

**EPFL**

# eSpace EPFL Space Center Activities 2022







# 2022 IN REVIEW

Writing the Activity Report is always a difficult yet rewarding exercise, as it presents both the challenge and opportunity of sitting down to see what we've done in the last year.

Looking back at 2022, we could not be prouder of all of the achievements made by EPFL's students in the space field: working on sending a payload to space, getting top ranking in competitions, performing space debris observation and organising an analog mission in the Swiss mountains. Each class of graduating students will have had hands-on experience in space projects and when they enter the professional space field will be efficient and able from day one!

At eSpace itself, we have been working on integrating the Space Innovation unit into the EPFL Space Center. We have created the Space Sustainability Rating Association, a unique NGO that will assess the level of sustainability of space missions. The Lunar Initiative was also very successful with the creation of the Hermes

working group and the Dragonfly Project that will be hosted from 2023 at the Advanced Quantum Architecture Laboratory (AQUA) at EPFL. These varied achievements have solidified eSpace's central role as actors in space sustainability and our capacity to support the development of key space technologies.

We are now looking towards 2023 with the restructuring of the EPFL Space Center and hosting the European Aerospace Conference, to which more than 700 participants are expected to attend at the Swiss Tech Convention Center. For us, it also means redefining our identity in a post-Covid world and understanding how this translates into our daily work activities. This is also why, in line with the EPFL respect campaign, we've decided to set well-being as a goal for the whole eSpace team in 2023. Finally, in 2023 we will be celebrating the 20th birthday of the EPFL Space Center!



**Emmanuelle David,**  
Executive Director, eSpace



**Jean-Paul Kneib,**  
Academic Director, EPFL Space Center





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# eSpace

## WHO WE ARE

eSpace is the unit of the EPFL Space Center dedicated to the two core areas of education and research, bringing together students, professors, researchers, engineers, industries, and international space agencies.

In the area of education, eSpace supports EPFL's space-affiliated professors and students, coordinates the Minor in Space Technologies, and provides guidance and support to the EPFL student teams: EPFL Rocket Team, EPFL Spacecraft Team, Asclepios, Xplore, Space Situational Awareness and Space@Your Service. eSpace also contributes to the EPFL New Space Economy MOOC.

In the area of research, eSpace pushes space-related projects by supporting researchers in funding, information and contact with the space community. eSpace boasts a team of experts and benefits from close collaborations with research laboratories and institutes at EPFL. The unit supports a number of space-related research projects with a focus on sustainability, such as the Space Sustainability Rating.

### The 2022 eSpace team

- **Jean-Paul Kneib**, academic director
- **Emmanuelle David**, executive director
- **Nicola Cardines**, engineer and student coordinator
- **Thomas Delacrétaz**, mediamaticien intern
- **Simon Hamel**, engineer and student coordinator
- **Stephan Hellmich**, postdoctoral researcher
- **Belén Yu Irureta-Goyena**, PhD student
- **Pierre-Alain Maüsli**, student projects supervisor
- **John Maxwell**, IT manager
- **Florian Micco**, project manager for the Space Sustainability Rating
- **Candice Norhadian**, administrative specialist and student coordinator
- **Stephanie Parker**, communication manager
- **Elisabeth Rachith**, PhD student
- **David Rodríguez**, research scientist
- **Anne-Marlene Rüede**, PhD student
- **Adrien Saada**, engineer for the Space Sustainability Rating and student coordinator
- **Mathieu Udriot**, engineer and student coordinator

# 2022 GOALS AND OBJECTIVES

In 2022, eSpace's focus was on securing financing to provide high-quality space education for students, supporting interdisciplinary projects, and advancing research and innovation in sustainable space logistics, the Space Sustainability Rating, lunar initiatives, and space-related research and applications within EPFL labs. eSpace put particular focus on maintaining staff and technological know-how at the eSpace, as well as increasing outreach and communication efforts to encourage engagement with the space community.

## General

- Continue to secure financing to serve students: MAKE supervision, engineers to supervise projects, guest lecturers, scholarships for students.

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## Education

### EPFL Minor in Space Technologies

- Ensure the high quality of the education and incorporate a younger generation of educators.
- Provide support to students for the transition from studies to industry.

### EPFL interdisciplinary projects (MAKE fund)

- Ensure the availability of engineers for the supervision of the MAKE projects.
- Ensure the educational value of the MAKE projects and provide quality education for the students.



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## Research & innovation

### Research Initiative for Sustainable Space Logistics

- Renew funding for the 2022–2023 period.
- Broader visibility at the national level and in particular within industry.

### Space Sustainability Rating

- Obtain funding for the 2022–2023 period.
- Launch the operation of the SSR and have the rating as a paying service.
- Broader visibility at the international level and in the sustainability community.

### Lunar initiative

- Renew funding for the 2022–2023 period.
- Broader visibility at the national level and in particular within industry.

### Space-related research and space application within EPFL Labs

- Increase awareness of opportunities in the space sector for the EPFL space professors.
- Support professors in the development of new proposals.

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## eSpace operations

### Staff management

- Maintain technological know-how of eSpace by retaining the staff on a mid-term basis of up to 3–5 years

### Communication and outreach

- Serve eSpace projects in term of communications and increase visibility
- Provide content to the EPFL space professors through social media, organisation of seminars and a newsletter.
- Support and encourage EPFL researchers and students to attend space-related conferences

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The following sections will present the activities performed to fulfil these objectives.



# 1.

## EDUCATION

As the educational hub for EPFL's space-related activities, eSpace is responsible for managing the Minor in Space Technologies, managing the MAKE projects that work on space, and supervising semester and student projects. In its role, eSpace also organises a series of monthly seminars for students to attend where EPFL professors and researchers, along with external experts, present their work on a wide range of topics. And this year, eSpace also participated in the development and management of the new massive open online course (MOOC) on the New Space Economy.

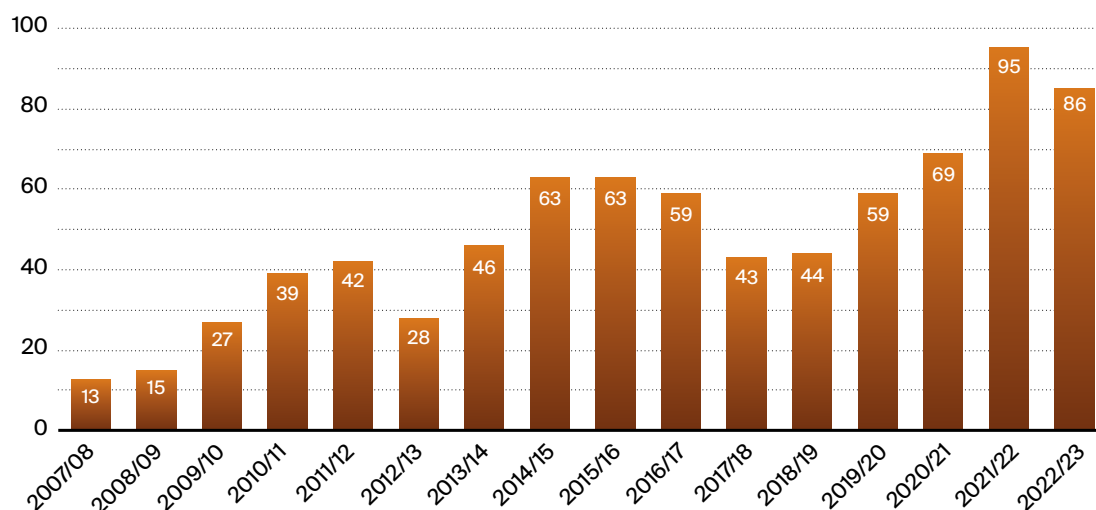
### 1.1 Minor in Space Technologies

Since 2005, EPFL has offered the Minor in Space Technologies to foster and promote the awareness of space technologies and applications among students. It is hosted by the Electrical Engineering and Electronics Section (SEL) but open to the entire EPFL student community and offers over two dozen courses for students to choose from.

The main goals of the minor are to help students increase their knowledge of space-related research; promote space applications, technology and science; and to foster a strong educational platform in the space sector, in parallel to the development of academic and research projects at EPFL.

05

Total students in the minor





## 1.2 Supervision of MAKE projects

### Asclepios



Two Asclepios analog astronauts during an EVA

In 2022, Asclepios successfully carried out its second mission, replicating the life of astronauts on the lunar south pole. Students recreated a crewed mission through different phases such as astronaut selection and training, mission planning and execution. The mission took place in July 2022 in Sasso San Gottardo, Switzerland. The astronauts had the opportunity to perform various experiments around life sciences, space medicine, lunar habitats and soils, and engineering of lunar systems either directly on the base, or through extravehicular activities (EVAs). Some experiments were designed by students while others were designed in collaboration with researchers who could test their projects. Asclepios II led to several publications in research fields that are crucial for future crewed exploration of other celestial bodies.

### EPFL Rocket Team



ERT at EuRoC 2022

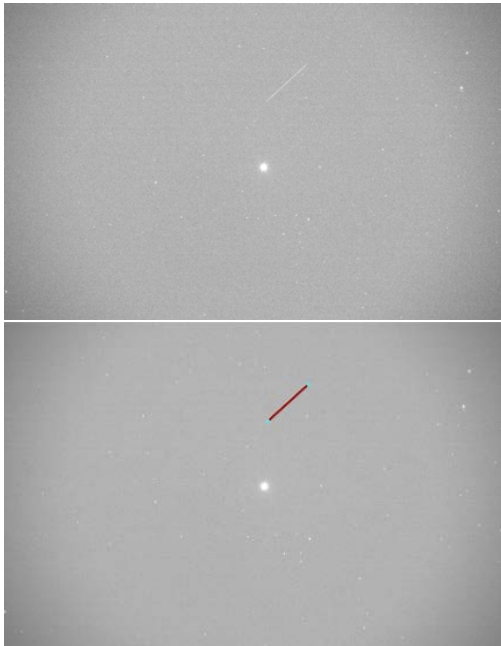
The EPFL Rocket Team with its “Wildhorn” rocket won first place in the 9 km solid commercial off the shelf (COTS) category at EuRoC 2022 by reaching 9500 m altitude and crossing the sound barrier. The student team continued to develop its first bi-liquid engine ( $\text{NO}_2$ /Ethanol) and test-fired it successfully. In parallel, the SpaceRace projects allowed dozens of students to be trained on the fundamentals of rocketry.

### EPFL Spacecraft Team



In 2022, the EPFL Spacecraft Team began work on a major milestone — to launch its onboard computer Bunny into space. In April 2022, the company D-Orbit offered the Spacecraft Team the opportunity to put their onboard computer onto one of their satellites that would be launched in 2023. In order to achieve this goal, the Spacecraft Team worked hard through the summer and fall of 2022, and saw their onboard computer launch on a D-Orbit spacecraft on a Starlink satellite launched in January 2023. This exciting launch experience is part of the Spacecraft Team's larger strategy to participate in a launch every year. They are also continuing their hard work to make their CHES mission to build and launch two CubeSats in 2026 a reality.

## Space Situational Awareness



In Detection of a spacecraft by the SSA Team

In 2022, the Space Situational Awareness (SSA) team used its new optical telescope “Low Earth Orbit Tracker” (LOST) to perform observations of space objects. Using its own images, the team further developed and improved its detection algorithms by training them using large quantities of data. In parallel, the team is supporting the upgrading of Telesto, a 60 cm diameter optical telescope run by the university of Geneva, to make it fit for space debris observations in LEO.

## Xplore



The Xplore team's Astra rover navigating a simulated Mars in Poland

The Xplore team improved on its 2021 results in the European Rover Challenge by coming in second place in 2022. With its newly designed 4-wheel Astra rover, the team managed to successfully perform all the required tasks over the simulated Mars yard located in Kielce, Poland. Xplore Navigation team gained further recognition at this year's competition winning a special prize for best performance at the navigation task. Ever since the competition ended, the team has been working hard on their 2023 rover, which may come with the addition of a few surprises.

### 1.3 Supervision of master's / PhD projects

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**Anne-Marlène Rüede, 2024**

**[PhD] Connecting space logistics and architecture – A pattern language for robust mission design**

This PhD project by Anne-Marlène Rüede is hosted by eSpace and co-supervised by eSpace and Prof. Jeffrey Huang of the Media and Design Laboratory, EPFL Architecture and Computer Sciences. The 4-year project aims to improve decision-making methods for early-phase system architecture design in long-term space missions with repeated material flow. In 2022, Rüede completed an 8-month research visit to MIT's Engineering Systems Laboratory, during which the pattern language and program was developed. In 2023, she is completing a 6-month visit at ESA to develop cases studies around the lunar exploration.

**Elisabeth Rachith, 2025**

**[PhD] Identification and characterisation of space debris from astronomical images**

Elisabeth Rachith's PhD work, supervised by the Laboratory of Astrophysics (LASTRO) in close collaboration with eSpace, focuses on the urgent and growing problem of space debris. She currently develops innovative machine learning techniques for the identification of space debris and satellites on astronomical images taken by the most prominent ground telescopes in the world. The techniques developed will be used to identify and characterise debris to improve our knowledge of the current population as well as to assist in the long-term understanding of its evolution and to support space debris removal missions.

**Belén Yu, 2025**

**[PhD] Identifying moving objects in astronomical surveys using artificial intelligence**

For her PhD work, Belén Yu is developing advanced machine-learning techniques to detect asteroids in astronomical images. For this, she is using images from the VST and ZTF telescopes, and she will soon be moving to the upcoming Euclid space telescope. A comprehensive accounting of all asteroids will improve our ability to forecast the fall of near-Earth asteroids onto Earth, mitigating local and global damage. Additionally, her work will increase the scientific return of the Euclid mission by identifying asteroid tracers of the structure of the Solar System. Belén Yu is part of the Laboratory of Astrophysics (LASTRO), although she works closely with eSpace and the European Space Astronomy Centre.

**Véronica Orlandi, spring 2022**

**[Semester] Asclepios – Scientific project selection (SPEL)**

Asclepios is an association organising student-led space analogue missions which can be performed by students. During the mission, several experiments will be carried out by the astronauts. The SPEL project aims at defining a clear methodology to select the scientific projects that will be carried out during the Asclepios missions.

**SSR Dark and Quiet Skies project**

While the number of both active satellites and space debris is set to grow in the coming years, there is growing concern among the astronomy community regarding the impact of such a densely populated sky on observations. In that context, the development of a dark and quiet skies module for the space sustainability rating was foreseen and was first studied during semester projects and internships in 2022. This project aims at proposing a quantification methodology to assess the impact of satellites on astronomical observations and provide recommendations to satellite operators to mitigate their impact. This module development will continue in 2023.

In 2022, the following three projects were carried out:

**Ambre Ghisalberti**

**[Internship] SSR dark and quiet skies**

In her work, Ghisalberti conducted a preliminary literature review and module preliminary definition, with a larger focus on the optical astronomy part.

**Emma l'Emira Chehab**

**[Semester] SSR dark skies**

This part of the project focused solely on optical astronomy. Chehab conducted detailed module definition and initiation of the quantification model usage from the SSR Detectability methodology.

**Koki Kimura**

**[Semester] SSR quiet skies**

This part of the project focused solely on radio astronomy. Kimura conducted high-level module definition and qualitative questionnaire definition.

**Master's and semester projects conducted within the framework of the Lunar Hub**

**Romeo Tonasso, fall 2022**

**[Master PDM] Feasibility analysis and preliminary design of a lunar reconnaissance drone service station**





XPlore team road tests their space rover. Credit: Murielle Gerber EPFL.

**Vincent Pozsgay, spring 2022**

**[Master PDM] Feasibility analysis and preliminary design of a lunar reconnaissance drone**

**Arion Zimmermann, spring 2022**

**[Semester] Space Localisation**

**Julien Moreau, spring 2022**

**[Semester] Mechanical design of the optical unit and structural subsystem for a lunar camera**

**Robin Bonny, fall 2022**

**[Semester] Dragonfly preliminary OBC design**

**Daniel Tataru, fall 2022**

**[Semester] Control of the lunar reconnaissance drone flight profile in Gazebo**

**Hippolyte Rauch, fall 2022**

**[Semester] Simulation of the lunar reconnaissance drone flight profile in Gazebo**

**Koki Kimura, fall 2022**

**[Semester] Rover locomotion subsystem design for fast extraterrestrial mobility**

## 1.4 Concurrent Engineering Challenge

In April 2022, an interdisciplinary group of EPFL students took part in the annual Concurrent Engineering Challenge. This week-long event organized by the ESA's Education Office and Systems and Concurrent Engineering Section is intended to teach graduate students the principles of concurrent design for space missions and to support the development of new concurrent design facilities throughout Europe.

Guided mainly by eSpace engineer Mathieu Udriot and guest researcher Denis Galagan, the team of students spent an average of ten hours per day at eSpace's redesigned Concurrent Design Facility (CDF). The objective of the challenge was to craft, in less than a week, a new mission aimed at prospecting the poles of the Moon from orbit using bi-static reflectometry. The feasibility of the mission was demonstrated by the end of this week-long study, the outcome of which can be used during subsequent, more exhaustive design phases of the mission. What would have taken weeks, if

not months, to complete using more traditional sequential methods, took just a few days in this setting of constant interaction, improvement, and iteration.

“The week gave me the opportunity to discover in depth the concurrent engineering approach widely used in the space sector,” said another participant, Thomas Manteaux, an EPFL master’s student in microengineering. “It was not an easy challenge, but it was certainly very interesting!”

This challenge has been expanded into an EPFL course offered in spring 2023 (section 1.6).

## 1.5 MOOC: New Space Economy

In 2022, eSpace, Space4Impact, E2MC and Space Innovation joined forces to launch an online massive open online course (MOOC) on New Space Economy. The course contains more than 30 videos from space experts from various space domains, including professors, scientists, representatives of public institutions and international organisations, entrepreneurs, and investors.

The course is aimed towards a broad audience of entrepreneurs, students, or someone switching careers to the space sector to learn about current and future space infrastructures that enable various applications, such as telecommunication, broadcasting, geolocation, Earth

observation and space manufacturing. They also learn about how space data can enable new products and services, and about how space can make Earth more sustainable and how to keep space sustainable in return.

The MOOC consists of:

- 7-week online course
- 30+ speakers and videos
- 100+ quiz questions

## 1.6 Education plans for 2023

In 2023, eSpace plans to continue its work on growing the Minor in Space Technologies, continuing work on the New Space Economy MOOC, and will continue its supervision and support of EPFL’s space-related student teams.

As a continuation of eSpace’s 2022 work on concurrent engineering, a new course will begin in the spring semester of 2023: “Concurrent engineering of space missions” as part of the EPFL Minor in Space Technologies. The main objective of this course is to teach the students the fundamentals of concurrent engineering for space missions and systems. The course is built around a similar framework to that of the European Space Agency’s (ESA) Concurrent Engineering Challenge. Students will design a space mission together with their team in an intensive, hands-on 2-week-long workshop, using the tools and processes of concurrent engineering.



eSpace CDF during the CEC 2022.



# 2.

## RESEARCH

eSpace is responsible for coordinating space-related research projects and supporting the Space Profs at EPFL. In this role, eSpace manages a number of research projects on space sustainability, lunar mapping and concurrent engineering with the participation of EPFL researchers. In addition, eSpace takes the initiative to connect EPFL's Space Profs with the wider Swiss and international space community by attending and organizing events, presenting at conferences, and finding and promoting funding opportunities.

### 2.1 Research projects



#### DAWN

The DAWN project for Development of Space Logistics Generic Process with ESA Future Launcher Preparatory Programme (FLPP) ended in 2022 after an extension. The Technology Combination and Analysis Tool (TCAT), the development of which began in 2019, extended its scope to include two mission scenarios: active debris removal of failed satellites, and constellation deployment. Based on active spacecraft designs, the tool optimises the fuel consumption with manoeuvres that are more or less efficient depending on a trade-off between the mission duration and its cost. (See section 3.2 for more information)

#### Green Space Logistics

Green Space Logistics (GSL) began in March 2022 with an ESA Future Launcher Preparatory Program contract. eSpace is the prime contractor to lead the development of a software that will be used by ESA to perform life cycle assessments of space transportation

vehicles. The outputs of the Assessment and Comparison Tool (ACT) software will be used for decision-making in important design trade-offs, including environmental impacts along with performance and cost metrics to allow engineers to select designs that reduce space debris risks and environmental footprint. (See section 3.2 for more information).

#### Concurrent Engineering

Based on lessons learnt from the Concurrent Engineering Challenge organised with the help of ESA, eSpace is setting up its own Concurrent Design Facility (CDF) with a focus on sustainable space. The medium-term goal is to integrate the tools being developed at eSpace (see section 1.4) into the design process of concurrent studies, and offer the CDF infrastructure and expertise as a service to partners and industries.

#### ADRIOS

In 2022, eSpace finalised one Innosuisse project involving two EPFL labs – Rehassit and LSMS – as well as the ADRIOS project with Clearspace.

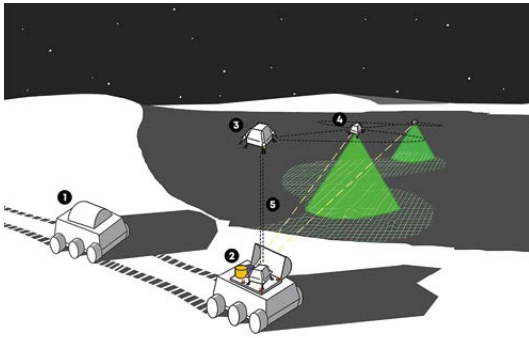
#### Lunar Initiative

##### **Lunar Reconnaissance Drone**

2022 marked the end of a 1.5-year preliminary study on the potential deployment of an autonomous, lightweight, compact, and reusable reconnaissance drone for the exploration, characterization and high-resolution mapping of particularly challenging and pristine locations on the lunar surface. Through the work of two master's projects and four semester projects, the lunar drone has been designed to assist other on-ground robotic assets operating on the surface into inaccessible environments (e.g., lunar skylights) and across unstructured and dynamic terrains (e.g., extreme topography locations and PSRs). The final results of this



preliminary study will be presented at the 2023 Space Resources Week in Luxembourg.



### Dragonfly

As part of an ongoing collaboration with EPFL's Advanced Quantum Architecture Lab (AQUA) and thanks to the financial support of Armassuisse Science and Technology (S+T), eSpace is developing a breadboard model of a camera that combines, for the first time, a 1-megapixel single-photon avalanche diode (SPAD) sensor with a novel energy-efficient, AI-on-chip algorithm capable of achieving high-dynamic range, ultra-fast imaging, and real-time, on-board image recognition and processing. This project will help us bring the technology from a TRL3 (proof-of-concept in lab) to a TRL5 (breadboard model in representative environment) in preparation for a potential in-orbit demonstration mission and a lunar mission planned for late-2024.

### HERMES working group

HERMES is an international working group founded in 2022 as a platform for exchanging ideas and fostering collaborations between researchers, scientists, and professionals interested in the subject of heterogeneous multi-robot cooperation for exploration and science in extreme environments (HERMES). Currently formed by fifteen members from eight different institutions, the working group will host its first international workshop at the 2023 IEEE International Conference on Robotics and Automation (ICRA).

## 2.2

### EPFL space community and labs

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The role of eSpace is to push space-related research by supporting interdisciplinary projects, often involving at least one of EPFL's labs involved in space research. eSpace helps organize and participates in space-related events on campus, such as EPFL Space Day and Week, Italy and Switzerland in Space, and Cosmos Archaeology. eSpace also participates in many external events as a representative for professors working on space-related research. In 2022, eSpace also provided also information regarding the ESA ministerial conference.

For more on events, see section 4.1.



## EPFL space-associated labs

AQUA	Advanced Quantum Architecture Laboratory	<a href="http://aqua.epfl.ch">aqua.epfl.ch</a>
LASPE	Advanced Semiconductors for Photonics and Electronics Lab	<a href="http://laspe.epfl.ch">laspe.epfl.ch</a>
LASTRO	Astrophysics Laboratory	<a href="http://lastro.epfl.ch">lastro.epfl.ch</a>
BIOROB	Biorobotics Laboratory	<a href="http://biorob.epfl.ch">biorob.epfl.ch</a>
CCLAB	Composite Construction Laboratory	<a href="http://cclab.epfl.ch">cclab.epfl.ch</a>
MCSS	Computational Mathematics and Simulation Science	<a href="http://mcss.epfl.ch">mcss.epfl.ch</a>
LSMS	Computational Solid Mechanics Laboratory	<a href="http://lsms.epfl.ch">lsms.epfl.ch</a>
CVLAB	Computer Vision Lab	<a href="http://cvlab.epfl.ch">cvlab.epfl.ch</a>
CHILI	Computer-Human Interaction Lab for Learning and Instruction	<a href="http://chili.epfl.ch">chili.epfl.ch</a>
EPSL	Earth and Planetary Science Laboratory	<a href="http://epsl.epfl.ch">epsl.epfl.ch</a>
EMC	Electromagnetic Compatibility Laboratory	<a href="http://emc.epfl.ch">emc.epfl.ch</a>
ESL	Embedded Systems Laboratory	<a href="http://esl.epfl.ch">esl.epfl.ch</a>
ECEO	Environmental Computational Science and Earth Observation Lab	<a href="http://eceo.epfl.ch">eceo.epfl.ch</a>
EERL	Extreme Environments Research Laboratory	<a href="http://eerl.epfl.ch">eerl.epfl.ch</a>
FLEXLAB	Flexible Structures Laboratory	<a href="http://flexlab.epfl.ch">flexlab.epfl.ch</a>
TOPO	Geodetic Engineering Laboratory	<a href="http://topo.epfl.ch">topo.epfl.ch</a>
ICT4SMG	ICT for Sustainable Manufacturing Group	<a href="http://ict4sm.epfl.ch">ict4sm.epfl.ch</a>
IIG	Immersive Interaction Research Group	<a href="http://iig.epfl.ch">iig.epfl.ch</a>
LSI	Integrated Systems Lab	<a href="http://lsi.epfl.ch">lsi.epfl.ch</a>
LAMD	Laboratory for Applied Mechanical Design	<a href="http://lamd.epfl.ch">lamd.epfl.ch</a>
LARA	Laboratory for Automated Reasoning and Analysis	<a href="http://lara.epfl.ch">lara.epfl.ch</a>
LPAC	Laboratory for Processing of Advanced Composite	<a href="http://lpac.epfl.ch">lpac.epfl.ch</a>
LIS	Laboratory of Intelligent Systems	<a href="http://lis.epfl.ch">lis.epfl.ch</a>
LMM	Laboratory of Mechanical Metallurgy	<a href="http://lmm.epfl.ch">lmm.epfl.ch</a>
LPI	Laboratory of Photonics and Interfaces	<a href="http://lpi.epfl.ch">lpi.epfl.ch</a>
K-Lab	Laboratory of Photonics and Quantum Measurements	<a href="http://k-lab.epfl.ch">k-lab.epfl.ch</a>
LRESE	Laboratory of Renewable Energy Science and Engineering	<a href="http://lrese.epfl.ch">lrese.epfl.ch</a>
LMTM	Laboratory of Thermomechanical Metallurgy	<a href="http://lmtm.epfl.ch">lmtm.epfl.ch</a>
MAG	Microwaves and Antennas Group	<a href="http://mag.epfl.ch">mag.epfl.ch</a>
LCM	Mobile Communications Laboratory	<a href="http://lcm.epfl.ch">lcm.epfl.ch</a>
MMSPG	Multimedia Signal Processing Group	<a href="http://mmspg.epfl.ch">mmspg.epfl.ch</a>
NAM	Nanophotonics & Metrology Laboratory	<a href="http://nam.epfl.ch">nam.epfl.ch</a>
PHOSL	Photonic Systems Laboratory	<a href="http://phosl.epfl.ch">phosl.epfl.ch</a>
PVLAB	Photovoltaics and Thin Film Electronics Laboratory	<a href="http://pvlab.epfl.ch">pvlab.epfl.ch</a>
APHYS	Physics of Aquatic Systems Laboratory	<a href="http://aphys.epfl.ch">aphys.epfl.ch</a>
POWERLAB	Power and Wide-Band Gap Electronics Research Lab	<a href="http://powerlab.epfl.ch">powerlab.epfl.ch</a>
PEL	Power Electronics Laboratory	<a href="http://pel.epfl.ch">pel.epfl.ch</a>
RFIC	Radio Frequency Integrated Circuits Laboratory	<a href="http://rfic.epfl.ch">rfic.epfl.ch</a>
RGL	Realistic Graphics Lab	<a href="http://rgl.epfl.ch">rgl.epfl.ch</a>
RRL	Reconfigurable Robotics Laboratory	<a href="http://rrl.epfl.ch">rrl.epfl.ch</a>
SPC	Swiss Plasma Center	<a href="http://spc.epfl.ch">spc.epfl.ch</a>
TCL	Telecommunications Laboratory	<a href="http://tcl.epfl.ch">tcl.epfl.ch</a>
TIC	Tribology and Interfacial Chemistry	<a href="http://tic.epfl.ch">tic.epfl.ch</a>
VITA	Visual Intelligence for Transportation	<a href="http://vita.epfl.ch">vita.epfl.ch</a>

## 2.3 Papers and posters

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[Master's thesis] V. Pozsgay. "Feasibility analysis and preliminary design of a lunar reconnaissance drone."

[Master's thesis] M. Udriot. "Implementation of a Space Sustainability Rating – Technical officer."

[Semester project] V. Dor. "Preliminary design of a radio antenna payload for a lunar far-side polar mission."

[Semester project] J. Moreau. "Mechanical design of the optical unit and structural subsystem for a lunar camera."

[Semester project] T. Pfeiffer & E. Uythoven. "Preliminary design of a lunar reconnaissance drone."

[Semester project] C. Vincent. "Lunar payload design: Definition of a lunar camera payload system architecture."

[Semester project] A. Zimmerman. "Space localisation."

[Conference paper] B. Y. I.-G. Chang, E. Rachith & J.-P. Kneib, "Identifying near-Earth objects on VST images using a convolutional neural network," at the *3rd IAA Conference on Space Situational Awareness (ICSSA)*.

[Conference paper] B. Y. I.-G. Chang, E. Rachith & J.-P. Kneib, "Identifying near-Earth objects on wide-field astronomical surveys using a convolutional neural network," at the *Advanced Maui Optical and Space Surveillance Technologies Conference (AMOS)*.

[Conference paper] E. Rachith, B. Y. I.-G. Chang & J.-P. Kneib. "Detection methods for a statistical analysis of the population of satellites and space debris from astronomical images," at the *Advanced Maui Optical and Space Surveillance Technologies Conference (AMOS)*.

[Conference paper] A. Saada, E. David, F. Micco, J.-P. Kneib, M. Udriot et al. "The Space Sustainability Rating: An operational process incentivizing operators to implement sustainable design and operation practices," at the *73rd International Astronautical Congress (IAC)*, Paris, France.

[Conference paper] A. Saada, E. David, F. Micco, J.-P. Kneib, M. Udriot et al, "The Space Sustainability Rating: An operational process incentivizing operators to implement sustainable design and operation practices," at the *73rd International Astronautical Congress (IAC)*, Paris, France.

[Conference paper] M. Udriot, E. David, J.-P. Kneib & A. Saada. "Development of a launch vehicle sustainability rating," at the *73rd International Astronautical Congress (IAC)*, Paris, France.

[Conference paper] M. Udriot, A.-M. Rüede, E. David & J.-P. Kneib. "Research initiative sustainable space logistics: an overview on the work performed at EPFL from 2019 to 2021 in space logistics modelling and optimisation," at the *9th European Conference for Aeronautics and Space Sciences (EUCASS)*.

[Conference abstract] V. Pozsgay, D. Rodríguez-Martínez & J.-P. Kneib. "A lunar reconnaissance drone mission concept for mapping and characterizing polar regions," in *Lunar Polar Volatiles Conference*.

[Poster] B. Y. I.-G. Chang. "Identifying Near-Earth Objects on Wide-Field Astronomical Surveys Using a Convolutional Neural Network," at the *Advanced Maui Optical and Space Surveillance Technologies Conference (AMOS)*.

[Poster] T. Pfeiffer, E. Uythoven, D. Rodríguez-Martínez, J.-P. Kneib & H. Koizumi. "Feasibility study and preliminary design of a lunar reconnaissance drone," at *LSIC Spring Meeting*.

[Poster] E. Rachith. "Detection Methods for the Statistical Analysis of the Population of Satellites and Space Debris from Astronomical Images," at the *Advanced Maui Optical and Space Surveillance Technologies Conference (AMOS)*.



## 2.4 Research plans for 2023



In 2023, eSpace will focus its research projects and initiatives around its three newly-formed hubs: Space technology and innovation, Space science and engineering, and Sustainable space and diplomacy. Sustainable space will be of particular focus, with the Space Sustainability Rating being spun off into its own non-profit association and the start of a new project in March 2023 entitled “Space sustainability: Policy options and interrelations with Earth system governance”, led by Dr Xiao-Shan Yap.

eSpace will also manage projects and perform system engineering for space science projects, support the development of key technologies, and collaborate with the Swiss Consortium for the Square Kilometre Array (SKACH). Regarding innovation, eSpace will strengthen ties and competencies with the Space Innovation unit, helping transfer knowledge to industry, and will support the development of the ESA Space Deep Tech Innovation Center.



# 3.

## SUSTAINABILITY

Sustainability has become a topic of increasing importance in nearly every area of research and industry, including for outer space. Currently, more than one million objects larger than 1 cm are orbiting Earth. Among them, less than 1% are active satellites, leaving an overwhelming majority of inactive objects crowding the orbital environment.

The fast-developing space industry has led to the emergence of a growing number of actors and plans for large constellations, while in parallel it has been challenging to develop and enforce best practices, guidelines, and norms in a complex regulatory landscape. Without a change towards using space in a more responsible manner, it has been shown that space will become an unstable environment where collision rates will increase exponentially.

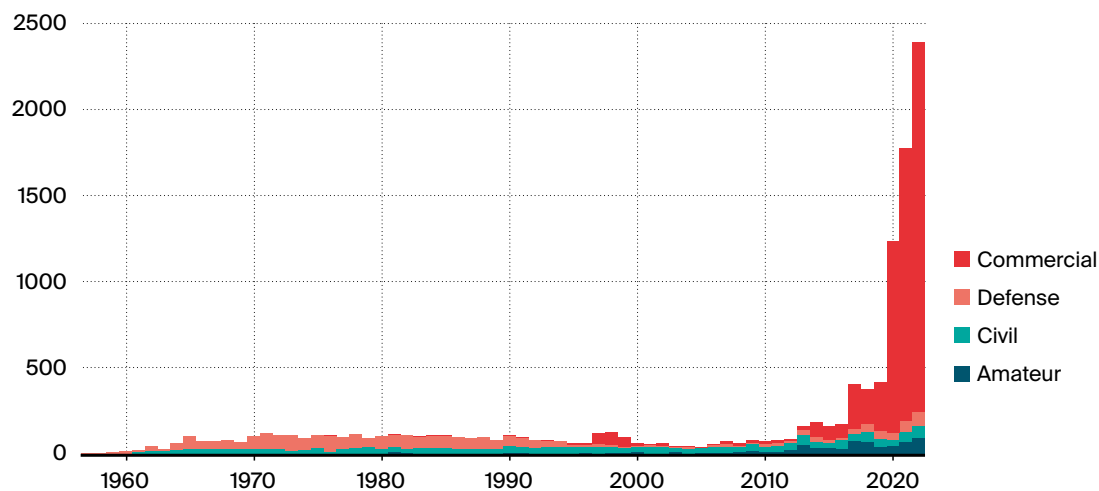
As the home of the Space Sustainability Rating (SSR) and the Sustainable Space Logistics initiative, eSpace is a leader in the space sustainability movement, and will continue to make the sustainable use of space a main focus of its activities in the coming years..

### 3.1 Space Sustainability Rating

The Space Sustainability Rating (SSR) is an innovative tool that aims to promote the responsible and sustainable use of outer space. It supports space actors, such as governments, space agencies, and commercial companies, in

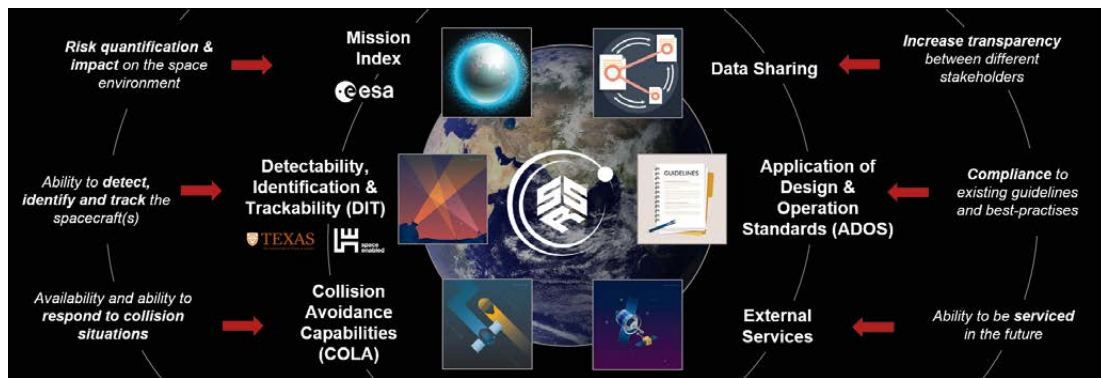
17

**Payload launch traffic into  $200 \leq h_p \leq 1750$  km**  
Number of objects per year of launch



Payload launch traffic in low Earth orbit. Credit: [ESA space environment statistics](#).





Space Sustainability Rating modules in a nutshell



Space Sustainability Rating labels

understanding the impact of their activities on the space environment, and to identify opportunities to reduce those impacts. The SSR was developed in 2016 under the World Economic Forum's Global Council on Space and is operated by an eponymous non-profit organisation hosted at eSpace. The SSR also involves the Massachusetts Institute of Technology (MIT), the European Space Agency (ESA), BryceTech and the University of Texas at Austin (UT Austin) to compose a consortium.

The SSR is a rating system based on a set of criteria that cover a range of areas, including a mission's collision risk footprint, collision avoidance and post mission disposal strategies, data sharing, compliance to existing standards, detectability and trackability, and readiness to on-orbit servicing and removal.

In May 2021, eSpace was selected to lead the operational development and implementation of the SSR, with the mandate to implement and operate the rating system. As the SSR went through a beta testing phase in which the rating methodology and process were streamlined and fine-tuned, the first official ratings were delivered in 2022.

### 3.1.1 Business model consolidation and SSR offering

Significant effort was put toward building a business model to be sustainable in the medium- and long-term, generating revenue to finance both operational and development

costs. Significant attention has been given to developing the SSR to allow for the involvement of satellite operators and other stakeholders from the space ecosystem.

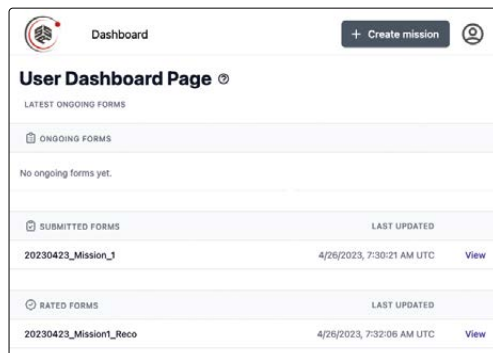
The SSR has centred its offering on a paying rating system and related practical guidance on how to improve sustainability performance and practices based on the results of the assessment. This is offered in a subscription with a flat fee to simplify the offering. In 2022, two companies have become rating subscribers and around half a dozen have expressed their interest and engaged with the SSR. 2023 will be dedicated to translating them into full rating subscribers, building on the momentum around the SSR to nurture and extend its network of supporters.

Although the rating system is mainly accessible to satellite operators, the SSR enables the participation of other important stakeholders of the space ecosystem and to channel engagement around the rating, association membership with paying fees has also been further developed. In 2022, nine organisations joined, including three founding members who were early supporters of the initiative: Ansys; Nihon University, who will head the development of a regional-hub for the SSR in Japan and the Asia-Pacific region; and Stellar. ALTER group, EnduroSat, Neuraspace, Privateer, the Secure World Foundation and Slingshot Aerospace have joined the SSR, providing key expertise and network to enhance the rating system and ensure its relevance and accuracy.

### 3.1.2 Rating operations

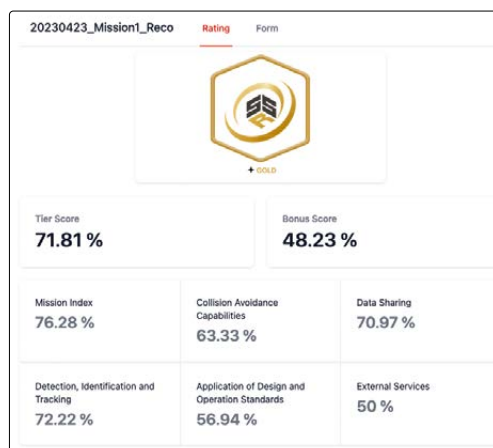
During the first half of 2022, eSpace performed beta-testing on a variety of missions from operators such as OneWeb, Astrocast, Axelspace, and the EPFL Spacecraft team. While the rating process is complex and needs updates from rating to rating, the SSR team worked iteratively on improving this process by allowing it to be more precise, efficient, but also resilient to diverse mission architectures, including constellations.

The SSR team also continued the development of Rate-Space (reporting and assessment tool for the evaluation of sustainable space activities), an online platform that will allow the SSR applicants to input their information and retrieve the SSR scores. The development of this platform will allow a more professional process, as well as increase the automation level of the operation, allowing to rate more missions and have a greater impact.



Dashboard		+ Create mission
<b>User Dashboard Page</b>		
LATEST ONGOING FORMS		
ONGOING FORMS		
No ongoing forms yet.		
SUBMITTED FORMS		
LAST UPDATED		
20230423_Mission_1	4/26/2023, 7:30:21 AM UTC	View
RATED FORMS		
LAST UPDATED		
20230423_Mission1_Reco	4/26/2023, 7:32:06 AM UTC	View

Rate-Space beta version: user dashboard



20230423_Mission1_Reco		
Rating Form		
		
+ GOLD		
Tier Score		Bonus Score
71.81 %		48.23 %
Mission Index	Collision Avoidance Capabilities	Data Sharing
76.28 %	63.33 %	70.97 %
Detection, Identification and Tracking	Application of Design and Operation Standards	External Services
72.22 %	56.94 %	50 %

Rate-Space beta version: rating outputs

In parallel, the SSR team continued to ensure the transition of the computation means of the DIT module from MIT to eSpace. Groundwork has also been made to facilitate the transition of the Mission Index module computation from ESA to the SSR association and is foreseen to continue in 2023.

### 3.1.3 Official launch of the SSR at the 4th Summit for Space Sustainability

In June 2022, the SSR entered a new phase of its mission by officially going live. At the 4th Summit for Space Sustainability organised by the Secure World Foundation, a member and active supporter of the SSR. The SSR celebrated its launch in front of a public of experts from the space sector and issued the first official rating to Stellar.



### 3.1.4 World Satellite Business Week

In recognition of the SSR's role in incentivising sustainable behaviour in space and value for the space industry, it was awarded Euroconsult's Sustainable Development & Business Award at the World Space Business Week (WSBW) organised by Euroconsult in September 2022.



### 3.1.5 SSR at IAC

Also in September 2022, members of the SSR consortium attended the annual International Astronautical Congress (IAC) in Paris. The SSR team presented several papers and participated on several panels, including with the support of the Swiss delegation to the IAC.



### 3.1.6 Creation of the SSR Association

From the outset, it was decided by the SSR Consortium that once the rating system was fully operational, an independent non-profit association would be created to operate the SSR, which would allow the establishment of a neutral platform through which all these actors interested in space sustainability could exchange. This structure, being created in 2023, will also facilitate fundraising efforts (both public and private), and allow the centralisation of the rating system ownership into a single entity.

### 3.1.7 SSR association working groups

As part of the association setup, two working groups have been scoped, and presented to the members of the association with the objective of channelling engagement around the rating system. One working group will address technical matters, and the other will cover policy considerations – two key dimensions of the SSR.

### 3.1.8 SSR research and developments

#### Dark and Quiet Skies

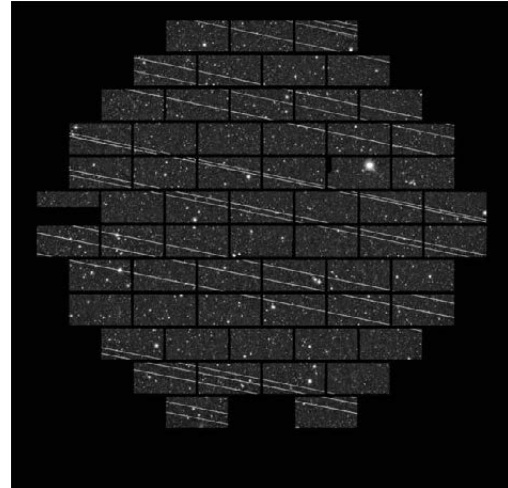
While the number of both active satellites and space debris is set to grow in the coming years, there is growing concern among the astronomy community regarding the impact of such a densely populated sky on observations. In that context, the development of a dark and quiet skies module for the space sustainability rating was foreseen and was first studied during semester projects and internships in 2022.

This module aims at proposing a quantification methodology to assess the impact of satellites on astronomical observations, both for optical and radio telescopes. The Dark and Quiet Skies module intends to quantify the impact of space missions on the astronomical observations, and output a score between zero and one, that will then contribute to the final SSR score. The module will be split into two sub components, addressing the impacts on both optical and radio astronomy. As other modules of the space sustainability rating, the Dark and Quiet Skies module will (i) assess the impact of a given mission that can be composed of one or several spacecrafts, and (ii) account for efforts from operators to mitigate their impact through design or operation of their satellites.

The Dark Skies (optical) component is derived from the detectability framework of the SSR, and aims at quantifying the apparent and effective magnitudes of spacecraft composing a mission. The impact of a mission in terms

of data loss for a given set of telescopes is set to be quantified. Whereas the aggregated impact of a mission shall be included, the goal of the SSR is also to incentivise every mission to implement best-practices. In that regard, a rating methodology to rate missions at spacecraft and mission (fleet) level will be proposed.

The Quiet Skies (radio) component follows a similar approach, in quantifying the level of harmful radio-frequency interference of a mission, and considering solutions that can be implemented to mitigate the impact at spacecraft and fleet level.



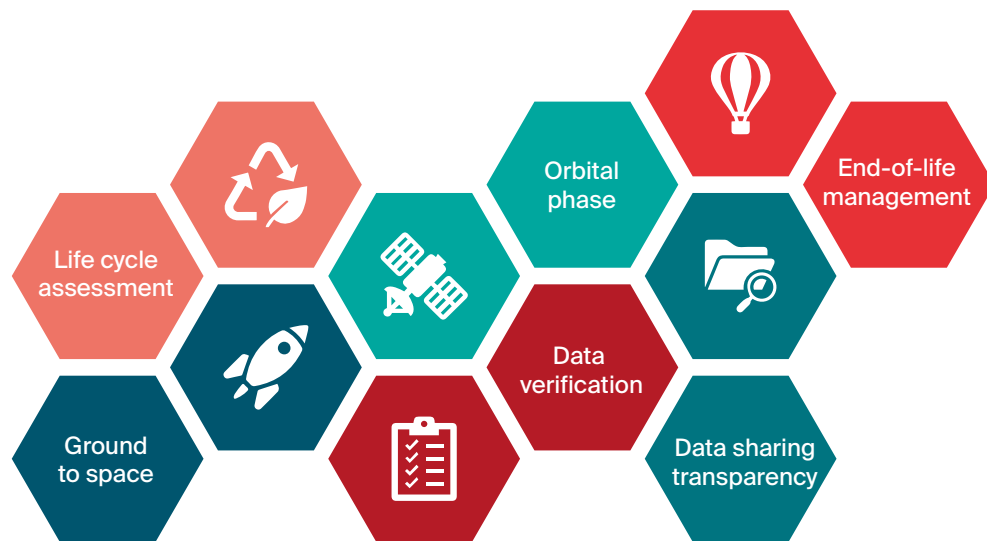
Wide field from the Dark Energy Camera on the Víctor M. Blanco 4-m telescope at the Cerro Tololo Inter-American Observatory, taken on 18 November 2019. Several Starlink satellites crossed the field of view. Image credit: CTIO / NOIRLab / NSF / AURA / DECam DELVE Survey.

#### Launch Vehicle Sustainability Rating (LVSR)

According to the ESA Space Debris Office, the largest contributors to debris risks on orbit are mission-related objects and rocket bodies generated by launch vehicles. Passivating and deorbiting upper stages are thus critical to safeguarding valuable orbits, even more since some end up crossing crowded low Earth orbits (LEO) and geostationary orbits (GEO), threatening many operating satellites.

After the successful development of the Space Sustainability Rating (SSR), a new formulation focusing on the sustainability of launch vehicles is being developed. A paper presenting the first iteration of this new rating methodology was written and presented at the International Astronautical Congress (IAC) in 2022). In 2023, the LVSR will enter its beta-testing phase, and a student project will improve and refine the definition of the LVSR during the semester.





LVS modules



LVS badges

### Life cycle assessment (LCA) module

Currently, the SRR is for now focused on the impacts on the space environment, in particular looking at space debris risks, end-of-life management from orbit, and debris mitigations. But with a continuously growing number of satellites launched in orbit, it becomes increasingly important to assess their impacts on the Earth's environment as well.

While interest in LCA for space missions has gained in strength in the past few years, particularly in Europe, no consensus has yet been reached on a single-score LCA system. eSpace has started a feasibility study for a single-score LCA module which could be integrated within the SSR to broaden its scope. The focus of the study lies in the identification of the initial inputs and the methodology to assess them, as well as the normalisation method to reach a single score.

The end goal is to develop an LCA module that can help SSR applicants assess the environmental impacts of their missions, and incentivise them to implement ecodesigned elements to tackle the identified environmental hotspots.

## 3.2 Sustainable Space Logistics (SSL)

Space is a harsh environment for humans and spacecraft. Vacuum, radiation, extreme temperatures, and orbital mechanics all add constraints to space missions. On top of that, with the increase of launches and satellites in orbit, the threat of space debris cannot be neglected, and the impacts of space mission on Earth's environments needs to be fully understood.

Space missions are also getting more complex, with more destinations to reach, reusable vehicles, in-orbit assembly and services and the potential of in-situ resources utilisation (ISRU), which means the space logistics paradigm is drastically shifting.

These changes and the state of the space environment have had and will continue to have deep implications for sustainability.

### 3.2.1 Projects done on SSL in 2022

eSpace's Research Initiative for Sustainable Space Logistics (RISSL) project ended in 2021 (see 2021 activity report). Since then, a few related research projects have been ongoing.

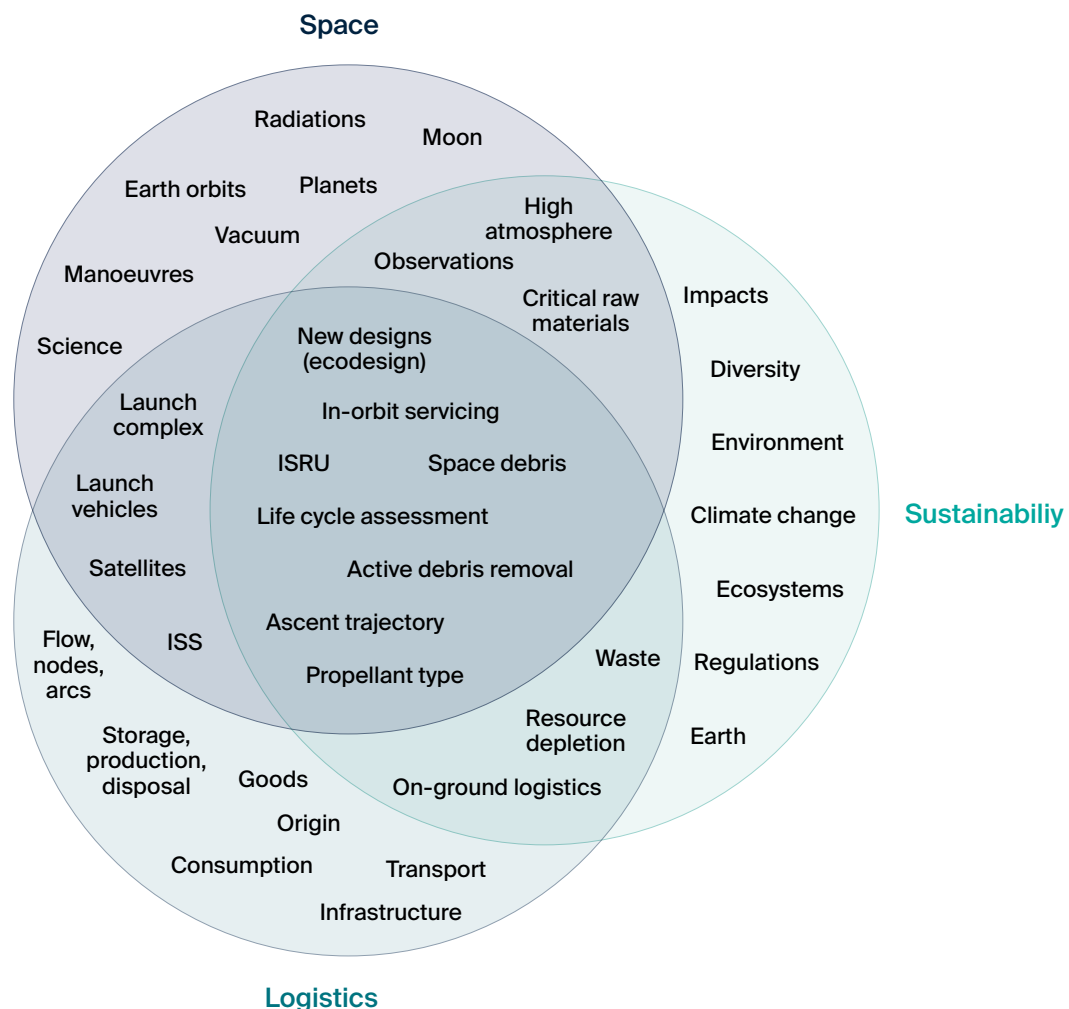
#### TCAT Tool

The Technology Combination Analysis Tool (TCAT) tool performs space logistics optimisation. Users can choose the vehicle (launcher and in-space vehicle), and the missions' objectives (targets and orbits), allowing the tool to calculate the global fleet of vehicles needed for a given mission, a plan for each active spacecraft, a sequence of phases and manoeuvres describing the mission, and a set of key performance indicators to select the fittest solution. The tool uses only high-level input data, making it most useful early in the mission design, for feasibility studies, and to rapidly choose between solutions.

#### ACT Tool

The Assessment and Comparison Tool (ACT) covers most of the life cycle of launch vehicles,

22



based on the available science to assess the environmental impacts of the different mission phases. The tool is coded in a modular way that will allow scope extension in future development, to improve the models and refine the computations. It interfaces with TCAT to use some python scripts useful to compute the space debris risks encountered and generated by any space transportation vehicle.

### 3.3 Sustainability plans for 2023



At the end of 2022, the activities around sustainable space at eSpace and in different EPFL labs have been brought together under the umbrella of the Sustainable Space Hub (SSH). This hub has been officially announced in 2023 (see section 5).

One of the goals of the hub is to foster collaboration between laboratories and projects within EPFL and Switzerland that have similar interests.

Regarding the software tools mentioned above, there are also ideas to develop the aforementioned software tools further and connect them with other existing tools, to create a more comprehensive space logistics tool. This will help approach the issue of space sustainability with an end-to-end approach, designing and optimise the mission and mission phases iteratively with the space transportation vehicles.

In the long run, the objective is to link ongoing activities at EPFL on the topics to secure the long-term usability of space.





# 4.

## COMMUNICATION AND OUTREACH

In its communication and outreach capacity, eSpace is responsible for promoting space-related activities that take place at EPFL, which includes liaising with media, organizing and promoting events, participating in meetings and conferences, sharing news with the wider EPFL community, and managing social media accounts.

In 2022, some communication and highlights included the co-organization of the first Kinetic Space Safety Workshop at EPFL with representatives from ClearSpace, LeoLabs, AXA Insurance, and the EPFL International Risk Governance Center (IRGC); members of the eSpace team participating and presenting at the International Astronomy Congress in Paris, the launch of a quarterly eSpace newsletter; and helping in the promotion of EPFL's Cosmos Archaeology exhibition.



## 4.1 Events



### 4.1.1 Events organised/supported by eSpace

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18–19 March 2022

#### Legends of Space

The Legends of Space event brought astronauts Dave Scott, Charlie Duke, Kathy Sullivan, Ellen Ochoa, Jean-François Clervoy and Claude Nicollier together along with members of NASA and ESA to invite attendees on an incredible journey through the past, present, and future of human spaceflight and space exploration, as we tell the continuing story of humankind's greatest adventure. The event also featured singers-songwriters Mark Armstrong and Kali Armstrong, the son and granddaughter of legendary Apollo 11 Astronaut and Commander Neil Armstrong, with a special musical tribute to the heroes of human spaceflight and exploration.

28 March – 1 April 2022

#### EPFL Space Week and Space Day

Swiss Space Week at EPFL offered numerous opportunities for participants to discover Switzerland as a space nation, including workshops, a public conference, and was capped off on March 30 by a full EPFL Space Day, where EPFL associations and research laboratories introduced themselves to the EPFL community.

4–5 May 2022

#### Low Earth Orbit Kinetic Space Safety Workshop

The LEO Kinetic Space Safety Workshop aimed to provide specific solutions and pragmatic actions to enhance collisional space safety in low Earth orbit (LEO). The workshop brought together international experts, space practitioners and others to debate specific solutions over the course of two days. Keynote speakers detailed the current state-of-the-art in spacecraft impact tolerance, collision avoidance, debris prevention and debris remediation. Interactive roundtable discussions assessed the identified proposals, focusing on their benefit, cost and maturity. The workshop took place in Lausanne, Switzerland and online.

15 December 2022

#### Italy and Switzerland: Together in Space

To celebrate the Italian National Day of Space, eSpace organized an event with the Italian Embassy in Bern to show the strong ties between these two countries and reinforce further the support to the collaboration in science and technology. This public event brought together Swiss and Italian astronauts and Space Agencies, large space companies and university spin-offs.

16 December 2022

#### Technical workshop for the Italian Day of Space in Switzerland: Space technology and sustainability – a challenge for the future

This technical workshop promoted a network of collaboration between Italy and Switzerland, involving Academia and space industries, large companies and SME. Starting from the presentation of new technologies, developed in Switzerland with a significant participation of Italian researchers, participants presented examples of how space can offer opportunities for young engineers and scientists, and for companies. As space becomes more and more crowded, its responsible use is key, as was discussed during a round table.





(top) Legends of Space, (right) EPFL Space Week and Space Day, (down) Low Earth Orbit Kinetic Space Safety Workshop, Italy and Switzerland: Together in Space



(top) Italy and Switzerland: Together in Space, (left) Technical workshop for the Italian Day of Space in Switzerland



#### 4.1.2 Events participated in by eSpace in 2022

- 13 January – LRA Institute Conference
- 4 March – SDG18.SPACE Workshop
- 15 March – Space Safety Industry Day #2
- 4–6 April – 3rd IAA Conference on Space Situational Awareness (ICSSA)
- 4–5 May – Lunar Surface Innovation Consortium
- 18–20 May – 6th European Space Debris Modelling and Remediation workshop
- 27 June–1 July – EUCASS
- 12–14 September – DECam at 10 years – Looking Back, Looking Forward
- 18–22 September – International Congress of Astronomy (IAC)
- 27–30 September – Advanced Maui Optical and Space Surveillance Technologies Conference (AMOS)
- 4–10 October – World Space Week
- 6–7 October – Workshop on “Life cycle assessment of space transportation systems”
- 12 October – CleanSpace Industry Days

#### 4.1.3 Seminar series 2022

1. 15 January – Space propulsion systems - Part 3, Prof. Hiroyuki Koizumi [🔗](#)
2. 27 January – Space propulsion systems - Part 4, Prof. Hiroyuki Koizumi [🔗](#)
3. 14 March – The SKA observatory and the Universe at radio-wavelength, Prof. Jean-Paul Kneib [🔗](#)
4. 11 April – Space robots: the frontiers of exploration, Shreya Santra [🔗](#)
5. 13 June – The Advanced Space Concept Lab (SaCLaB): an interdisciplinary approach to solving the challenges of future space missions, Stéphanie Lizy-Destrez [🔗](#)
6. 3 October – ExoMars: a planetary mission to explore Mars, Francesco Garrone [🔗](#)
7. 7 November – VIRUP: the Virtual Reality Universe Project, Yves Revaz and Florian Cabot [🔗](#)
8. 14 November – Solar system objects (SSOs) pipeline for the Euclid Mission, Aurelien Verdier [🔗](#)
9. 12 December – Lunar Hub: a venture to explore the extreme and the uncharted, David Rodríguez [🔗](#)

*Cosmos Archeology* exhibition at EPFL Pavilions. Credit: EPFL Pavilions





## 4.2 Cosmos Archaeology exhibition

From 16 September 2022 until 5 February 2023, EPFL Pavilions presented the *Cosmos Archaeology* exhibition, which used cutting-edge technologies, such as machine learning and big data analysis, to uncover the mysteries of the cosmos. This exhibition was created by Sarah Kenderdine at the EPFL Laboratory of Experimental Museumology (EM+) and Jean-Paul Kneib, Academic Director of eSpace. Through

interactive displays and visualizations, visitors were immersed in different kinds of space and astrophysics research taking place at EPFL.

The exhibition featured a wide range of exhibits, including stunning displays of the cosmos, interactive models of galaxies, visualizations of space debris, video archives of Claude Nicollier, and much more. The *Cosmos Archaeology* exhibition was an excellent opportunity for anyone interested in astronomy, archaeology, or technology to experience a unique and fascinating display. In the end, the exhibition had 14,154 visitors, a record number!



*Cosmos Archeology* exhibithion at EPFL Pavilions. Credit: eM+ and Lastro



*Cosmos Archeology exhibithion* at EPFL Pavilions. Credit: eM+

## 4.3 Publications

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### 4.3.1 In the media

In order to reach people who are interested and invested in space both at EPFL and within the larger Switzerland, as well as abroad, eSpace prioritises its contacts with media outlets and is proud to have its work covered by both Swiss and international media in 2022.

- 13.01 Migros Magazine [🔗 La tête dans les étoiles](#)
- 21.01 L'Agefi [🔗 Cysec lève 4 millions de plus pour son expansion en Europe](#)
- 08.02 SwissInfo [🔗 Space junk: a Swiss warning to the world](#)
- 15.03 Heidi.news [🔗 Le Point du Jour: Volker Gass](#)
- 01.04 Heidi.news [🔗 Dans le ciel et l'espace, le paradoxe du développement durable](#)
- 05.04 Newsweek [🔗 How Do Leaders Deal With Space Debris?](#)
- 04.05 24 Heures [🔗 Lausanne, capitale mondiale des éboueurs de l'espace](#)
- 05.05 Heidi.news [🔗 Lausanne, capitale internationale de la chasse aux débris spatiaux](#)
- 24.05 Heidi.news [🔗 «En matière spatiale, la collaboration Suisse-Union européenne est immunisée»](#)
- 31.05 Bilan [🔗 La Suisse se positionne comme nation du spatial](#)
- 02.06 Le Temps [🔗 L'intelligence artificielle pour éviter les débris spatiaux](#)
- 15.06 SpaceNews [🔗 A new way to incentivize safer conditions for operating in space](#)
- 30.06 Heidi.news [🔗 Guide de durabilité spatiale à l'usage du voyageur galactique](#)
- 20.07 RTS Info [🔗 Pendant deux semaines, des étudiants de l'EPFL se glissent dans la peau d'astronautes](#)
- 29.07 ABC News Australia [🔗 Space junk, space lasers and space law: Cleaning up earth's debris | Video Lab | ABC News](#)
- 02.08 Heidi.news [🔗 Aux frontières du cosmos, là où nos télescopes sont aveugles](#)
- 03.08 20 Minuti [🔗 Un viaggio nello spazio... ma al San Gottardo](#)
- 04.08 EE News Europe [🔗 Rating for designing sustainable space systems](#)
- 07.09 CNN [🔗 Opinion: Why I'm a space environmentalist – and why you should be, too](#)
- 13.09 Geospatial World [🔗 Space Sustainability as a Business and Economic Imperative](#)
- 23.09 Le Courrier [🔗 «Cosmos Archeology», vers l'infini et au-delà!](#)
- 20.10 La Liberté [🔗 Exposition: Vers l'infini et au-delà à l'EPFL](#)
- 20.10 RTS [🔗 Une exploration dans le temps et dans l'espace](#)
- 28.10 La Côte [🔗 A deux pas de chez nous, des jeunes préparent une mission spatiale](#)
- 17.11 Le Temps [🔗 A bord de la mission Artemis, des petits satellites low cost mais ambitieux](#)
- 26.11 Aargauer Zeitung [🔗 «Claude Nicollier war mein Mentor»: Wie Marco Sieber zum zweiten Schweizer Astronauten wurde](#)
- 09.12 Le Courrier [🔗 Mieux comprendre l'Univers](#)
- 12.12 Curiosity Daily Podcast [🔗 Space Sustainability Rating System, the Chameleon Effect, and How to Blow Your Nose](#)
- 16.12 Le Monde [🔗 Espace : des débuts de solution pour nettoyer les orbites](#)
- 22.12 Ask the Monsters [🔗 The real reason why Paolo Nespoli went to space](#)
- 26.12 24 Heures [🔗 Visite aux dimensions spatiales](#)



### 4.3.2 eSpace news articles

eSpace regularly publishes articles on the EPFL Actu channel and the eSpace website to share activities and news with the wider EPFL community.

- 13 March - New EPFL online course is launching learners into the New Space [↗](#)
- 31 March - Swiss Space Week and Space Day come to EPFL [↗](#)
- 12 April - International workshop to address problem of space debris [↗](#)
- 21 April - Space Sustainability Rating to launch in June [↗](#)
- 19 May - eSpace hosts students for Concurrent Engineering Challenge [↗](#)
- 25 May - Radio astronomy to foster Swiss research and industry [↗](#)
- 23 June - Space Sustainability Rating is now live (published on the main EPFL website) [↗](#)
- 20 September - Unlocking the potential of space for the UN SDGs [↗](#)
- 29 September - Paris Calling: eSpace goes to IAC2022 [↗](#)
- 10 November - eSpace joins Net Zero Space initiative [↗](#)
- 25 November - ESA CM 2022: What's in it for Switzerland and EPFL? [↗](#)
- 19 December - Two events celebrating Italy and Switzerland in space [↗](#)

### 4.3.3 Newsletter

In 2022, eSpace began its quarterly newsletter Mission Log. This newsletter presents eSpace's activities and events, along with interesting news from the wider field of space, to an audience of EPFL researchers and students, along with other stakeholders in Switzerland and internationally. [↗ Newsletter archive.](#)

## 4.4 Social media

eSpace has a presence on multiple social media channels: Twitter, LinkedIn, Instagram, YouTube and Facebook. These platforms are a key channel in eSpace's communication mix, especially for the promotion of larger events (Kinetic Space Safety Workshop, *Cosmos Archaeology* exhibition, EPFL Space Week), for sharing eSpace online seminars on YouTube, and disseminating eSpace project work.

2022 saw an increase in followers for all social media channels. LinkedIn did especially well with engagement, in particular from members

of the space industry and governmental organizations, while Instagram did best at engaging with the EPFL student population. While Twitter saw a good sized increase (29%) in its number of followers, tweets did not always receive the amount of engagement that was hoped for. Facebook has increasingly less and less value, to the point that eSpace decided to keep the account, but no longer invest much time nor energy in updating it.

	January 2022	December 2022	Difference
FB	1,187	1,264	+ 6.8%
Twitter	404	507	+ 28.7%
Instagram	1,130	1,268	+ 12.7%
LinkedIn	1,318	2,152	+ 66.6%
YouTube	113	164	+ 54.2%
Total	4,152	5,355	+ 30.6%

## 4.5 Outreach and communication plans for 2023

In 2023, eSpace will create an updated communications plan for the current phase of the unit, 2023–2027. One of the main focuses of 2023 and the 2023–2027 period is to strengthen the space community at EPFL. This will entail defining said community, organising outreach events, and connecting with them through digital channels such as the eSpace newsletter and through social media and the website.

Another important communications focus for 2023 will be reinforcing eSpace's and EPFL's commitment to raising awareness about the important issue of space sustainability. To this end, eSpace will organize and attend conferences, participate on panels and in meetings, write articles, and continue promoting the newly-formed Space Sustainability Rating association.







# 5.

## LOOKING AHEAD

### 5.1 New structure of EPFL Space Center: eSpace & Space Innovation

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The EPFL Space Center was created in 2003 to encourage research and teaching activities related to space technologies, and to facilitate collaborations between academia and industry. The Center was renamed the Swiss Space Center (SSC) in 2012 and became a partner of the Swiss Space Office of SEFRI (SEFRI/SSO). In 2014, the SSC was split into two separate entities: the EPFL Space Center (eSpace) and the Swiss Space Center (SSC). In January 2017, the Swiss Space Center came under the management of the EPFL Vice Presidency for Innovation (VPI) and changed its name to the Space Innovation Unit.

Following the decision of the SEFRI/SSO to select EPFL as the home of the new Space Exchange Switzerland (SXS), which takes over certain services previously provided by the SIU, and to ensure its financing (according to the decision of October 2021 and the performance mandate of December 2021), the Vice Presidency for Academic Affairs is now responsible for the management of the Space Innovation Unit, which is now part of the EPFL Space Center.

Now, the EPFL Space Center is still the interdisciplinary hub that brings together all aspects of space education, research and innovation at EPFL. The EPFL Space Center comprises two units, eSpace and Space Innovation. eSpace is specifically in charge of space projects connected to EPFL laboratories, which entails promoting space-related research, supporting

EPFL's space-affiliated professors, coordinating the Minor in Space Technologies, and managing the EPFL student teams.

The mission of Space Innovation is to support the space industry in Switzerland by coordinating and maintaining a network of companies and offering access to cutting technologies from academia, research offices, and industrial partners. For more information about space innovation please refer to [space-innovation.ch](https://space-innovation.ch).

### 5.2 Introducing the hubs

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The EPFL Space Center has undergone significant changes recently, including a new structure and the addition of our Space Innovation colleagues. As we move forward, we recognize the need to align our Center's structure with the new EPFL rules (LEX), which is a critical component of the university's new strategy for 2025–2028.

2023 will be a transitional year for us, with several important projects coming to an end, such as contribution to the ADRIOS mission and the Space Sustainability Rating being spun off into an association.

As we move forward and navigate these changes and challenges, we remain focused on our Center's core mission and are working collaboratively to achieve our goals. With the right mindset and approach, we believe that we can continue to make a significant impact in the field of space technologies and support the broader Swiss space community.

In order to clarify the areas of focus within the research and education area: eSpace has identified three focal areas that we are structuring as hubs:

- Space technology and innovation
- Space science and engineering
- Sustainable space and diplomacy

The mission of the hubs is to coordinate activities related to the thematic, to answer to the three pillars of EPFL, research, education and innovation, and to push interdisciplinary research at EPFL, Switzerland and globally.

The steering committee is composed of three space professors Andreas Burg, Edoardo Charbon, and Mathieu Salzman who are strong supporters of eSpace, are collaborating with the Center, and are conducting research relevant to our future activities (2023–2027).

They will offer ad-hoc support based on the specific needs of the project, and they will be available to provide expertise, advice, and guidance.

Finally, in the first semester of 2023, an advisory board will be appointed. It will be composed of upper management of EPFL, and external key professionals from ESA and the Swiss space industry.

## 5.3 2023 objectives



The EPFL Space Center is committed to achieving academic excellence in space engineering, and promoting space technologies, innovation, science and engineering, sustainability, diplomacy and education of future leaders. In order to achieve these objectives, the Center has identified a series of strategies and action points for each of its five focus areas.

Firstly, to achieve academic excellence in space engineering, the Center will continue its work to consolidate EPFL strategy regarding space and support the application of young talents for grants, while also providing information to faculties and supporting professors with space-related information.

Secondly, with regard to space technologies and innovation, the Center aims to identify future trends and projects, support the development of the ESA Space Deep Tech Innovation Center, contribute to making the Space Innovation Unit (SIU) a stronger entity, transfer knowledge to industry, and build up the EPFL academic community.

Thirdly, in the area of space science and engineering, the Center will perform project management and system engineering for space science projects, support the development of key technologies, and collaborate with the Swiss Consortium for the Square Kilometre Array (SKACH).

Fourthly, in terms of space sustainability and diplomacy, the Center aims to support the development of key technologies and offer a space policy platform.

Finally, in the area of space education of future leaders, the Center aims to ensure the financing of the space technology minor, offer innovative education, and provide opportunities for EPFL students.

Through these initiatives, the EPFL Space Center aims to be at the forefront of space-related research, education and innovation, contributing to the development of a sustainable and prosperous space industry.





# THANK YOU!

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Thank you to all our supporters starting from the eSpace team and staff, the motivated students, the dedicated researchers, our EPFL colleagues, our followers, our audience at eSpace Seminars, and all our partners who have trusted us to develop new projects! We look forward to working with you more in 2023!





