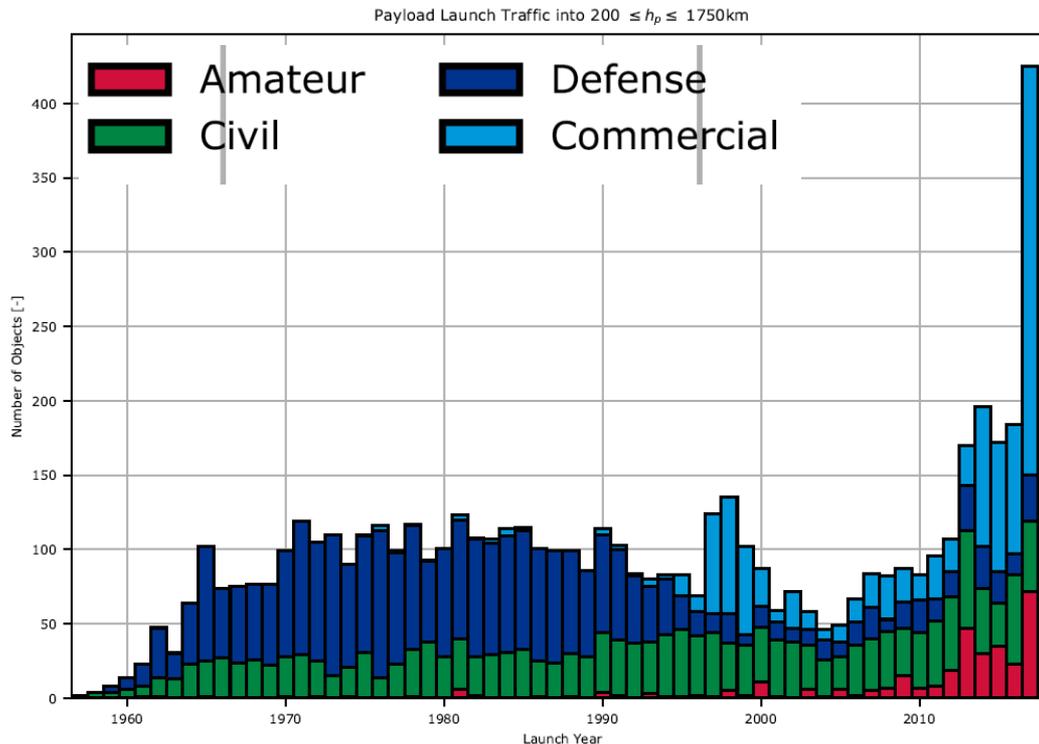
 

European Space Agency  
SJ-15 debris

# Annual ESA Space Debris Environment Report



## Launches into LEO

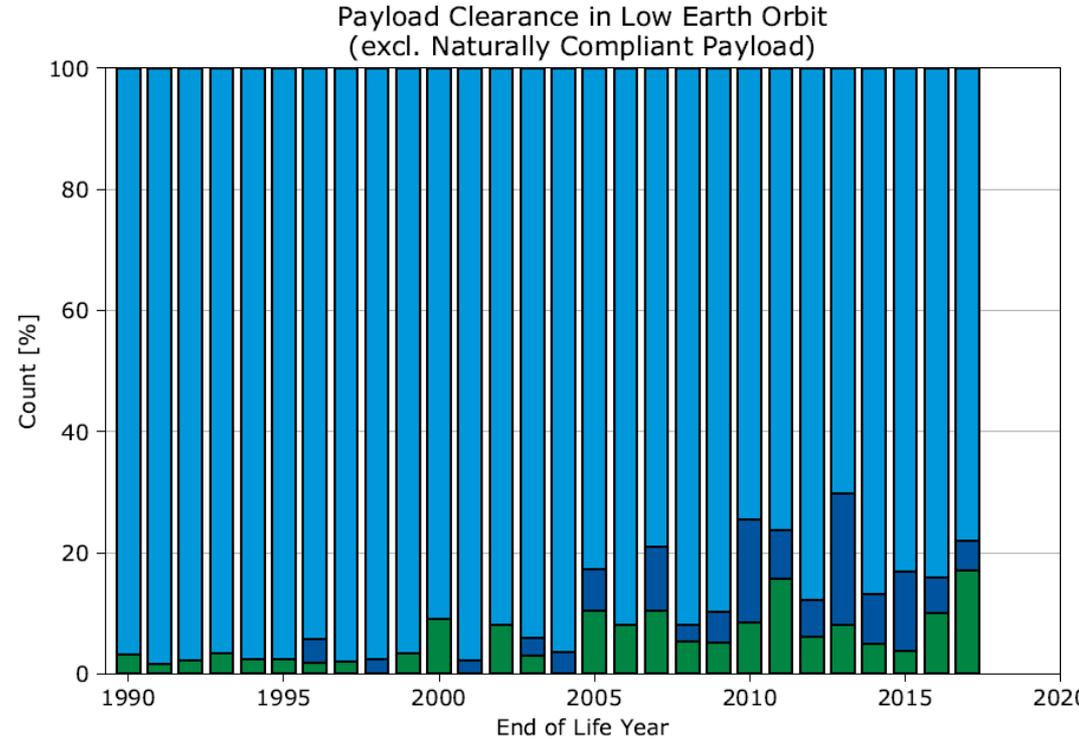
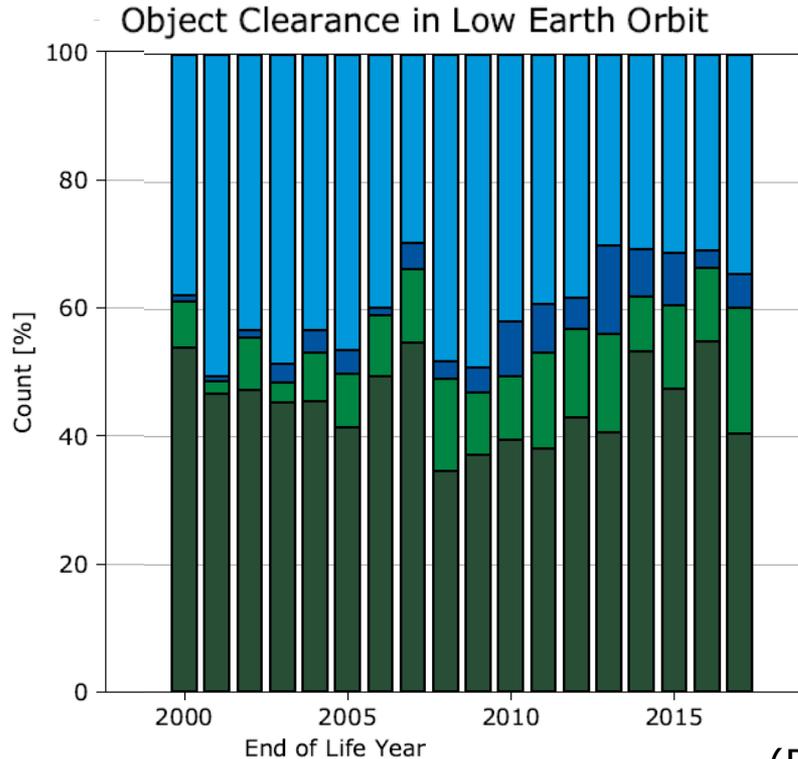


[[https://www.sdo.esoc.esa.int/environment\\_report](https://www.sdo.esoc.esa.int/environment_report)]



# Post Mission Disposal in LEO

- No Attempt
- Insufficient Attempt
- Successful Attempt
- Naturally Compliant



(Preliminary results)

# Summary



- ESA has launched 8 spacecraft in 2018 in compliance to UN guidelines
- ESA and ECSL run a debris regulation, standards and tools workshop (March 18-21, 2018)
- ESA has its annual environment report online
- Global performance in mitigating debris still very poor for spacecraft in LEO

