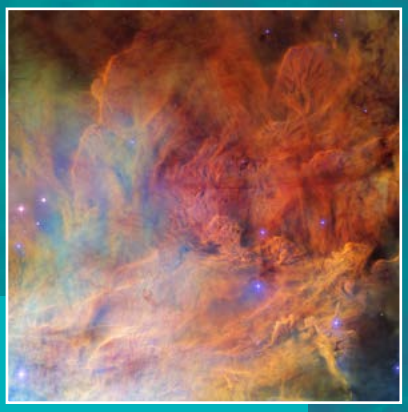
UNITED NATIONS
OFFICE FOR OUTER SPACE AFFAIRS

ANNUAL REPORT 2022

UNITED NATIONS



On the right: A portion of the open cluster NGC 6530, a collection of several thousand stars lying around 4,350 light years from Earth in the constellation Sagittarius
Credit: European Space Agency (ESA)/Hubble and NASA, ESO, O. De Marco

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2022 ANNUAL REPORT

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Vienna, 2023

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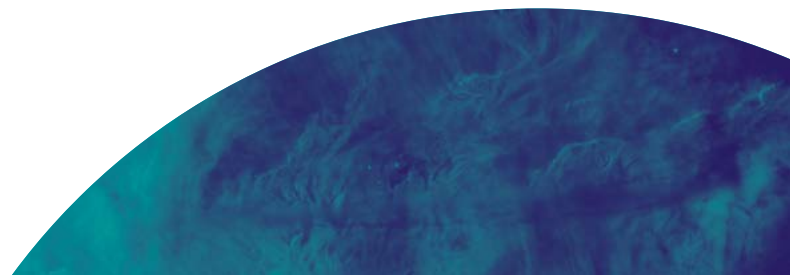

FOREWORD

Mr. Niklas Hedman
Credit: UNIS

Today, the space sector is a diverse field increasingly attracting the attention of business, academia, the general public, civil society and governments. The developments are unprecedented in their pace and scale. Investments in financial and human capital are growing exponentially as does the value of the global space economy, breaking new records year after year. Announcements of new missions, destinations and discoveries are constantly making headlines and it is exciting to see that efforts to advance space exploration are increasingly conceived through cooperation.

These realities translate into the surging number of payloads launched into Earth orbit and beyond, calling for a strengthened attentiveness from the international community, and decision and policymakers. In 2022 alone, the space community deployed 15 per cent of all the objects ever sent to space in over six decades of the space era that started with Sputnik 1 in 1957. The sixty-fifth anniversary of this astounding feat, commemorated in October, was grounds for celebration. Satellites have gradually become one of the cornerstones of modern society, making our lives safer, expanding access to information and knowledge, underpinning climate action, stimulating sustainable development and so much more. The world today would look very different without the hardware orbiting our planet, delivering benefits one would not have even dreamed of a century ago.

It is now up to the space community to universalize access to these transformative tools to benefit communities worldwide. In a world riddled with inequalities, the space sector cannot become yet another field of persistent gaps among and within countries. As we approach the midpoint of the efforts to achieve the Sustainable Development Goals, we will gather for the Summit of the Sustainable Development Goals. This will serve as a great opportunity to solidify the role of space in achieving global agendas as today, we do not ponder the role of space activities in supporting the quest for a more equal and sustainable world. On the contrary, we ask whether we can get there at all without maximizing the use of satellites. United Nations plays a crucial role in expanding access to these tools. The Office for Outer Space Affairs has worked tirelessly over the years to expand the portfolio of opportunities for non and emerging space nations to accelerate the closing of the capabilities gap.

In parallel to the expanding space sector, we need to remain vigilant to many realities. For space endeavours to thrive, we need a safe, stable, predictable and sustainable

space environment. Stemming from the unique character of orbital regions, multilateralism and international cooperation are the only means forward. In near-Earth space, every action has implications for everyone else. The confluence of legal and policy, and scientific and technical approaches to preserving space for future generations is integral for today's achievements if we are not to impede future progress. By promoting adherence to and further development of relevant instruments, the Office continues to underpin the safe and sustainable use of space in order to maximize the benefits of space.

The fifty-fifth anniversary of the Outer Space Treaty, the most prominent of the space treaties born under United Nations auspices, was celebrated in 2022. The United Nations Register of Objects Launched into Outer Space, initially established to help establish laws governing space activities, also reached a notable milestone. Thanks to close cooperation between the United Nations and the international community, it has been maintained for 60 years. These anniversaries are constant reminders of the need to respect the "rules of the orbit" to sustain the Earth's orbital environment.

As we look ahead towards new developments in space, we must work with sustainability at heart. The Office has been working with United Nations Member States and the space community at large to bridge the space divide in a consistent and responsible manner. We stand ready to continue supporting such efforts to empower future generations and advance sustainability in space to achieve sustainability on Earth.

Mr. Niklas Hedman
Acting Director, Office for Outer Space Affairs

UNOOSA Staff photo
Credit: UNIS

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UNOOSA: WHO WE ARE

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The United Nations Office for Outer Space Affairs is mandated to deal with space affairs, specifically the peaceful uses of outer space. Among its mandates, it promotes international cooperation in the field, as well as the use of space science and technology for sustainable development, particularly for the benefit of developing countries. The Office is integral to the work of the United Nations in advancing multilateralism on space matters as it serves as the secretariat to the **Committee on the Peaceful Uses of Outer Space** (COPUOS), a body responsible for intergovernmental dialogue on cooperation, advancing space research programmes, and studying space-related activities that could be undertaken by the United Nations as well as analysing legal problems arising from the exploration of outer space. The Committee has two subsidiary bodies: the Scientific and Technical Subcommittee and the Legal Subcommittee, both established in 1961. COPUOS reports to the Fourth Committee of the General Assembly, which adopts an annual resolution on international cooperation in the peaceful uses of outer space.

The Office helps countries enhance their capacity to develop national legislation in line with international space law. This work is done through outreach efforts, consultations and dedicated capacity development activities, including the **Space Law for New Space Actors** project. Advocating for and fostering responsible conduct of space operations is of particular importance in these dynamic times.

UNOOSA discharges the responsibilities of the Secretary-General under international space law, including maintaining the **United Nations Register of Objects Launched into Outer Space**, first created in 1961 at the request of Member States. The Register is a Treaty-based transparency mechanism.

Through the **Programme on Space Applications** (PSA), UNOOSA helps countries build capacity in basic sciences, space technology and human space technology, and leverage space data and applications in areas such as global health, disaster and climate change management, humanitarian assistance, environmental monitoring and natural resources management.

Access to Space for All, which is a flagship capacity-building initiative under the PSA, bridges the space capabilities gap among countries, aiming to make space benefits universally accessible. Partnerships and cooperation sit at the centre of the initiative, with leading space stakeholders enabling access to state-of-the-art facilities and research and orbital opportunities for Member States, particularly developing countries.

UNOOSA works closely with the six Regional Centres for Space Science and Technology Education affiliated with the United Nations to reinforce space-related education globally. The Centres provide unique training and education programmes, especially for nurturing talent in developing countries.

Through the **United Nations Platform for Space-based Information for Disaster Management and Emergency Response** (UN-SPIDER) programme, UNOOSA helps countries use space data and technologies, such as satellite imagery, to reduce the risks of disaster and respond to disasters when they occur. UN-SPIDER has offices in Beijing, Bonn and Vienna and is funded with generous financial support from China and Germany.

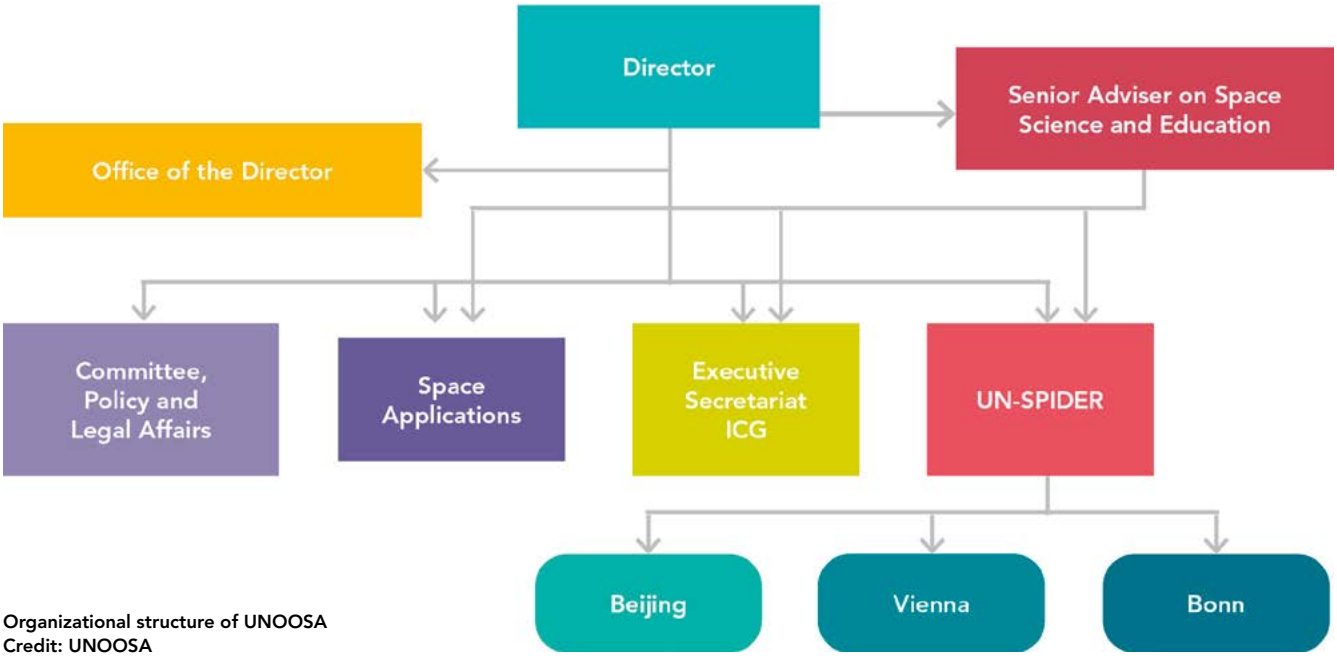
UNOOSA serves as executive secretariat of the **International Committee on Global Navigation Satellite Systems** (ICG) that brings together global navigation satellite system (GNSS) providers to improve technology, compatibility and interoperability, and the use of GNSS for

sustainable development. The ICG Programme is made possible by the generous financial contributions of the United States of America and the European Commission.

UNOOSA is the secretariat to the **Space Mission Planning Advisory Group** (SMPAG), which connects the world's space agencies active in the domain of planetary defence. SMPAG is responsible for preparing an international response to a near-Earth object threat through the exchange of information, the development of collaborative research and mission opportunities, and by conducting planning activities to mitigate such threats. The work of UNOOSA with SMPAG is supported by the contribution of the European Space Agency (ESA) as Chair of this advisory group. UNOOSA also cooperates with the International Asteroid Warning Network (IAWN) in strengthening international coordination and cooperation in case of near-Earth object impact hazards.

UNOOSA leads the **Inter-Agency Meeting on Outer Space Activities** (UN-Space), a United Nations-wide endeavour that examines the contribution of space science and technology and their applications to the work of the organization and the achievement of the Sustainable Development Goals. Through the breadth of its activities, UNOOSA addresses all stages and aspects of space applications, space law and space policy, helping all countries leverage the benefits of space for sustainable development.

UNOOSA organizational chart



Organizational structure of UNOOSA
Credit: UNOOSA

The capital of Austria captured from Earth orbit
Credit: Copernicus Sentinel Data/ESA

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UNOOSA IN 2022: EXECUTIVE SUMMARY

2 | UNOOSA IN 2022: EXECUTIVE SUMMARY

For UNOOSA, 2022 was an eventful year of building capacities, advancing gender equality, facilitating sustainability and promoting cooperation across the spectrum of space-related activities. Dozens of activities, including workshops, conferences and training sessions provided platforms for discussion and learning opportunities for thousands of participants. Capacity-building efforts delivered great results with the Republic of Moldova becoming yet another country to benefit from the Access to Space for All KiboCUBE programme to develop and deploy a satellite from the International Space Station. The projects selected to fly on the Payload Hosting Initiative are coming to fruition.

The Office also progressed with endeavours to bring more women and girls, young people as well as people with disabilities into the sector. Incentivizing and empowering future astronauts, engineers, scientists or even space lawyers bring long-term benefits for all of us. Hosting another edition of the Space4Women Expert Meeting helped us collect recommendations informing future steps towards building a more equal and diverse space sector. For the first time, UNOOSA convened Space4Water stakeholders and invited indigenous women to provide insights into the challenges and opportunities facing their communities and the use of space in addressing water-related issues.

The educational efforts and fellowships promoted by the Office unlocked access to quality facilities and curricula, equipping students and graduates with both theoretical knowledge and practical experiences and skills. Efforts in facilitating dialogue, awareness and skills in Global Navigation Satellite Systems also continued through workshops and training sessions. The role of UN-SPIDER in boosting access to and use of space-based solutions for disaster management was also crucial. Thanks to the different types of missions delivered by experts, many countries are now better equipped to deal with disaster hazards.

By promoting space law, UNOOSA continued to facilitate the safe and sustainable use of space. It convened the sixty-fifth session of the Committee on the Peaceful Uses of Outer Space, an intergovernmental platform that has championed multilateralism in space affairs since the dawn of the space age. The Committee has been instrumental in creating the international legal framework for space and road maps for greater use of space in sustainable development. Its work on marrying the use of space with public health led to the resolution on Space and Global Health adopted by the General Assembly in December.

The Space Law Conference organized in May addressed governance and legal perspectives on space activities in Earth orbit and beyond. The Office continued efforts to raise awareness and deliver capacity-building related to the Guidelines for the Long-term Sustainability of Outer Space Activities. The interview series with space stakeholders provided insights into the experiences, challenges and future steps in their implementation. The Space Law for New Space Actors project helped Member States enhance their capacity to develop national legislation in line with international space law.

The Office welcomed a record number of visitors to its website with space law resources claiming top spots among the most sought-after content items. The website segment devoted to the role of space in supporting the achievement of the Sustainable Development Goals (SDGs) also drew encouraging figures underscoring the growing interest in and recognition of the benefits offered by space activities. The UN-SPIDER Knowledge Portal welcomed close to 500,000 users who were mostly interested in the taxonomy of disasters as well as step-by-step practices on the mapping of flood hazards and damages.

Through the expanding stakeholder base as well as the growing repository of resources, the Space4Water Portal continued delivering solid growth. The number of users visiting increased with a year-to-year rate of 78 per cent, reaching close to 70,000 people. The Space4Women website kept expanding in its third year since inception attracting close to 16,000 visitors to resources on gender equality, empowerment and activities related to the Space4Women project. The dedicated Space Sustainability website, which has operated since 2021, is gradually getting more traction with new resources, including the Stakeholder Study report reflecting the views collected through interviews with relevant space representatives.

Digital

Website	*Visitors as of 31 December 2019*	*Visitors as of 31 December 2020*	*Visitors as of 31 December 2021*	*Visitors as of 31 December 2022*
UNOOSA	290,306	308,597	446,531	489,495
SPIDER KP	305,632	407,752	514,883	469,514
Space4Water	10,230	14,641	37,623	67,138
Space4Women	N/A	8,642	16,130	19,975

UNOOSA website page views

~1.75 MILLION

Social media followers

~ 105,000

Delivery of work

15
countries achieving increased understanding and application of the international legal regime governing outer space activities

106
parliamentary documents released

2,055
satellites registered

81
days of seminars, workshops and training events

5
publications produced

5
UN-SPIDER capacity-building missions

Event participants

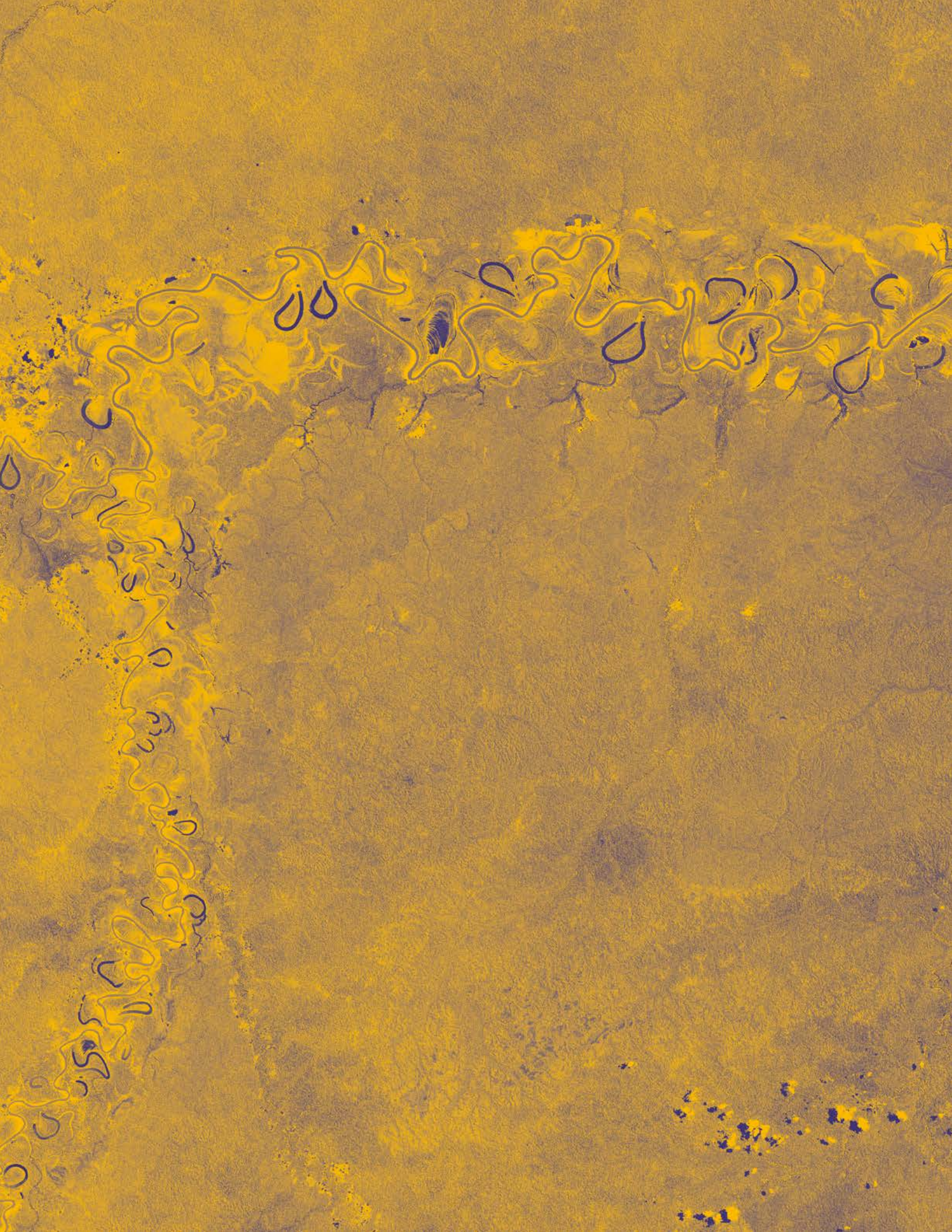
2,300
Climate Action training session participants from 104 countries

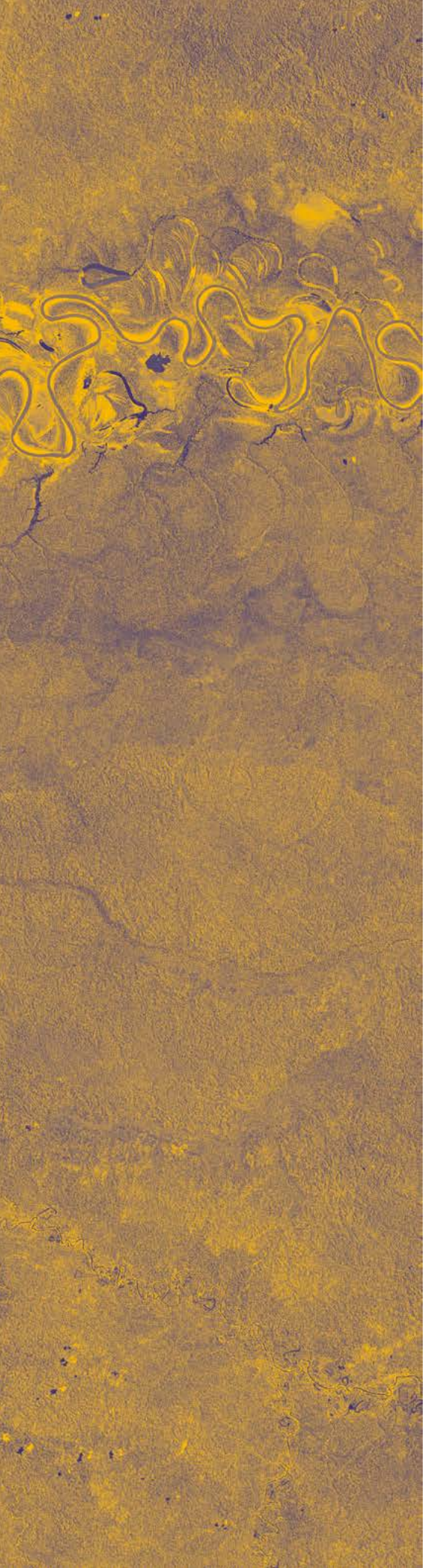
68
countries represented at the United Nations/Chile Space Law Conference

1,034
World Space Forum participants from 114 countries

74
Space4Women Expert Meeting participants from 27 countries

729
World Space Week Webinar series participants





Part of the Amazon rainforest in the Amazonas
Credit: Copernicus Sentinel Data / ESA

From a transformative resolution linking space and global health, through advancing gender equality and access to space, to the promotion of water and climate action, many highlights stood out in the work of UNOOSA in 2022.

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HIGHLIGHTS OF 2022

3 | HIGHLIGHTS OF 2022

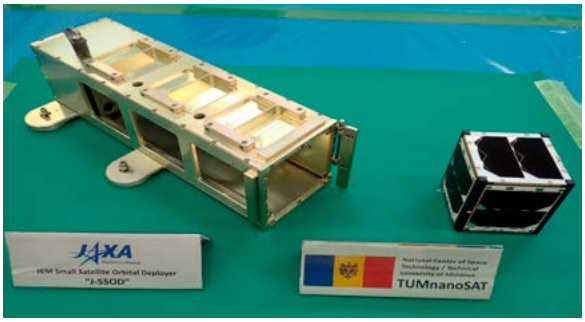
REPUBLIC OF MOLDOVA DEPLOYED ITS FIRST SATELLITE THROUGH THE KIBOCUBE PROGRAMME

The KiboCUBE programme, delivered in partnership with Japan Aerospace Exploration Agency (JAXA), successfully enabled yet another country to put a satellite into Earth orbit. On 12 August, the Republic of Moldova deployed the nation's first satellite, TUMnanoSAT, constructed by the Technical University of Moldova from the Japan Experiment Module "Kibo" of the International Space Station. The Technical University of Moldova Tekwiil Centre hosted a ceremony that was also attended by the Prime Minister of the Republic of Moldova to celebrate this historical moment.

The mission of TUMnanoSAT aims at demonstrating various modules and subsystems of the CubeSat, such as the behaviour of sensors, solar electric power management and the endurance of electronic components. This experience also proved to be an important step for the team in advancing its knowledge and skills in satellite communications.

Through the project, students have familiarized themselves with aerospace engineering technologies and gained valuable insights, skills and expertise necessary for building future satellites on their own, paving the way for future generations in the space sector. This complex experience was made possible through collaboration with industry, academia and other experts in CubeSat development, science and research.

The Republic of Moldova became the fourth country to deploy 10cm x 10cm x 10cm CubeSat through KiboCUBE, following in the steps of Guatemala, Kenya and Mauritius. With this latest deployment, KiboCUBE has reached Africa, Eastern Europe and Latin America and the Caribbean.



GENERAL ASSEMBLY ADOPTED RESOLUTION ON SPACE AND GLOBAL HEALTH

On 12 December 2022, the General Assembly adopted a resolution on Space and Global Health (**A/RES/77/120**). Through this resolution, the General Assembly encourages greater coordination and cooperation among all relevant actors in key space activities regarding global health that foster the exchange of ideas and data between the space and health sectors. In addition, it urges United Nations entities and intergovernmental organizations to support the development of, access to and application of space solutions for global and public health. Through the resolution, the General Assembly also requests UNOOSA to strengthen capacity-building and networking in Africa, Asia and the Pacific and Latin America and the Caribbean.

The draft text of the resolution was developed under the purview of COPUOS by the Working Group on Space and Global Health of the Scientific and Technical Subcommittee. The final report on the work of the Working Group under the multi-year workplan that began in 2019 was issued as a valuable source of information and guidance for advancing the use of space science and technology for global health by spacefaring and emerging space nations. Over the years, expert exchanges helped shape the content submitted to the General Assembly. The work of the Working Group also led to the establishment of the Space and Global Health Platform, based in Geneva, to promote effective collaboration on space and global health issues among a range of stakeholders, as well as the establishment of the Space and Global Health Network.

Astronaut Serena Auñón-Chancellor mixing protein crystal samples on the ISS to help scientists understand how they work
Credit: NASA

Astronaut Alexander Gerst conducting physiology experiments to provide new insights into the interaction between the body, clothing and climate
Credit: ESA/NASA

Previous page (clockwise):

H.E. Natalia Gavriliț a, Prime Minister of the Republic of Moldova (second from right) at the Deployment Event
Credit: Technical University of Moldova

TUMnanoSAT delivered to JAXA in February 2022
Credit: JAXA

TUMnanoSAT deployed into space from the ISS along with two other CubeSats
Credit: JAXA/NASA

Testing of CubeSat at the facilities of TUM
Credit: Technical University of Moldova

GENDER EQUALITY EFFORTS BOOSTED THROUGH SPACE4WOMEN EXPERT MEETING IN THE REPUBLIC OF KOREA AND THE MENTORSHIP PROGRAMME

In August 2022, the Office, together with the Ministry of Science and ICT of the Republic of Korea and the Korea Aerospace Research Institute organized the Space4Women Expert Meeting in Daejeon, Republic of Korea. The Expert Meeting convened 74 experts from 27 countries to discuss topics related to the access and participation of women and girls in the space sector.

The three-day programme was full of engaging presentations, discussions and networking opportunities aimed at promoting gender equality and women's empowerment in the space sector, contributing to SDG 4, Quality Education and SDG 5, Gender Equality. Experts and advocates shared their experiences and insights on the status quo and efforts to advance gender equality in the space sector. Special sessions featured inspirational speakers, such as Ms. Soyeon Yi, the first and only Korean astronaut, who shared her experiences and discussed the challenges of becoming a woman astronaut.

Working group discussions allowed participants to exchange views on space education, female entrepreneurship, measuring the participation of women in the space workforce, and analysing the impact of gender empowerment activities. These efforts resulted in a series of recommendations for ensuring the equal and active role of women and girls in the space sector.

More details about the event and the recommendations are available in this report.

The next Space4Women Expert Meeting will take place on 30 October – 3 November 2023, in Montreal, Canada.

Expert Meeting participants in front of the event venue
Credit: Korea Aerospace Research Institute (KARI)

Visit to the National Space Situational Awareness Organization
Credit: KARI

Quotes from Expert Meeting participants:

I loved meeting all these brave and brilliant women and great advocates for change, and working and exchanging on such important topics during the working sessions. This event gave me confidence, in the actions, I do every day for gender equality in space and also in my place within the space sector. Let's continue working on these crucial themes together!

It was incredible to meet everyone from all over the world and learn about the work they do and what they hope to accomplish. They were all so inspiring!

This event was a life-changing experience for me, both professionally and personally! I would love to come back and help bring more people to it.

Tips from participants for future activities
Credit: KARI

Mentorship programme

The Space4Women Mentorship Programme matches experienced mentors in the space sector with women and girls (mentees) who aspire to pursue studies or careers in space or STEM-related subjects. As professionals and leaders in the industry, mentors, be they men or women, provide encouragement and act as role models for women and girls.

Mentors in the Space4Women Mentorship Programme are leaders and professionals in the space industry and represent a variety of fields and geographic regions. Together, these mentors support women and girls around the world and share their expertise, knowledge and experience to build an environment where women and girls play an equal and active role in space science, technology, innovation and exploration.

In December 2022, 95 mentors from 40 countries were selected. Access all the mentor profiles **at this link**.

The programme was supported by the Ministry of Foreign Affairs of Israel.

INNOVATIVE PAYLOADS FROM BAHRAIN AND NEPAL SELECTED FOR THE PAYLOAD HOSTING INITIATIVE

In September, UNOOSA and the Mohammed Bin Rashid Space Centre (MBRSC) of the United Arab Emirates announced the first awardees of their joint Payload Hosting Initiative (PHI) opportunity, a cooperation programme under the Hypergravity/Microgravity Track of the Access to Space for All initiative. At the margins of the seventy-third International Astronautical Congress hosted in Paris, the parties selected two payloads from the National Space Science Agency of the Kingdom of Bahrain and the Antarikchya Pratisthan Nepal to go on board the PHI-1 mission.

The AMAN payload conceptualized by the team from Bahrain will test an optimized Advanced Encryption Standard, aimed at securing communication between the satellite and ground station/Internet of things terminals. The APN LoRA Payload Mission of Nepal will study the operation of PX4 Autopilot, a middleware for drones in space, with a focus on the system's behaviour and operation. This opportunity generates practical experience, knowledge and skills in space technology for both teams.

The first round of the PHI programme opened for applications in 2022. Through the programme, UNOOSA and MBRSC provide the opportunity to fly an experimental payload with a maximum volume of 5 units on a 12-unit modular satellite platform developed by MBRSC. The maximum available volume enables different configurations and sizes making it possible to host multiple payloads on board the PHI platform. The programme promotes the use of space science and technology in developing nations and advances capacity-building efforts in access to space solutions.

12U satellite platform to host innovative payloads
Credit: MBRSC

UNOOSA and MBRSC announced the awardees in Paris
Credit: UNOOSA

WATER ACTION – TOWARDS A MIDTERM REVIEW OF THE WATER ACTION DECADE

United Nations/Ghana/PSIPW hosted the fifth International Conference on the Use of Space Technology for Water Resources Management

In May, UNOOSA and the Prince Sultan Bin Abdulaziz International Prize for Water (PSIPW) organized the **fifth International Conference on the Use of Space Technology for Water Management** hosted by the Government of Ghana in Accra and online. The event attracted the broad participation of over 800 people from 99 countries attending in-person and virtually. To enhance knowledge exchange and partnership development, as well as to identify user needs, demonstrate actionable solutions and encourage regional contributions, the Conference provided a holistic overview of how space-based Earth observation can improve water resources management.

The University of Energy and Natural Resources served as the local organizer in cooperation with the Ministry of Education, the Ministry of Foreign Affairs and Regional Integration, the Ministry of Environment, Science, Technology and Innovation and the Ministry of Sanitation and Water Resources. The European Space Agency (ESA) and the secretariat of the Inter-Islamic Network on Space Sciences and Technology also supported the Conference.

Ghana Vice-President, HE Mahamudu Bawumia, receives a certificate of participation
Credit: University of Energy and Natural Resources

Ghana Minister of Education, Yaw Osei Adutwum, delivering a speech
Credit: University of Energy and Natural Resources

A moment captured during the Conference
Credit: University of Energy and Natural Resources

Indigenous women in Vienna to voice roles and responsibilities related to water

In October, the Office welcomed a group of indigenous women for a workshop focused on the roles and responsibilities of indigenous women related to water. Through the insights offered by the six participating women from different communities and countries, UNOOSA learned about their specific approaches to managing water, obstacles and opportunities linked to space applications, as well as the challenges and environmental changes they observe. During the workshop, the Office collected stories feeding into the new feature on indigenous voices on the Space4Water Portal.

Group photo of participants at the workshop for indigenous women on their roles and responsibilities related to water
Credit: UNOOSA

Group photo taken at the First Space4Water Stakeholder Meeting
Credit: UNOOSA

3D model of the water cycle – interactive exercise carried out during the meeting
Credit: UNOOSA

The first Space4Water Stakeholder Meeting

Together with PSIPW, the Office organized the first Space4Water stakeholder meeting convening dozens of individuals representing Space4Water stakeholders, as well as professionals featured on the Portal. The delivered presentations showcased the complementary skillsets of this community, helped identify common objectives and effective approaches to facilitating matchmaking between relevant actors, provided guidance to advance joint efforts for finding space-based solutions to water-related challenges, and helped determine future steps. They also served as important elements to improve the understanding of how members are assessing user needs in water-related sectors.

Space4Our planet exhibit at headquarters in New York
Credit: ESA

SPACE4OUR PLANET EXHIBITION HOSTED AT UNITED NATIONS HEADQUARTERS

Since its inception, the unique Space4OurPlanet exhibition created under the patronage of UNOOSA with the support of various leading space organizations has travelled the world. In 2022, the Office, curators and partners worked together to bring it to New York for display at United Nations Headquarters. The exhibition effectively and visually communicates the benefits of space technology by putting stories of users of space applications at the centre, reflecting the power of space assets for achieving the Sustainable Development Goals. The exhibition provided an outstanding opportunity to further raise awareness of the importance of "Space4OurPlanet" to Member State delegations and visitors.

In addition to the official opening, the Office organized two dedicated events on 26 and 27 October to present the importance of space technologies in achieving the objectives and targets enshrined in the 2030 Agenda for Sustainable Development and to exchange views on the need for international cooperation and multilateralism in outer space. These activities were organized to initiate concrete actions to support the preparation of the 2023 SDG Summit – the High-level Political Forum on Sustainable Development under the auspices of the General Assembly.

Aurora over the Moon-lit Earth captured from the ISS
Credit: ESA/Thomas Pesquet

UNOOSA MAPPED COORDINATION EFFORTS IN USING SPACE 4 CLIMATE ACTION

Space-derived information is a powerful tool for monitoring and observing changes in the Earth's climate as well as mitigating, building resilience and preparing for the impacts of the climate crisis. The growing recognition of the role of space has sparked a significant increase in the number and variety of actors, climate services and climate actions at the global, regional and local levels.

As addressing climate change requires bold, joint action by all relevant stakeholders, it is encouraging to see more and more actors working in collaboration across different intergovernmental coordination bodies which use space technology to support climate action globally. However, a holistic overview of such bodies and their activities was missing.

To fill this information gap, UNOOSA, with the generous support of the Government of the United Kingdom, developed a report depicting coordination and collaboration in the various areas where space technology for climate action is applied. The report provides an overview of the existing policy, and technical and coordination mechanisms to support stakeholders in their strategic decision-making, enabling the identification of collaboration opportunities, and defining potentially existing niche areas as well as domains for further development and evolution.

This mapping exercise demonstrated that there is a well-established system with clear responsibilities and mandates in the areas of monitoring, observation and science, as well as policy development. At the same time, it revealed the lack of a forum for exchange and cooperation with private sector entities which could support targeted space and climate actions in the future. The changing and rapidly developing domain of climate services has seen more and more non-governmental actors entering the field and it is critical that their voices be heard and recognized when planning subsequent steps. In addition, the report suggests there is a potential for increased international and multilateral cooperation and coordination in the realm of capacity-building and climate services to advance more quickly and enable a better and more targeted result on the ground.

TWENTY-EIGHTH EDITION OF THE UNITED NATIONS/AUSTRIA SYMPOSIUM COMPLEMENTED WITH CLIMATE ACTION TRAINING SESSIONS

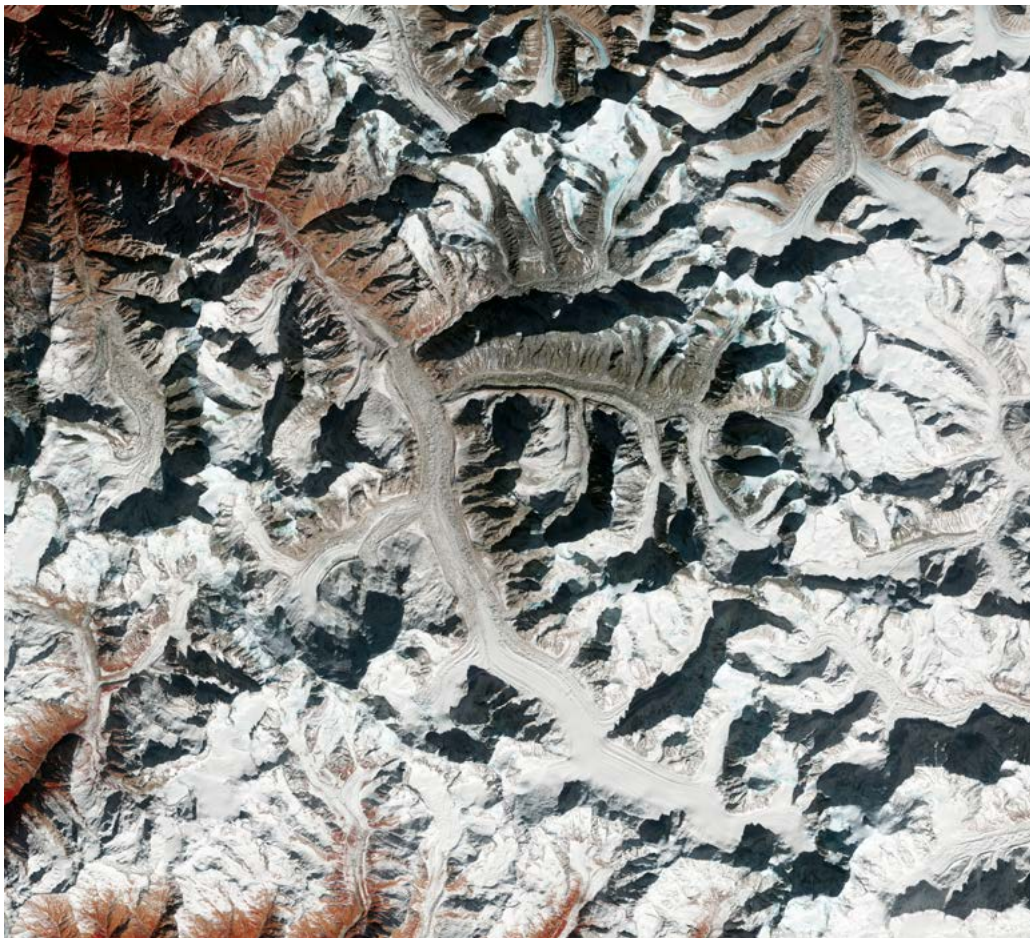
In 2022, the Office and its Austrian counterparts continued to deliver the long-standing United Nations/Austria Symposium series. The twenty-eighth edition focused on "Space for climate action: experiences and best practices in mitigating and adapting to climate change and supporting sustainability on Earth" and was organized in a virtual format from 13 to 15 September. This event attracted over 800 registrations from over 100 countries with most participants coming from developing nations. Speakers presented the most recent initiatives, experiences and best practices in mitigating and adapting to climate change and supporting sustainability on Earth as well as innovations in green space engineering practices and discussions of incentives for their adoption.

The symposium also showcased country case studies from Austria, India and Nigeria where representatives gave briefings on technical initiatives using space applications to support their national policies against climate change.

The participants of the Symposium had a unique opportunity to access technical training and data sets thanks to the partnership between the Office and the European Space Agency, the Indian Space Research Organization, the National Aeronautics and Space Administration, the Earth Observation Data Centre and the European Centre for Medium-Range Weather Forecasts.

Partners delivered five online training sessions bolstering the capacity of participants to utilize space data and applications for climate action. Topics varied from green space engineering practices such as life cycle assessment and ecodesign to using Earth observation applications for climate analysis. The online nature of the sessions effectively extended the reach of the capacity-building activities, especially for the benefit of developing countries where such opportunities may not be available. Through virtual participation, people could attend free of charge. In total, the symposium and training sessions reached over 2,300 participants from 104 countries.

All the materials are available on the UNOOSA website.



Gangotri, one of the largest glaciers in the Himalayas
Credit: Copernicus Sentinel data/ESA

NEW AGREEMENT ON SPACE ECONOMY SIGNED WITH UNITED NATIONS DEVELOPMENT PROGRAMME AND BRAZILIAN SPACE AGENCY

UNOOSA boosted its efforts to deliver thriving, responsible and sustainable national space economies by entering into a new partnership with the United Nations Development Programme and the Brazilian Space Agency (AEB). The partnership focuses on strengthening the Brazilian space sector through specialized technical assistance. Through the agreement, the partners will support AEB throughout 2023 and 2024 to further develop the national space sector for socioeconomic development and enhance the cooperation between AEB and public and private stakeholders.

The funds will be used to conduct research on the Brazilian space sector, develop e-learning material and training for the Brazilian space workforce and organize the first UN-Space Economy Conference in 2024.

The Space Economy initiative sees UNOOSA working with policymakers in governmental institutions and the private sector from countries that are either embarking upon new phases of space activities or in the early stages of space sector development.
A capacity-building service, the Space Economy initiative is tailored to support countries in scaling up growth to deliver strong and sustainable national space economies, increase global awareness and understanding of how space sector growth can reinforce socioeconomic development and enhance cooperation across the global space sector.

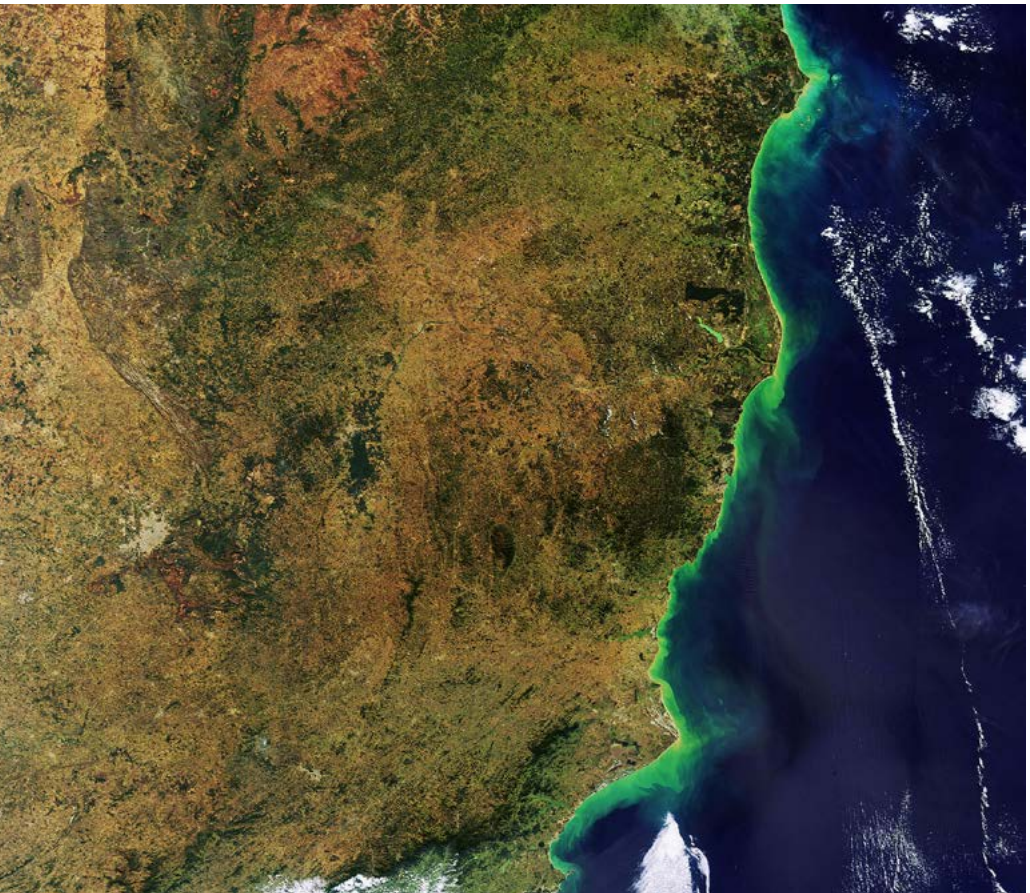


Image of the Brazilian coast mostly covered by Atlantic Forest
Credit: ESA

Participants following a panel at the venue
Credit: CNSA

Acting Director of UNOOSA addressing the Workshop
Credit: CNSA

UNITED NATIONS/CHINA SECOND GLOBAL PARTNERSHIP WORKSHOP ON SPACE EXPLORATION AND INNOVATION

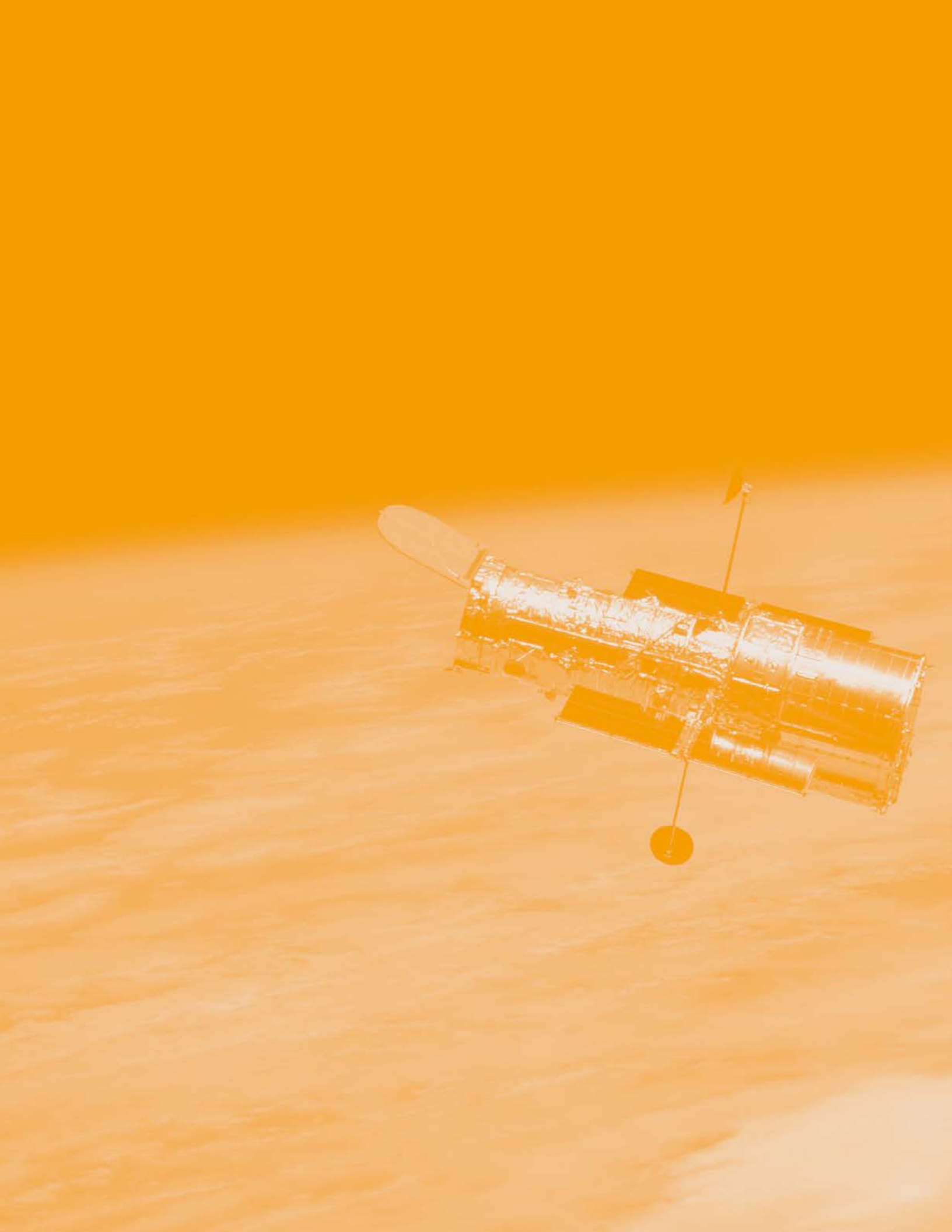
This hybrid event in November in Haikou, China, offered stakeholders from space agencies, international organizations, academia, industry and private sectors a platform for building partnerships and strengthening international cooperation in the peaceful uses of outer space and in the global governance of outer space activities.

In his congratulatory letter to the inauguration segment of the Workshop, the President of China reaffirmed the willingness of China to work with all countries to strengthen exchanges and cooperation to jointly explore the mysteries of the universe, make peaceful use of outer space and promote space technology to benefit people around the world.

Among the key outcomes of the Workshop was the consensus that global partnership in capacity-building and the transfer of technology are indispensable for the realization of the common objective of the peaceful use of outer space.

A total of 520 people from 82 countries registered for the event. Two-thirds of the participants were from developing countries.

All presentations are available on the UNOOSA website.



The Hubble Space Telescope orbits with the Earth in the background
Credit: NASA

The importance of space law in creating a thriving and sustainable space sector is undeniable. In 2022, the international community commemorated many milestones as apt reminders of the need to preserve space for future generations and the Office continued to increase the understanding and application of the international legal regime governing outer space activities.

4

IN FOCUS: SPACE LAW UNDERPINNING SAFE AND SUSTAINABLE USE OF SPACE

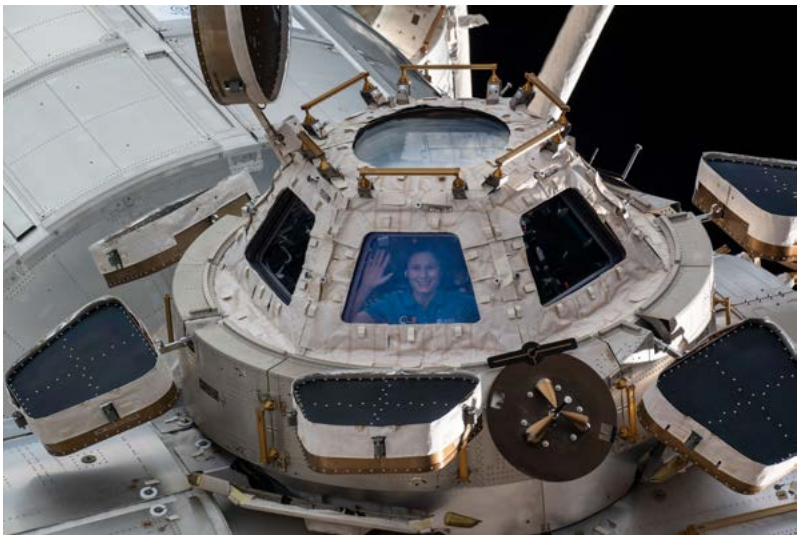
4 | IN FOCUS: SPACE LAW UNDERPINNING SAFE AND SUSTAINABLE USE OF SPACE

SIXTY YEARS OF SPACE OBJECT REGISTRATION

In 2022, the space community celebrated the sixtieth anniversary of the United Nations Register of Objects Launched into Outer Space. In the early 1960s, the General Assembly requested space nations to voluntarily register their satellites with the Secretary-General to help the newly established COPUOS develop laws governing activities in humanity's newest frontier. Eventually, States adopted the Convention on Registration of Objects Launched into Outer Space in 1975 which entered into force in 1976. The Secretary-General received the first information for the new Register established under the Convention in April 1977. The initial Register is still used today by countries who are yet to join the Registration Convention.

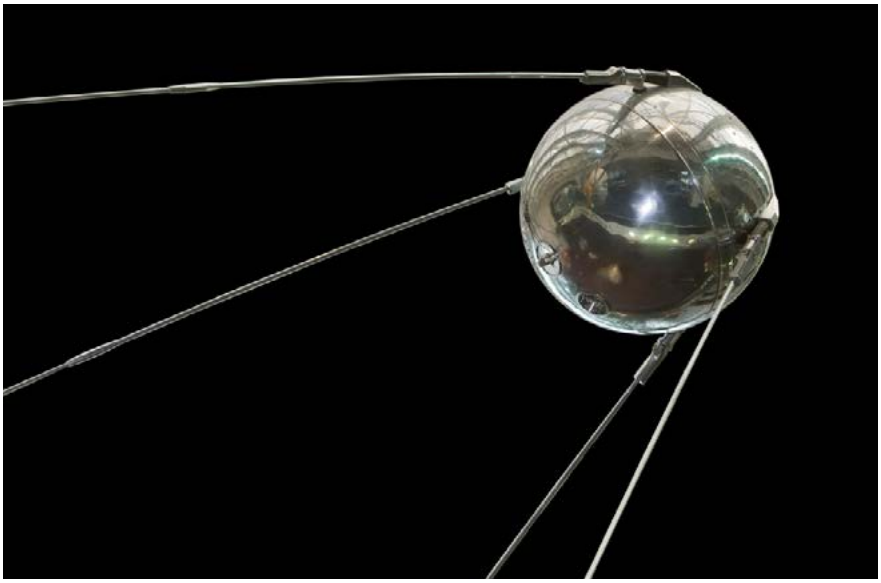
UNOOSA is responsible for discharging the obligations of the Secretary-General under the treaties, principles and General Assembly resolutions on space and in this role maintains the Register. Drawing on six decades of expertise in this area, the Office provides technical assistance to States and international intergovernmental organizations in implementing their treaty obligations, including the registration of space objects.

In 2022, more than 2,050 satellites were registered breaking the annual record for the third time in succession. This means that submissions for about 15 per cent of all the objects ever registered with the United Nations were delivered in 2022 alone. These figures reflect the swift pace of development in the sector and the need for the organization to proactively engage Member States to find actionable solutions for advancing registration practices.



ESA astronaut Samantha Cristoforetti looking out of the cupola of the ISS Credit: ESA/NASA

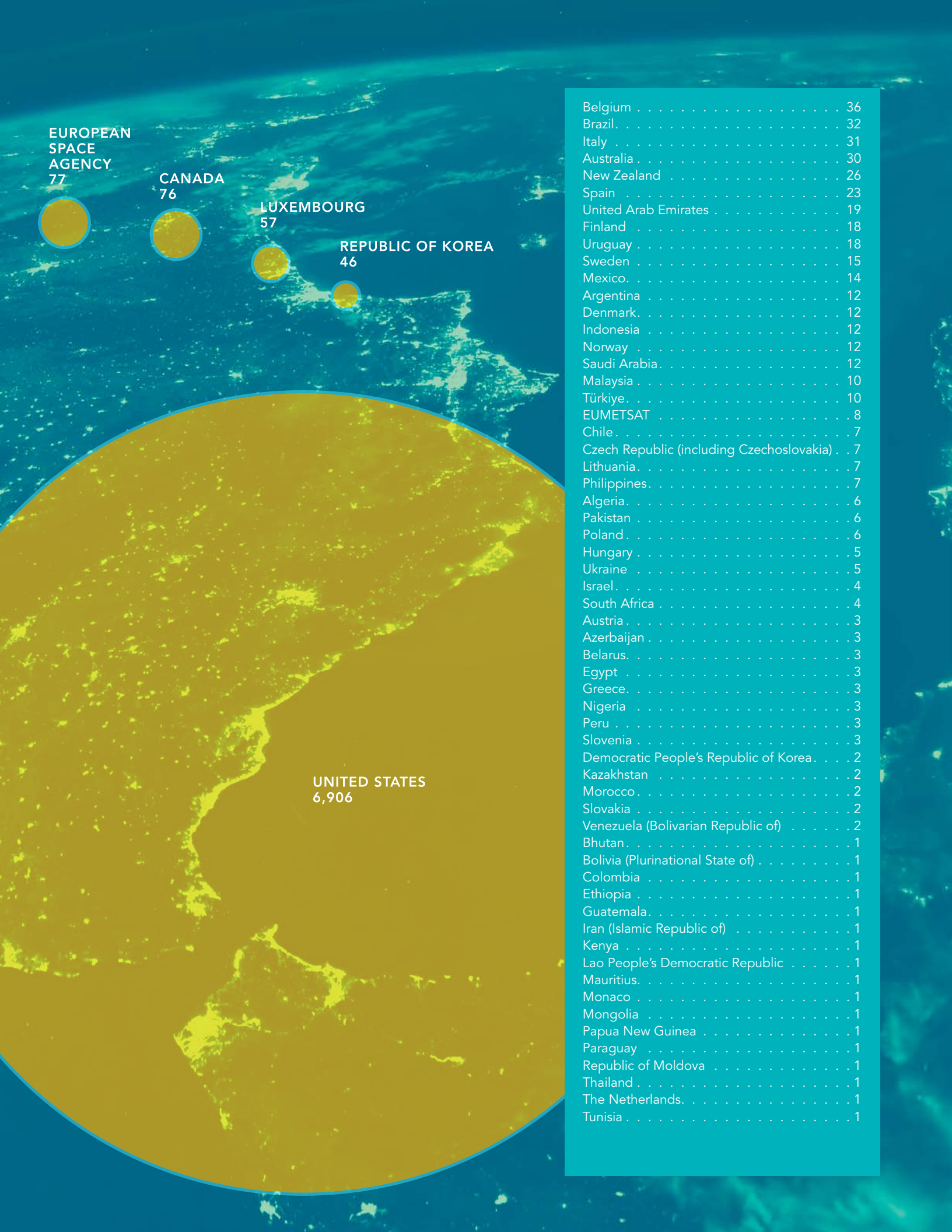
Satellites launched into Earth orbit or beyond



A model of Sputnik 1, the first-ever artificial satellite in Earth orbit
Credit: Mark Thiessen, National Geographic

Sixty years after the very first object was registered with the United Nations, over 70 States and two international organizations have registered over 88 per cent of all satellites, probes, landers, crewed spacecraft and space station flight elements launched into Earth or beyond since 1957. As of 1 April 2023, of the approximately 10,290 satellites still in Earth orbit, nearly 7,800 are operational.

Total space objects registered 1957–2022



Belgium	36
Brazil	32
Italy	31
Australia	30
New Zealand	26
Spain	23
United Arab Emirates	19
Finland	18
Uruguay	18
Sweden	15
Mexico	14
Argentina	12
Denmark	12
Indonesia	12
Norway	12
Saudi Arabia	12
Malaysia	10
Türkiye	10
EUMETSAT	8
Chile	7
Czech Republic (including Czechoslovakia)	7
Lithuania	7
Philippines	7
Algeria	6
Pakistan	6
Poland	6
Hungary	5
Ukraine	5
Israel	4
South Africa	4
Austria	3
Azerbaijan	3
Belarus	3
Egypt	3
Greece	3
Nigeria	3
Peru	3
Slovenia	3
Democratic People's Republic of Korea	2
Kazakhstan	2
Morocco	2
Slovakia	2
Venezuela (Bolivarian Republic of)	2
Bhutan	1
Bolivia (Plurinational State of)	1
Colombia	1
Ethiopia	1
Guatemala	1
Iran (Islamic Republic of)	1
Kenya	1
Lao People's Democratic Republic	1
Mauritius	1
Monaco	1
Mongolia	1
Papua New Guinea	1
Paraguay	1
Republic of Moldova	1
Thailand	1
The Netherlands	1
Tunisia	1

NEW PARTNERSHIP TO BOOST REGISTRATION PRACTICES

The Register is a key Treaty-based transparency tool and is ever more relevant to safe, secure and sustainable operations in this unique domain with the outlook of tens of thousands of new satellites reaching orbit this decade. Modernizing the registration of space objects is a prerequisite for advancing joint efforts in coordinating space traffic.

UNOOSA and the United Kingdom established a new partnership aimed at enhancing international expertise in the registration of space objects at the national level, as well as with the United Nations Register of Objects Launched into Outer Space, which UNOOSA maintains on behalf of the Secretary-General. The partnership creates a baseline understanding of good practices, lessons learned, capacity-building and challenges related to the registration of space objects. Funding for the project will be used to conduct an interview series with national registration focal points; host an international expert event; and prepare a stakeholder study report on the experiences of Member States in implementing international law, including the Registration Convention that was drafted by the Committee on the Peaceful Uses of Outer Space (COPUOS) and adopted by the General Assembly.

Sixty-fifth session of COPUOS at the Vienna International Centre
Credit: UNIS

COMMITTEE ON THE PEACEFUL USES OF OUTER SPACE CONVENED FOR THE SIXTY-FIFTH TIME

The General Assembly established COPUOS as its specialized permanent committee in 1959 to address the exploration and use of outer space for the benefit of all humanity. For over 60 years, it has provided a unique intergovernmental platform for discussing perspectives, needs and solutions in space affairs. Over this period, the agenda on the table of COPUOS and its subcommittees has been constantly evolving to remain fit-for-purpose and responsive to the latest trends. COPUOS has 102 States members representing around 90 per cent of the population. By the decision of the General Assembly, on 15 December 2022, Guatemala and Uzbekistan became the latest countries to join the Committee. In addition, 49 permanent observer organizations from around the world also attend the meetings of the Main Committee and its subcommittees.

Newly appointed Chair of COPUOS, Omran Sharaf of United Arab Emirates
Credit: UNIS

Signing of the Outer Space Treaty
Credit: United Nations

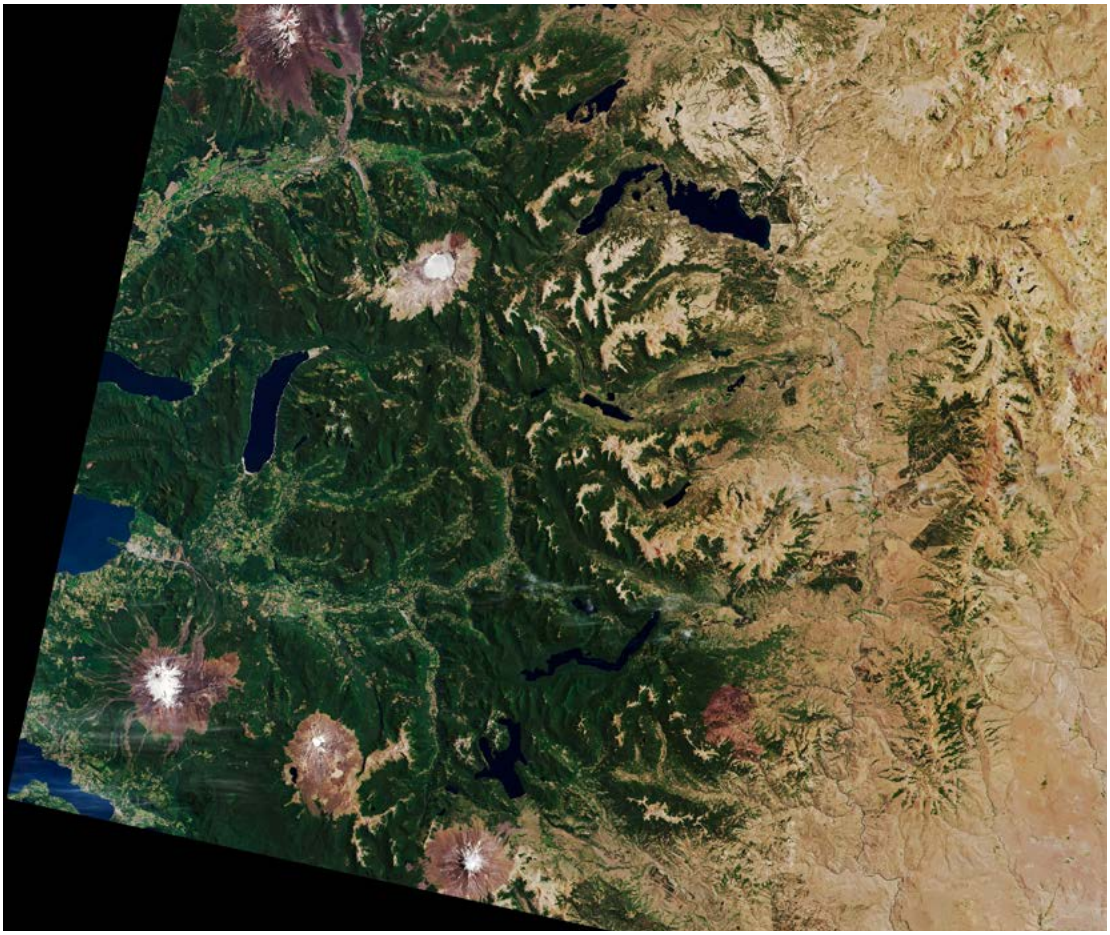
The sixty-fifth session of COPUOS continued to break previous records of participation and engagement. Representatives from 87 States members attended the session. In addition to countries, five United Nations entities, eight intergovernmental organizations and 14 non-governmental organizations attended the meeting.

Omran Sharaf (United Arab Emirates) was elected Chair of the Committee, Jenni Tapio (Finland) was elected First Vice-Chair, and Oleg Ventskovsky (Ukraine) was elected Second Vice-Chair/Rapporteur for the period 2022–2023. At the same meeting, the Committee endorsed the election of Juan Francisco Facetti (Paraguay) as Chair of the Scientific and Technical Subcommittee and Nomfuneko Majaja (South Africa) as Chair of the Legal Subcommittee for the period 2022–2023.

THE MAGNA CARTA OF SPACE LAW CELEBRATES ITS FIFTY-FIFTH ANNIVERSARY

In 2022, the Outer Space Treaty, the magna carta of international space law that outlines the key provisions and rules for the conduct of space operations in Earth orbit and beyond, celebrated 55 years since its entry into force on 10 October 1967. The Treaty was negotiated in sessions of the Legal Subcommittee of COPUOS in 1966 and eventually adopted by the General Assembly in resolution 2222 (XXI) of 19 December. It opened for signature by the three depository Governments (the Russian Federation, the United Kingdom and the United States of America) in January 1967. As of December 2022, 112 countries are parties to the Treaty.

The date of the entry into force of the Treaty is recognized as one of the major milestones in space affairs reflected by its selection as the closing day of World Space Week, an annual celebration that runs between 4 and 10 October. The first day of World Space Week reminds us of the launch of Sputnik 1 in 1957. In 2022, to commemorate these milestones, UNOOSA organized a series of virtual events on *Sustainability from space: Satellites as our eyes towards a better future* and *Sustainability in space: Responsibility today means progress tomorrow.* Recordings of these webinars are available on the UNOOSA YouTube Channel.



The slopes of Villarrica volcano in the southern Andes Mountains Credit: NASA

UNITED NATIONS/CHILE CONFERENCE ON SPACE LAW AND POLICY: "GOVERNANCE AND LEGAL PERSPECTIVES ON SPACE ACTIVITIES IN EARTH ORBIT AND BEYOND"

The Space Law Conference series organized by the Office since 2002 continued with another edition. With the support of the Government of Chile, the Chilean Air Force and the National Academy of Political Studies, the Office organized the virtual Conference in May 2022 that attracted participants from 68 countries.

A broad range of topics was addressed during the Conference including the overview of the legal regime of outer space, perspectives on space traffic management, governance of space resources, and the safety, security and sustainability of outer space activities in the context of overall governance perspectives. Participants together considered trends and challenges in contemporary international space law and agreed that COPUOS and its subcommittees remain instrumental in serving as the international forum for strengthening governance and cooperation. Furthermore, they underscored the importance of collaboration and multilateralism in global governance as well as the need for greater coordination among different actors. Capacity-building also needs to be further encouraged so that States derive the maximum benefits offered by space.

The recordings and presentations are available on UNOOSA website.

SPACE LAW FOR NEW SPACE ACTORS

Responding to the growing number of requests for legal advisory services provided by the Office, the Space Law for New Space Actors project was established in 2019 to help Member States enhance their capacity to develop national legislation in line with international space law. In 2022, the Office delivered six technical advisory missions that included regional technical advisory missions to Asia and the Pacific region, as well as to the African region, and tailor-made events for the national authorities of Malaysia, the Philippines, Rwanda and Thailand delivered thanks to the support of the Government of Japan and the Government of Luxembourg.

In December, the Office welcomed 15 countries to the Vienna International Centre for a tailored in-person technical advisory mission, namely: Algeria, Angola, Côte d'Ivoire, Egypt, Ethiopia, Gabon, Ghana, Kenya, Morocco, Namibia, Nigeria, Rwanda, South Africa, Tunisia and the United Republic of Tanzania. Subject matter experts briefed participants on numerous topics, including the scope of application of national space law, registration, authorization and supervision, insurance, frequency allocation, the safety of space operations and legal aspects of setting up a spaceport. A scenario-based exercise during which participants worked in teams to solve practical issues helped identify specific gaps and needs in the current national laws and regulations. As the next step, UNOOSA plans to conduct in-country technical advisory missions to the African countries requesting support.

UNOOSA also delivered a series of lectures to students enrolled in the Space Engineering International Course at the Kyushu Institute of Technology to teach space law and policy and explain the importance of responsible and sustainable use of the space environment.

Technical advisory mission for African countries hosted in Vienna
Credit: UNOOSA

Technical advisory mission to the Philippines
Credit: Philippine Space Agency

The Space Law for New Space Actors project is generously supported by the Governments of Belgium, Chile, France, Japan and Luxembourg, and the Asia-Pacific Space Cooperation Organization (APSCO), Kyutech and the Secure World Foundation.

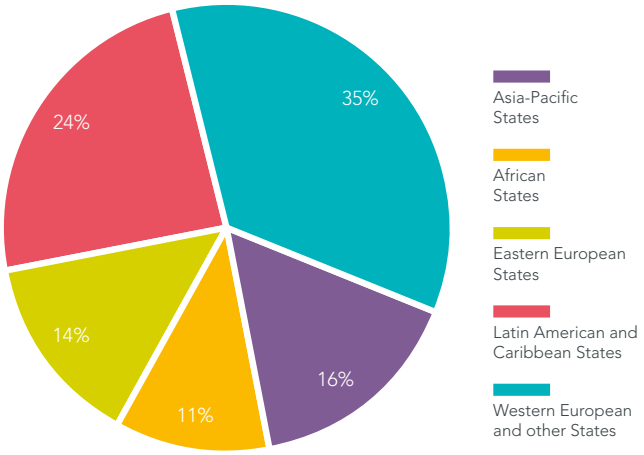
AWARENESS-RAISING AND CAPACITY-BUILDING

In 2022, UNOOSA and the Government of the United Kingdom solidified their partnership to bolster space sustainability. Efforts continued to raise awareness and build capacity related to the implementation of the Guidelines for the Long-term Sustainability of Outer Space Activities. Under the project, the Office produced a stakeholder study report on the implementation of the Guidelines. The report highlights key elements gathered in 42 anonymous interviews through which the Office collected views of States members of COPUOS and international intergovernmental organizations about implementation experiences, challenges to as well as actions for improving implementation, and assistance they might need for scaling up sustainability efforts. The interviews were framed around the four sections of the Guidelines (A-D) and the substantive preamble.

In general, the interviewed representatives of countries and international intergovernmental organizations consider the adoption of the Guidelines in 2019 a landmark achievement in space policy and space diplomacy, as well as a crucial step towards protecting the Earth's orbital space environment and ensuring equitable access to the benefits of exploration and use of outer space for peaceful purposes. At the same time, interviewees agreed that further steps are needed to support the implementation of the Guidelines – both at national and international levels.

The report and other awareness-raising materials on the Guidelines are publicly available on the project website.

Regional groups of interviewed Member States



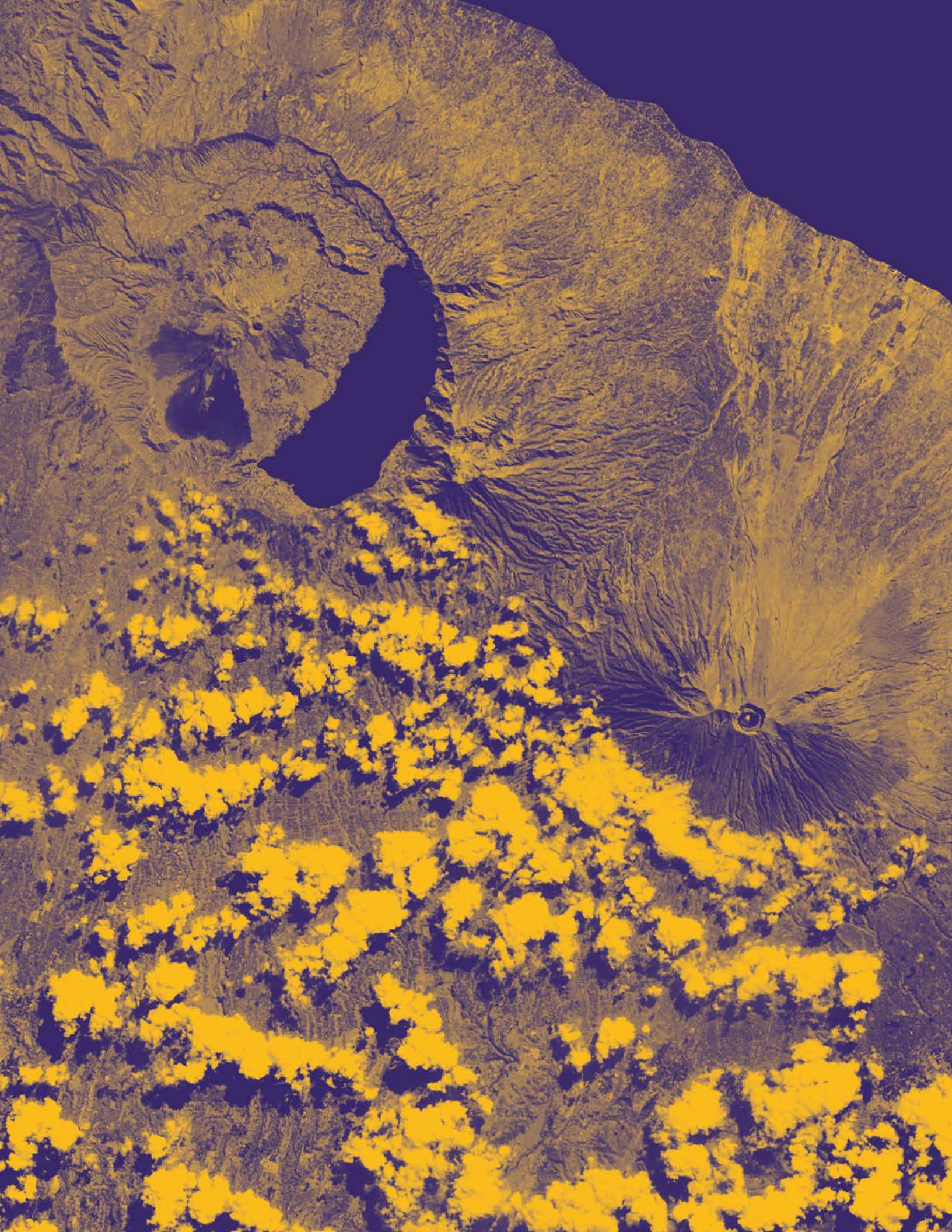
Cover page of the Stakeholder Study Report
Credit: United Nations

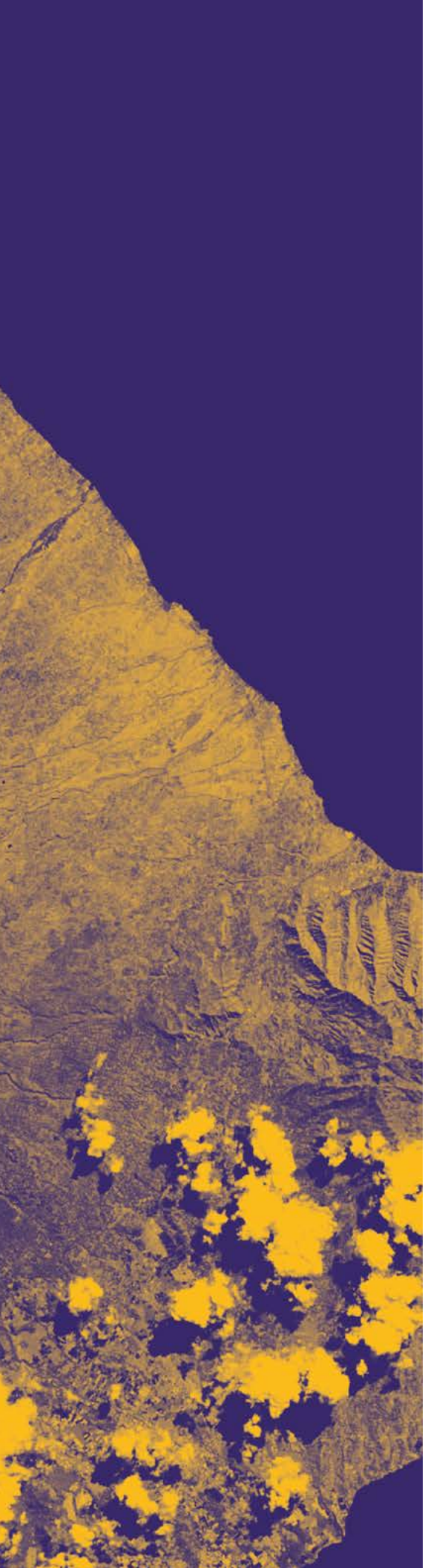
Some perspectives shared
in the Stakeholder Study:

> *A conversation on capacity-building needs and requirements will help countries promote sustainability.*

> *Legal certainty is one of the best incentives that a Member State can offer to its space sector.*

Twenty-seven rocket engines firing in a close-up image of a Falcon Heavy rocket
Credit: SpaceX





Mount Seraya (top left) and Mount Agung (centre) volcanoes on the island of Bali, Indonesia
Credit: Copernicus Sentinel Data / ESA

Building resilient communities in the light of the climate crisis is paramount for saving lives, preventing damage and facilitating recovery efforts. Boosting access to space benefits is among the key avenues to achieving this with the data and information generated by satellites underpinning informed decisions and policies in managing disaster risks. Explore how the UN-SPIDER programme helped deliver access to and advance the use of space for disaster management.

5

LEVERAGING SPACE FOR DISASTER RISK REDUCTION AND MANAGEMENT

5 | LEVERAGING SPACE FOR DISASTER RISK REDUCTION AND MANAGEMENT

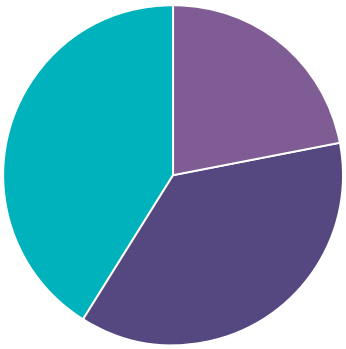
Disaster risks are among the most dire challenges to sustainable development, often erasing decades of progress in socioeconomic indicators and targets. The climate crisis turbocharges these risks, accentuating the need for improved adaptation and resilience across all levels. Technologies and capabilities that facilitate preparedness and response to disasters are vital. In this context, space assets are among the key tools. Investing in space, however, requires considerable financial and other types of resources and not all countries can afford such investments. The international community should maximize efforts to enhance access to and use of these technologies.

The UN-SPIDER programme managed by the Office helps build capacity for utilizing space in disaster risk reduction. At the request of Member States, UN-SPIDER experts deliver technical advisory missions assessing existing space-related capabilities. In over 15 years since its inception, the programme has conducted 41 such missions and produced recommendations on topics such as policy and coordination; data access, availability and sharing; capacity-building; institutional strengthening; early warning; and preparedness and emergency response efforts. These recommendations are integral in institutionalizing the use of space-based information in disaster management. Following these missions, experts deliver technical advice and training activities tailored to the needs of a country to strengthen local Earth observation capacity. In total, the programme has delivered 100 missions.

The main office of UN-SPIDER is based in Vienna, with additional dedicated offices in Beijing and Bonn. The latter are funded by the generous financial support of the Governments of China and Germany. Global support for the programme is provided by 27 regional support offices (RSOs) hosted by space agencies, universities, research institutions and civil protection entities. On a voluntary basis, the RSOs provide regional coverage for UN-SPIDER activities, offering valuable support from institutions specialized in Earth observation, disaster risk reduction and emergency response. With their expertise, services and content, they also contribute to the UN-SPIDER Knowledge Portal.

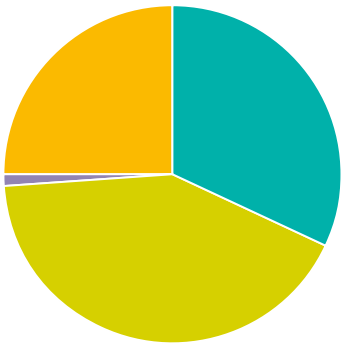
MISSIONS DELIVERED BY UN-SPIDER SINCE INCEPTION

Type of mission



Expert	22
Institutional strengthening	37
Technical advisory	41
Total	**100**

Region



Africa	32
Asia	42
Europe	1
Latin America and the Caribbean	25
Total	**100**

41 **UN-SPIDER technical advisory missions**

Armenia
Bangladesh
Bhutan
Burkina Faso
Cabo Verde
Cameroon
Chile
Dominican Republic
Ecuador
El Salvador
Fiji
Gabon
Georgia
Ghana
Guatemala
Haiti
Honduras
Jamaica
Kenya
Lao People's Democratic Republic
Malawi
Maldives
Mongolia
Mozambique
Myanmar
Namibia
Nepal
Nigeria
Paraguay
Peru
Philippines
Samoa
Solomon Islands
Sri Lanka
Sudan
Togo
Tonga
Tunisia
Viet Nam
Zambia
Zimbabwe

UN-SPIDER TECHNICAL ADVISORY SUPPORT TO MEMBER STATES IN 2022

Armenia

The technical advisory mission to Armenia took place from 27 June to 1 July 2022 to identify existing capacities and needs related to using space-based information in disaster management efforts. Experts briefed the Ministry about the opportunities offered by the space community and visited 10 government agencies, including the Ministry of Emergency Situations. A meeting was also organized with the United Nations country team, which supports the coordination of national disaster management efforts. The experts took note of the use of geographic information systems by many of the institutions visited and of their efforts to make better use of satellite imagery to analyse natural hazards in the country.

Dominican Republic

UN-SPIDER experts, supported by the national office of the United Nations Development Programme, organized two webinars to train new members of the Geospatial Information Team for Disaster Management. The Comisión Nacional de Emergencias de la República Dominicana founded the team in 2012 following the recommendation of UN-SPIDER. It comprises professionals and specialists from more than 15 organizations in the Dominican Republic with skills related to geographic information systems and remote sensing. The team now contributes to disaster risk reduction, preparedness and response efforts by generating relevant space-based and geospatial information.

Hispaniola and the Caribbean photographed from ISS
Credit: NASA

UN-SPIDER experts delivering a technical advisory mission to Armenia
Credit: UNOOSA

Participants to the mission conducted by UN-SPIDER in Ghana
Credit: UNOOSA

Ghana

An institutional strengthening mission to Ghana in May helped plan an earthquake simulation exercise organized by the National Disaster Management Organization and numerous government agencies supported by the National Guard of North Dakota. The exercise was based on a hypothetical earthquake impacting the southern region of Ghana, triggering impacts in communities and several sectors of development. UN-SPIDER proposed a simulated activation of the International Charter on Space and Major Disasters to raise awareness about the provision of space-based information for disaster response efforts provided by this emergency mechanism, free of charge, to national disaster management agencies.

Nigeria

In September, UN-SPIDER delivered an institutional strengthening mission to Nigeria as requested by the National Space Research and Development Agency (NASRDA). Experts continued to raise awareness of the benefits of disaster management applications enabled by space technologies. The mission included a three-day workshop on the use of emergency operations centres to coordinate the response of government agencies and the international community in the case of large floods in Nigeria. Over 100 participants from Nigeria attended the workshop that featured presentations by several institutions and a simulated activation of the International Charter on Space and Major Disasters.

Paraguay

At the request of, and in coordination with, the Paraguayan Space Agency, UN-SPIDER experts carried out a technical advisory mission to Paraguay in November to encourage government agencies and stakeholders to take full advantage of the opportunities offered by the space community in the use of space-based information, services and products for disaster management. The mission team visited several government agencies, including the National Emergency Secretariat and two universities, and met with the United Nations Resident Coordinator and colleagues at the United Nations Development Programme. Experts noted the use of geographic information systems by those institutions and their efforts to advance the use of satellite imagery to analyse natural hazards in the country. A workshop organized during the mission welcomed over 20 participants to discuss ways to enhance inter-institutional cooperation, information-sharing of geospatial data and capacity-building needs to address the challenges posed by natural hazards.

Philippines

In September, UN-SPIDER delivered a technical advisory mission to the Philippines at the request of the Philippine Space Agency and in coordination with the National Disaster Risk Reduction and Management Council of the Philippines. This mission identified existing capacities and needs related to the use of space-based information in disaster management efforts and helped the Agency and the Council take full advantage of opportunities made available by the space community. The mission included a national workshop, with more than 130 participants from various institutions in the Philippines, which raised awareness among stakeholders about the ongoing disaster management efforts in the country and elicited their input on current challenges to maximizing the use of space-based information in disaster management.

Moderate Tropical Storm Ana shortly after landfall in Mozambique
Credit: NOAA

Group photo taken during the UN-SPIDER technical advisory mission to the Philippines
Credit: Philippine Space Agency

EMERGENCY SUPPORT

As part of its activities, UN-SPIDER facilitated the activation of the International Charter on Space and Major Disasters on several occasions at the request of national disaster management agencies. The Charter is a worldwide collaboration through which satellite data are made available for disaster relief efforts. Activations of the Charter occurred on the following occasions:

- On behalf of the National Institute of Disaster Management of Mozambique and the Department of Disaster Management Affairs of Malawi at the end of January 2022. The request was elevated owing to the very serious floods in Malawi and Mozambique triggered by Tropical Cyclone Ana that affected over 200,000 people. An expert from the Federal University of Santa Maria of Brazil, a UN-SPIDER regional support office, served as the project manager of the activation.
- On behalf of the National Institute of Disaster Management of Mozambique in response to Tropical Cyclone Gombe, which affected the northern region of Mozambique in early March 2022 and destroyed more than 45,000 homes. An expert from the Federal University of Santa Maria served as the project manager.
- On behalf of the Philippine Space Agency, at the request of the National Disaster Risk Reduction and Management Council, in response to Tropical Storm Megi which killed over 200 people in April 2022.
- On behalf of the Philippine Space Agency, at the request of the National Disaster Risk Reduction and Management Council, in response to Tropical Storm Ma-On in August 2022.
- On behalf of the National Emergency Commission of the Dominican Republic owing to the floods triggered by Hurricane Fiona in September 2022. The first hurricane to hit the country in 18 years left more than a million people without electricity and caused $375 million in damages. An expert from the Federal University of Santa Maria contributed to the activation as a value-added provider.

Tropical Storm Ma-on at its peak intensity hitting South-East Asia
Credit: NASA/NOAA

- On behalf of the Philippine Space Agency, at the request of the National Disaster Risk Reduction and Management Council, in response to Tropical Cyclone Noru in September 2022. Damage to agriculture amounted to over $62 million, affecting 166,630 hectares of land and losing almost 160,000 metric tons of produce.
- On behalf of the Permanent Contingency Commission of Honduras in response to the floods and landslides triggered by Hurricane Julia in October 2022. An expert from the Federal University of Santa Maria contributed to the activation as a value-added provider.
- On behalf of the Philippine Space Agency, at the request of the National Disaster Risk Reduction and Management Council, in response to Tropical Cyclone Nalgae in October 2022.

Eruption of the Hunga Tonga–Hunga Ha'apai volcano
Credit: Jamie Perera/Midjourney

The Coordination Centre for the Prevention of Natural Disasters in Central America and UN-SPIDER joined forces to organize a simulated activation of the International Charter. This was done as part of an exercise organized by the National Coordinating Agency for Disaster Reduction of Guatemala to enhance disaster preparedness for earthquakes. The National Space Research Institute of Brazil and Roscosmos provided archived satellite imagery for this exercise.

In addition to requesting the activation of the mechanism, UN-SPIDER continued to raise awareness of the opportunities offered by the Charter. At the request of NASRDA in Nigeria, the International Charter and UN-SPIDER joined forces to organize a virtual course in September to train nearly 50 professionals from various government agencies of Nigeria in the use of the Charter Mapper. Experts from ESA and Terradue of Italy served as instructors. The training course was carried out in preparation for a national workshop organized by NASRDA, the Centre for Remote Sensing of the University of Bonn and UN-SPIDER that included a simulated activation of the Charter in response to large floods. UN-SPIDER staff also delivered statements and presentations describing the Copernicus Emergency Mapping Service at international events and missions during the reporting period, with a view to increasing the familiarity of disaster managers worldwide with all of the mechanisms at their disposal.

Path of a tornado that swept over Texas in November 2022
Credit: NASA

NEW RESOURCES ON THE PORTAL

The UN-SPIDER Knowledge Portal, as one of the cornerstones of the programme, hosts information on activities conducted by UN-SPIDER as well as by the disaster management, emergency response and space communities. The Portal provides easy digital access to resources and recommended practices on using space technologies for disaster management.

New content items continued to be added to the Portal and by the end of 2022, their total number surpassed 9,200. On average, the Portal attracted around 40,000 monthly users with the sections such as news, events (including training events), data sources and disaster management sections seeing the highest growth rates.

Online learning plays an important role in today's digital environment and in facilitating access to these resources and enabling self-paced learning. The UN-SPIDER portal now hosts a new feature containing a selection of links to on-demand online courses offered by a variety of institutions.

The UN-SPIDER team worked on improving the information architecture, linking content that covers the same natural hazards, space technologies and UN-SPIDER activities to facilitate the discovery of relevant content in the knowledge portal and encourage users to explore related pages.

OTHER UN-SPIDER ACTIVITIES

Boosting disaster preparedness in the Asia-Pacific region

In December, UNOOSA and the Economic and Social Commission for Asia and the Pacific (ESCAP), in collaboration with the Ministry of Emergency Management of China, the Asia-Pacific Space Cooperation Organization, the Geo-Informatics and Space Technology Development Agency of Thailand and the Asian Institute of Technology, convened the Workshop on Space-based Technologies for Disaster Risk Reduction in Bangkok. The Workshop provided a forum for disaster management communities and geospatial experts to strengthen their knowledge and capabilities using space-based information to identify, assess, monitor and respond to disaster risks and to integrate space technology in long-term disaster risk management efforts. Over 130 participants from African, Asian and European countries, as well as from United Nations entities, regional and international organizations and UN-SPIDER regional support offices attended this event.

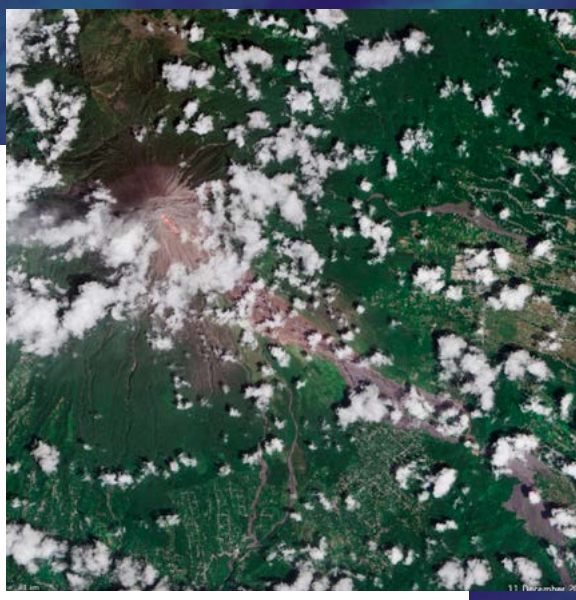
City of Bangkok with its green oasis Bang Kachao in the centre
Credit: Copernicus Sentinel data/ESA

Annual meeting of UN-SPIDER regional support offices

Representatives of 17 regional support offices got together, joined by two new candidate offices, to get briefed by UN-SPIDER on ongoing and upcoming activities. The meeting included presentations on the work carried out by all current regional support offices and candidate offices as well as sessions on topics such as the engagement of end users, gender inclusivity and the potential for cooperation between regional support offices. Participants identified joint activities to be organized in 2023 and exchanged views on potential project proposals and other resource mobilization efforts to continue implementing UN-SPIDER activities worldwide.

International Multi-Hazard Early Warning Conference

The Office, through UN-SPIDER, the United Nations Office for Disaster Risk Reduction, the World Meteorological Organization and other partners of the International Network for Multi-Hazard Early Warning Systems organized the this third Conference in Bali, Indonesia, on 23 and 24 May 2022. The Conference was attended by nearly 750 participants representing various stakeholders and included technical sessions and hands-on segments. Speakers stressed the need for adequate hazard, exposure, vulnerability and impact data and for effective, inclusive and gender-responsive early warning systems and actions. Modern information and communications technologies were emphasized as useful means to facilitate anticipatory action. Participants also stressed the accountability of governments for ensuring access to people-centred early warning systems.



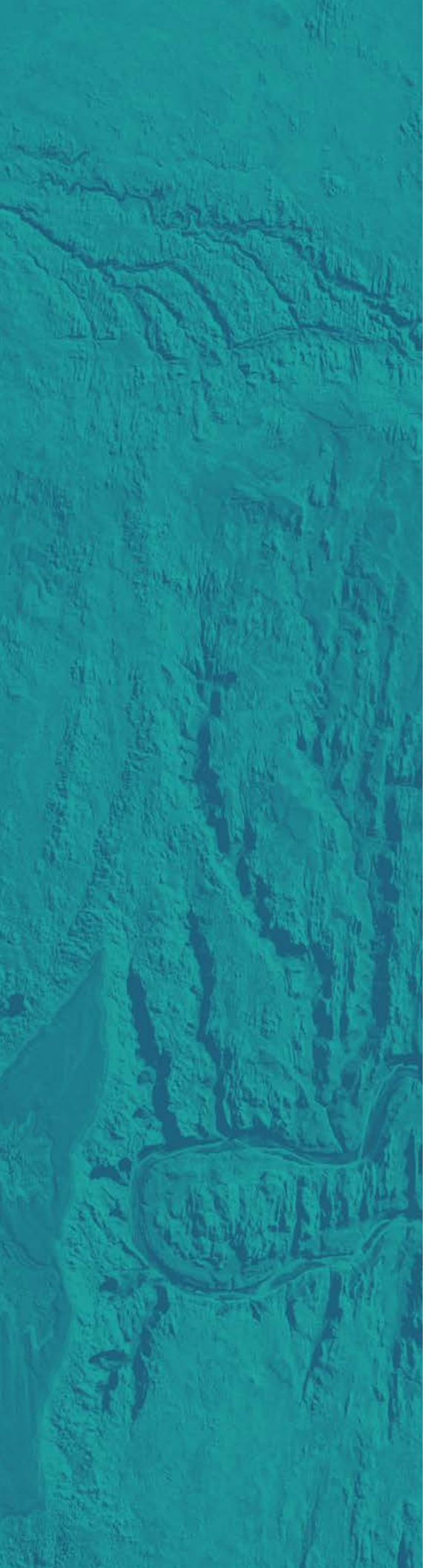
The Mount Semeru volcano in Indonesia erupting in December 2022
Credit: Copernicus Sentinel data/ESA

Networking session on Bridging the Gap: Linking the Space and Disaster Management Communities

During the Living Planet Symposium in Bonn, Germany, the German Aerospace Center and UN-SPIDER co-organized a networking session bringing together representatives from the space and disaster management communities. Participants discussed ways of using space solutions to confront the challenges posed by natural hazards and addressed challenges to gaining access to space-based information, in particular when disasters affect communication tools.

Recovery Observatory Session

UN-SPIDER participated in an awareness-raising session for decision makers on satellite initiatives supporting recovery efforts and the Recovery Observatory (RO) Demonstrator in Latin America and the Caribbean. The RO demonstrator, part of the implementation plan of the "Space2030" Agenda, will lead to a generic RO concept that can be activated on a regular basis after catastrophic events.



Colorado River in south-eastern Utah from the ISS
Credit: NASA

The midpoint of the efforts to achieve the Sustainable Development Goals is around the corner and yet, the multitude of crises the world is seeing has halted, and in some instances even reversed, progress across many indicators. Renewed commitment is crucial. Space tools are one of the key assets in reinvigorating and reinforcing our common quest towards a more equal, just and liveable planet, and they must be made more accessible. The following chapter provides an overview of UNOOSA activities in closing the space capabilities gap.

6

SPACE FOR SUSTAINABLE DEVELOPMENT

6 | SPACE FOR SUSTAINABLE DEVELOPMENT

ACCESS TO SPACE FOR ALL

The Access to Space for All initiative is a joint initiative of UNOOSA, space agencies, research institutions and industry, aimed at developing technical know-how, engineering expertise and infrastructure to support capacity-building for United Nations Member States.

The initiative provides opportunities to access space and to ensure that the benefits of space, in particular for sustainable development, are made accessible to everyone. Access to Space for All delivers results along three tracks that offer gradual learning steps and hands-on opportunities to help participants acquire capabilities in a sustainable way:

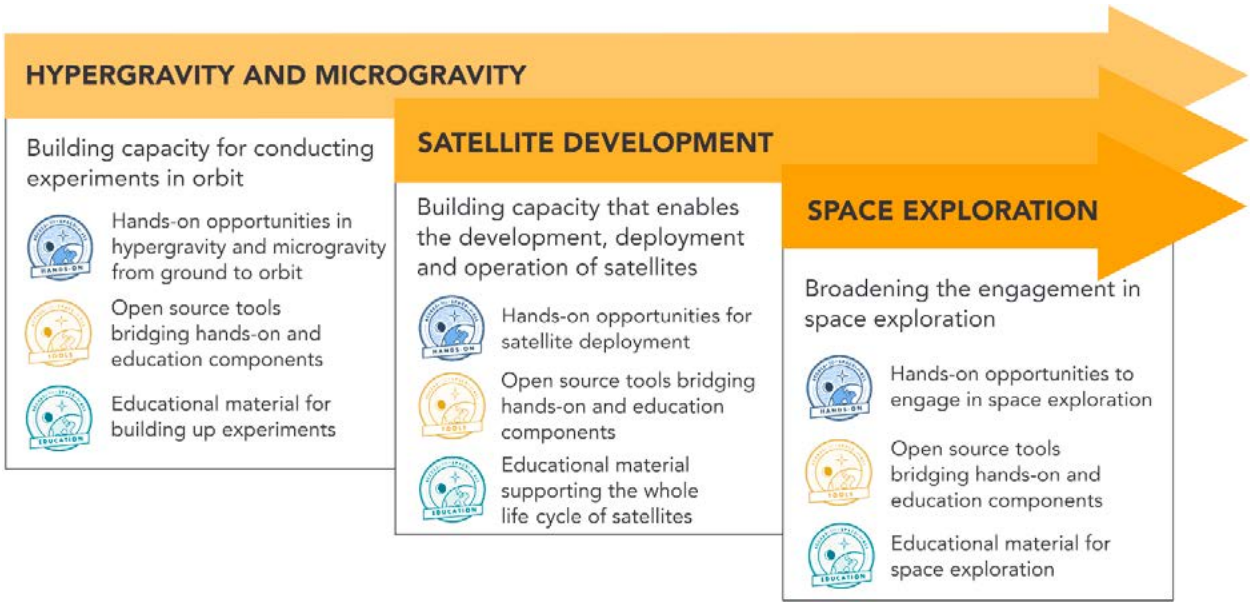
Hypergravity/Microgravity Track: aims to develop the capacity of running space experiments on board orbital vehicles or space stations

Satellite Development Track: aims to build the capacity to design, develop, test, operate and utilize a satellite

Exploration Track: aims to develop capacity relevant to space exploration beyond the geostationary orbit

Each track is underpinned by three components – hands-on, tools and education – to provide a complete capacity-building programme. Under the hands-on component, UNOOSA provides nine on-ground and on-orbit experiment opportunities. The tools component is a collection of open and free software and tools that can support the implementation of the different activities for the hands-on component. The education component provides the theoretical foundations needed to take part in the opportunities under the hands-on component and utilize the tools provided under the tools component.

SPACE4SDGS



Structure of the Access to Space for All initiative
Credit: UNOOSA

The Sustainable Development Goal 17 on Partnership for the Goals sits at the core of Access to Space for All. The initiative is generously supported by a range of partners who provide access to world-class facilities and infrastructure contributing to the development of technical and scientific capabilities. The Office is working on expanding its portfolio by engaging with the broader space community and seeking new partnerships to offer new opportunities in areas that are currently missing.

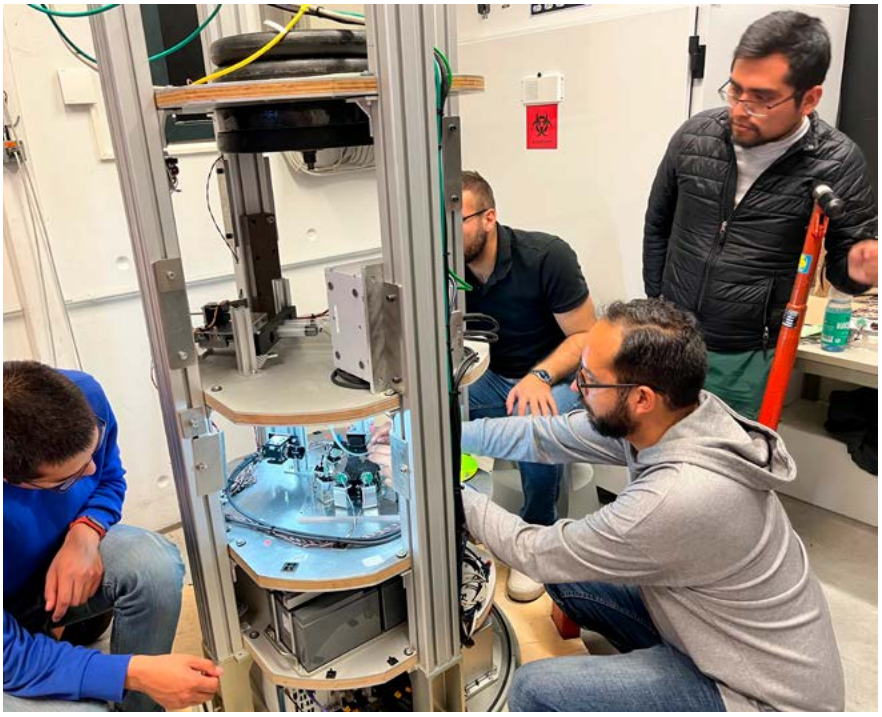
Access to Space for All is key in raising awareness about what space technology can do for the Sustainable Development Goals. The initiative actively contributes to the achievement of the SDGs as the Office requires applicants to link their project proposals with at least one of the SDGs. Many successful applications target multiple Goals. The applications the Office has received over the years collectively link to all the 17 SDGs. An interview series was started to showcase the human story behind the actors of the initiative and focuses on the contribution of their activities to the SDGs. The interview articles are available on the UNOOSA website.

DropTES

In July, a team from the Universidad Católica Boliviana "San Pablo" (UCB) of Bolivia conducted their microgravity experiment at the DropTower in Bremen, Germany. This team was selected in 2020 as the seventh round awardee of the DropTES programme delivered in partnership with the Centre of Applied Space Technology and Microgravity (ZARM) and the German Space Agency at DLR. Due to the COVID-19 pandemic, the experiment campaign was postponed until 2022.

The series of microgravity drops explored possible new applications in the field of additive manufacturing. The team tested the feasibility of 3D printing using liquid resin without any kind of structure to support the printing process. This promising technology could lead to innovations that can bring benefits to life here on Earth and in space activities. Owing to great teamwork and extensive support from ZARM, the experiment campaign was delivered on time and produced sufficient data to further educate students about additive manufacturing at UCB.

With a height of 146 metres, the Bremen Drop Tower is the only drop tower of its kind in Europe, enabling scientists and researchers from all around the globe to benefit from the longest duration of the highest quality of microgravity achievable on Earth. Microgravity experiments offer unique insights across many fields and generate knowledge and skills in different scientific disciplines. These experiments provide a beneficial first step towards capacity-building in space-related activities.



The UCB team adjusting the experiment set-up after a drop
Credit: UNOOSA

Group photo of UCB, ZARM and UNOOSA
Credit: UNOOSA

City lights in North Africa photographed by a Shenzhou-XII crew astronaut from China Space Station
Credit: CMSA

The Large Diameter Centrifuge Facility at the European Space Research and Technology Centre
Credit: ESA

Bartolomeo (Hypergravity/ Microgravity Track)

In 2022, thanks to expert advice from Airbus Defence and Space, the ClimCam team selected in the first round of the Bartolomeo programme has progressed with the detailed design of the payload and the development of the planned remote sensing camera. The camera will eventually be attached to the external platform of the European Colombus Module of the International Space Station. Once operational, the joint project proposed by a consortium from Egypt, Kenya and Uganda will monitor climate change, focusing especially on the East African region.

China Space Station (Hypergravity/ Microgravity Track)

Thanks to the progress achieved by the China Manned Space Agency (CMSA), the mission segment of the joint programme the Office launched together with CMSA in 2018, is ever closer to becoming a reality, as the China Space Station (CSS) was completed in November 2022. In parallel with this remarkable milestone, UNOOSA and CMSA have been working with the selected teams on the development of each experiment, which will utilize both the internal and external platforms of the CSS. Seven teams proceeded to the second stage by signing an agreement with CMSA and are now developing different types of experiments. These focus on space life science, biotechnology, microgravity fluid physics, microgravity combustion, astronomy and space technologies.

HyperGES (Hypergravity/ Microgravity Track)

The HyperGES programme continued opening avenues for teams from developing nations to carry out hypergravity experiments at the Large Diameter Centrifuge Facility of ESA. This unique on-ground infrastructure can create a broad gravity spectrum between 1-20G. UNOOSA and ESA opened a new round of applications and offered technical consultation sessions to increase interest in the programme and help potential applicants improve their bids. The awardees of the second round that was open for applications in 2022 will be announced in 2023.

Handover of Indonesian CubeSat to JAXA
Credit: JAXA

KiboCUBE Academy held in Tunis
Credit: UNOOSA

KiboCUBE (Satellite Development Track)

UNOOSA and JAXA continued advancing the opportunity for institutions from developing economies and economies in transition to construct a cube satellite (CubeSat) and deploy it from the Kibo module of the International Space Station. As of December 2022, the KiboCUBE programme has completed six rounds of selection and picked eight teams to be awarded the opportunity. TUMnanoSAT, the first satellite of the Republic of Moldova, was sent into space in August 2022 (see details in the Highlights chapter) as the fourth CubeSat under KiboCUBE.

In 2022, Surya University in Indonesia completed the assembly and testing and safely delivered its CubeSat to JAXA in Japan. Surya Satellite-1 is the first student satellite from Indonesia and was launched to the ISS in November 2022. However, its actual deployment into space from the ISS took place on 6 January 2023.

The satellites of the other awardees are currently under development for launch in the coming years. Teams from the Central American Integration System (SICA), Universidad Popular Autónoma del Estado de Puebla of Mexico, and the Private Higher School of Engineering and Applied Technology (ESPITA) of Tunisia are in the final stages of the design process.

UNOOSA and JAXA continued with the delivery of KiboCUBE Academy, a popular virtual lecture series covering the fundamentals of designing, manufacturing, testing, operating and utilizing a CubeSat. In addition, UNOOSA and JAXA organized the first live KiboCUBE Academy event in Tunis, and conducted an on-site facility visit and meeting with the sixth round awardee ESPITA. The presentations and recordings of KiboCUBE Academy are available on the UNOOSA YouTube Channel.

In 2022, ESPITA expanded its activities by inaugurating the Aerospace, AI and Digital Center in July, as a result of being awarded the KiboCUBE opportunity. The team plans to use the facility to develop their CubeSat, TUNSAT-1.

Postgraduate Study on Nano-satellite Technologies (PNST) Fellowship (Satellite Development Track)

UNOOSA and the Kyushu Institute of Technology (Kyutech), supported by the Government of Japan, selected three students from Mongolia, South Africa and Thailand for the master's programme, and three students from Egypt, Mexico and Türkiye for the doctoral programme. The Fellowship enables students from developing countries and non-spacefaring nations to access education focused on the whole life cycle of nano-satellite development.

The selected fellows receive a grant from the Government of Japan for the duration of their fellowship, air tickets to and from their country to Japan, and a waiver of the university-related fees granted by Kyutech. The programme equips students with knowledge of space technology that will help accelerate space activities in their countries. So far, UNOOSA and Kyutech have provided access to space education to over 60 students.

In 2022, the partners also organized a webinar with current and past fellows to share experiences with the prospective candidates and future students. The presentations and recordings along with an interview with one of the current beneficiaries are available on the UNOOSA website.

Students conducting tests
Credit: Kyutech

ISONscope (Space Exploration Track)

The two awardees from Kenya and Nigeria selected in 2021 for the ISONscope programme, a joint programme of UNOOSA and the Keldysh Institute of Applied Mathematics of the Russian Academy of Sciences (KIAM RAS), are preparing for the arrival of the telescope to be provided by KAIM RAS. A series of outreach activities were conducted by the awardees to support and strengthen science, technology, engineering and mathematics (STEM) education in their countries. One of the awardees, the Kenya Space Agency, is developing the Kenyan Space Observation and Research Telescope (K-SORT Project) in partnership with the National Museum of Kenya, to host the telescope at Olorgesailie. This prehistoric site is a renowned cultural and tourist destination blessed with excellent dark skies that attract star hunters. As such, the location will enhance the visibility of the project.

Student assembling a 1U CubeSat
Credit: Kyutech

Collection of photos taken by Space4Youth winners during their Space Camp experience

SPACE FOR YOUTH

Space4Youth Competition winners participated in the UNVIE Young Professional Space Exchange

Thanks to the generous support of the Permanent Mission of the United States to International Organizations in Vienna (UNVIE), the authors of the best essays of the 2020 and 2021 competitions had the chance to participate in the UNVIE Young Professional Space Exchange. The 2021 winners Mahlak Abdullah, Karina Berbert Bruno and Tejasvi Shivakumar, and the 2020 winners Paola Ivanova, Satrio Wickaksono and Tsz So Long attended an adult space camp organized by the University of Alabama in Huntsville, United States.

At the space camp, the winners focused on space activities and simulation scenarios such as solving possible challenges and applying procedures for the safe landing of a rocket, experiencing gravitational walking on the Moon and attending lectures on space exploration and developments. They also travelled to Washington, D.C. to meet space experts from the government and the private sector, with whom they discussed the commitment of the United States to the peaceful exploration of outer space.

In October 2022, UNOOSA and the Space Generation Advisory Council launched the fourth edition of the Space4Youth Competition with a focus on the use of space for water resources management and aquatic ecosystem preservation.

Testimonies by winners

This was one experience I will NEVER forget. My favourite parts included the conferences we had with space professionals (in a variety of fields: aerospace engineering, space policy, chemistry...) and getting to tour the White House and meet with the National Space Council and the U.S. State Department.

My fellow Space4Youth peers and company brought this trip to life. Learning about their professional backgrounds and experiences showed me a great deal about how I could move forward with my professional and academic career. Speaking and listening to different professional perspectives in the field showed me that I could combine my academic interests and not be limited to one field of study.

An unforgettable experience to say the least...

Mahlak Abdullah

First of all, the exchange programme allowed me to connect with participants around the globe and exchange cultures. Professionally, the programme has benefited me because I learned so many things about space travel and climate change – attending the space camp is an example of this. As a scientist, it was amazing to explore rocket propulsion at the United States Space and Rocket Center. Personally, I made a lot of connections and new friends. I gained a lot of motivation to pursue a career in the space sector and this programme has increased my visibility in order to do so.

Tejasvi Shivakumar

Banner for the sonification webinar
Credit: UNOOSA

SPACE FOR PERSONS WITH DISABILITIES

The power of spectacular astronomical images to inspire and spark curiosity is unquestionable, but sight is not the only way to explore space. Sonification, the use of non-speech audio to convey information, is a powerful tool to overcome this barrier. In November, the Office organized an online event to showcase sonification projects as well as discuss the challenges and opportunities for the use of sonification in the space sciences. To support workplace diversity and empowerment, UNOOSA successfully conducted three personalized internships adapted to the needs of interns with disabilities.

"Working with ADHD can be challenging in a standard workplace environment. The UNOOSA approach to designing their internships has enabled me to apply myself to the best of my ability and given me the flexibility to work in a way that makes sense for me. I am delighted to have been able to make a genuine impact."

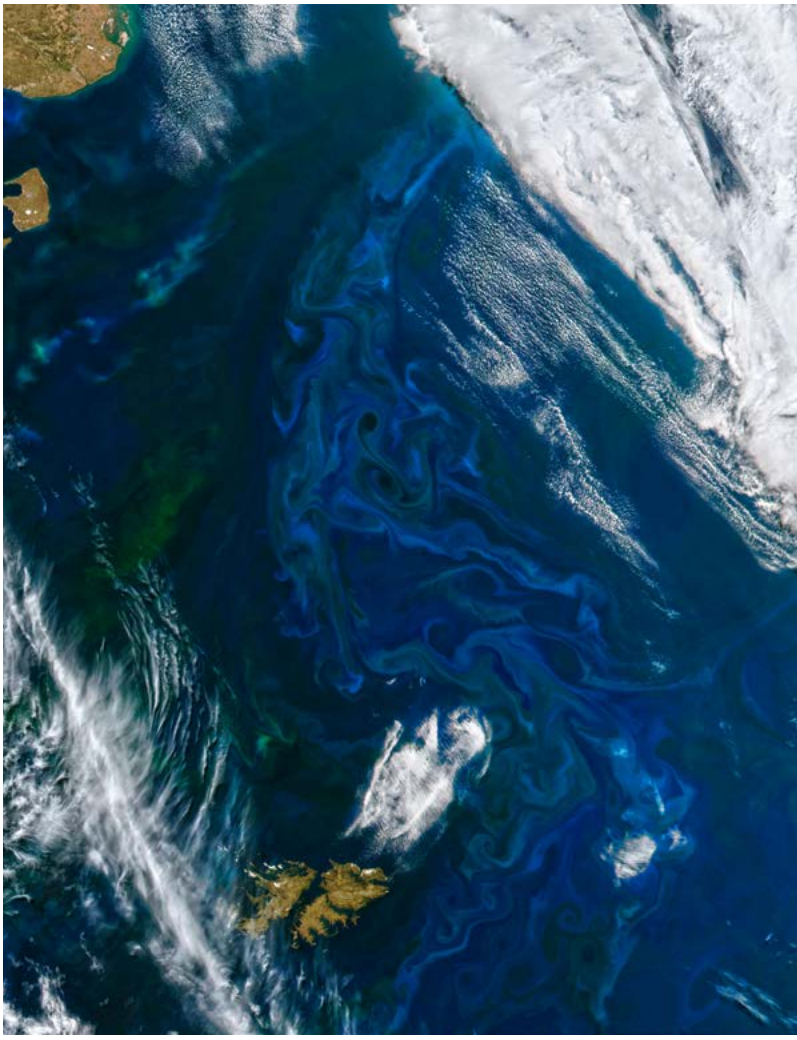
Alice Oates, intern

SPACE FOR WATER

The Space4Water Portal was launched at the beginning of the Water Action Decade in 2018 and serves as a one-stop shop for activities merging the realms of water and space. It is part of an interdisciplinary multi-stakeholder project by UNOOSA and the Prince Sultan Bin Abdulaziz International Prize for Water to foster knowledge exchange among actors in the space and water-related sectors. Currently, the Portal brings together 87 stakeholders, 25 of whom joined the project in 2022.

With its ever-growing repository of resources, the Portal is an invaluable source of information for space and water students and professionals, decision and policymakers as well as the public. Thanks to the increasing interest in the topic as well as proactive outreach throughout the year, the Portal saw year-to-year growth of 78 per cent in the number of users, bringing the total to more than 67,000 visitors. The most popular article covered the use of space technologies for the detection, monitoring and management of groundwater.

New features on the Space4Water Portal include the mapping of locations of Space4Water stakeholders and professionals as well as of local perspectives and case studies. An interactive model of the water cycle was also published.



Phytoplankton bloom in the South Pacific
Credit: NASA/Joshua Stevens

Type of content	*Content published as of 31 Dec 2022*
Stakeholders	87
(Young) professional features	33
Articles	46
Activities/opportunities	42
Publications	130
Software	22
Projects	17
Training material	89
Events	235

World Space Forum 2022: Sustainability in Space for sustainability on Earth

The World Space Forum 2022, organized from 13–15 December thanks to the generous support of the Government of Austria, provided an opportunity for space community representatives to discuss current and future activities with a focus on the landmark "Space2030" Agenda: space as a driver of sustainable development and its implementation plan.

Through its transformative power, space technology contributes to common efforts across different sectors and areas, many relevant to implementing the objectives and targets set out in the 2030 Agenda for Sustainable Development. This 2022 edition of the World Space Forum sought to raise awareness about the benefits of space applications and the need to make them universally accessible. It also aimed at putting the "Space2030" Agenda in the centre as a guiding document to enhance space-derived economic benefits and strengthen the role of the space sector as a major driver for sustainable development.

The Forum was organized in a virtual format and attracted over 1,000 registrations from different governmental and non-governmental entities. Such a broad attendance allowed the Office to effectively raise awareness on the "Space2030" Agenda with a specific goal to elevate space affairs in the context of the 2023 SDG Summit under the auspices of the General Assembly.

The recordings of the 2022 World Space Forum sessions are available on the UNOOSA YouTube.

OTHER SPACE FOR SDGS ACTIVITIES

Twenty-ninth United Nations/France/International Astronautical Federation Workshop on Space Technology for Socioeconomic Benefits

The annual UNOOSA/International Astronautical Federation Workshop on Space Technology for Socioeconomic Benefits was hosted in conjunction with the seventy-third International Astronautical Congress in Paris under the theme "Access to Space for All: Bridging the Space Divide". While the space industry is becoming ever more accessible and more nations than ever are operating satellites and engaging in exploration efforts, the gap in space capabilities is a persistent issue.

This in-person event provided a forum to discuss how space science, technologies and applications can support sustainable economic, social and environmental development and progress in science, technology and innovation policies related to space.

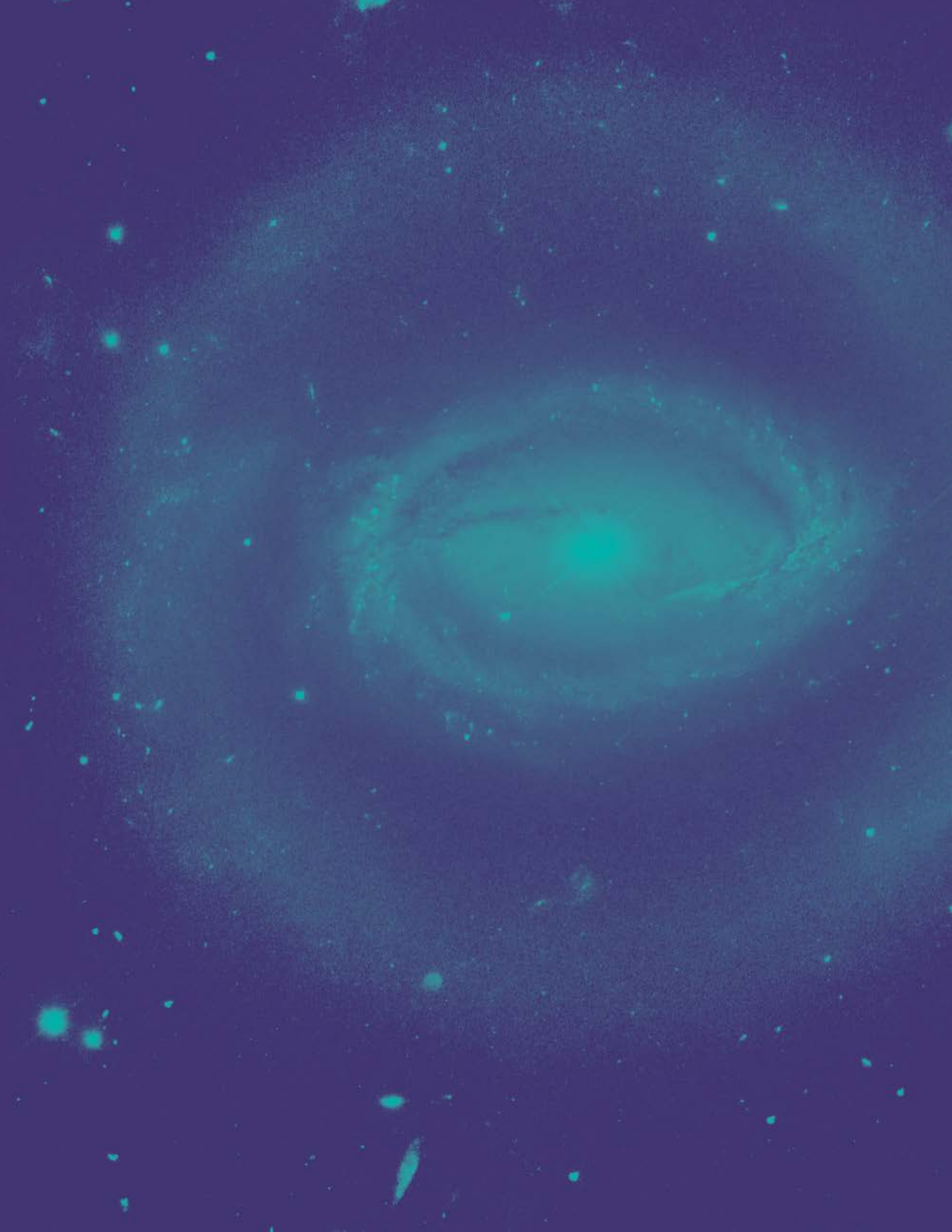
The workshop was attended by 180 participants from over 50 countries. Among the key perspectives shared by the participants was the need to strengthen efforts towards international cooperation, capacity-building and awareness-raising of the socioeconomic benefits of space, as well as continued discussions on space debris and space sustainability.

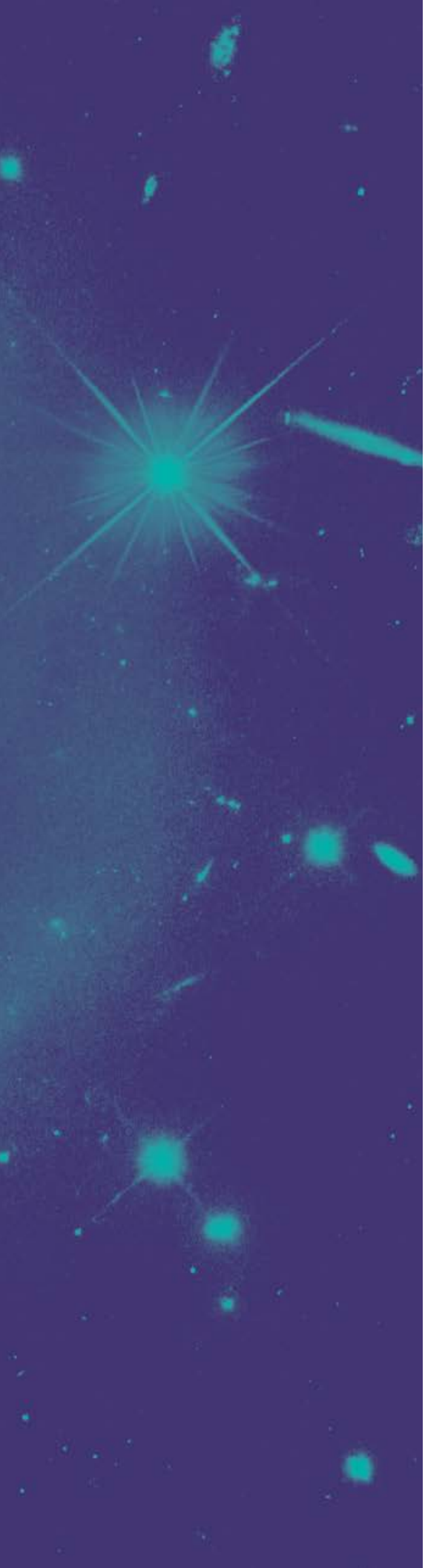
Group photo of speakers and participants
Credit: UNOOSA

Joining the space community at the biggest annual gathering

The annual International Astronautical Congress offers the opportunity for the space community to come together, share updates about contemporary and future efforts, and forge new partnerships. At the seventy-third Congress in Paris, the Office organized a small booth to promote the work of the United Nations in space and share perspectives on sustainability aspects in and from space. UNOOSA staff engaged in numerous bilateral meetings, explored synergies, made exciting announcements and promoted open and future capacity-building opportunities.

The Office engaging with the space community at the International Astronautical Congress
Credit: UNOOSA /Andrew Peebles, Martin Stasko





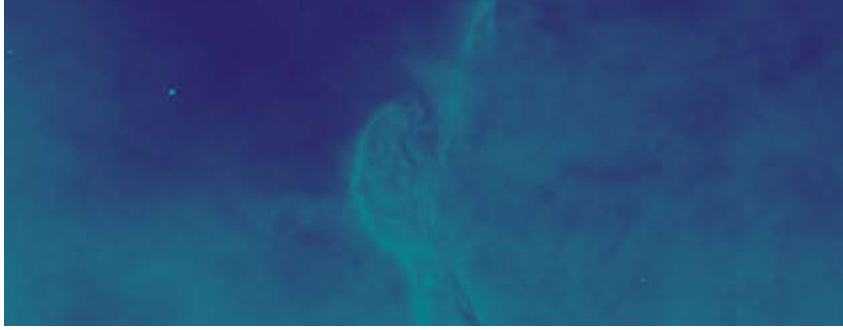
A spiral galaxy Z 229-15 captured by NASA/ESA Hubble Space Telescope
Credit: ESA/Hubble and NASA, A. Barth, R. Mushotzky

Thriving space economies depend on well-educated, skilled and motivated younger generations to become the engineers, astronauts, scientists and leaders of tomorrow. Already today, the space sector employs well over a million people and with its forecasted growth, these figures will only increase. UNOOSA fosters the next generation through space-related education and training opportunities with special focus on developing nations. Learn more about our activities in this context in the chapter focused on space education.

7

SPACE EDUCATION

7 | SPACE EDUCATION



The success and future progress of exploration efforts in space and the use of this unique environment for the betterment of life on Earth rest on the shoulders of a skilled, well-educated workforce. Currently, the industry employs over a million people and the employee base will only grow in parallel with the rapidly expanding space economy globally. Access to quality and affordable education and research opportunities is crucial for nurturing the talent of today and tomorrow so that the space sector can thrive. Delivering unique hands-on and educational opportunities remains among the top priorities for the Office as it further expands its fellowship programmes and advisory services to space agencies and research institutions in developing countries to broaden their knowledge of space applications.

The Office also provides access to online educational resources and directories of educational opportunities on many space-related topics. Endeavours such as international conferences and workshops provide additional platforms for networking and sharing actionable solutions for improving educational practices. Direct engagement with youth further raises awareness of the benefits of space and inspires future generations to pursue education and careers in fields relevant to space exploration and use. Annually, UNOOSA staff connect with students from the Central European region to talk about the work of the Office during the shadowing day organized by the United Nations Information System (UNIS) in Vienna. This chapter presents selected educational initiatives from 2022.

REGIONAL CENTRES

The network of Regional Centres for Space Science and Technology Education, affiliated with the United Nations, promotes education and research in space science and technology. The Centres are hosted at existing research and higher education institutions. Currently, six centres located in China, India, Jordan, Mexico/Brazil, Morocco and Nigeria are part of the network. This network develops skills and knowledge of individuals ranging from university educators, scientists and government officials through theory, research, applications, field exercises and pilot projects in space science and technology.

Delivering quality education requires a common standard of teaching. Education curricula developed by the Office focus on all major fields of space applications, including satellite meteorology, climate, SatComs, space and atmospheric science, remote sensing, as well as GIS and GNSS. These materials are open source and available to other educational institutions and training initiatives free of charge.

The Regional Centres also actively support the work of UN-SPIDER efforts. For example, the Centre for Space Science and Technology Education in Asia and the Pacific (CSSTEAP), based in India, regularly provides experts for the technical advisory missions and capacity-building endeavours of UN-SPIDER in Asia. Additionally, the Centres conduct routine postgraduate programmes related to the SDGs. The following section presents highlights from the work of selected Centres in 2022.

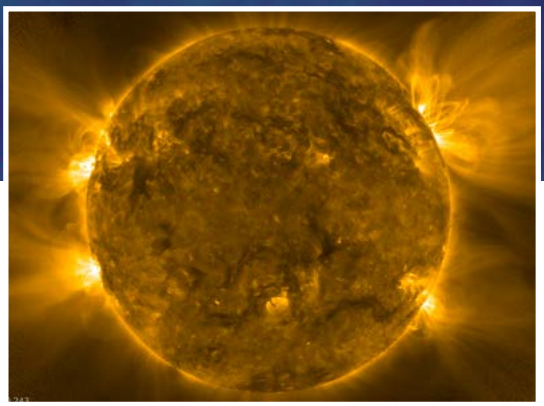


Image from a close approach of the Sun by the Solar Orbiter spacecraft
Credit: ESA and NASA/Solar Orbiter/EUI Team

The capital of China captured by Sentinel-2
Credit: Copernicus Sentinel Data/ESA

African Regional Centre for Space Science and Technology Education – in French

Each year, the African Regional Centre for Space Science and Technology Education (CRASTE-LF), based in Rabat and operating in the French language, organizes postgraduate courses for a master's degree in Space Science and Technology. In the academic year 2021–2022, the Centre conducted three postgraduate courses that brought together 32 trainees from 13 countries. Additionally, the Centre organized several workshops focusing on environmental monitoring and the digitalization of statistics in agriculture, among others. In May, the Centre delivered a regional workshop on GNSS and space weather, convening 149 specialists from 34 countries, engaging students who participate in the course offered by the Centre. Participants were introduced to the physics of the ionosphere and basic knowledge of GNSS and their scientific and technological applications. Particular attention was devoted to space weather research using GNSS data in African countries.

Regional Centre for Space Science and Technology Education in Asia and the Pacific

The Regional Centre for Space Science and Technology Education in Asia and the Pacific (RCSSTEAP), hosted by Beihang University in Beijing, continued to develop the delivery of its programmes to ensure the continuity of educational activities. The Centre utilized online broadcasting, recording, massive open online courses, WeChat and learning materials to provide virtual teaching, participant self-study and independent research. In 2022, 15 international participants in three academic fields enrolled to study at the Centre, while 11 participants graduated. Additionally, in October 2022, the APSCO Student Small Satellite-1, jointly developed by Beihang University and eight member States of the Asia-Pacific Space Cooperation Organization, celebrated the anniversary of its launch. During its orbital period, the satellite has been operating smoothly, with a stable attitude, normal platform power supply and distribution, and effective verification of all payload tasks.

Centre for Space Science and Technology Education in Asia and the Pacific

In 2022, the Centre (CSSTEAP), in Dehradun, India, continued delivering quality education, training and knowledge-sharing activities. The twenty-fifth course in remote sensing and geographic information systems was attended by 18 participants from 12 countries in a hybrid mode. In the school year 2022–2023, the centre is delivering the twenty-sixth edition of the course in addition to the fourth postgraduate course in satellite communication and global navigation satellite systems.

African Regional Centre for Space Science and Technology Education – in English

The Centre in Nigeria (ARCSSTE-E), located at the Obafemi Awolowo University Campus ILE-IFE (-E), operates in English and delivered postgraduate diploma certificates to 27 students in remote sensing and geographic information systems, and SatComs.

The curving ridges of the Aravalli Range in India
Credit: NASA/Jesse Allen

RESEARCH AND TRAINING

United Nations/Azerbaijan Workshop on the International Space Weather Initiative: the Sun, Space Weather and Geosphere

UNOOSA and Baku State University on behalf of the Government of Azerbaijan jointly organized the workshop to review the results of the operation of the instrument arrays of the International Space Weather Initiative (ISWI) and discussed ways and means to continue space weather research and education. The workshop raised awareness among Member States of the impact of space weather and focused on the deployment of new instruments, particularly in developing countries. This approach is in line with the three core elements of ISWI: (a) the instrument array programme to operate and deploy space weather instruments; (b) the data coordination and analysis programme to develop predictive models using initiative data; and (c) training, education and public outreach programmes.

Sharafat Gadimova of UNOOSA addressing the United Nations/ Azerbaijan Workshop
Credit: Ministry of Science and Education of the Republic of Azerbaijan

Group photo taken at the African Capacity-building Workshop
Credit: ICTP

United Nations International Meeting on the Applications of GNSS

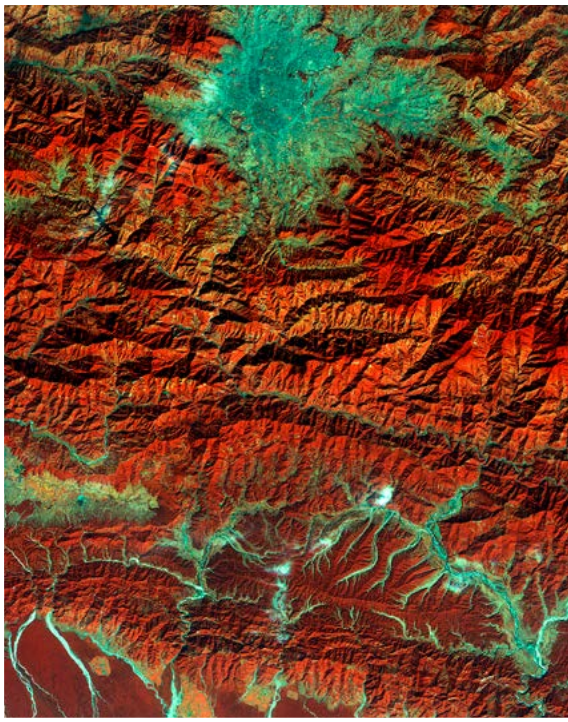
The meeting, hosted in December in Vienna, raised awareness of the importance of GNSS in our societies and promoted international collaboration in this field. Among the main objectives, the meeting reinforced the exchange of information and helped identify actions that could benefit from partnerships established by user institutions, in particular in developing countries. In total, 219 specialists from 28 countries participated in the meeting.

International Workshop on Machine Learning for Space Weather: Fundamentals, Tools and Prospects

The workshop, held in Buenos Aires from 7 to 11 November 2022, aimed at fostering space weather research through the application of machine learning and statistical techniques and, to do so, provided participants with theoretical and practical training on space weather and machine learning fundamentals, including hands-on tutorials.

The African Capacity-building Workshop on Space Weather Effects on GNSS

Organized in October in Trieste, Italy, this capacity-building workshop provided in-depth insights into the phenomenon of space weather, including its effects on technological systems. Speakers offered tutorials on GNSS and the exploitation of their signals for ionospheric studies to expand the knowledge and the research capabilities of young scientists, in particular those from African countries. Participants also engaged in group projects on GNSS data analysis, offering practical experience in investigating the ionospheric response to space weather events.



Part of Nepal with Kathmandu and the Himalayan foothills pictured from space
Credit: Copernicus Sentinel Data/ESA

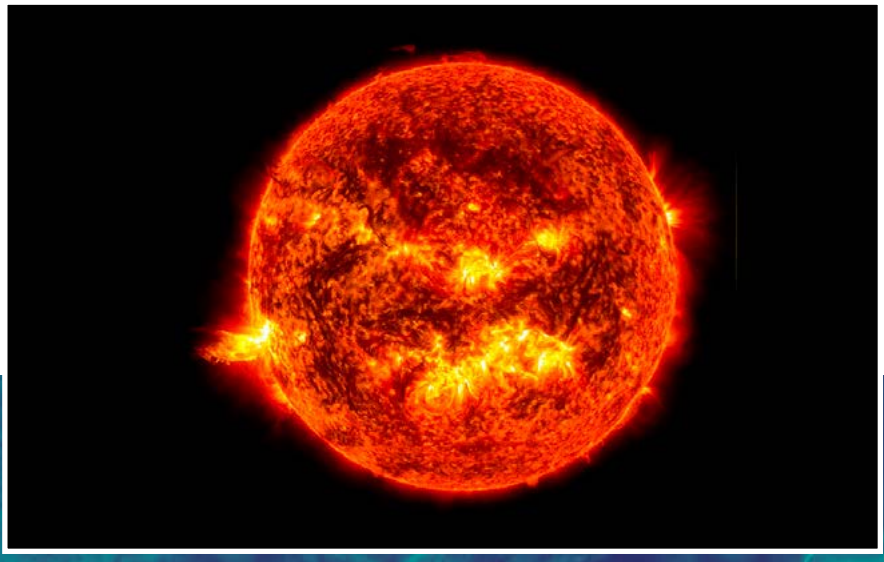
The International Space Weather Initiative Webinar Series

This webinar series hosted every month by UNOOSA features experts who deliver lectures on space weather science and instruments to enhance ISWI capacity-building activities. Seven webinars were recorded in 2022 and made publicly available on the YouTube channel of UNOOSA. So far, the lectures have been viewed over 2,500 times.

Training programme on GNSS

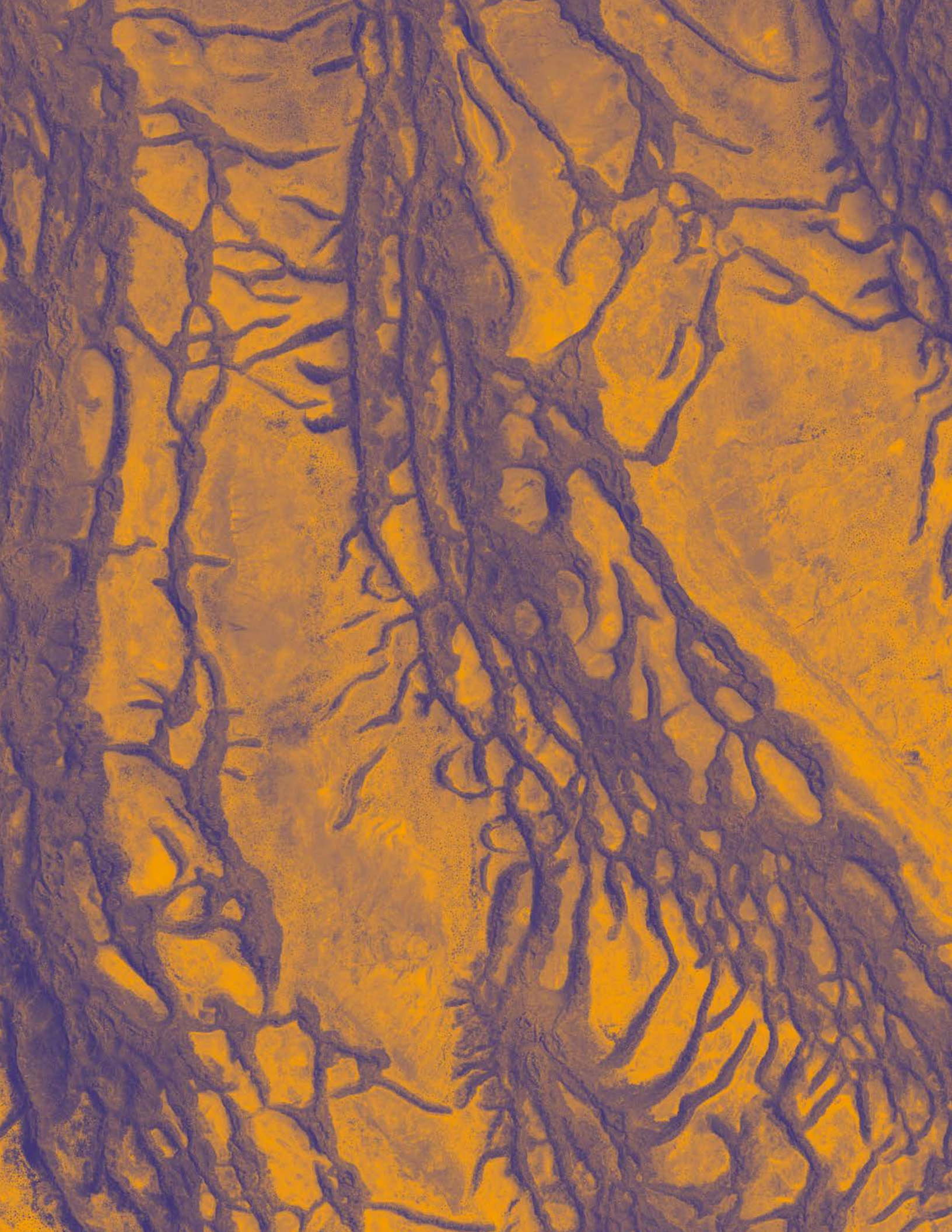
The training hosted in Pokhara, Nepal, from 11 to 14 January 2022 focused on GNSS data types, GNSS errors, coordinate systems and applications, and low-cost receiver system data. Participants also engaged in discussions on a real-time kinematic and multi-GNSS advanced demonstration tool for orbit and clock analysis to process GNSS data with high accuracy.

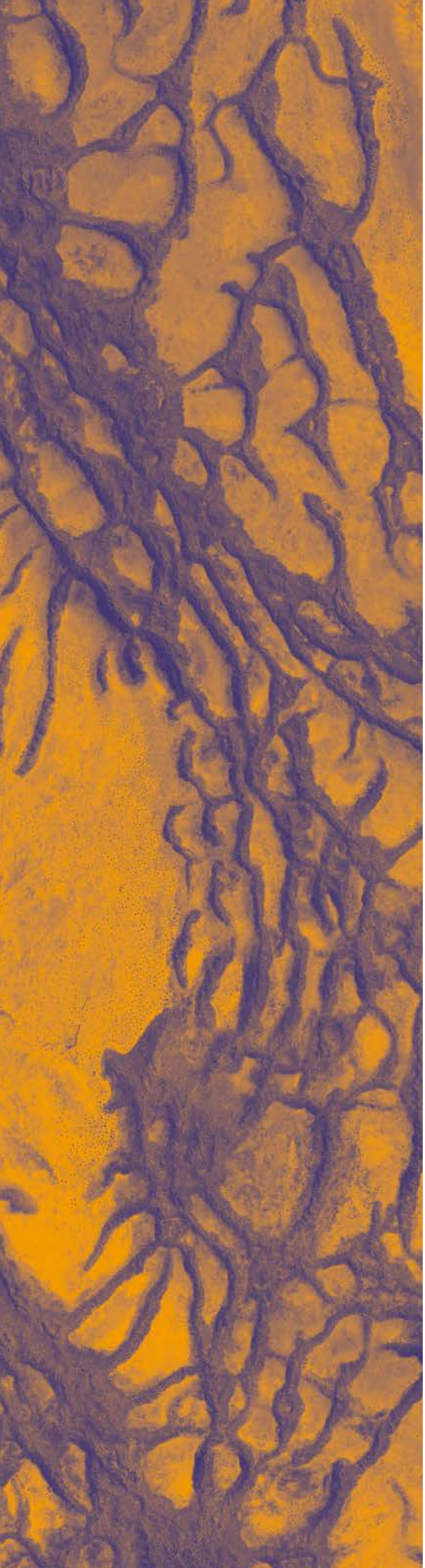
Bright solar flare from the sun
Credit: NASA/SDO



Technical seminar on Reference Frames in Practice

In recognition of several ongoing projects and initiatives to establish regional reference frame networks that meet the growing needs of industries, science programmes and members of the general public that use precise GNSS-positioning applications, a technical seminar was organized in Warsaw on 10 and 11 September. The focus of the seminar was reference frames in general, with a specific focus on United Nations initiatives, global and regional frames and selected national case studies.





Namib-Naukluft
National Park in
Namibia
Credit: Airbus DS 2022

The Office, and the entities it serves as secretariat to, sits at the centre of space multilateralism and coordination among stakeholders. From servicing the Committee on the Peaceful Uses of Outer Space to advancing the work on planetary defence, planetary protection and climate action, UNOOSA promotes cooperation for the benefit of humankind. Discover updates from 2022 in the following chapter.

8

INTERNATIONAL COOPERATION IN OUTER SPACE

8 | INTERNATIONAL COOPERATION IN OUTER SPACE

COPUOS UPDATES

At the fifty-ninth session of the Scientific and Technical Subcommittee in February 2022, the Working Group of the Whole recommended that the multi-year workplan on the governance and method of work of the Committee and its subsidiary bodies be extended until 2023. The Working Group on the Long-term Sustainability of Outer Space Activities agreed on its terms of reference, methods of work and workplan. The Scientific and Technical Subcommittee Working Group on Space and Global Health completed its multi-year workplan and produced a final report summarizing these efforts. The Working Group on the Use of Nuclear Power Sources in Outer Space extended its multi-year workplan by one year. At the sixty-first session of the Legal Subcommittee, the Working Group on Legal Aspects of Space Resource Activities agreed on its five-year workplan and methods of work.

COPUOS advanced its agenda on several critical matters to keep pace with the rapid development and diversification of space activities and their relevance for tackling global challenges. Member States exchanged views on topics such as "Dark and Quiet Skies", endorsed the draft resolution on space and global health, and proposed new initiatives to strengthen the use of space tools to tackle the climate crisis.

Vienna International Centre
Credit : UNIS Vienna/Nikoleta Haffar

UN-SPACE

UNOOSA leads the United Nations system-wide cooperation and coordination on space-related issues and activities through the Inter-Agency Meeting on Outer Space Activities (UN-Space). This mechanism promotes collaboration, synergies, exchange of information and coordination among United Nations entities of programmes implementing activities involving the use of space technology and its applications.

The forty-first session of UN-Space was held from 7 to 8 December 2022 in Bangkok. The session was co-organized by the Office, in its capacity as UN-Space secretariat, and ESCAP as the host. The Information and Communications Technology and Disaster Risk Reduction Division of ESCAP actively supported this meeting.

Two open sessions of UN-SPACE entitled "Joint UN-Space – UN-SPIDER Workshop High-level Panel on Space-based Technologies for Disaster Risk Reduction" and "UN-Space – World Space Forum Session IV: Space in the United Nations" were also organized in December 2022.

South-East Asia at night from the ISS
Credit: NASA

In its annual resolution on "International cooperation in the peaceful uses of outer space", the General Assembly urged UN-Space, under the leadership of UNOOSA, to continue examining how space science and technology and their applications could contribute to the 17 SDGs and encouraged United Nations system entities to participate in UN-Space coordination efforts.

INTERNATIONAL COMMITTEE ON GLOBAL NAVIGATION SATELLITE SYSTEMS

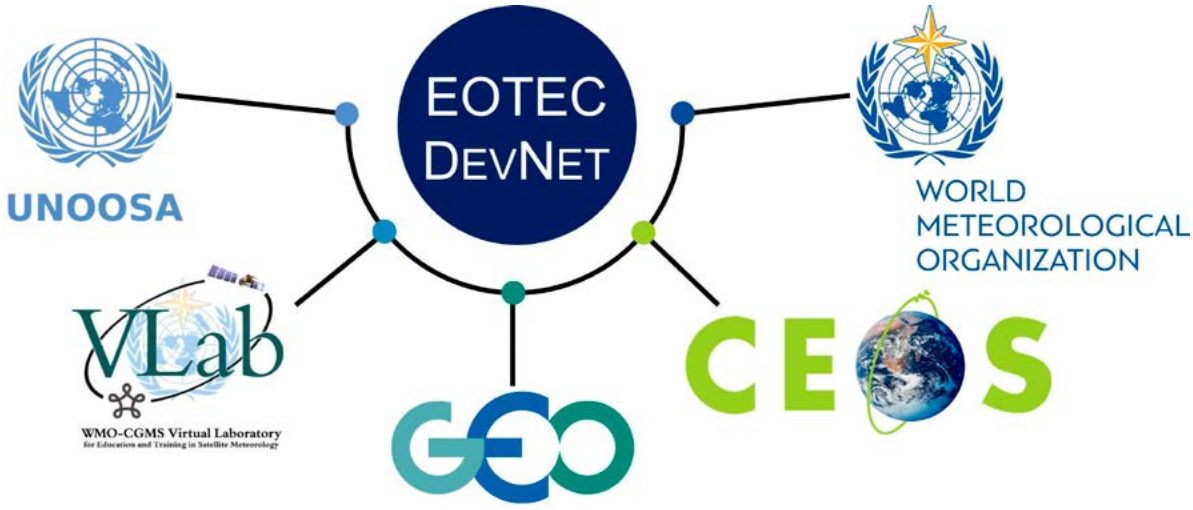
The International Committee on Global Navigation Satellite Systems (ICG), established in 2005 under the umbrella of the United Nations, has allowed GNSS technology to evolve, while still providing the structure necessary to achieve efficient interaction in one of the most important fields of space applications. GNSS immeasurably contributes to sustainable development and through ICG, GNSS users are assisted with their development plans and applications by encouraging coordination and offering a platform for exchanging information.

In 2022, based on experience from the International Space Weather Initiative (ISWI) instrument network, which has been developing space weather science, the ICG Working Group on Information Dissemination and Capacity-building, led by UNOOSA, began the implementation of a project entitled "space weather monitoring using low-cost GNSS receiver systems". The project aims to explore the possibilities of using low-cost receiver systems for space weather monitoring and implement a prototype system. The Working Group's project team made progress in: (a) exploring low-cost GNSS receivers that could be used to compute total electron content-related parameters; (b) exploring software that could be used to process data from low-cost GNSS receivers to compute total electron content; and (c) designing a prototype low-cost GNSS receiver for space weather-related applications.

High-resolution view of Dimorphos from DART mission
Credit: NASA/Johns Hopkins APL

PLANETARY DEFENCE

The issue of near-Earth objects has long been on the agenda of COPUOS as well as in the purview of UNOOSA. The Office works closely with coordination bodies established by COPUOS in 2014, namely the International Asteroid Warning Network (IAWN) and the Space Mission Planning Advisory Group. These entities serve as global mechanisms to address challenges posed by near-Earth objects, including through detection, tracking, and impact risk assessment and planetary defence measures such as civil protection or asteroid deflection. Should a credible impact threat be discovered by the network, the available information would be provided by IAWN and disseminated to Member States through UNOOSA to facilitate the planning of actions that could be taken to prevent or minimize the devastating effects of an asteroid impact. In 2022, preparations have continued for the hosting of the eighth IAA Planetary Defense Conference at the United Nations premises in Vienna.



COMMITTEE ON SPACE RESEARCH PANEL ON PLANETARY PROTECTION

UNOOSA continued working with the Committee on Space Research (COSPAR) Panel on Planetary Protection, holding the role of vice-Chair of the Panel. UNOOSA supported virtual meetings of the Panel, which resulted in updated requirements for missions to the Moon in the COSPAR Planetary Protection Policy. In addition, UNOOSA undertook various outreach activities, such as articles to raise awareness of planetary protection and the work of COSPAR.

COMMITTEE ON EARTH OBSERVATION SATELLITES

As the first United Nations entity since the inception of the Working Group on Capacity-building and Data Democracy (WGCapD) of the Committee on Earth Observation Satellites (CEOS), UNOOSA continued its term as Chair and organized the eleventh annual meeting of the working group. The meeting served as an important forum for space agencies to discuss cooperation in capacity-building activities and data democracy. Among the results, WGCapD identified regional needs to guide its work towards increasing the capacity of institutions in less developed countries to use Earth observation data more effectively for the benefit of society and to achieve sustainable development. The group continued to pursue activities to unify CEOS efforts such as enhancing access to Earth observation data, increasing the sharing of software tools, expanding data dissemination capabilities, transferring relevant technologies and providing intensive capacity-building, education and training to benefit end users.

Created in 2021 with UNOOSA as a member, the Earth Observation Training, Education and Capacity Building Network (EOTEC DevNet) originated in CEOS WGCapD. In 2022, together with other United Nations entities and international groups and committees, UNOOSA continued participating in EOTEC DevNet, ramping up and strengthening the network of capacity-building networks, finding synergies among participating entities and streamlining efforts in capacity-building for Earth observation.

INTERNATIONAL EFFORTS TO REDUCE IMPACT OF LIGHT POLLUTION ON THE NIGHT SKY

Satellite constellation projects, especially those in low-Earth orbit, already provide services, or aspire to do so, of high economic and social value, such as broadband connectivity and Earth observation data. Progress in this field promises economic growth as well as benefits across many industries, sustainable development and climate action. However, the unprecedented number of satellites launched and operated in this region of space has already degraded the quality of astronomical observations as satellites cross the field of view of telescopes, reflecting sunlight and impacting radioastronomy measurements. The international community recognizes this issue and seeks solutions to make these activities thrive without compromising sustainability in the space environment and the feasibility of space sciences.

The activities of the Office regarding this issue focus on raising awareness, encouraging dialogue, innovation and new approaches to this multifaceted issue. At the fifty-ninth session of the Scientific and Technical Subcommittee, UNOOSA organized a Symposium on Dark and Quiet Skies to take stock of global efforts. After reviewing recommendations from the United Nations/Spain/International Astronomical Union Conference and the workshops on Dark and Quiet Skies for Science and Society organized in 2020 and 2021, the event provided insights from both satellite stakeholders and astronomers. Thanks to this gathering, the community has made promising progress in identifying mitigation measures in collaboration between the satellite and astronomical communities. Efforts to reduce the visibility of satellites have not yet reached the proposed targets as this field of technology development is still relatively new and innovation efforts must continue.

Streaks from satellites cross the Pleiades constellation
Credit: T. Hansen/IAU OAE/CC


Kibo
CUBE
TUMnanoSA
ENDUROSAT

TUMnanoSAT fully assembled
Credit: Technical University of Moldova

UNOOSA maintains the United Nations Register of Objects Launched into Outer Space, a Treaty-based transparency mechanism that helps to solidify trust among countries in outer space activities. It is a crucial component in understanding space traffic, particularly considering the rapidly increasing number of launches globally. In 2022, 2,099 functional and non-functional objects were registered with the Secretary-General.

9

SPACE OBJECTS REGISTRATION

9 | SPACE OBJECTS REGISTRATION

The transformative power of space assets remains the driving force behind the increased frequency of launch services as well as the rising number of functional objects being deployed into space. In 2022, the international space community broke the records for annual rocket launches, satellites reaching orbit and objects registered with the United Nations voluntarily under General Assembly resolution 1721B (XVI) or as a treaty obligation under the 1975 Convention on Registration of Objects Launched into Outer Space. These developments confirmed the trend of rapid progress in the sector.

Throughout the year, 25 Member States submitted registrations on 2,055 satellites, an increase of 8.5 per cent on 2021. Mega-constellation satellites dominated the registrations submitted and in the future this trend is expected to amplify even further.

First-time registrations were received from the Islamic Republic of Iran, Morocco, Republic of Moldova and Tunisia.

Awardees of the different KiboCUBE rounds continued to be committed to the responsible utilization of space. The Republic of Moldova, the awardee of the fourth round, registered its satellite with the United Nations on 14 December 2022. Re-entry notifications were submitted by Guatemala and Mauritius, awardees of rounds two and three.

At the time this report went public, an additional 1,140 objects launched during 2022 or prior had also been registered.

For a historical overview of space objects registration, please refer to chapter 4.

TECHNICAL ADVISORY SERVICES ON SPACE OBJECT REGISTRATION

As part of its responsibilities in discharging the obligations of the Secretary-General under international space law, UNOOSA provides technical advisory services on space object registration-related matters to States and international organizations. In 2022, UNOOSA provided assistance and services to 29 governmental entities and other institutions.

Lift-off of the Space Launch System on the Artemis 1 flight test
Credit: NASA/Bill Ingalls

Resupply mission arriving at the International Space Station
Credit: NASA

An image from Tianhe panoramic camera during the first Shenzhou-13 spacewalk
Credit: CMSA/CCTV/Chinese Academy of Sciences

The wetlands of Adair Bay between the Great Altar Desert and the Gulf of California
Credit: NASA

This chapter provides an overview of the UNOOSA budget, expenditure, voluntary contributions and staff numbers in 2022.

10

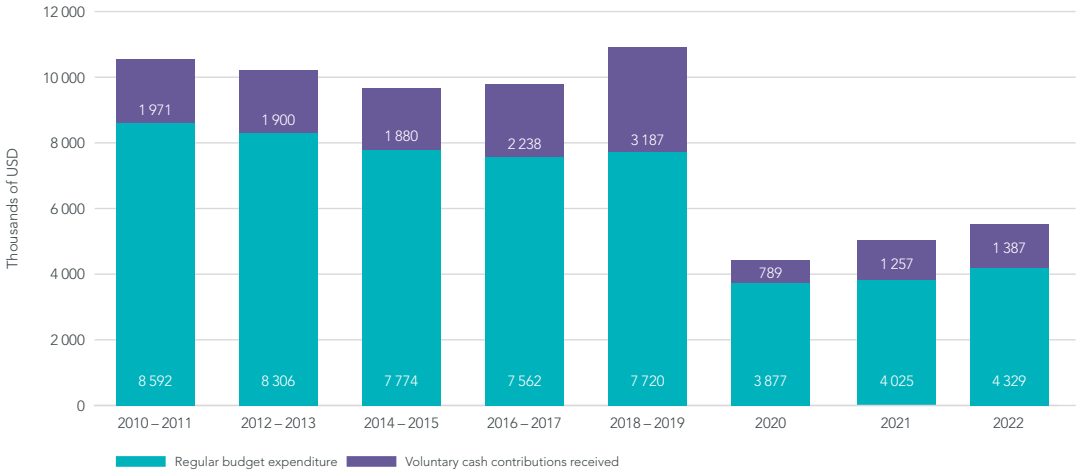
UNOOSA IN NUMBERS

10 UNOOSA IN NUMBERS

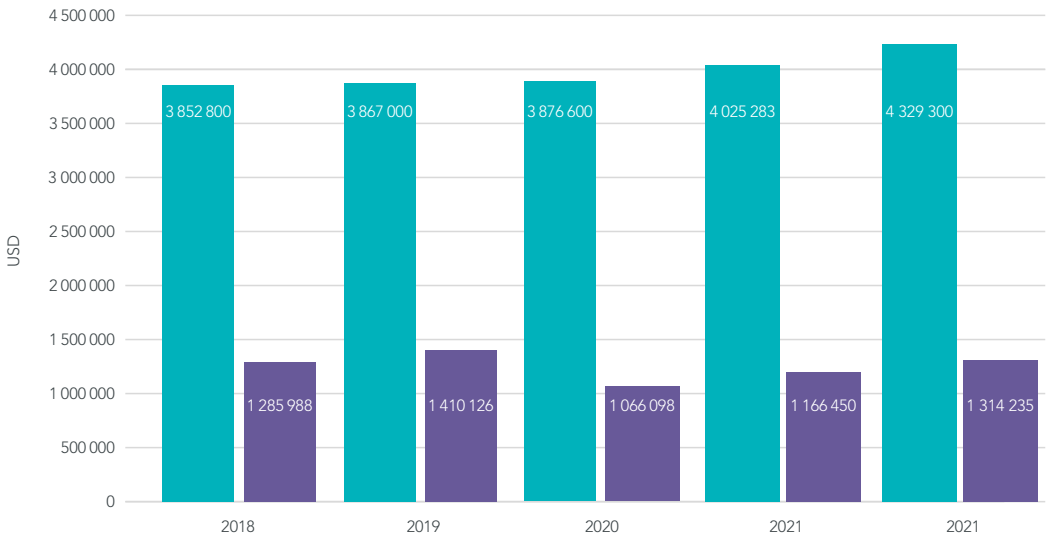
This section presents data on the financial and human resources of UNOOSA covering the period through 31 December 2022. The Office acknowledges and wishes to express its gratitude to all its Member States that continuously support its activities, whether through an in-kind or a cash contribution. Since January 2023, and at the time of finalizing this report, the Office had received additional cash contributions from the following donors: Prince Sultan Bin Abdulaziz International Prize for Water, the United Kingdom Space Agency and the United Nations Development Programme.

The data relating to those and other contributions will be reflected in the Annual Report 2023.

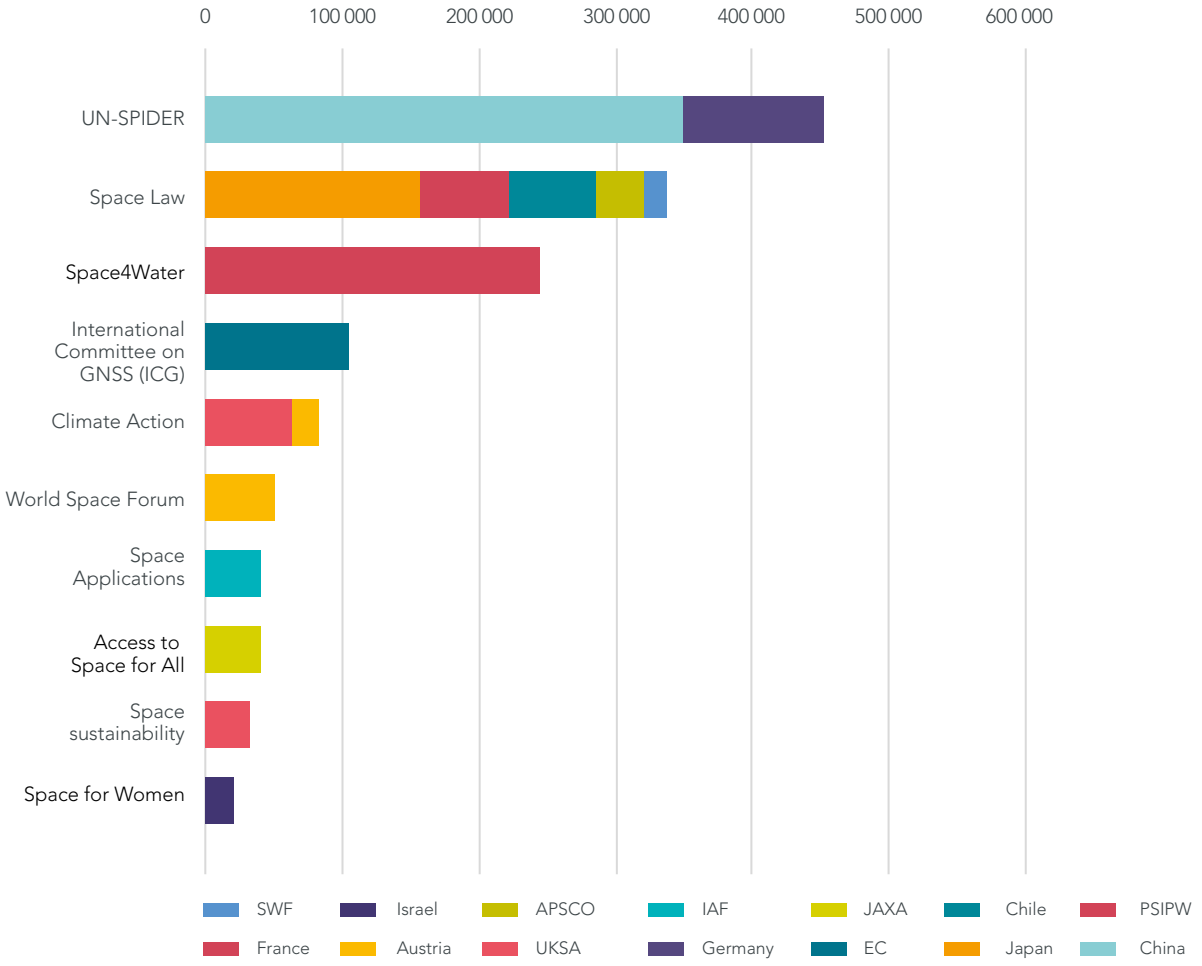
Budget overview



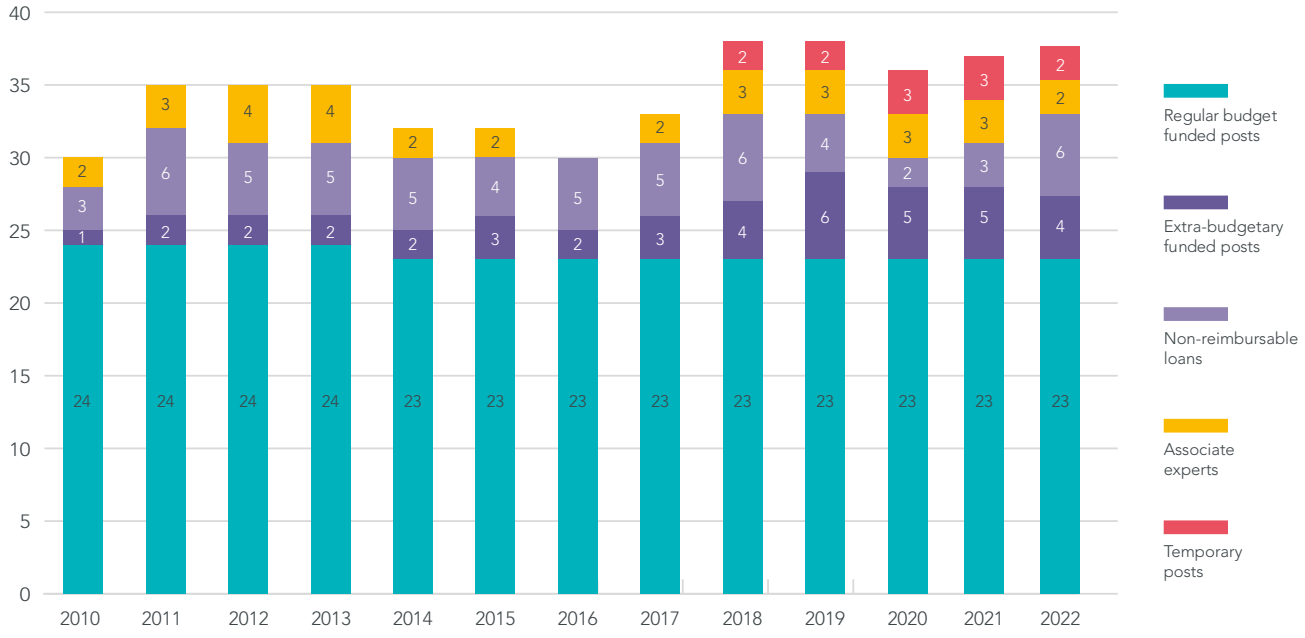
Expenditure



Voluntary cash contributions (does not include in-kind contributions)



Staff overview



ACRONYMS

APSCO	Asia Pacific Space Cooperation Organization
CEOS	Committee on Earth Observation Satellites
CMSA	China Manned Space Agency
CSS	China Space Station
COPUOS	Committee on the Peaceful Uses of Outer Space
COSPAR	Committee on Space Research
CSSTEAP	Centre for Space Science and Technology Education for Asia and the Pacific
DLR	German Aerospace Centre
DropTES	Drop Tower Experiment Series
EC	European Commission
ESA	European Space Agency
ESCAP	Economic and Social Commission for Asia and the Pacific
ESPITA	Private Higher School of Engineering and Applied Technology of Tunisia
GNSS	Global Navigation Satellite System
IAWN	International Asteroid Warning Network
ICG	International Committee on Global Navigation Satellite Systems
ISON	International Scientific Optical Network
JAXA	Japan Aerospace Exploration Agency
K-SORT Project	Kenyan Space Observation and Research Telescope
KARI	Korea Aerospace Research Institute
KIAM	Keldysh Institute of Applied Mathematics
Kyutech	Kyushu Institute of Technology (Japan)
LTS Guidelines	Guidelines for the Long-term Sustainability of Outer Space Activities
MBRSC	Mohammed Bin Rashid Space Centre
NASA	National Aeronautics and Space Administration (United States of America)
NASRDA	National Space Research and Development Agency
PSA	Programme on Space Applications
PSIPW	Prince Sultan Bin Abdulaziz International Prize for Water
RSOs	Regional support offices (of UN-SPIDER)
SDGs	Sustainable Development Goals
SFW	Secure World Foundation
SMPAG	Space Mission Planning Advisory Group
STEM	Science, technology, engineering and mathematics
UNIS	United Nations Information Service (in Vienna)
UNOOSA	United Nations Office for Outer Space Affairs
UN-SPIDER	United Nations Space-based Information for Disaster Management and Emergency Response
WGCapD	Working Group on Capacity-building and Data Democracy
ZARM	Centre of Applied Space Technology and Microgravity

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https://www.unoosa.org/oosa/en/aboutus/annual-reports.html


SPACE4SDGS

THE UNITED NATIONS OFFICE FOR OUTER SPACE AFFAIRS (UNOOSA)
IS RESPONSIBLE FOR ADVANCING INTERNATIONAL COOPERATION IN THE PEACEFUL USES OF OUTER SPACE AND HELPS ALL COUNTRIES USE SPACE SCIENCE AND TECHNOLOGY TO ACHIEVE SUSTAINABLE DEVELOPMENT.

BRINGING THE BENEFITS OF SPACE TO HUMANKIND

V.22-02175

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