

ESA activities - since 40th IADC2022 (October)

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Observations

- No ESA-funded **BPEs** in 2022/2023
- **Survey campaigns** with 1-m ESA telescope at the OGS Tenerife (~19 nights in year 2023 by June)
 - Follow-up breakup fragments
 - Maintenance of catalogue of HAMR objects
 - Measurement campaigns supporting the development/qualification of cataloguing tools
- **Laser tracking and TIRA tracking** of (un)cooperative debris
 - Support tumbling motion assessment and VESPA analysis
 - Use of ESA's iOTA tool

Re-entry predictions

- 2022-01 test campaign in October 2022.
- 2023-01 test campaign in April 2023.
- Aeolus semi-controlled re-entry (also test object for IADC) will happen between July and August (more details in following slides).
- Preparing for the re-entry from highly eccentric orbit for Cluster-II FM2 in 9/2024, as template for 4 more events and new mission baseline.
- ESA supports campaigns with detailed follow-up of selected re-entries.

Re-entry break-up

- Design for demise activities have moved from material- to full scale component-testing (e.g. reaction wheels, magnetorquers, etc.) and dedicated developments (tanks, magnetorquers), and mission implementation
- Verification of prediction models (AVUM, thermomechanical testing), development of new models: High fidelity (FD, FEM) and automated multifidly models (TITAN)
- Mission preparation for controlled destructive re-entry break-up experiment (DRACO) to verify models in flight.

Database activities

- **IADC new REDB front-end** successfully used in 2023-1 Reentry test campaigns.
- **External API to DISCOS** available, integration via token system possible
- Collision avoidance support front-end further upgraded
- Front-end for re-entry support upgraded: <https://reentry.esoc.esa.int/>
- Front-end for fragmentation support: <https://fragmentation.esoc.esa.int/>
- Front-end for space debris index calculations: <https://index.sdo.esoc.esa.int/>

Reporting

- **24th** and **25th** **issue** of the Classification of Geosynchronous Objects, covering the years 2021 and 2022, completed. New distribution policy -> Summarised in Environment Report
- **ESA's 2023 Annual Space Environment Report** (7th issue) released
 - Statistics: <https://sdup.esoc.esa.int/> (updated monthly)
 - Report: https://www.sdo.esoc.esa.int/environment_report/Space_Environment_Report_latest.pdf
- **ESA registry of objects** in space, coordinated with DISCOS

- **Maintenance and Development**

- **DRAMA 3.1.0** released April 2022 (Support to ESSB-U-HB-002 **Issue 2** , Major improvements in re-entry safety module)
 - **MASTER 8.0.3** released April 2022 (bug fix)
- Updates for Q4 2023 foreseen.

- **DELTA 4.0.1** Limited licensed release for scientific research, verified for Environment Report 2023
- **DMF** (Debris Mitigation Facility) New Integration of DRAMA/MASTER GUI. Public Beta release Q4 2023.
- **DISCOS 3** updates include new shape models to support applications

- Web-based front-end <https://sdup.esoc.esa.int> with ~6500 active users worldwide (~100daily)
- Active forum for extended user support.

The updated ESA Space Debris Mitigation Policy



The current ESA Space Debris Mitigation Policy is currently in the update process, expected to be ready by the end of 2023.

All stakeholders including industry are consulted to help defining the boundaries of the new SDM policy.

The objective of the new ESA SDM Policy is to promote ESA's world lead role for space sustainability with ESA forward-looking at "inverting debris contribution", maximizing re-mediation actions and successful disposal rate.

The new SDM ESA policy will:

- Outline the path to "ESA Zero Debris by 2030";
- Replace the currently applicable ECSS Space Debris Mitigation standard with a new updated ESA Space Debris Mitigation standard;
- Advancing technology needed to maintain space sustainability;
- Foster the adoption of technologies, services, and procedures beyond the requirements in the relevant ECSS/ISO standards;
- Adhere to the IADC Space Debris Mitigation Guidelines;
- Foster the use of Active Debris Removal services;
- Clarify applicability of the policy including the mission in cooperation with other Agencies and missions using commercial services;
- Extend ESA Policy applicability to Moon and Mars orbits, Sun-Earth Lagrange Points and Human Spaceflight Missions;
- Follow the UNCOPOUS "Guidelines for the Long-term Sustainability of Outer Space – Safety of Space operations".

The new policy will eventually be reviewed in 2026 and updated to enable meeting the 2030 objectives.



HVI Risk Assessment tools

- ESABASE2/Debris version 12.0 available at <https://esabase2.net>
- ESABASE2/Debris new minor release in preparation, including latest ORDEM 3.2 model
- Prototype developed of a fast Collisional Break-up Model that can be based on numerical simulations

Meteoroid model activities

- Focusing of micrometeoroids in X-ray optics
- Characterisation of Micrometeoroid induced Dark Current Increase in Si detectors
- Cometary dust coma model
- Dust model for the Saturnian System

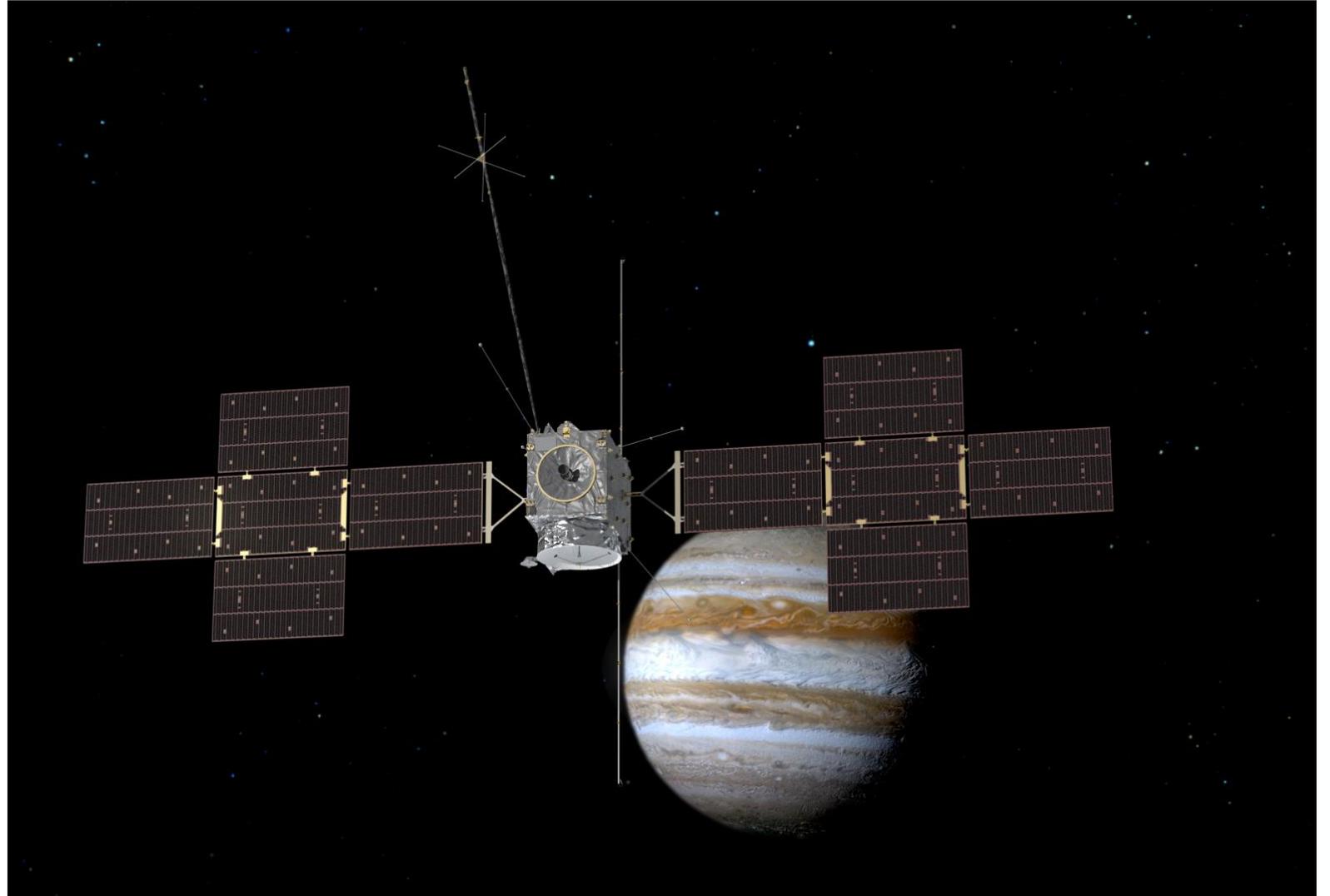
mm-cm size instrument studies

- Large area low resource integrated impact detector
- Coincident Lasersheet Particle Monitor
- Mission feasibility assessment to deploy large sails with visual inspection system

ESA Launches since 40th IADC 2022

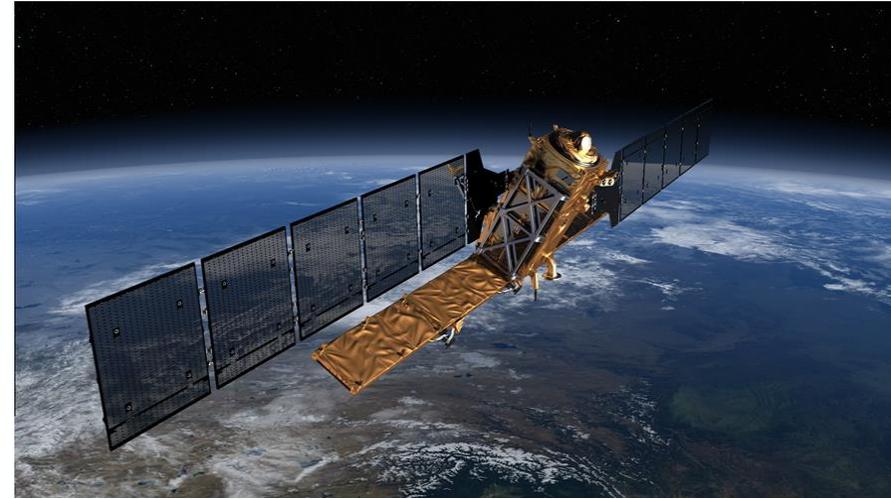
JUICE (Jupiter Icy Moons Explorer)

Ariane 5 launcher VA260 from Europe's Spaceport in French Guiana at 12:14 UTC on 14 April 2023



Sentinel-1B

- One of a two-satellite constellation
- Mission ended for Sentinel-1B in 2022.
- De-orbiting operations are ongoing



Aeolus

- Dedicated Wind monitoring spacecraft
- Mission ends in June 2023.
- Attempting assisted natural re-entry



Debris Mitigation Efforts by ESA

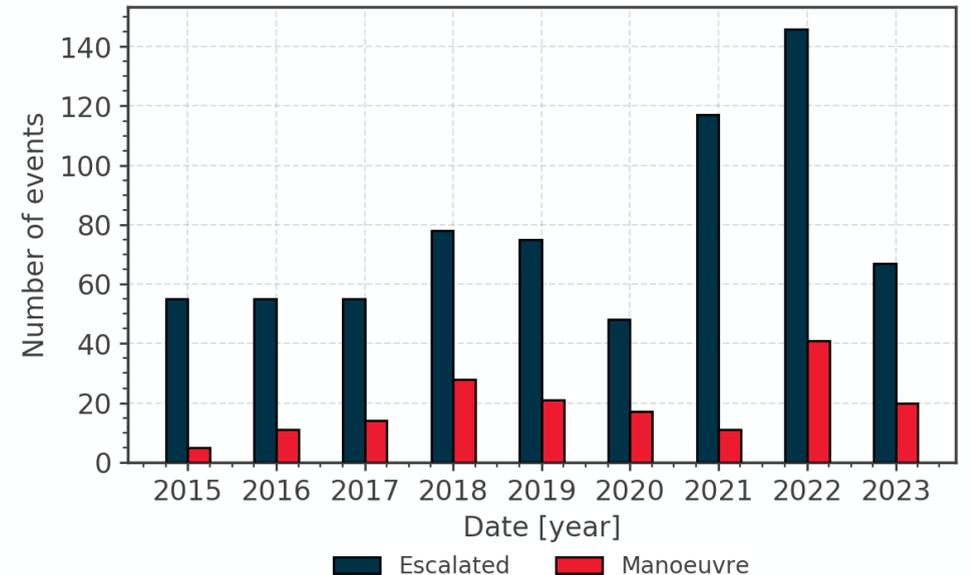
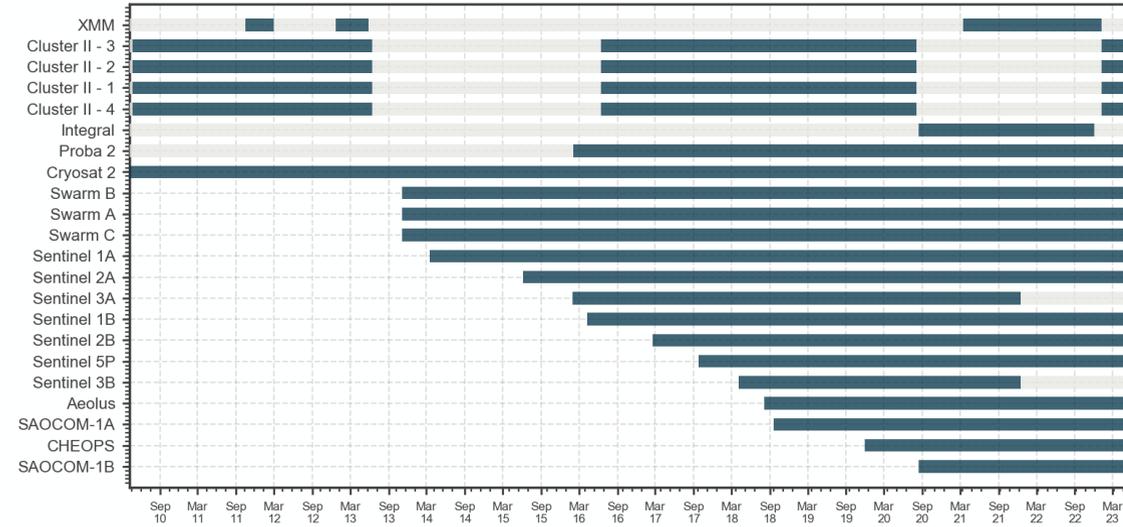


Collision Avoidance:

- ESA team currently monitors conjunctions for a total fleet of 18 spacecraft
- 24 avoidance manoeuvres since last IADC

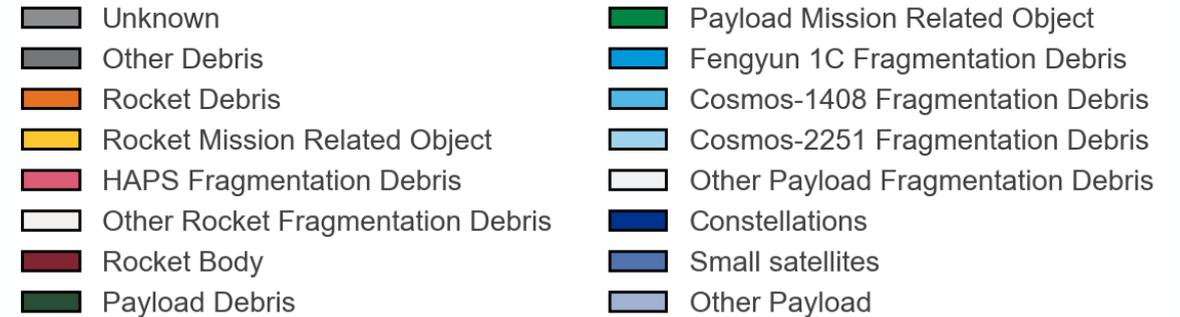
Co-chairing Space Operations Sustainability WG:

- Interagency Operations Advisory Group (IOAG)
- Report published covering Space Debris and Collision avoidance, End of Life activities, Spectrum and Interferences
- Available via www.ioag.org -> Public Documents



Operational reality of close approaches

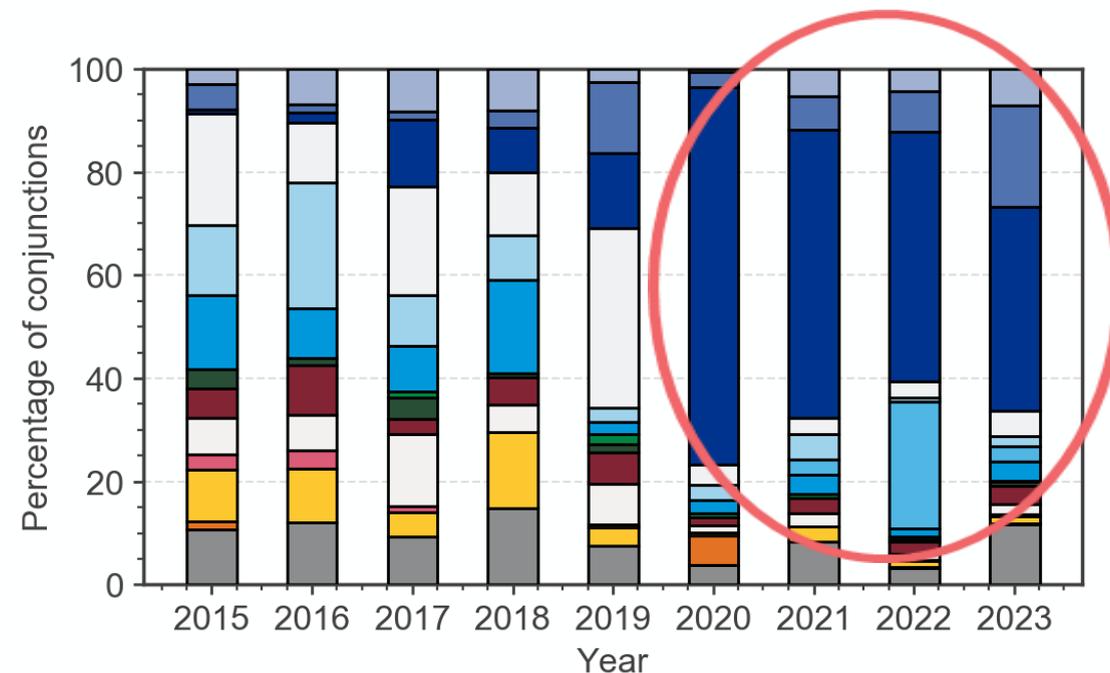
Object class of secondary objects for conjunctions of ESA missions in lower LEO (Aeolus and Swarm)



Drastic increase of conjunctions among operational spacecraft

Experience:

- positive coordination achieved usually
- however clumsy at first occasion
- different timelines
- slow communication
- unclear mano plans / invalid catalogue data
- unknown accuracy of operator provided data



CREAM (Collision Risk Estimation and Automated Mitigation)

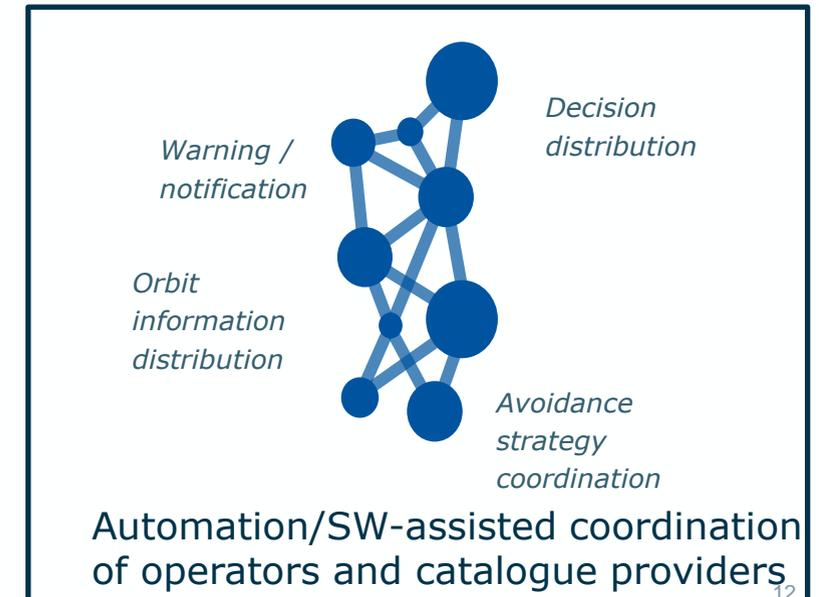
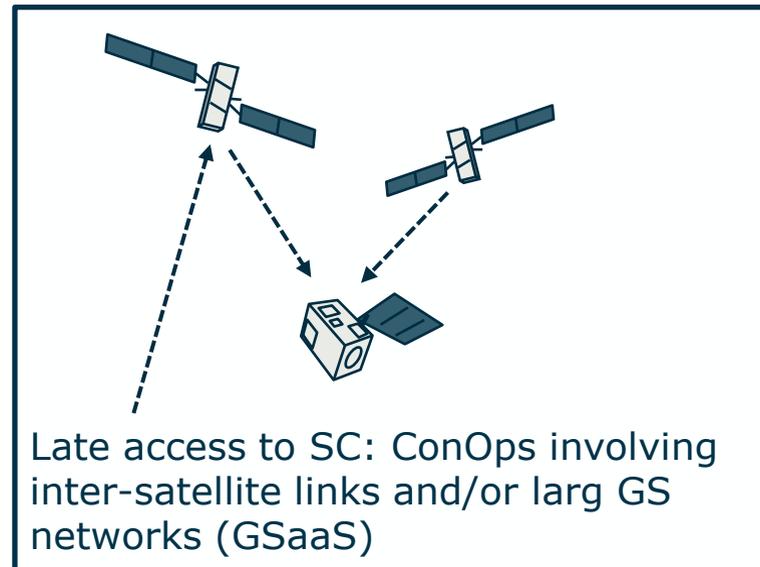
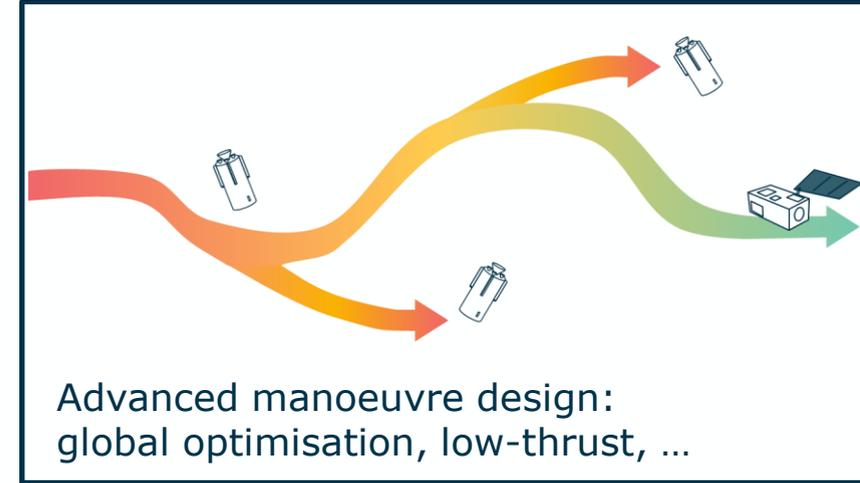
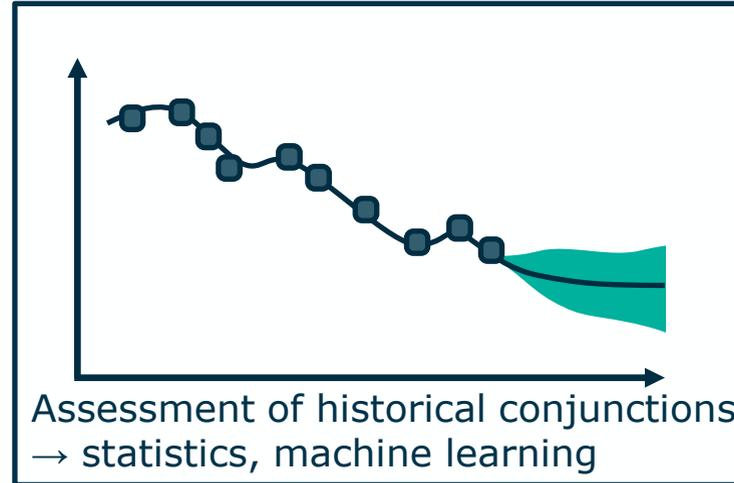
R&D within ESA's Space Safety Prog

Key objective: Reduce human effort for collision avoidance ensuring mission safety.

- **Reduce number of false alerts** (i.e. events triggering preparation of avoidance action involving human work)
- **Involve humans later and shorter**, i.e. shorten time between avoidance manoeuvre decision and time of close approach
- **Increase automation of design and decision** of avoidance manoeuvre

Period 1: Prototype SW + studies

Period 2: Pilot use/demo, maturation



Event
Registration
Travelling to ESOC
Accommodation
Contact
✉ cleanspace@esa.int

The European Space Agency (ESA) is organising the 1st Zero Debris Operations Workshop. The event will take place 27-28 June 2023, in ESOC (Germany).



The [ESA Zero Debris approach](#) embodies the Agency's commitment to lead by example on the long-term sustainability of space. Building upon the work done by the [Space Safety Programme](#), ESA aims to develop and implement by 2030 the most ambitious commitments on space debris mitigation and remediation, and stop the generation of debris in valuable orbits.

The 1st ESA Zero Debris Operations Workshop, in ESOC on the 27th and 28th of June 2023, aims to engage the European space sector to collectively develop the Zero Debris approach and bring Europe to the forefront of space sustainability.

<https://indico.esa.int/event/459/>

European Hypervelocity Impact Risk Assessment Forum (22-23 Nov 2022, <https://indico.esa.int/event/413/>)

- Intended to cover hypervelocity impact testing, impact effects modelling, numerical impact simulations, failure equations modelling, impact risk assessment tools and development, mitigation by design and particle detection / instrumentation
- This 2nd event will focus on Ballistic Limit Equations

2nd ESA NEO and Debris Detection Conference

24-26 January 2023

Take home message (220pax, 24 countries, >100 papers)

“Space Debris and NEO observational means develop rapidly on-ground and in space and aim to address the fast growing challenges to meet requirements of space safety and sustainability. Further extending on collaboration and effective data sharing will be key for success.”

Full proceedings

<https://conference.sdo.esoc.esa.int/>

