UNITED NATIONS
OFFICE FOR OUTER SPACE AFFAIRS

ANNUAL REPORT 2021

UNITED NATIONS

On the right: Original cover image
Cover: The Danube Delta, a labyrinth of water and land shared between Romania and Ukraine

ST/SPACE/80

This publication has not been formally edited.
Publishing production: English, Publishing and Library Section, United Nations Office at Vienna.

UNITED NATIONS
OFFICE FOR OUTER SPACE AFFAIRS

2021
ANNUAL REPORT

UNITED NATIONS
Vienna, 2022

CONTENTS

FOREWORD

Ms. Simonetta Di Pippo
Mr. Niklas Hedman
Credit: SDA Bocconi/UNIS

2021 started with a glimmer of hope as vaccination campaigns began to take shape underscoring the power of science in addressing the global pandemic. Nevertheless, despite our improved understanding of the health, social, economic and cultural impacts of the coronavirus disease (COVID-19) crisis, the pandemic continued to influence our lives, decisions and the delivery of our activities. By virtually erasing decades of progress in many indicators, it has dealt a severe blow to the mission for a sustainable world. The COVID-19 crisis serves as reminder that we ignore the warning signals provided by science at our peril. It is important to learn from the lessons that have emerged from the suffering and sacrifices of the past two years.

Repeating the same error in the context of the climate crisis will prove catastrophic, causing considerably worse impacts over the longer term. We must leverage on our understanding of the danger and use it to guide the way forward. At the global gathering in Glasgow in 2021, world leaders exhibited strong political will to act, but nevertheless much stronger ambition is required.

The urgency of the climate crisis calls for an unprecedented, concerted and multilateral effort, employing all available assets. Satellites will be intrinsic components in this important quest. Space technologies are transformative tools for collecting data about the Earth, its spheres, and the dynamics and impacts of human activities that drive mitigation, adaptation and resilience efforts. Space stakeholders are enhancing evidence-based decisions and policymaking, putting satellites into action for sustainable development, and working together to understand specific needs and develop tailored solutions. In this context, the United Nations Office for Outer Space Affairs (UNOOSA) utilizes the unique convening power of the United Nations to provide a platform and means to exchange information, build capacity and engage in diplomacy in the peaceful uses of space for climate action.

The focus chapter of this report singles out the activities we embarked on in 2021 to ensure that Member States of the United Nations are better equipped with the knowledge and instruments to help avoid a climate catastrophe and prepare societies for consequences we cannot avoid. With Austria, we convened the third World Space Forum to engage in conversation about space solutions and connect users with providers. We continued amplifying the voices of young people, collecting essays

on the use of space as a tool to foster climate mitigation and adaptation. We brought together stakeholders to debate the benefits of space for sustainable food systems and entered into a partnership to map global space-related climate action efforts. The Space4Water portal continued to grow and provide a valuable platform for networking, promoting water management practices, and fostering collaboration and knowledge exchange.

At UNOOSA, we also took advantage of the experience of 2020 and enhanced the work and delivery of the mandates to continue the formal intergovernmental mechanisms. We adopted new solutions and applied them across our activities to guarantee adequate performance and a results-driven approach. By adjusting our modus operandi, we succeeded in convening the full cycle of the Committee on the Peaceful Uses of Outer Space (COPUOS). The "Space2030" Agenda developed in that unique setting was adopted by the General Assembly in October 2021. The Agenda represents a new road map for advancing the use of space for a better tomorrow. In addition, by means of active outreach and diplomatic efforts, five countries joined COPUOS, taking the membership to 100 States.

We also carried on with capacity-building activities as the means to bridge the capabilities gap between and within countries. To help create an equal and diverse space sector globally, we advanced empowerment efforts through the Space4Women Project and complemented that work with a new endeavour that focuses on persons with disabilities. Through the Space Law for New Space Actors project, we answered the demand for promoting the development of national space law and policies in line with existing frameworks. UN-SPIDER provided services and advisory missions in Africa, Asia and Latin America, strengthening capabilities to address disasters, save lives and prevent damage.

UNOOSA went on opening windows of opportunity and worked to turn dreams into realities in a collective effort with the international space community. The Access to Space for All initiative, as a manifestation of triangular cooperation, continued to break glass ceilings. Thanks to the support offered under the KiboCUBE programme, Mauritius is now a spacefaring nation. The primary objective of its satellite programme is the acquisition of technology, knowledge and skills to help advance the country's future efforts in the space domain. The Bartolomeo programme, under the Access to Space for All initiative, became the first opportunity delivered in partnership with a private sector entity to announce an awardee. A joint endeavour of researchers from Egypt, Kenya and Uganda was selected for a free one-year mission utilizing the Bartolomeo platform at the International Space Station. Through novel avenues, including our participation at Expo 2020 in Dubai, we reached new audiences by promoting the benefits that space offers to humankind. We are proud that despite the obstacles and challenges, UNOOSA continued its strong legacy of support for the interests of Member States in 2021.

As space occupies an ever more prominent position in the United Nations system and beyond, the demand for our activities and inputs, and the call for our engagement as a convener and facilitator of international cooperation will only increase. This is integral for the way forward as the value of partnerships and the fruits of our collective work manifest themselves across the whole spectrum of activities. We are confident that, if we work together, an even brighter future lies ahead of us as we make the benefits of space universally accessible. In close coordination with the international space community, UNOOSA remains committed to using all aspects of space to build a better future for everyone, everywhere.

Ms. Simonetta Di Pippo
Former Director, Office for Outer Space Affairs

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

Almost cloud-free glimpse at a large portion of Europe
Credit: ESA

1

UNOOSA: WHAT WE DO

1 | UNOOSA: WHAT WE DO

The United Nations Office for Outer Space Affairs is the only United Nations entity dedicated exclusively to outer space affairs.

The Office focuses specifically on the peaceful uses of outer space to advance international cooperation in space and the use of space science and technology for sustainable development, particularly for the benefit of developing countries. The Office serves as the secretariat to the Committee on the Peaceful Uses of Outer Space through which an annual multi-stakeholder dialogue on outer space is held with the aim of advancing these objectives. The Committee has two subsidiary bodies: the Scientific and Technical Subcommittee (STSC) and the Legal Subcommittee (LSC), 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 the only treaty-based transparency and confidence-building mechanism that identifies the State responsible for a space object.

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 disaster risks and support the full disaster cycle. UN-SPIDER has offices in Beijing, Bonn and Vienna and is funded with generous financial support from China and Germany.

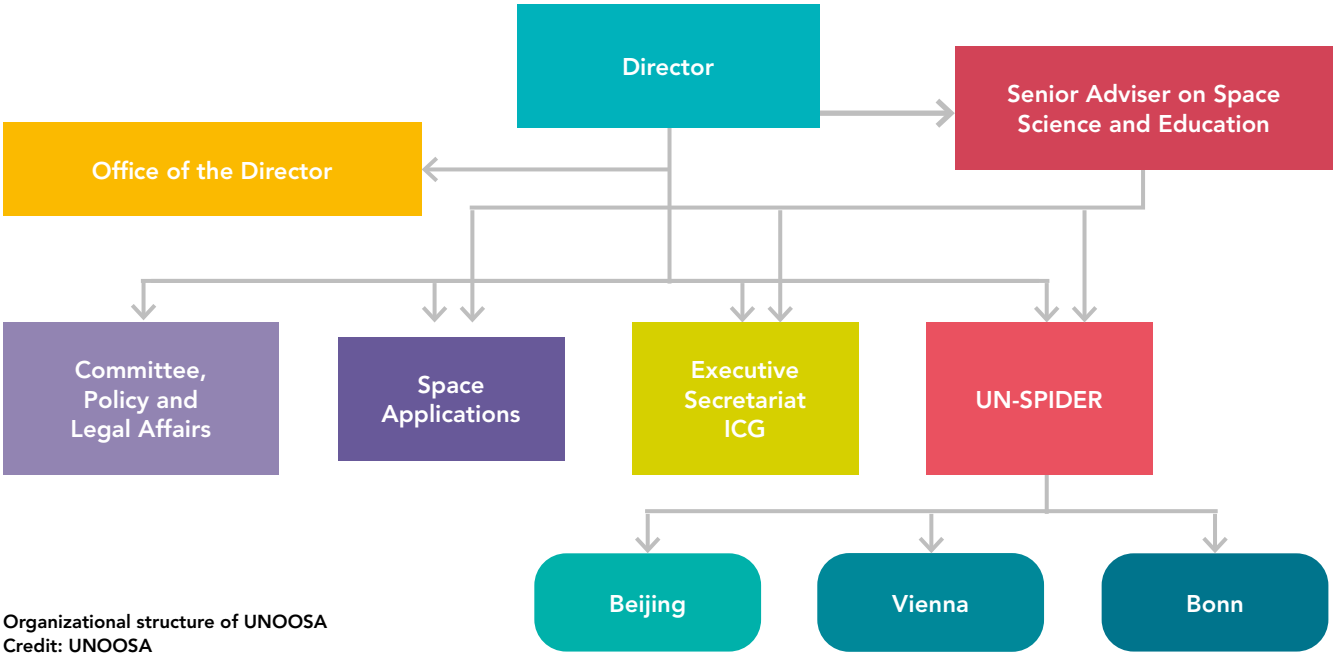
UNOOSA serves as Executive Secretariat of the International Committee on GNSS (ICG) that brings together global navigation satellite system (GNSS) providers to improve technology, compatibility and interoperability, and the use of GNSS for sustainable

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

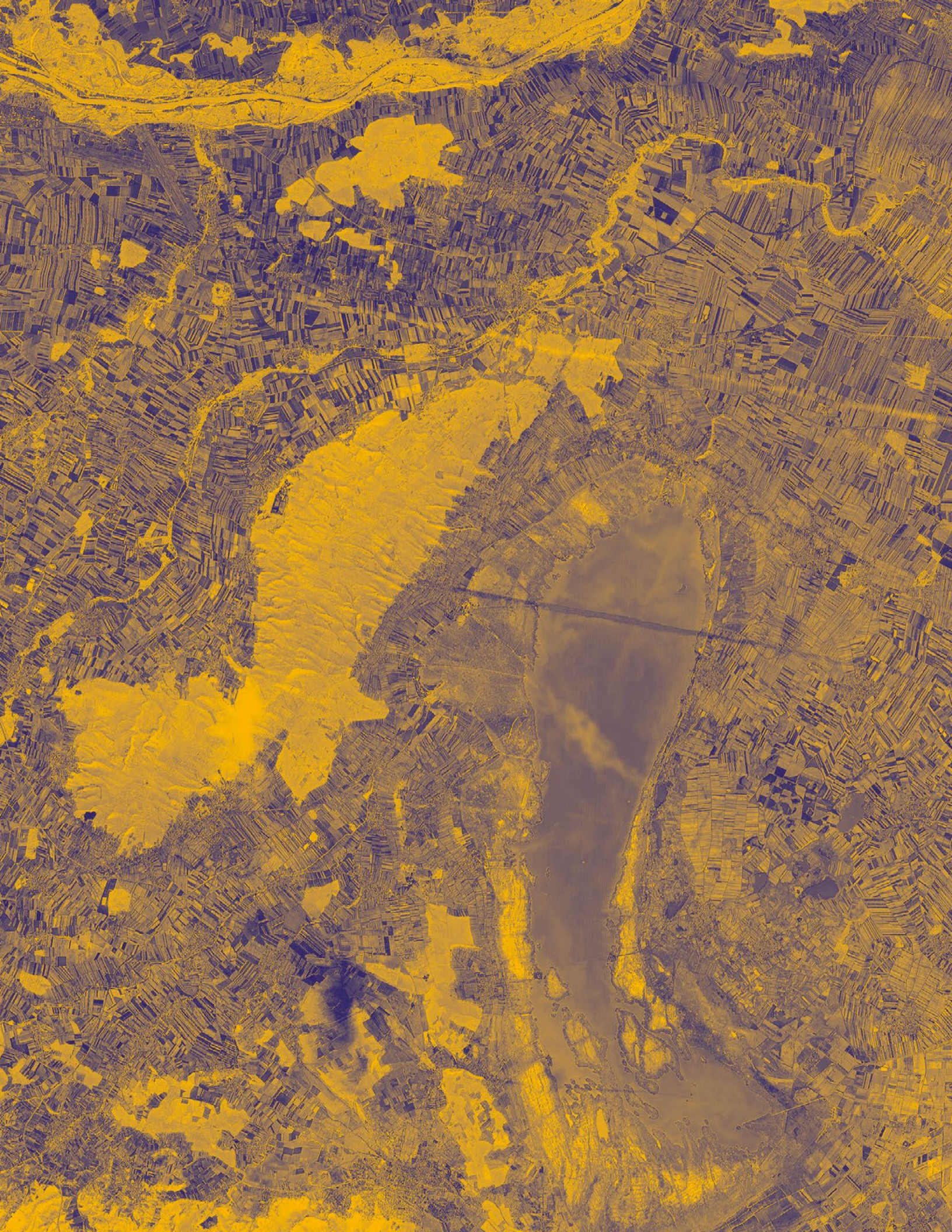
UNOOSA is the Secretariat to the Space Mission Planning Advisory Group (SMPAG), which connects the world's space agencies active in the domain of planetary defence. SMPAG is responsible for preparing an international response to a near-Earth object threat through the exchange of information, the development of collaborative research and mission opportunities, and 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



Lake Neusiedl
Credit: ESA

2

UNOOSA IN 2021 AT A GLANCE

2 | UNOOSA AT A GLANCE

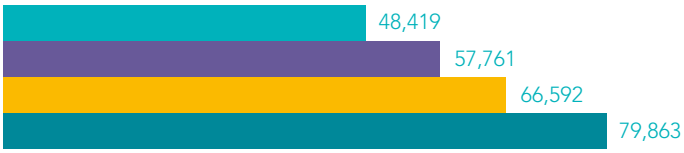
The Office engaged in an active outreach campaign in 2021, with the number of users visiting our websites growing substantially, hitting a record with over 44 per cent growth compared to 2020. The users have consistently consulted our space law resources, with web pages dedicated to the international treaties visited the most, underlining the reinforced interest in the frameworks that underpin the governance of space activities. The pages on the Committee sessions and capacity-building activities of the Office also experienced significant traffic over the year.

Visits to the UN-SPIDER Knowledge Portal also reached record numbers. The new visualization of the website, the relevance and quality of the information provided, and the ever-growing importance of space assets for disaster management attracted more than 500,000 users. These users consulted resources on disaster risk reduction and early warning systems, national efforts in these areas, and UN-SPIDER missions, training and events.

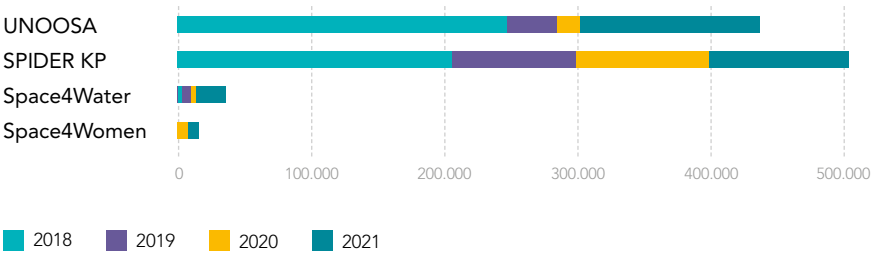
The Space4Water portal welcomed close to 40,000 visitors in the third year since its commencement. With its expanding network, growing resources on leveraging space applications for sustainable water management, and stories from space professionals, the portal saw a staggering 157 per cent increase in visits compared to 2020. The Space4Women website, now in its second year, brought over 16,000 visitors to our resources on gender equality, empowerment, and activities conducted within the realm of the Space4Women project. In the second half of 2021, the Office launched a dedicated Space Sustainability website, a resource to advance awareness-raising and capacity-building related to the implementation of the Guidelines for the Long-term Sustainability of Outer Space Activities.

Followers: Social media

Total



Visitors: Websites



Total impressions on social media

>6 million

Total page views on UN-SPIDER

1.02 million

Total page views on UNOOSA

1.65 million

Newsletter **>1,800 subscribers**

ESA and UNOOSA Space Debris podcast plays **12,504**

YouTube **24,400 views**

Event participants

Online events

World Space Forum

540
participants

88
countries

United Nations/Spain/ International Astronomical Union Conference on Dark and Quiet Skies for Science and Society

724
participants

76
countries

United Nations/Mongolia Workshop on the Applications of Global Navigation Satellite Systems

324
participants

61
countries

United Nations/Austria Symposium on Space Applications for Food Systems

333
participants

76
countries

United Nations/Islamic Republic of Iran Workshop on Space Technology Applications for Drought, Flood and Water Resource Management

378
participants

64
countries

Webinars

Webinars on Access to Space for All

1,565
participants

Webinars on Space Economy

313
participants

Webinars on Space for the Great Reset

655
participants

In-person events

UNOOSA, Brazil and United Arab Emirates Space for Women Expert Meeting: Initiatives, Challenges and Opportunities for Women in Space

60
participants

20
countries

Twenty-eighth Workshop on Space Technology for Socio-economic Benefits: "Space Exploration – A source of inspiration, innovation and discovery"

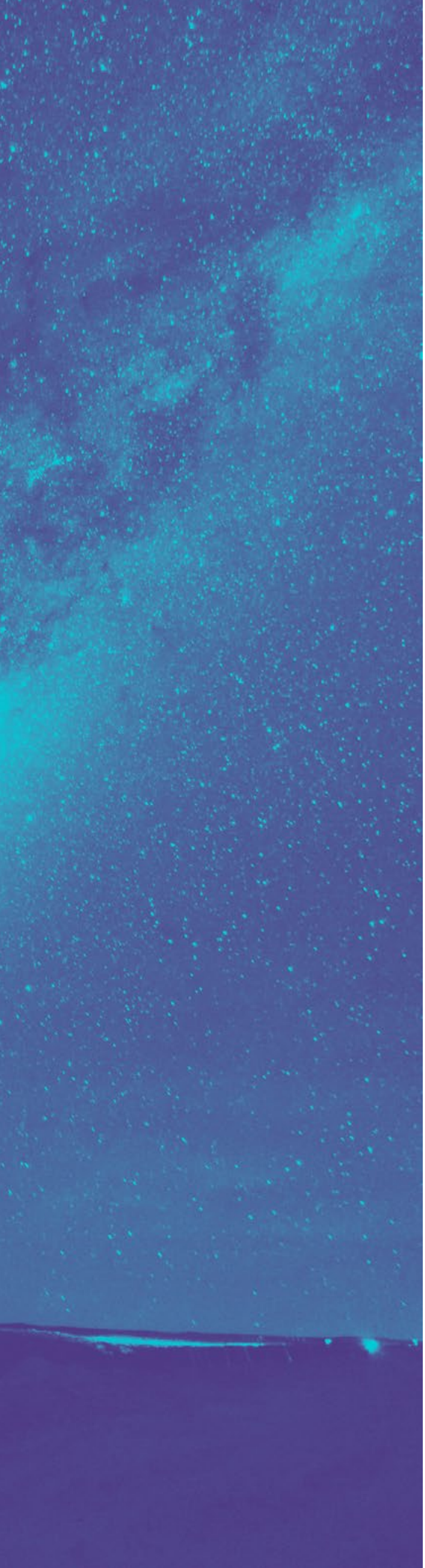
90
participants

20
space agencies

47
countries

Space objects registered

>1,900
(highest ever)



An arm of the
Milky Way galaxy
Credit: S. Otarola/ESO

From the historic launch of the first Mauritian satellite under the KiboCUBE programme, through the enlargement of the Access to Space for All initiative, to the participation of the office at Expo 2020, this chapter focuses on the highlights of the work of UNOOSA in 2021.

3

HIGHLIGHTS OF 2021

3 | HIGHLIGHTS OF 2021

MAURITIUS DEPLOYS ITS FIRST SATELLITE THANKS TO THE KIBOCUBE PROGRAMME OF UNOOSA/JAXA

In 2021, the KiboCUBE programme, delivered in partnership with Japan Aerospace Exploration Agency (JAXA), continued to break glass ceilings to enable access to space. Mauritius deployed its first-ever satellite from the International Space Station on 22 June. The Mauritius Research and Innovation Council (MRIC) of the Ministry of Information Technology, Communication and Innovation constructed the Mauritius Imagery and Radiotelecommunication Satellite (MIR-SAT 1). The Government of Mauritius fully funded its construction and testing.

KiboCUBE is a symbol of triangular cooperation under the Access to Space for All initiative (see more in the Space4SDGs chapter) offered by UNOOSA and its partners. MIR-SAT 1 is the third satellite launched under the KiboCUBE programme joining 1KUNS-PF of Kenya and Quetzal-1 of Guatemala. The first Mauritian satellite was registered with the Secretary-General on 29 July through the Register maintained by UNOOSA (see the final chapter of this report).

Its primary objective is technology, knowledge and skill acquisition, as well as advancing the future efforts of Mauritius in the space domain. MIR-SAT 1 pilots technology pertinent to the main challenges faced by the country.

The launch of the Mauritian satellite
Credit: NASA/Tony Gray and Kevin O'Connell

MIR-SAT1 is equipped with an optical camera that tests the transmission of imagery and onboard communication systems in collaboration with amateur radio enthusiasts. Generated data is available to all institutions in the country for capacity-building, experimentation and research.

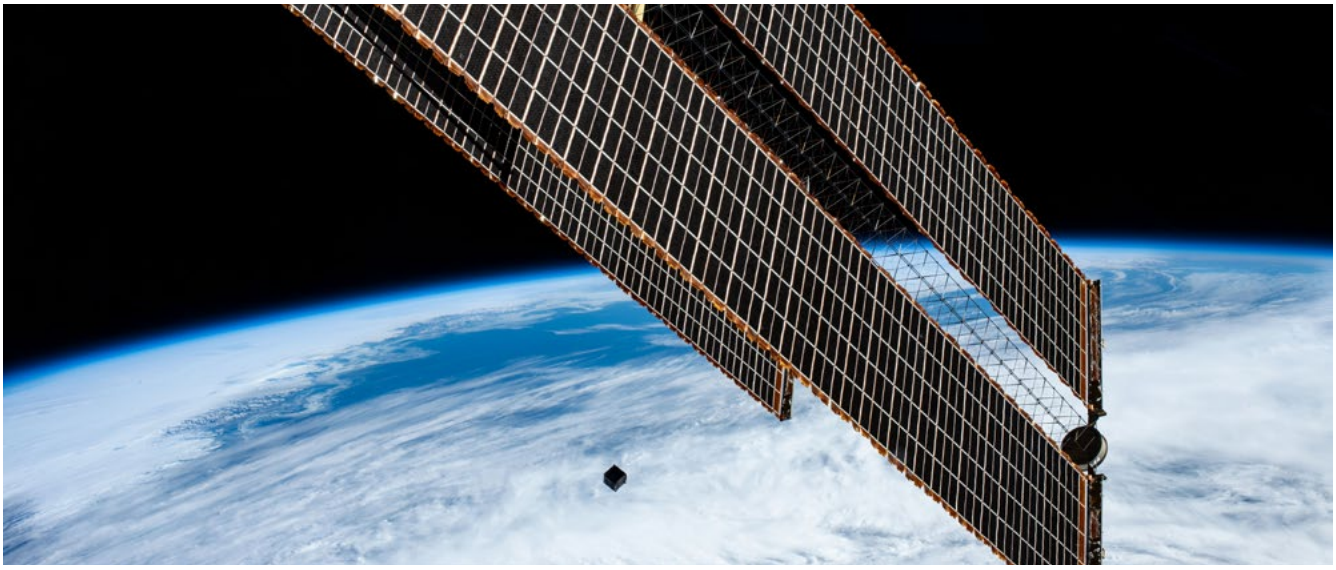
The MRIC team, supported by the Mauritius Amateur Radio Society, conducted capacity-building activities for secondary schools and university students to acquaint them with antennas and communication technology. Within a month of the launch, over 100 students from more than a dozen schools and five universities constructed antennas to download telemetry data from MIR-SAT 1. The Forest Side SSS (Girls) College was the first to receive the data, emphasizing the role of the satellite in advancing efforts towards gender equality in Mauritius.

MIR-SAT 1, the first Mauritian satellite
Credit: JAXA

> *We are delighted to welcome Mauritius to the community of spacefaring nations. With eyes from above, the country will gain powerful data and tools to confront challenges such as rising sea levels and managing ocean resources. UNOOSA and JAXA are proud to have made this achievement possible and stand ready to support the utilization of this CubeSat and the overall development of the space sector in Mauritius.*
>
> **Simonetta Di Pippo, former Director of UNOOSA**

Team from Mauritius Research and Innovation Council
Credit: MRIC

> *The first Mauritian satellite is a historic achievement for the Republic of Mauritius. We are proud to count ourselves among the handful of space-faring Small Island Developing States. This initiative prompts a number of promising avenues for research development and innovation in space and satellite technology in Mauritius – fields which were, in the recent past, inaccessible to our small nation. We look forward to seeing space and satellite technology bring a new thrust to STEM in Mauritius.*
>
> **Vickram Bissonauth, research coordinator from the Mauritius Research and Innovation Council**



Deployment of MIR-SAT 1 from Kibo
Credit: JAXA/NASA

Participants at the Space4Women Expert Meeting
Credit: United Nations/Martin Stasko

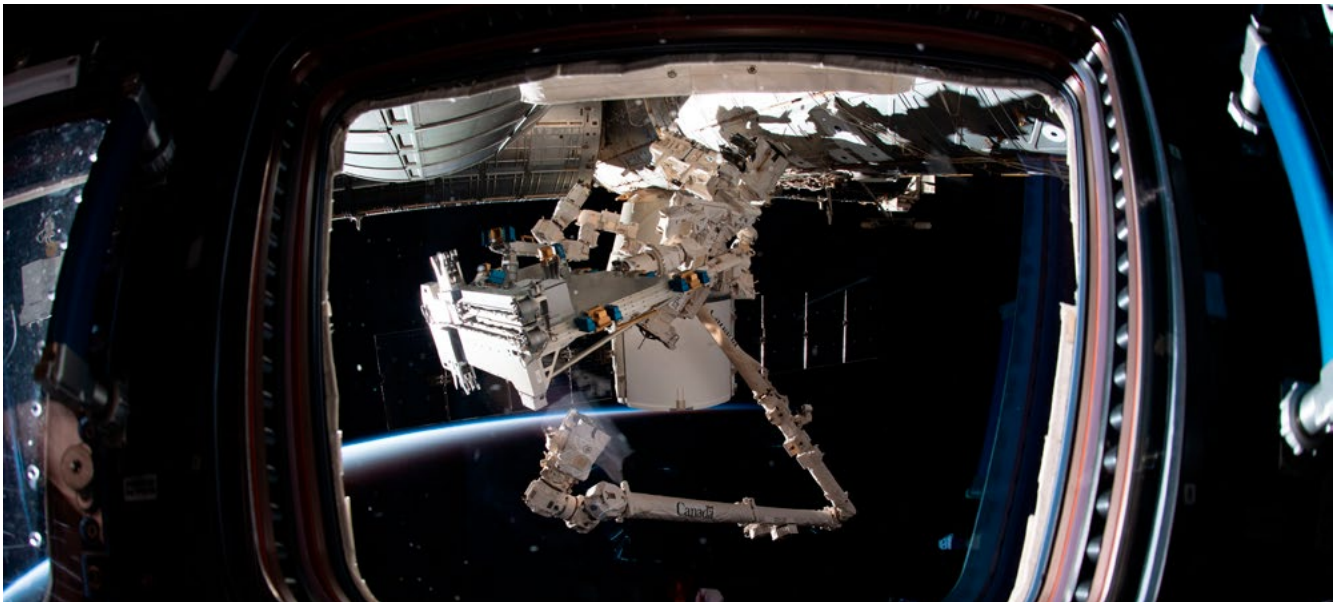
UNOOSA, BRAZIL AND THE UNITED ARAB EMIRATES CONVENE SPACE FOR WOMEN EXPERT MEETING: INITIATIVES, CHALLENGES AND OPPORTUNITIES FOR WOMEN IN SPACE

Science, technology, engineering and mathematics (STEM) represent transformative fields to achieve the Sustainable Development Goals (SDGs), with space exploration and its utilization as vital components in this context. Space also matters when it comes to the rights of women and girls to benefit from science and technology, encouraging them to contribute to creating solutions and participate in space-related education and careers. The international community strives to empower women and girls in these fields. Through the "Space for Women" project, UNOOSA continued making strides towards these goals.

On the margins of the Space Week at Expo 2020 in Dubai, UNOOSA, the Ministry of Science, Technology and Innovation of Brazil, the Brazilian Space Agency, the National Institute for Space Research and the Mohammed Bin Rashid Space Centre (MBRSC) organized the United Nations/Brazil/United Arab Emirates Space for Women Expert Meeting: Initiatives, challenges and opportunities for women in space.

The meeting brought together 60 experts and Space4Women mentors from 20 Member States. Discussions revolved around the benefits to women and girls from better access to space, and ways to ensure their equal and active role in space science, technology, innovation and exploration.

Participants highlighted the importance of providing policy-relevant advice and data on gender empowerment, equity and equality to institutions and governments, and advancing knowledge management and evidence-based awareness-raising. They also recommended developing stocktaking exercises and assessments of impacts and improvements resulting from gender empowerment activities in the space sector to establish common ground and a comparable starting point for everyone.



Bartolomeo platform mounted on the International Space Station
Credit: Airbus

JOINT PROJECT FROM EGYPT, KENYA AND UGANDA SELECTED FOR THE BARTOLOMEO PROGRAMME WITH AIRBUS DEFENCE AND SPACE

On the margins of the seventy-second International Astronautical Congress in Dubai, UNOOSA and Airbus selected the ClimCam project developed by a consortium of three different national agencies from Egypt, Kenya and Uganda as the awardee of the first round of the Bartolomeo programme. This programme under the Access to Space for All initiative offers an opportunity for United Nations Member States to utilize the Airbus Bartolomeo external platform attached to the European Columbus Module of the International Space Station (ISS) for a free one-year mission in the space environment. The remote sensing camera to be developed by the ClimCam Team will monitor water, floods and the changing climate, and directly contribute to five different SDGs.

The Bartolomeo programme broadens access to space benefits, activities and applications, and builds capacity in space science and technology. The partnership attracted considerable interest and catalysed international collaboration with the initial call for interest inspiring over 60 replies. The final proposals received by UNOOSA under the announcement of opportunity brought together 29 different institutions from 18 countries, aspiring to address 16 of the 17 SDGs, underscoring the importance of space for sustainable development.

Announcement of the awarded team
Credit: International Astronautical Federation

TELESCOPES TO BE DELIVERED TO KENYA AND NIGERIA AS FIRST AWARDEES OF ISONSCOPE OPPORTUNITY

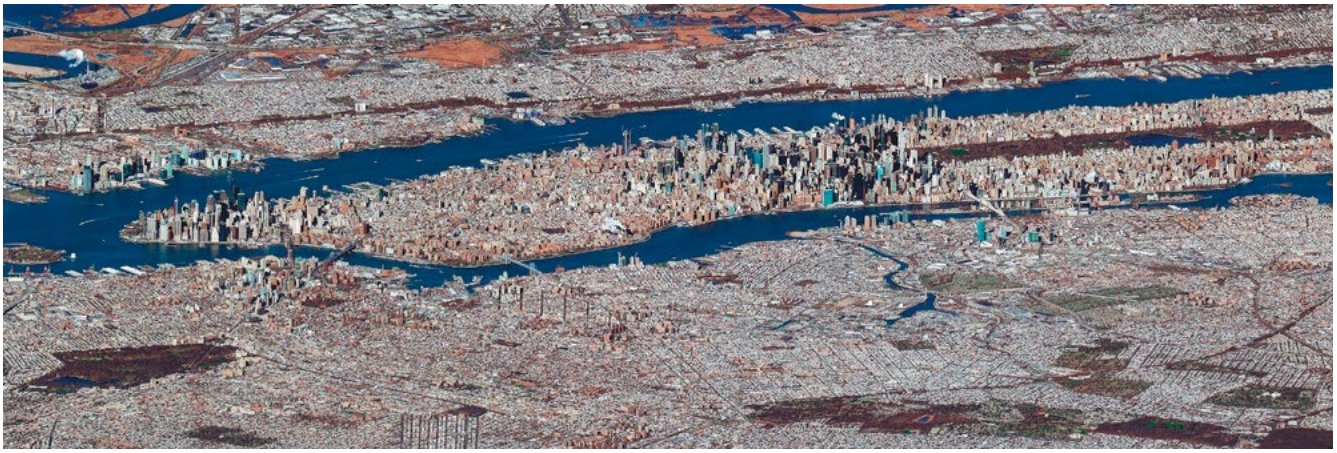
Following a competitive application process, UNOOSA and the Keldysh Institute of Applied Mathematics of the Russian Academy of Sciences (KIAM RAS), selected entities from Kenya and Nigeria to receive small wide-field-of-view telescopes. The Kenyan Space Observation and Research Telescope (K-SORT Project), led by the Kenya Space Agency, aims to monitor space debris, space weather and near-Earth objects. The K-SORT Project also hopes to promote and support space science research and outreach programmes in Kenya. The Nigeria Centre for Basic Space Science will conduct a photometric study on a type of variable star known as Delta Scuti. By partnering with several Nigerian universities, access to the telescope will benefit students and their skills.

The selection followed after UNOOSA and KIAM RAS entered into a partnership in early 2021 to provide an opportunity within the International Scientific Optical Network (ISON). This joint effort is devoted to providing telescopes and training on their operation to the selected academic and research institutions and to supporting the establishment of telescope-related facilities located in United Nations Member States, especially developing nations. As part of the Access to Space for All initiative, ISONscope bridges the space capabilities gap to leverage the benefits of space by increasing visibility, accessibility and ease of utilization of astronomy and space science.

Westerlund 2, a cluster of young stars about 20,000 light years from Earth
Credit: X-ray: NASA/CXC/SAO/Sejong Univ./Hur et al; Optical: NASA/STScI

Small wide-field-of-view telescopes in ISONscope
Credit: KIAM

> *Granting the opportunity for new generations of discoverers, astronomers, astronauts, even policymakers or artists, to glimpse through a telescope is much more than just a one-time opportunity. It is a life-changing experience.*
>
> **UNOOSA**



New York City from space
Credit: Maxar Technologies

LANDMARK "SPACE2030" AGENDA: SPACE AS A DRIVER OF SUSTAINABLE DEVELOPMENT AGREED BY UNITED NATIONS MEMBER STATES

2021 marked the finalization of the landmark "Space2030" Agenda and implementation plan, a blueprint document that charts the way to enhance the contribution of space and its applications to sustainable development. The Agenda contains valuable tools and international and regional mechanisms, programmes, projects and platforms to benefit Member States and facilitate economic growth and prosperity with a strong focus on multi-stakeholder partnerships and cooperation.

This multilateral agreement results from a three-year-long negotiation process in COPUOS that began at UNISPACE+50, where the international community reflected on more than 50 years of achievement in space exploration and use, and called for reinforcing global cooperation in space. In October 2018, the General Assembly expressed its appreciation for the progress in the UNISPACE+50 process and invited COPUOS to continue to develop a "Space2030" agenda and implementation plan. COPUOS endorsed the final document in September 2021 and the General Assembly adopted it in resolution 76/3 on 25 October 2021.

Sunrise on our planet Earth
Credit: NASA/Jeff Williams

> *We, the States Members of the United Nations, acknowledge that the exploration and peaceful uses of outer space have enriched our collective knowledge and revolutionized life on Earth. Space science and technology are now intrinsic to our daily lives and bring an abundance of unique and fundamental benefits to Earth. As the space community moves forward with its space exploration endeavours, space will continue to serve as a source of inspiration and innovation and to provide applications for the benefit of humankind.*
>
> **General Assembly resolution A/RES/76/3.**

Vienna International Centre
Credit: Rodolfo Quevenco/IAEA

APPROVAL BY THE GENERAL ASSEMBLY ENLARGES COPUOS TO 100 STATES MEMBERS

Angola, Bangladesh, Kuwait, Panama and Slovenia became the latest States members of COPUOS, as confirmed by the decision of the General Assembly in resolution 76/76 adopted on 9 December. Welcoming five new countries to COPUOS brings the total membership of this intergovernmental platform to a milestone number of 100. In recent years, COPUOS has been one of the fastest-growing Committees in the United Nations system. Driven by the dynamics of the sector, we have seen unprecedented interest by countries to invest financial, human and political capital in space activities and related policy developments. The active engagement of UNOOSA in outreach and proactive diplomacy has also supported countries in their path to becoming Member States of the Committee.

As the international space community strives to address the novel challenges of contemporary space dynamics, it is important to consider the perspectives of future generations and currently non-spacefaring or emerging space nations. UNOOSA welcomes the increased interest of United Nations Member States in multilateral dialogue through the Committee and will actively engage with non-member countries to support them on the path to becoming members of this unique intergovernmental hub for promoting international cooperation in the peaceful uses and exploration of outer space.

UNOOSA AND THE EUROPEAN SPACE AGENCY LAUNCH SPACE DEBRIS CAMPAIGN

On 10 February, UNOOSA and the European Space Agency (ESA) started to release a series of infographics and podcasts to address and raise awareness of the issue of space debris. This new series of straightforward infographics includes illustrations, facts and figures to clarify what space debris is and the challenges it poses. The topics range from debris generation, collision avoidance measures and techniques, risks to human and robotic missions and people on Earth in case of re-entries, and technologies for space debris mitigation and removal. UNOOSA and ESA experts also created a podcast series to help navigate and understand the material in each of the nine infographics. The infographics, as well as the podcasts, are publicly available on the UNOOSA website.

Space debris infographic
Credit: UNOOSA/ESA

Space debris raises concerns across the global space and non-space community as one of the main challenges to the long-term sustainability of outer space activities. With near-Earth space being a finite resource, millions of debris fragments orbiting at high speeds pose the risk of damage or even destruction to active spacecraft and human space flight missions. In the light of the rapid development of the space industry in recent years, it is increasingly important to protect these unique orbital regions with the long-term sustainability of space activities in mind.

Infographic campaign on the Guidelines
Credit: United Nations

UNOOSA AND THE UNITED KINGDOM PARTNER FOR AWARENESS-RAISING AND CAPACITY-BUILDING RELATED TO THE IMPLEMENTATION OF THE GUIDELINES FOR THE LONG-TERM SUSTAINABILITY OF OUTER SPACE ACTIVITIES

The partnership between UNOOSA and the Government of the United Kingdom of Great Britain and Northern Ireland boosts international efforts to protect future space activities. Together, the partners encourage all space stakeholders to implement the Guidelines for the Long-term Sustainability of Outer Space Activities adopted by consensus at the sixty-second session of COPUOS in 2019 to the fullest extent possible. The Guidelines focus on the policy and regulatory framework, the safety of space operations, international cooperation, capacity-building and awareness-raising, and scientific and technical research and development.

As part of the project, UNOOSA convened regulators, policymakers, space operators and the commercial sector to share experiences about actionable and sustainable solutions and to collect operational case studies. The awareness-raising component also entailed an accessible version of the Guidelines and an infographic series in all six official languages of the United Nations. These materials are publicly available on the new Space Sustainability website. In addition, the website features case studies that show how the stakeholders have operationalized the Guidelines.

In the second phase of the project, the Office has sought experiences from the COPUOS Member States and international intergovernmental organizations in implementing the Guidelines to produce a stakeholder study report.

INTERNATIONAL EFFORT TO REDUCE IMPACTS OF LIGHT POLLUTION ON THE NIGHT SKY BOOSTED THROUGH THE UNITED NATIONS/SPAIN/INTERNATIONAL ASTRONOMICAL UNION CONFERENCE ON DARK AND QUIET SKIES FOR SCIENCE AND SOCIETY

For thousands of years, the silent and ordered beauty of the night sky has inspired humankind in all its intellectual and emotional pursuits, such as poetry, philosophy, religion and science. Modern science is particularly indebted to the observation of astronomical phenomena. Today, artificial illumination in urban areas is making it increasingly difficult to observe the night sky in its pristine magnificence. Even remote sites, often chosen to host the most sophisticated astronomical observatories because of their favourable location, are becoming gradually endangered by light pollution, radio signal interference and artificially induced climatic modifications, including by mega-constellations of artificial satellites released in low-Earth orbit.

Satellite tracks interfere with this image of Venus and the Pleiades
Credit: Torsten Hansen/IAU OAE

Tenerife, Canary Islands from space
Credit: ESA

Building on the initial findings and draft recommendations from the online workshops in 2020, UNOOSA and Spain, jointly with the International Astronomical Union (IAU), organized the "Dark and Quiet Skies for Science and Society" conference from 3 to 7 October 2021. The conference hosted by the Instituto de Astrofísica de Canarias was delivered online owing to the disruption to air travel caused by the serious volcanic eruption on the nearby island of La Palma.

The conference focused on the implementation of recommendations, including by identifying technical and political actions needed to be taken by individual stakeholders and in partnerships to achieve effective realization and satisfactory solutions for the preservation of dark and quiet skies. The recommendations will be presented to COPUOS for consideration.

UNOOSA REACHES NEW AUDIENCES THROUGH PARTICIPATION AT EXPO 2020 AND THE SEVENTY-SECOND INTERNATIONAL ASTRONAUTICAL CONGRESS

The space industry contributes significantly to the achievement of global pledges to alleviate human suffering, improve the well-being of societies, and protect our planet. UNOOSA has been vocal about the transformative power of space at every possible opportunity. Expo 2020 represented a novel avenue and influential platform to raise awareness of the benefits of space and broaden the space audience.

In cooperation with local organizers, UNOOSA helped shape content for Space Week at Expo 2020. The Office co-curated "The People's Mission: Citizens in Space Exploration and Space Tech for Inclusive Development" to popularize space exploration, exemplify space benefits and inspire the next generation. Director Di Pippo presented real-life examples of the use of space to address global problems.

As a contribution to the mission of the Women's Pavilion to raise awareness of the influential role women have played throughout history, Director Di Pippo paired with Marcos Pontes, Minister of Science, Technology and Innovation of Brazil, in the "Fireside Chat: Space4Women – Challenges and Opportunities for Women in Space." Joining Sarah Al Amiri, United Arab Emirates Minister of State for Advanced Technology, Director Di Pippo contributed to the opening of the World Women's Majlis "Mission Equality: Expanding Equal Opportunities in the Space Economy," focusing on building a prosperous and equitable future for everyone. UNOOSA also participated in other events upon invitation of United Nations Member States and other partners.

Following the Space Week at Expo 2020, UNOOSA joined the space community at the seventy-second International Astronautical Congress (IAC) at the Dubai World Trade Centre. Through activities organized by UNOOSA and the participation at the dedicated exhibition, the Office raised awareness of the opportunities under the Access to Space for All initiative and efforts related to space law capacity-building, as well as promoting the need for sustainable space operations for a sustainable planet.

Fireside chat at the Women's Pavilion
Credit: Women's Pavilion

UNOOSA at Expo 2020 Space Week
Credit: Stuart Wilson/Expo 2020 Dubai

Presenting real-life examples of the use of Space for SDGs
Credit: Stuart Wilson/Expo 2020 Dubai

ASTRONAUTS COME TOGETHER TO CELEBRATE THE SIXTIETH ANNIVERSARY OF GAGARIN'S HISTORIC SPACE FLIGHT

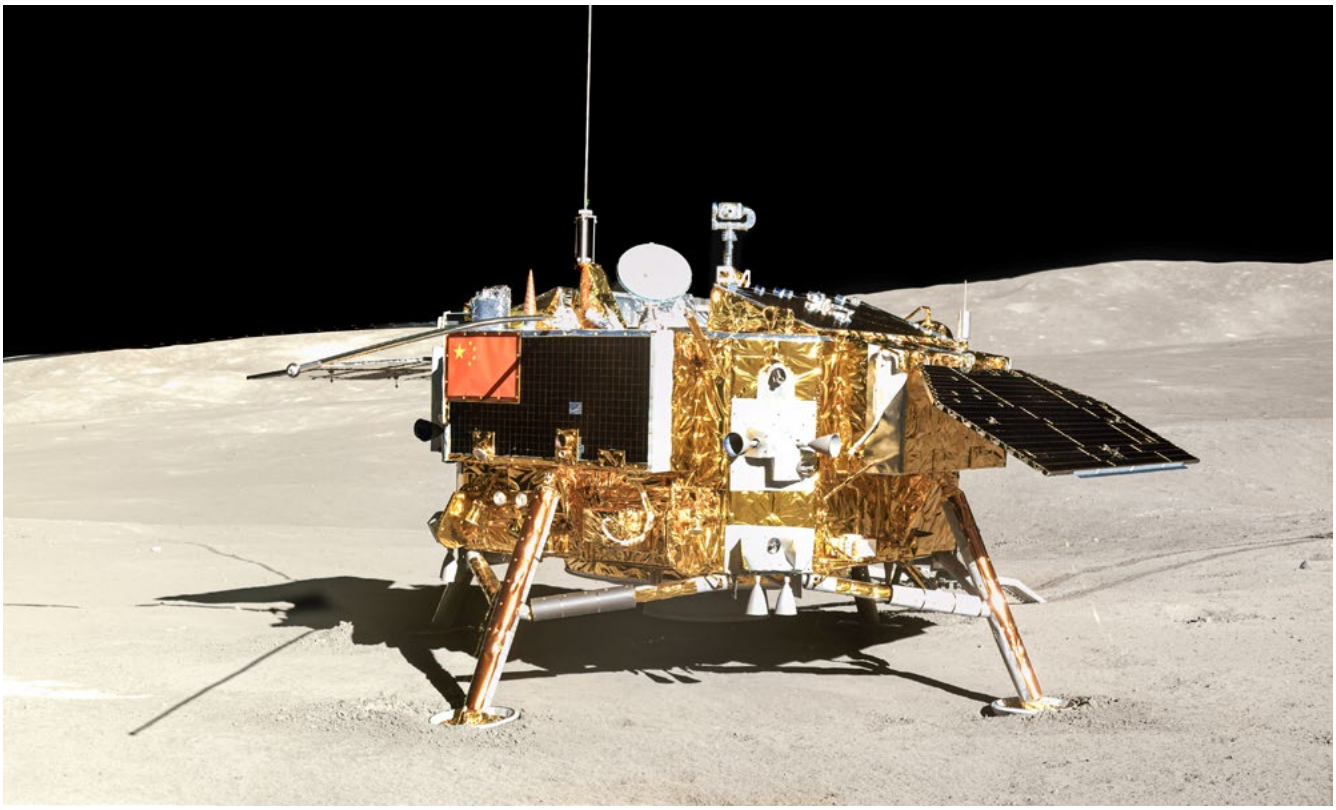
The International Day of Human Space Flight, declared by the General Assembly in 2011 and commemorated annually on 12 April, "celebrates each year at the international level the beginning of the space era for humankind, reaffirming the important contribution of space science and technology in achieving SDGs and increasing the well-being of States and peoples, as well as ensuring the realization of their aspiration to maintain outer space for peaceful purposes."

In 2021, the international space community marked the tenth anniversary of the declaration and commemorated the sixtieth anniversary of the first trip to space with a human on board. The space flight of the Soviet cosmonaut Yuri Gagarin opened a new chapter in space exploration and humanity's continuous quest to reach new frontiers.

UNOOSA launched a campaign dedicated to commemorating this historic achievement with 29 astronauts and test astronauts from over 15 countries sharing inspirational messages about their journeys, perspectives and visions for the future of human space flight in the decades to come. The messages are available on the UNOOSA website.

The bust of Yuri Gagarin at the UNOOSA exhibition at the Vienna International Centre
Credit: United Nations

> *Gagarin's first words from space – I feel well – made us understand that humans could truly go beyond our Earth, an achievement that humanity dreamed of for millenniums and that was finally ours. That day, people all over the world marvelled at how far our species had come.*
>
> *One of the great things about space exploration and human space flight is the common desire to push the boundaries of what is possible. Space unites all humans for a shared and higher purpose; it excites, motivates and inspires us in so many ways.*
>
> **Simonetta Di Pippo, former Director of UNOOSA**

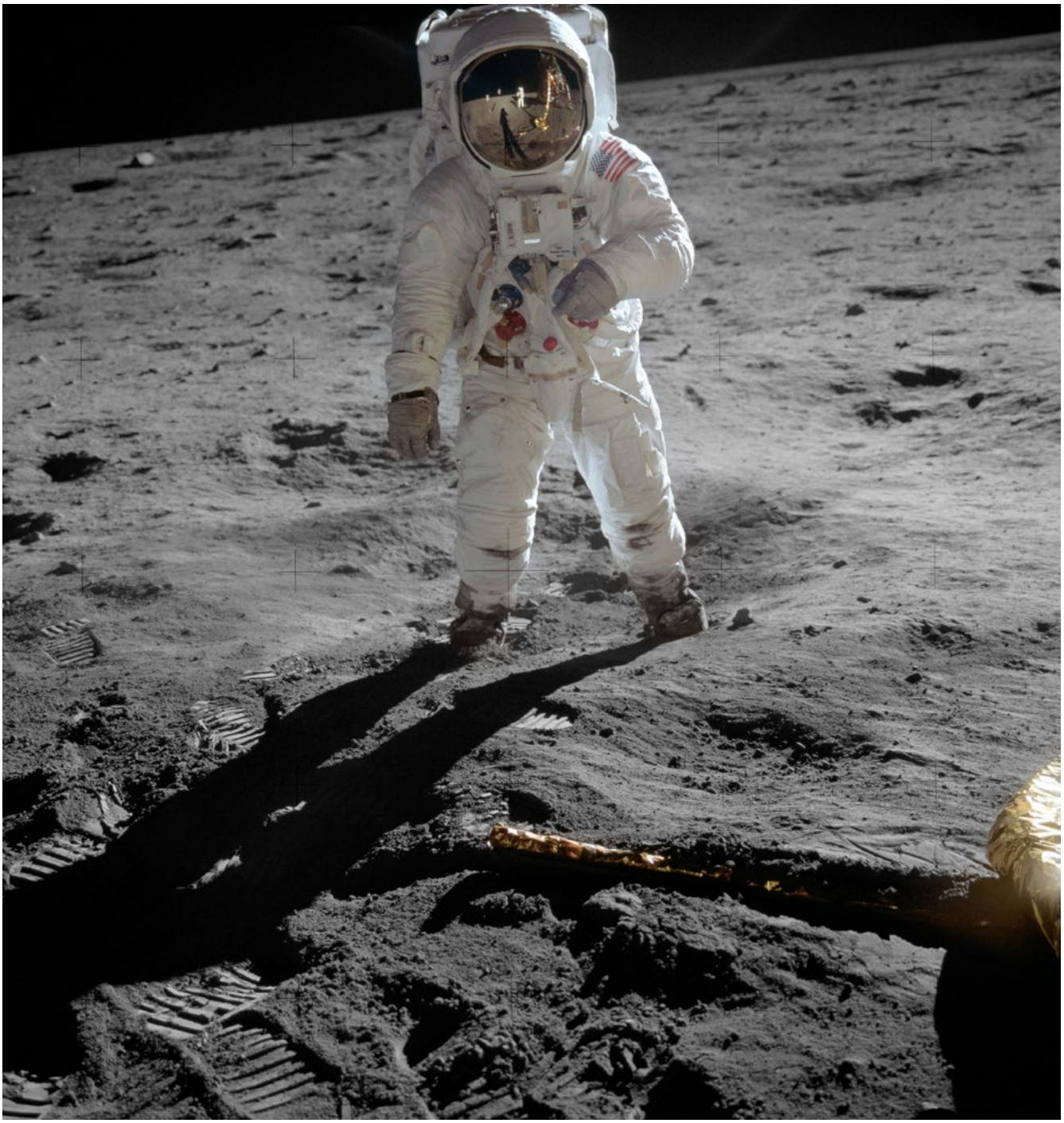


Chang'e 4 lander on the surface of the Moon
Credit: CNSA/Siyu Zhang/Kevin M. Gill

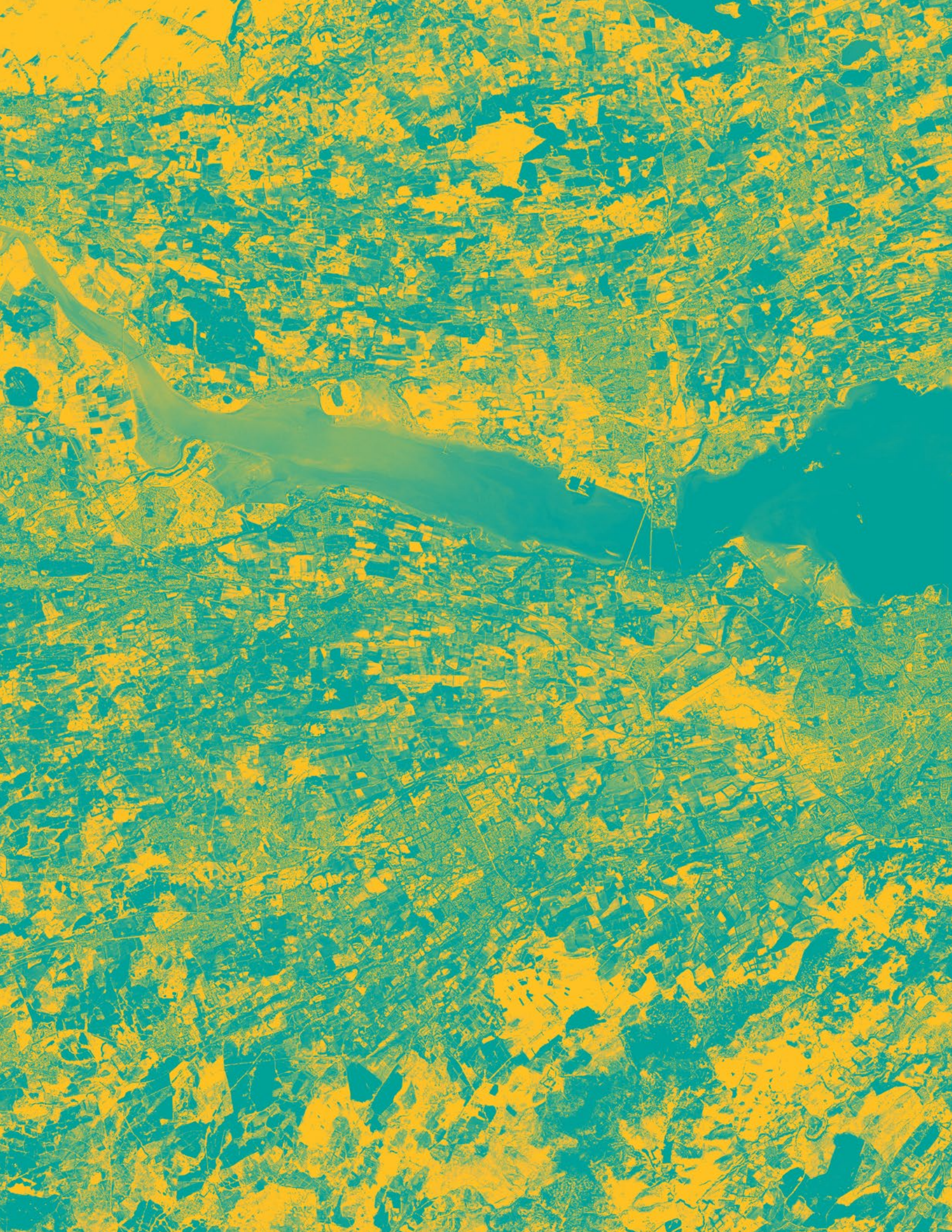
INTERNATIONAL MOON DAY DECLARED BY THE GENERAL ASSEMBLY

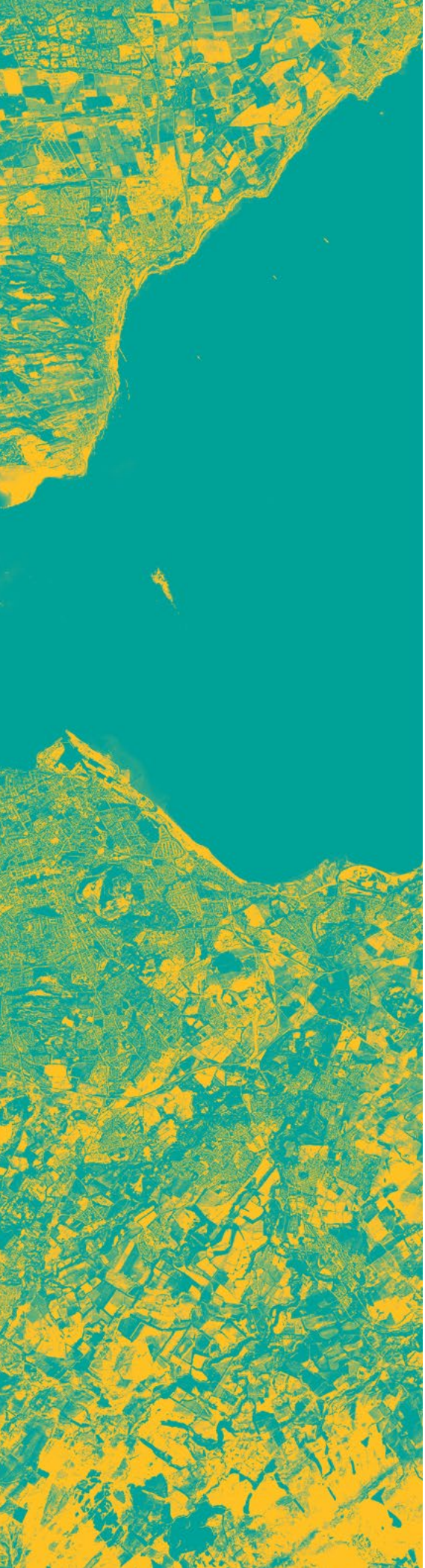
The General Assembly declared International Moon Day, a United Nations-designated international day to be observed annually on 20 July, in its resolution 76/76 on "International cooperation in the peaceful uses of outer space" in 2021. International Moon Day marks the anniversary of the first landing by humans on the Moon as part of the Apollo 11 lunar mission. The celebrations will also consider the achievements of all States in the exploration of the Moon and raise public awareness of sustainable Moon exploration and utilization.

For thousands of years, human civilizations have looked up to the sky pondering the origin and mysteries of the Moon – our only natural satellite. Ground-based observations enabled by the invention of the first telescopes opened a new chapter in our understanding of our celestial companion. With the birth of space activities, the Moon became the ultimate destination of countless missions, including crewed flights that brought the first human footprints to another place in the universe. As Moon exploration efforts continue taking shape with ambitious plans, this global celebration will serve not only as a reminder of success in the past, but as an annual testimony to future endeavours.



Buzz Aldrin photographed by Neil Armstrong on the surface of the Moon
Credit: NASA





The West Lothian region of Scotland
Credit: NASA/Joshua Stevens

This focus chapter explores the role of space in combating the climate crisis, listing some of the activities UNOOSA conducted to broaden the use of space to address climate-related challenges, nurture synergies and partnerships, and amplify the voices of future generations. It starts by looking at the value of multilateral discussions at the World Space Forum.

4

FOCUS CHAPTER: SPACE FOR CLIMATE ACTION

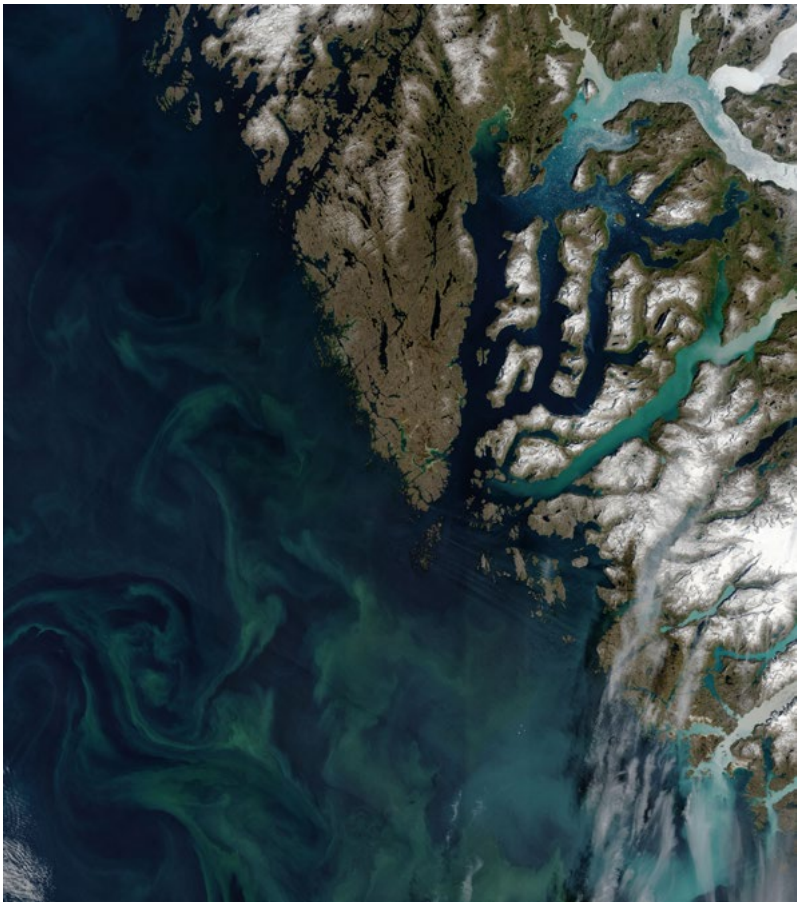
4 | FOCUS CHAPTER: SPACE FOR CLIMATE ACTION

Climate science depends heavily on the hardware that orbits our planet. It guarantees global coverage and collects comparable, reliable and impartial data allowing us to track changes and evaluate the different climate models. More than half of the 54 essential climate variables that contribute to the characterization of the planet's climate can only be measured reliably and consistently from space. Satellites are our eyes into the natural world.

Addressing climate change requires that we turn climate science into climate action. The space community has worked for decades to develop solutions to mitigate, adapt and make societies more resilient to its impacts. Satellites help us identify locations for renewable energy generation, improve efficiency across industries and facilitate urban planning. Their contributions also help feed the world, manage precious resources, and even save lives and reduce damage caused by disasters.

As the pressures of climate change mount, there is a growing need to make the benefits of space universal. The Office works to democratize access to space and helps build regional, national and local strategies for climate action. Promoting dialogue, advancing international cooperation, amplifying the voices of the young generation, and building capacity in the use of space assets are at the core of this effort.

This focus chapter provides an overview of some of the activities UNOOSA carried out in 2021 in a bid to translate ambition into action, data into solutions, and individualism into multilateralism.



Phytoplankton bloom in the Arctic
Credit: NASA

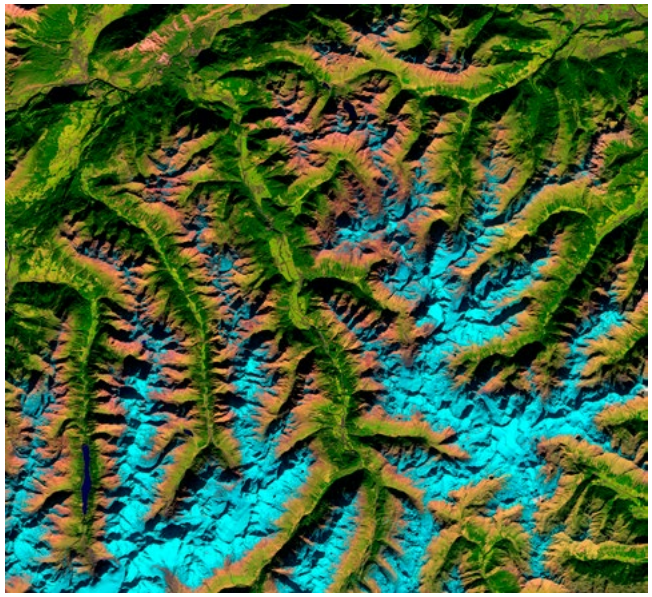
The World Space Forum logo
Credit: UNOOSA

UNITED NATIONS/AUSTRIA WORLD SPACE FORUM 2021 ON SPACE FOR CLIMATE ACTION

UNOOSA launched the annual World Space Forum (WSF) in 2019 as a holistic platform for exchanging user needs, actionable solutions and the means to strengthen the use of space in achieving sustainable socioeconomic development. The 2021 edition (held virtually) was organized jointly with Austria and attracted 540 individual participants, 42 per cent of whom were women. Recordings of the sessions are all available on the UNOOSA YouTube channel.

WSF 2021 themed "Space 4 Climate Action" focused on stakeholder exchange about current and future activities, actionable solutions and cooperation in support of SDG 13, on climate action. The Federal Minister for Climate Action, Environment, Energy, Mobility, Innovation and Technology of Austria, the Minister for Science, Research and Innovation of the United Kingdom, and the Director of UNOOSA opened the event. The three-day programme explored successful partnerships, initiatives and activities in leveraging space technologies for climate action, elevated the voices of youth, and provided an opportunity for both providers and users to share their perspectives and participate in international networking and matchmaking.

As climate action starts with evidence- and science-based information, much of which is derived from space infrastructure, participants called for reinforced cooperation on greenhouse gas monitoring and the development of new applications based on space-generated knowledge. Furthermore, panellists underscored the need for increased capacity-building in applying space data for climate action and strengthened knowledge transfer among different sectors to nurture synergies on a national and international scale.



Ötztal Alps in Tyrol
Credit: ESA

INSPIRING IDEAS ON UTILIZING SPACE AS A TOOL TO FOSTER CLIMATE MITIGATION AND ADAPTATION SELECTED IN THE THIRD EDITION OF THE SPACE4YOUTH COMPETITION

The Space4Youth essay competition co-organized with the Space Generation Advisory Council aims at amplifying the voices of young people in the pressing issues that we face as a society. The theme of the third edition was "Space as a tool to foster climate change mitigation and adaptation." Of the 436 submissions from 80 countries and nine finalists, three essays were shortlisted: Mahlak Abdullah (United States) based her essay on a research experiment she sent to the ISS; Karina Maria Berbert Bruno (Brazil) highlighted regional applications of Earth observation technologies in her home country; and Tejasvi Shivakumar (India) focused on space influencers and renewable energy.

Mahlak Abdullah from the United States (19)
Credit: herself

Karina Maria Berbert Bruno from Brazil (31)
Credit: herself

Tejasvi Shivakumar from India (23)
Credit: herself

The United States Permanent Mission to the International Organizations in Vienna and the UK Space Agency supported the competition by involving awardees in activities such as mentorship programmes and meetings with experts. "Space4Youth has opened many opportunities for me," said one of the participants. One highlight was the Space4Youth presence at the United Nations Climate Change Conference (COP 26) in Glasgow. The winners delivered a message to COP26 global leaders in a pre-recorded video at a booth called "Space4Climate Now and in the Future." Tejasvi Shivakumar participated in the Youth Takeover Day on November 12 in person and shared her experience in a blogpost on the UNOOSA Space4Youth Stories webpage.

Elevating the voices of youth is crucial to achieving the SDGs. Especially when it comes to climate action, young people can contribute with innovative ideas to shape the world they will inherit. With Space4Youth, UNOOSA remains committed to promoting the next generation of space professionals.

Thanks to the generous contribution of the United States, the winners will be able to visit the United States to meet with representatives of the space industry and attend the Adult Space Camp, organized by the University of Alabama, at the United States Space and Rocket Center.

Space4Youth Awardee Tejasvi Shivakumar at COP 26
Credit: Tejasvi Shivakumar

Space4Youth presence at the Glasgow Climate Change Conference
Credit: Tejasvi Shivakumar

Glasgow, host of COP 26 from space
Credit: ESA

United Kingdom from the International Space Station
Credit: NASA

UNOOSA PARTICIPATES IN THE EARTH INFORMATION DAY AT COP 26

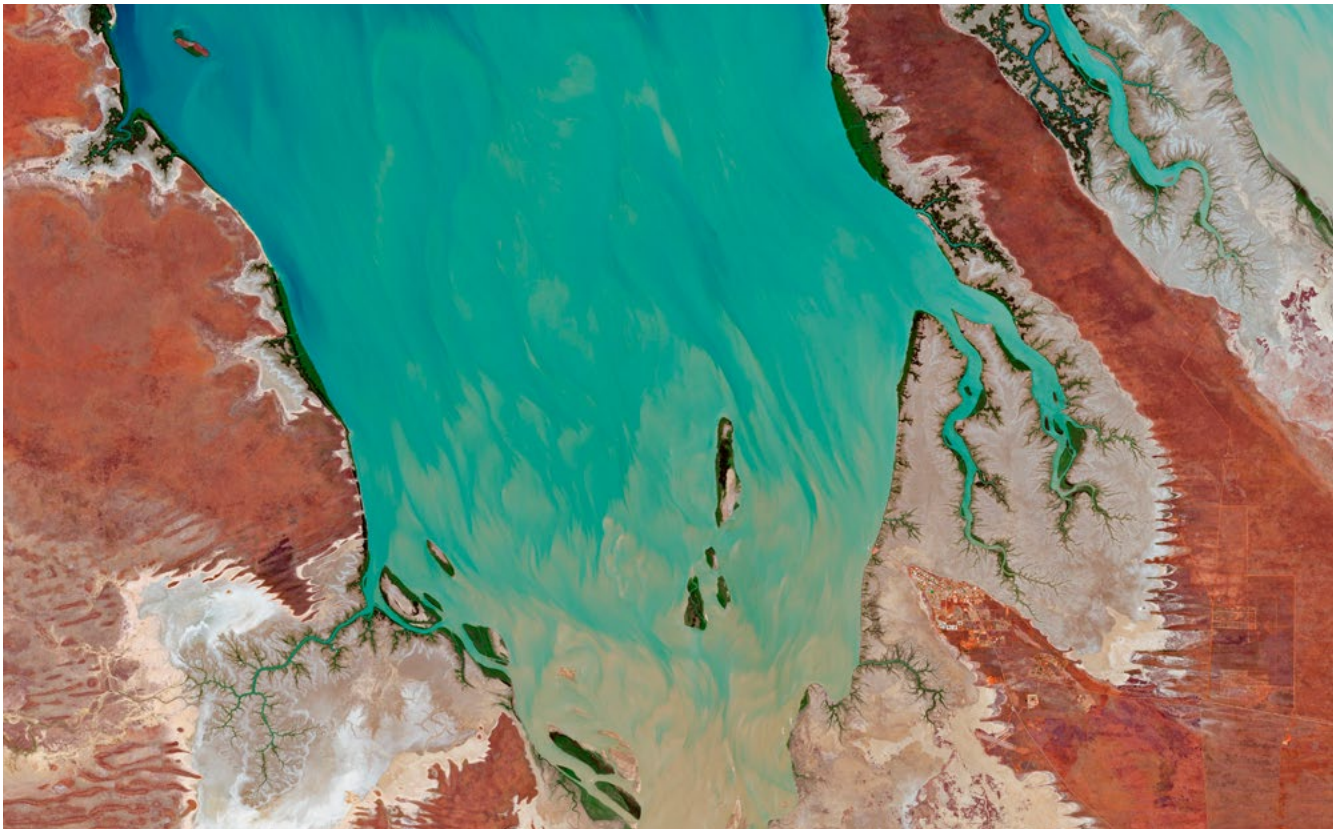
Earth Information Day provided the opportunity for exchanging information on the state of the global climate system and developments in systematic observation. In its intervention, UNOOSA underlined the fundamental need for the consolidation of climate science and research to generate the most accurate understanding of the drivers, dynamics and impacts of climate change. To succeed in such endeavours, multilateralism, integration of data and interoperability of systems are paramount – an approach that must be driven through political commitment. UNOOSA pledged to continue delivering targeted capacity-building and technical advisory activities, facilitating multi-stakeholder collaboration, and promoting efforts to encourage the use of space for sustainable development.

AGREEMENT WITH THE UNITED KINGDOM TO MAP GLOBAL SPACE-RELATED CLIMATE ACTION EFFORTS

Global leaders at COP26 in Glasgow emphasized that addressing the climate crisis demands a holistic and collaborative approach using resources, tools and technologies at full speed. While the scientific community and the United Nations system have long recognized and utilized space-based assets as essential components in climate change research, monitoring and policy enactment, a comprehensive overview of the broad spectrum of current and planned activities in using space for climate action has been missing. The agreement with the United Kingdom addresses this information gap for space-related climate action and will also contribute to building synergies, facilitating coherence and avoiding duplication among already existing activities. The outcome report aims to help the international community gain a better understanding of existing technical, policy and coordination efforts. The report can also inform strategy development or research and bring policy coherence across the multilateral system.

UNOOSA AND INTERNATIONAL PARTNERS ADVANCE WORK ON DELIVERING SPACE BENEFITS TO COMBAT CLIMATE CHANGE AT THE LOCAL LEVEL

With climate action embedded within the mandate of UNOOSA across different levels, both the participation and contribution to the work of international coordination bodies are of great importance. For these reasons, UNOOSA has been involved with the Space Climate Observatory (SCO) since 2016, which offers a unique opportunity to raise awareness of the transformative power of space tools and facilitate the adoption of space solutions on the ground. Combining space technology expertise in the downstream sector with the broad reach of the United Nations is efficient in connecting solution providers with users, and in advancing universal access to space benefits.
SCO breaks down the benefits that space assets readily offer to national and local levels, helping authorities and communities on the ground to make informed decisions and adopt the right policies based on the data available. In 2021, SCO continued to expand its membership with the incorporation of three new members bringing the total to 36. By the end of 2021, 43 activities had been labelled as SCO projects.



Valentine Island in northern Western Australia
Credit: ESA

Farmland in Hereford, Texas, United States
Credit: ESA

> *The crisis brought on by the COVID-19 pandemic is unfolding against a planetary crisis that is threatening our climate and life as we know it. Sustainable food production systems should be recognized as an essential solution to these existing challenges. It is possible to feed a growing global population while protecting our planet.*
>
> **Secretary-General's Chair Summary and Statement of Action on the United Nations Food Systems Summit**

UNOOSA AND AUSTRIA COME TOGETHER TO ADVANCE DIALOGUE ON SPACE APPLICATIONS FOR FOOD SYSTEMS

The 2021 United Nations/Austria Symposium "Space Applications for Food Systems", held virtually from 7 to 9 September, showcased the concrete support of space applications for food systems. The discussions and outcomes contributed to activities around the United Nations Food Systems Summit convened by the Secretary-General as part of the Decade of Action to achieve the 17 SDGs by 2030.

The Symposium provided a platform for specific policy discussions and the exchange of experience and know-how on the integration of space applications and tools into the domain of agriculture and food security. The overarching objective was to offer users an opportunity to explore tools, policies and approaches fit for their respective regional, national or local contexts. Participants also discussed specific challenges to the implementation of space applications for food systems, such as the need to enhance the understanding of user needs, raising awareness of space solutions, technology transfer, financing for development and youth engagement.

Keynote statements from UNOOSA and ESA complemented the sessions, providing insights into international cooperation to leverage space technologies against climate change in support of sustainable food systems.

For the first time, post-symposium online training was organized by UNOOSA, ESA, the Indian Space Research Organisation and NASA to raise awareness of the use of Earth observation technologies and remote sensing for agriculture and enhance participants' capabilities to use them.

All presentations made at the Symposium are available on the UNOOSA website.

Qeshm Island – the largest island in the Islamic Republic of Iran
Credit: ESA

UNOOSA AND THE ISLAMIC REPUBLIC OF IRAN EXPLORE THE ROLE OF SPACE TECHNOLOGY APPLICATIONS FOR DROUGHT, FLOOD AND WATER RESOURCE MANAGEMENT

Earth observation technologies are crucial to managing and monitoring water resources and water-related disasters such as floods and droughts, which increasingly affect agricultural production and food security. In this context, UNOOSA, through UN-SPIDER, and the Islamic Republic of Iran organized the "United Nations/Islamic Republic of Iran Workshop on Space Technology Applications for Drought, Flood and Water Resource Management" in August. The workshop hosted by the Iranian Space Agency provided an opportunity to deepen awareness and understanding of the possibilities offered by outer space for monitoring floods, drought conditions and water resource environments. Speakers emphasized that capacity-building, knowledge exchange, interdisciplinary thinking, policy developments and international cooperation were the driving factors for the achievement of the SDGs. Convening over 370 participants from 64 countries, this event contributed to the Food Systems Summit of the Secretary-General and the Decade of Action to achieve the SDGs.

Maupiti Island in the South Pacific Ocean
Credit: NASA/Robert Simmon

SPACE4WATER

Climate change has wide-reaching implications in the water domain. Alterations in the water cycle, growing disaster risks and rising sea levels, and increased water stress are only a few examples. These realities underscore the demand for more effective water and disaster management and international cooperation. Space technology and applications play a crucial role in mapping watercourses and aquatic ecosystems, monitoring and mitigating the effects of floods and droughts, and monitoring the water cycle. To leverage this potential, UNOOSA launched the Space4Water Project, delivered jointly with the Prince Sultan bin Abdulaziz International Prize for Water. The project fosters collaboration and knowledge exchange between stakeholders in the space and water sectors and helps tap into the full potential of space assets in addressing water issues. The Portal's delivery comprises three pillars: multilateralism, awareness-raising and community-building.

The effort to facilitate scientific exchange via conferences informs decision-making and helps shape policy. The Space4Water Portal showcases exceptional work in the water domain, enables networking opportunities, and supports capacity-building by making information easy to access and compare. The community-building component of the Portal aims at creating an Experts Committee for Quality Assurance and Scientific Guidance.

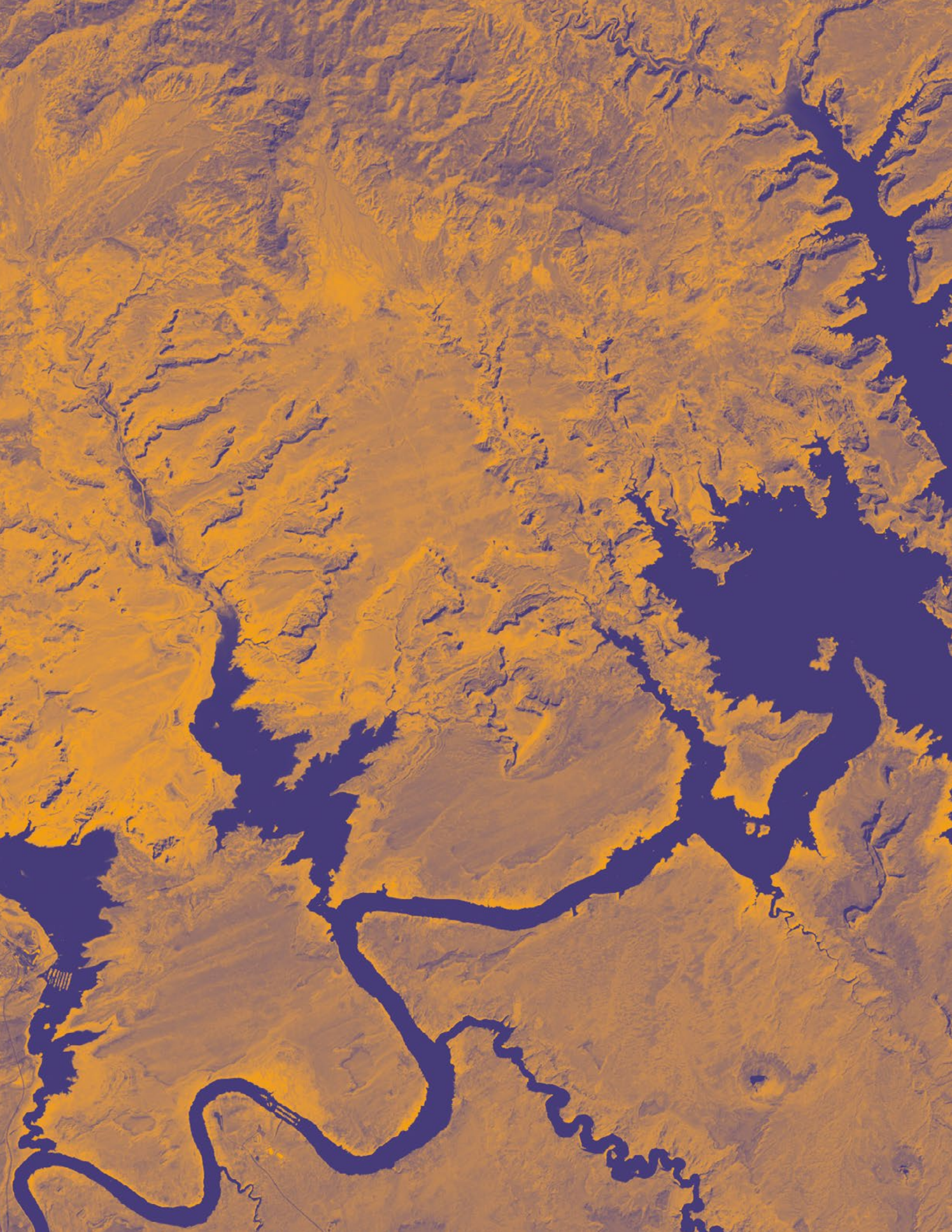
> *Water is one of the immediate means of experiencing how our climate is changing.*
>
> Stuart Crane in his 2021 Space4Water, Meet a Professional interview.

In 2021, the Office continued to expand the Portal with new content. As of 2021, it featured 66 stakeholders, interviews with 12 professionals and 15 young professionals, and over 500 knowledge resources on the use of space-based technology for water, with over 200 items added in 2021 alone. Throughout the year, the Portal continued to advance its reach, evidenced by the ground-breaking growth of users visiting the platform in 2021, surpassing 2020 figures by 150 per cent. The Office also launched calls for local perspectives and case studies as a new feature. These calls aim to identify needs and potential space solutions and learn about gaps in water resource management from individuals, communities, civil society, professionals, researchers or organizations in the field.

The Space4Water Community keeps growing and UNOOSA invites stakeholders and professionals to reach out and learn more at Space4Water Portal.

Type of content/ Number of content items published	*As at 31 Dec. 2021*
Stakeholders	62
(Young) Professionals	24
Articles	35
Interviews	23
Activities/opportunities	25
Publications	77
Software	21
Projects	12
Training material	79
Events	155
TOTAL	513

Space4Water Logo
Credit: UNOOSA



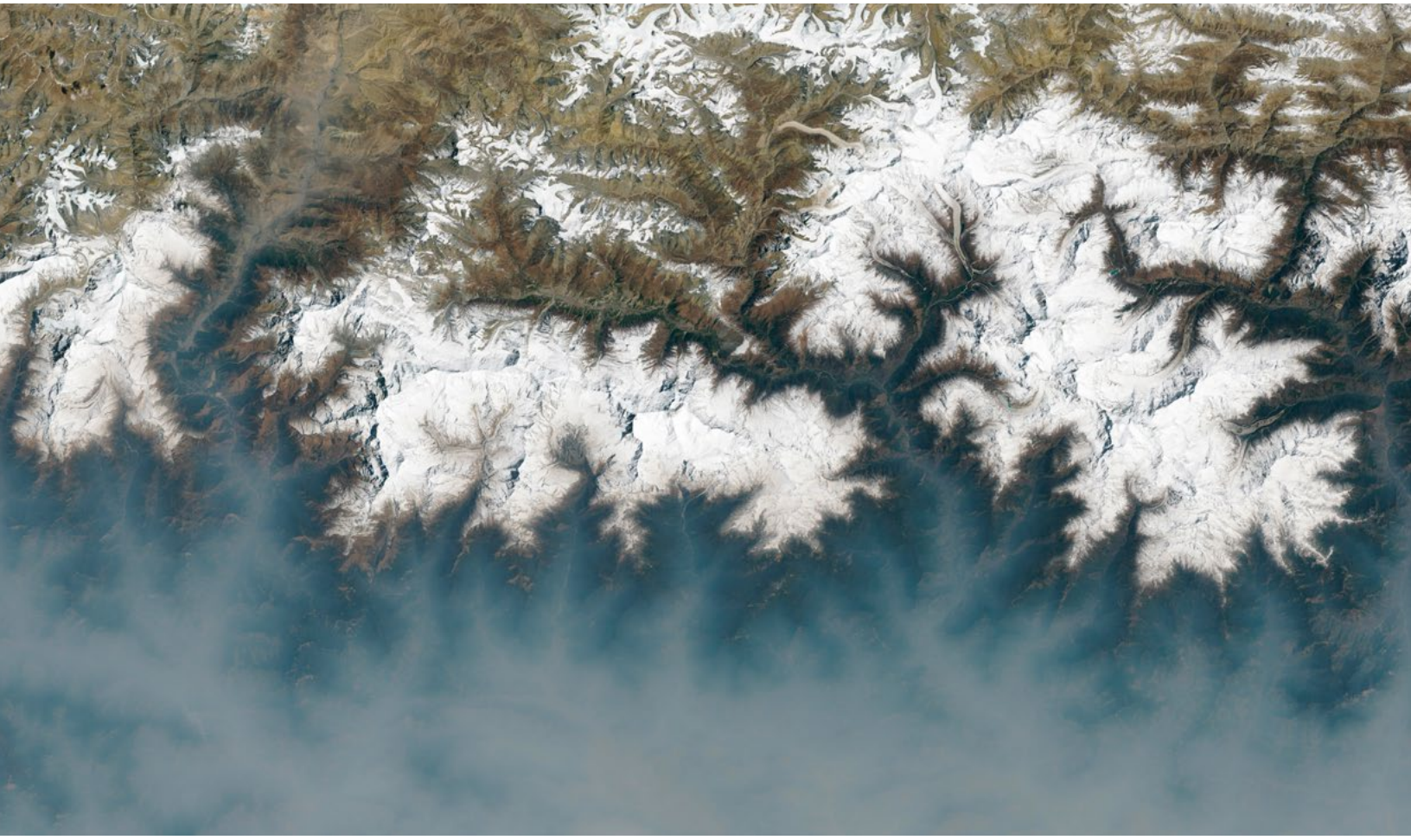
Lake Powell bordering Utah and Arizona, United States
Credit: NASA/Lauren Dauphin

The resilience of communities depends on an interplay of data and information, technologies and policy developments. Space assets are crucial for evidence-based decision-making, tailored and targeted policies and reinforcing the full disaster management cycle. UNOOSA, through the UN-SPIDER programme, helps developing countries find, access and use space-based information and implement the Sendai Framework for Disaster Risk Reduction, the Paris Agreement and the 2030 Agenda for Sustainable Development. In this chapter devoted to UN-SPIDER, you can read about the main activities of 2021.

5

LEVERAGING SPACE FOR DISASTER RISK REDUCTION AND MANAGEMENT

5 | LEVERAGING SPACE FOR DISASTER RISK REDUCTION AND MANAGEMENT



Extreme seasonal fires in Nepal
Credit: NASA

The impacts of climate change affect the occurrence, type and severity of disasters, exerting pressures on adaptation and resilience as crucial components of climate action. Investing in technologies and capacities to advance disaster preparedness and management is paramount. Space technologies play a vital role in this context. Established in 2006, UN-SPIDER enhances access to and the use of these technologies by all countries and international and regional organizations in all phases of the disaster management cycle.

At the request of Member States, UN-SPIDER conducts technical advisory missions to assess a country's existing capacity for leveraging space for disaster management and emergency response. Since 2006, UN-SPIDER has carried out 38 such missions and produced recommendations on the following topics: policy and coordination; data access, availability and sharing; capacity-building; institutional strengthening; early warning; and preparedness and emergency response efforts. These have helped countries institutionalize the use of space-based information in

disaster management. Building on the results of technical advisory missions, UN-SPIDER follows up with technical advice and training activities tailored to the needs of a country and strengthens local capacity for using Earth observation and remote sensing assets.

UN-SPIDER is based in Vienna with offices in Beijing and Bonn, thanks to generous contributions by the Governments of China and Germany. A global network of 26 regional support offices (RSOs) hosted by space agencies, universities, research institutions and civil protection entities supports the programme and provides expertise, services and content for the UN-SPIDER Knowledge Portal. With the conclusion of the memorandum of understanding in May 2021, the Joint-Stock Company National Center of Space Research and Technology (NCSRT) in Kazakhstan joined the RSO network, bringing valuable experience of monitoring various disasters and emergencies using space-based information. Over the years, the Center has developed technologies in remote sensing and Earth observation and become experienced in international capacity-building.

UN-SPIDER TECHNICAL ADVISORY SUPPORT TO MEMBER STATES IN 2021

Guatemala

In March and April, UN-SPIDER provided virtual advisory support to the National Coordinating Agency for Disaster Risk Reduction following the eruption of the Pacaya volcano. As part of this support, the National Space Commission of Argentina, in its role as a UN-SPIDER regional support office, donated satellite imagery from its SAOCOM 1 satellite to contribute to the tracking of active lava flows.

Nigeria

UN-SPIDER organized several virtual teleconferences with the National Space Research and Development Agency, the National Emergency Management Agency, and the Nigerian Hydrological Services Agency to advance discussions on ways to address the growing challenges posed by the annual floods. As part of these discussions, the parties agreed to conduct a national expert meeting, which took place from 13 to 15 April 2021.

Niger River delta in Nigeria
Credit: Airbus

Namibia

In recent years several countries in Southern Africa have been experiencing more frequent and intense droughts that impact rural communities. To raise awareness of the use of UN-SPIDER recommended practices, the RSO Centre for Remote Sensing of Land Surfaces (ZFL) of the University of Bonn created more than 490 maps of the Standardized Vegetation Index, covering the period between April 2000 and June 2021. In addition, maps of flooded areas in Namibia from April 2020 were also presented to the National Directorate of Disaster Risk Management of Namibia.

Malawi

Standardized Vegetation Index maps covering more than 20 years of data were also created for Malawi. To raise awareness regarding the benefits of the combined use of archived and up-to-date satellite imagery in drought early warning systems, ZFL created hundreds of maps of the Standardized Vegetation Index. Complemented by the map of areas flooded in March 2019, these resources were presented to the Department of Disaster Management Affairs of Malawi and to the Office of the United Nations Resident Coordinator in Malawi.

Paraguay

In October, at the request of the Paraguayan Space Agency, ZFL in its role as a UN-SPIDER RSO, prepared almost 500 maps of the Standardized Vegetation Index in the country over a period of two decades. This effort was conducted in response to agricultural and hydrological droughts that contributed to severe forest fires in Paraguay in 2021.

Convergence of two contrasting geological regions in south-central Namibia
Credit: NASA

Lake Malawi in the eastern rift of the Great Rift Valley
Credit: ESA

Colombo, from above
Credit: Airbus

Sri Lanka

UN-SPIDER organized three capacity-building programmes in Sri Lanka with officials from various agencies and provincial offices of the National Emergency Management Agency. The national consultant supported the strengthening of the Platform for Real-time Impact and Situation Monitoring, developed with the help of the World Food Programme, and assisted the National Emergency Management Agency with the training programme required to become an authorized user of the International Charter on Space and Major Disasters. UN-SPIDER also supported the establishment of approaches for monitoring forest fires, burn severity mapping and drought monitoring using open-source satellite images and software tools. The Programme also facilitated the nomination of two officers from the Disaster Management Centre of Sri Lanka to undertake a nine-month postgraduate diploma course in Remote Sensing and Geographic Information Systems at the Centre for Space, Science and Technology Education for Asia and the Pacific (CSSTEAP).

Afghanistan

In January, UN-SPIDER held an introductory meeting to support Afghanistan at the request of the Office of the State Ministry for Disaster Management and Humanitarian Affairs. This meeting focused on understanding policy, institutional coordination, current capacity and supportive legislation related to the use of geospatial information for disaster preparedness, early warning, response and recovery. The priorities identified at the meeting led to the provision of advisory support on drought monitoring in Afghanistan in the January–May period. In May, the Office of the State Ministry for Disaster Management and Humanitarian Affairs and UN-SPIDER conducted a virtual thematic meeting with key stakeholder agencies on "Assessing Drought and Water Resources Conservation using Earth Observation" together with Delta State University, Mississippi, United States and the Intentional Water Management Institute as UN-SPIDER RSOs.

Niger

At the request of the National Civil Protection Directorate of Niger, UN-SPIDER carried out a second online training course on flood mapping with Sentinel-1 radar imagery in Google Earth Engine to continue strengthening the capacity of Niger to use space-based information to respond to floods in the country. UN-SPIDER staff introduced basic principles of radar remote sensing to 36 participants from government agencies and the United Nations Resident Coordinator's Office, and taught all participants to use relevant recommended practices, present the results in geographic information systems as flood maps, and explore the process with selected case studies.

UN-SPIDER EMERGENCY SUPPORT

Activations of the International Charter "Space and Major Disasters"

As part of its activities, UN-SPIDER facilitates activations of the International Charter on Space and Major Disasters, a worldwide collaboration through which satellite data are made available for disaster relief efforts. In 2021, the Charter was activated on behalf of the National Board for Disaster Management of Indonesia, and with support from the Indonesian National Institute of Aeronautics and Space as an RSO, as a result of a major earthquake on 15 January. The earthquake displaced almost 95,000 people, causing over 90 deaths and 3,300 injuries.

In addition to requesting the activation of the mechanism, UN-SPIDER continued to raise awareness of the opportunities offered by the Charter through international events and conferences. For example, from 30 November to 2 December 2021, UN-SPIDER, the Central American Coordination Centre for Natural Disaster Prevention (CEPREDENAC) and the International Charter on Space and Major Disasters carried out a training course on the procedures employed by project managers in case of activation of the International Charter in Guatemala. The training course allowed over 20 participants from Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Mexico, Nicaragua and Panama to understand the procedures and rules related to the use of the Charter.

Participants were trained in the use of the UN-SPIDER recommended practice for rapid flood mapping using Sentinel-1 radar imagery. The training course was also used to establish a regional remote sensing team that will support CEPREDENAC and national disaster management agencies in countries of the region in mapping efforts in case of disasters.

Additionally, thanks to the efforts of UN-SPIDER, in 2021 the Charter Secretariat incorporated the national disaster management agencies of Mexico and the Gambia as authorized users.

Group photo of the Guatemala training course participants
Credit: UNOOSA

Raja Ampat archipelago in the West Papua province of Indonesia
Credit: Airbus

UN-SPIDER worked with relevant institutions in Bangladesh, the Gambia, Honduras, Mexico, Mozambique, Nicaragua, Niger, Panama, the Solomon Islands, Viet Nam and Zimbabwe to support them to become authorized users of the International Charter. As a result, Mexico and the Gambia have already been accepted as authorized users of the Charter.

NEW RESOURCES ON THE UN-SPIDER KNOWLEDGE 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.

In 2021, the Portal was updated to a newer version and further content was added to the French and Spanish versions. The Portal continued to attract an increasing number of users, with website visits rising by over 10 per cent compared to 2020, and approximately 45,000 monthly visitors in 2021. UN-SPIDER continued to add and update content items and improved the coverage of activities of the RSOs.

UN-SPIDER developed the following tools/resources:

- Flood Guide project with Copernicus, Airbus Defence and Space, ZFL of the University of Bonn, and institutions from Ghana, Guatemala, Nigeria, Peru and South Africa. The project aims to use the information generated in the Global Flood Awareness System of the Copernicus programme, in combination with in-situ historical data on impacts of floods in these five countries to improve flood early warning systems through the incorporation of impact-based forecasts.
- Procedure to use the Global Wildfire Information System of the Copernicus programme for national focal points of the Sendai Framework Monitor to report on forests destroyed by fire in reference to target C of the Sendai Framework. Within the framework of the procedure, a benchmark for calculating the extent of burned areas was created that serves as a baseline for present measurements.
- UN-SPIDER increased the use of cloud-based geographic information system solutions based on observations made during technical advisory support activities about the limited availability of information on technology resources among civil protection agencies. Examples include the use of online and web-based systems, such as Google Earth Engine, in recommended practices.

Forest fires on the Greek island of Euboea
Credit: Airbus

OTHER UN-SPIDER ACTIVITIES

UN-SPIDER Bonn International Conference on "Space-based Solutions for Disaster Management in Africa: Networks and Information Technologies in Times of Crisis"

The visualizations using GIS and web-based dashboards, the wider reach of communication technologies and the increasing availability of information technologies open an opportunity for the increased use of space solutions. Virtual networks and partnerships must be reinforced to facilitate these opportunities and ensure that staff in civil protection agencies and other actors involved in disaster management activities can take advantage of such solutions effectively. The conference addressed innovative solutions by the space community and the means of implementation of space solutions, and allowed UN-SPIDER to strengthen its network of African stakeholders for improved use of space technologies for disaster management. It was attended by 225 participants from 81 institutions in more than 28 countries.

Snow atop Mount Kilimanjaro in the United Republic of Tanzania
Credit: NASA

UN-SPIDER regional expert meeting for Latin America and the Caribbean on "Space-based Solutions for Disaster Risk Reduction and Emergency Response in Latin America"

In November, UN-SPIDER, CEPREDENAC, four RSOs and NASA joined forces to organize an expert meeting to discuss the contribution of satellite technologies and innovative applications to tackle natural hazards in Latin America and the Caribbean. The event was attended by almost 200 participants from 16 countries who represented more than 100 institutions, including United Nations entities. Participants highlighted the need to continue noting the advances made by Latin American institutions in the use of space technologies and the establishment of a regional technical group of professionals to contribute to disaster response efforts. Participants also recommended that quarterly virtual meetings should be organized to continue raising awareness of the efforts, exchange lessons learned on the use of space technologies, and continue facilitating synergies between the space and disaster management communities.

Hurricane Dorian over the Caribbean from the ISS
Credit: NASA

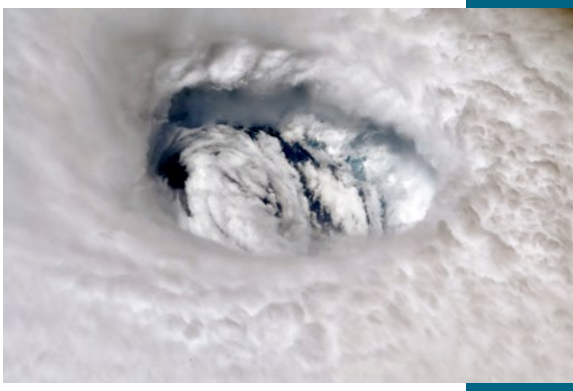
Virtual training course on "Space Technology for Building Disaster Resilience to Water Scarcity"

Monitoring drought conditions and water stress using space assets is becoming increasingly essential to enable early warnings and response, especially in developing countries. Considering the importance of the topic, UNOOSA and the Asia Pacific Space Cooperation Organization organized two virtual training sessions. Experts from UNOOSA, the National Disaster Reduction Centre of China, and three RSOs of UN-SPIDER delivered technical sessions on various topics related to water scarcity. The courses were attended by over 60 participants from 11 countries.

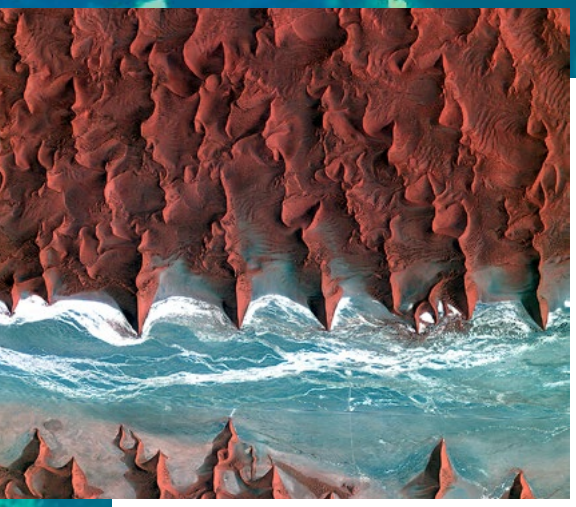
Multitemporal Sentinel-1A radar image of the Aral Sea
Credit: NASA

Second Massive Open Online Course on "Geospatial Applications for Disaster Risk Management"

On 1 June, UNOOSA, together with the India-based CSSTEAP, launched the second phase of the Massive Open Online Course (MOOC) on Geospatial Applications for Disaster Risk Management. MOOC provided free and flexible online training to enhance capabilities related to the use of geospatial and Earth observation technologies in disaster risk management. The second phase of MOOC reflected lessons learned from the first course launched in 2020. Phase II attracted more than 6,300 participants from 122 countries.



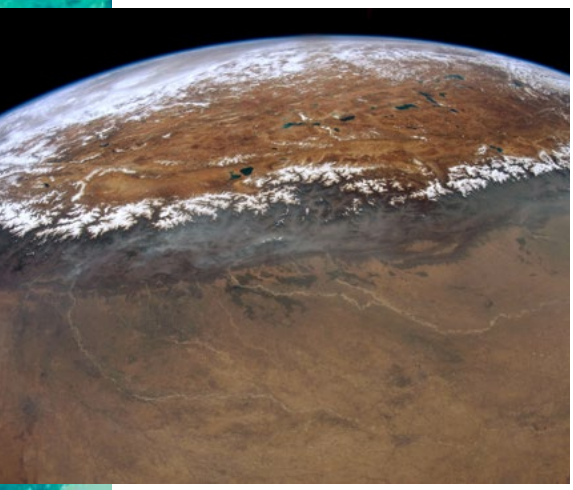
The eye of Hurricane Dorian seen from the ISS
Credit: NASA



Sand seas of the Namib Desert
Credit: ESA

Regional expert meeting on "Space-based Solutions for Risk And Disaster Management in Southern Africa"

The expert meeting organized by UN-SPIDER and ZFL brought together 120 participants and addressed the role of satellite technologies and novel applications developed by the space community to respond to challenges posed by natural hazards in Southern Africa. In three sessions, participants from different regional, national and international institutions explored the structures and activities of disaster management agencies in Southern Africa. Concrete tools that support disaster management efforts were presented alongside UN-SPIDER recommended practices.



Himalayas, the Tibetan Plateau and the Indo-Gangetic plain from the International Space Station
Credit: NASA

Regional workshop on "Enhancing Preparedness for Climate-related Disasters Using Space-based Technologies"

The Workshop was carried out jointly by UN-SPIDER and the South Asian Association for Regional Cooperation (SAARC) Disaster Management Centre, in collaboration with the International Water Management Institute of Sri Lanka and CSSTEAP. The training and simulation exercises that support regional efforts for the effective utilization of space-based information for providing early warning and risk information were attended by 50 experts. This effort allowed participants to identify areas at risk, access flood- and cyclone-related early warning information, use emergency response mechanisms such as the International Charter on Space and Major Disasters and Sentinel Asia, and prepare products needed for supporting emergencies.

National expert meeting on "Space-based Solutions for Disaster Risk Management and Emergency Response in Nigeria"

In April, UN-SPIDER together with ZFL, the National Space Research and Development Agency, the National Emergency Management Agency of Nigeria and the Nigerian Hydrological Services Agency delivered a national expert meeting. More than 80 participants from European and African institutions received insights on challenges and recommendations for flood management in Nigeria. UN-SPIDER delivered a technical presentation on procedures developed by the Programme to process satellite imagery for generating relevant information on flood management. Recordings and materials from the meeting are available on the Knowledge Portal.

Online workshop on "Drought Monitoring and Management Using Earth Observation and Weather Forecast Data"

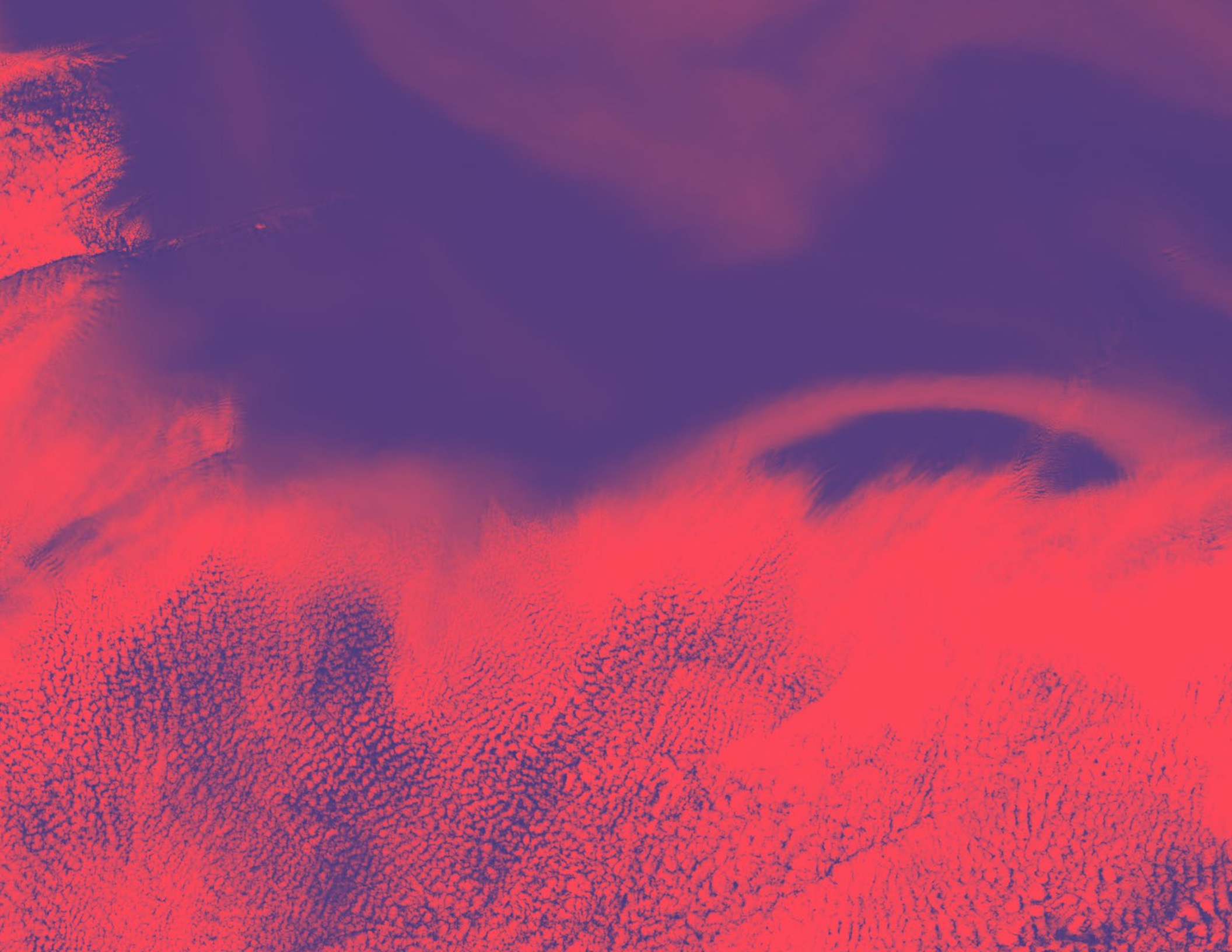
The workshop carried out jointly by UN-SPIDER, the SAARC Disaster Management Centre and the International Water Management Institute in Sri Lanka addressed the increased frequency of droughts in South Asia. Over 50 senior officials from SAARC member States discussed advances in Earth observation and weather forecast data as well as approaches and tools to foster drought resilience in the region, highlighting global and regional platforms and related tools for efficient drought management.

Annual meetings with UN-SPIDER regional support offices

Following the recommendation of the tenth annual RSO meeting, UN-SPIDER organized three virtual gatherings of its RSOs to debate and coordinate workplans, explore potential joint activities and identify knowledge gaps. The parties discussed Earth observation techniques for monitoring locust infestation and new ways to conduct capacity-building activities, including eLearning. At the last meeting, a new RSO was introduced, and updates were provided about ongoing and upcoming activities.

RUS Remote Training on "Disaster Management: Assessment of Floods and Burned Areas"

The European Commission-funded Copernicus Research and User Support (RUS) capacity strengthening team (through the service provider SERCO), the Central European University and UN-SPIDER co-organized a two-day online training session for master-level students and other interested young or aspiring disaster management professionals on 18 and 19 November 2021. The training used practical examples from recent disaster events in Europe to demonstrate how to generate maps of the geographical extent of (a) burned areas caused by forest fires using Sentinel-2 imagery and (b) floods using Sentinel-1 imagery. The 68 participants who attended the course were provided access to a RUS virtual machine environment for image processing and other complex analytical tools.



Algal blooms swirling just off the coast of Japan
Credit: ESA

Our quest for sustainable development requires the utilization of all assets. Satellites are among the most important. More than 50 per cent of SDG targets benefit from space operations. Space activities have become inalienable parts of our lives, even if their impact often remains hidden. Exploration efforts change our perspectives, satellites enable countless benefits that improve our well-being, and the data we gather empower economic growth and industrial development. This chapter opens a window on UNOOSA activities that bring the benefits of space to everyone, everywhere.

6

SPACE4SDGS

6 | SPACE4SDGS

FIFTY YEARS OF THE PROGRAMME ON SPACE APPLICATIONS

At the first United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE) held in 1968, Member States recommended the creation of a dedicated programme in the framework of the United Nations. In 1971, the United Nations Programme on Space Applications was established to raise awareness of the benefits of space technology and assist countries in acquiring the knowledge, skills and practical experience necessary for their application.

In 2021, UNOOSA celebrated the fiftieth anniversary of the Programme and its achievements. Provision of country capacity-building, education, research and development support, and technical advisory services have all helped reduce the capabilities gap between countries. In the five decades of its existence, the Office has welcomed more than 25,000 participants, mainly from developing countries, in over 700 training courses, workshops, seminars and conferences conducted globally.

In addition, capacity-building efforts have evolved to offer hands-on opportunities. Cooperating with space stakeholders, the Office has developed programmes to enable access to space research facilities, infrastructure and information. These efforts contribute to developing technical know-how, engineering processes and infrastructure in Member States. The Access to Space for All initiative, which consolidates such activities, manifests the value of cooperation and the work of the United Nations in democratizing the benefits of space. The three satellites launched by Guatemala, Kenya and Mauritius are outstanding examples of dreams becoming a reality. The opportunities arising from the opening of the China Space Station to the international community and those offered in partnership with selected private entities will further contribute to the achievements of the Programme.

Over these 50 years, the Office has exhibited flexibility in the delivery of the Programme, keeping abreast of the latest developments in space science and technology. Targeted training through webinars and massive open online courses, new ways of convening experts and partners, and reaching new audiences, especially from developing countries, are but some of the results. As we look towards the future, this innovative spirit will ensure the Office remains well equipped to address the capacity-building needs of countries, facilitate the use of space-based solutions in building a better future, and promote international cooperation in the peaceful uses of space.

A commemorative video featuring JAXA astronaut Soichi Noguchi speaking from the International Space Station was shown as a highlight during COPUOS 2021. The video is available on UNOOSA YouTube.

From outer space, you don't see countries, you see continents, you see oceans, you see mountains. You see one Earth. We are all in this together and we need to work together, utilizing all available technologies, to solve the pressing issues of our times, here on the only planet that we call home.

Soichi Noguchi, JAXA astronaut featured in the PSA 50 video

The Programme on Space Applications is committed to building capacity among Member States to harness space technologies to address issues of common concern to all humanity and to contribute to achieving the Sustainable Development Goals. As we celebrate the fiftieth anniversary of the Programme on Space Applications, we would like to thank all Member States, space agencies and other stakeholders for their contributions. The Office looks forward to many more collaborations in the years to come.

Simonetta Di Pippo, former director of UNOOSA

The Great Rift Valley of Kenya has been shaped by major tectonic and volcanic activity
Credit: ESA

ACCESS TO SPACE FOR ALL

Access to Space for All is a UNOOSA initiative delivered in partnerships with space agencies, research institutions and industry. This unique cooperative venture offers access to space research facilities, infrastructure and information to bridge the capabilities gap among nations in accessing and utilizing the benefits of space. 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, mostly focusing on SDG 4, on quality education, SDG 8, on decent work and economic growth, SDG 9, on industry, innovation and infrastructure, SDG 10, on reduced inequalities, and SDG 17, on partnerships for the Goals.

ACCESS • TO • SPACE • 4 • ALL

UNITED NATIONS OFFICE FOR OUTER SPACE AFFAIRS

Access to Space for All is structured around three tracks that share the objective of bringing the benefits of space to humankind:

Hypergravity and Microgravity Track: Aimed at gradually acquiring the capability of designing, implementing and conducting experiments in orbit and of the associated engineering skills and processes

Satellite Development Track: Aimed at gradually acquiring the capability of designing, building, verifying, deploying, operating and decommissioning small satellites in orbit

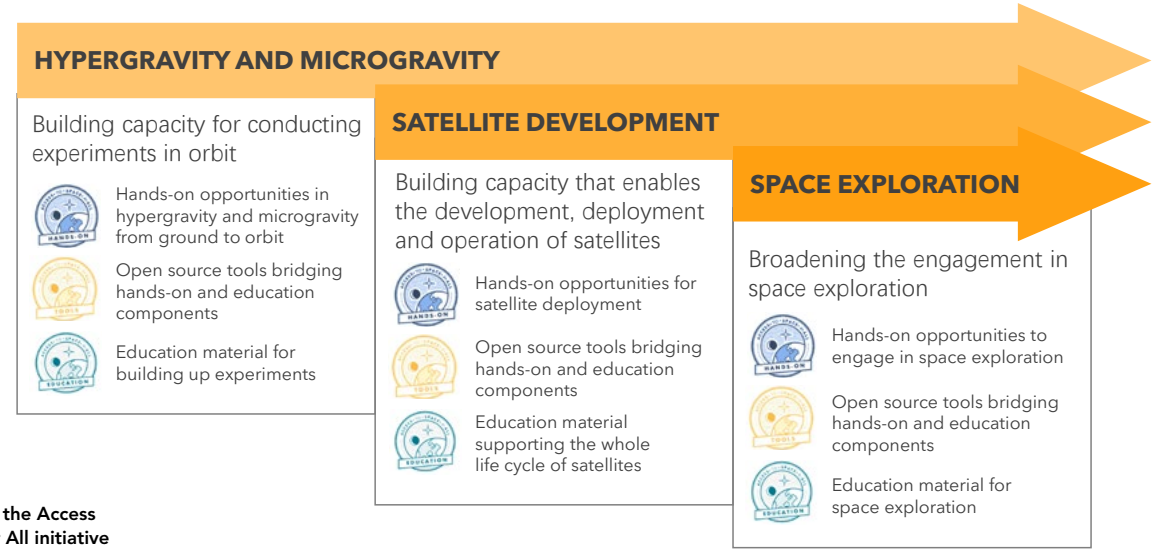
Space Exploration Track: Aimed at broadening engagement in space exploration and developing associated capacity through technology and communication

In 2021, Access to Space for All kept evolving. Two new partners joined the initiative, expanding the portfolio with additional activities. UNOOSA and partners selected awardees in several programmes, with these updates covered in chapter 3 of this report. Furthermore, building on the success of the educational activities in 2020, Access to Space for All has advanced from providing hands-on opportunities to delivering a comprehensive capacity-building programme with each track underpinned by three components developed to provide better support to Member States.

- The hands-on component is based on opportunities provided by different partners and aims at providing access to space research facilities and infrastructure to develop technical know-how.
- The tools component provides information on open-source tools to support the hands-on component.
- The education component provides the theoretical foundation to fully utilize the tools and opportunities.

The success of the initiative rests on partnerships with public and private actors. As of 2021, the following partners contributed to the Access to Space for All initiative:
The Center of Applied Space Technology and Microgravity, the China Manned Space Agency, the European Space Agency, the German Aerospace Center, the Japan Aerospace Exploration Agency, the Keldysh Institute of Applied Mathematics, part of the Russian Academy of Sciences, as well as Airbus Defence and Space GmbH, Avio S.p.A. and the Sierra Space Corporation.

UNOOSA remains committed to expanding opportunities on offer through the Access to Space for All initiative and welcomes offers for new partnerships to develop and strengthen strategic alliances to help address the challenges facing humanity using the power of space.

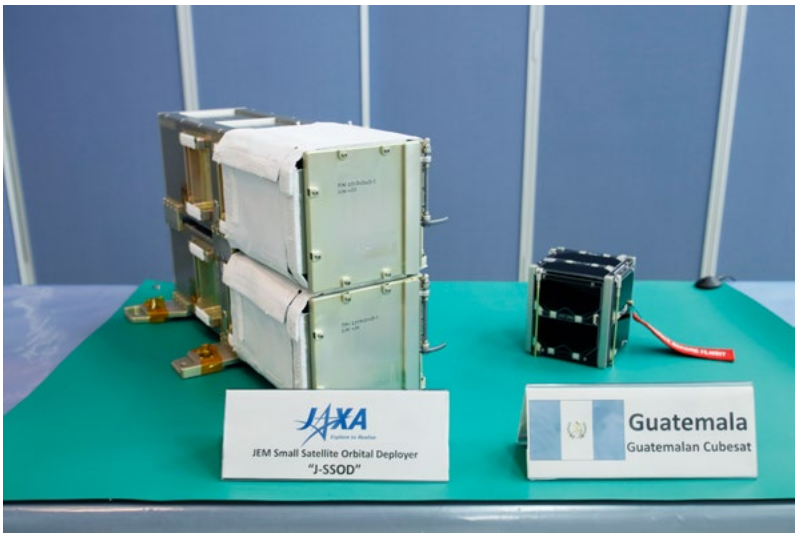


Structure of the Access to Space for All initiative
Credit: UNOOSA

KiboCUBE

UNOOSA and JAXA continued advancing the opportunity for institutions from developing countries to construct a cube satellite (CubeSat) and deploy it from the ISS Japanese Experiment Module (Kibo).
As of December 2021, the KiboCUBE programme, delivered under the Satellite Development Track of the Access to Space for All initiative, conducted five rounds of selection to deploy a 1-unit CubeSat from the Kibo module of the International Space Station. MIR-SAT1, the first-ever satellite of Mauritius, was launched in June 2021 (see details in the Highlights chapter) as the third CubeSat under KiboCUBE, after Kenya and Guatemala. The fifth-round awardee, the Central American Integration System (SICA), is in the initial stage of satellite development, working to finalize the design of its CubeSat. Surya University of Indonesia and the Technical University of Moldova, the awardees of the third and fourth round, completed the assembly and testing of their satellites and are preparing for launch in 2022.
In 2021, UNOOSA and JAXA also concluded the application period for the sixth round and opened the seventh round of this opportunity.

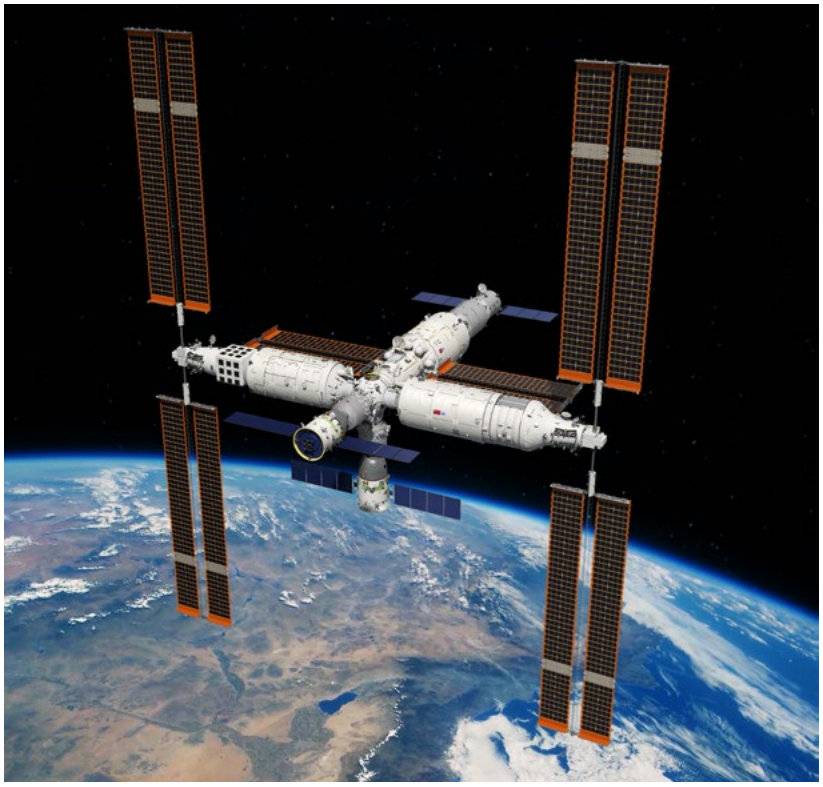
CubeSats from Costa Rica, Kenya and Turkey are installed into the JEM Small Satellite Orbital Deployers
Credit: JAXA/NASA



Quetzal-1, the first Guatemalan CubeSat by Universidad del Valle de Guatemala
Credit: JAXA

United Nations/China Cooperation on the Utilization of the China Space Station

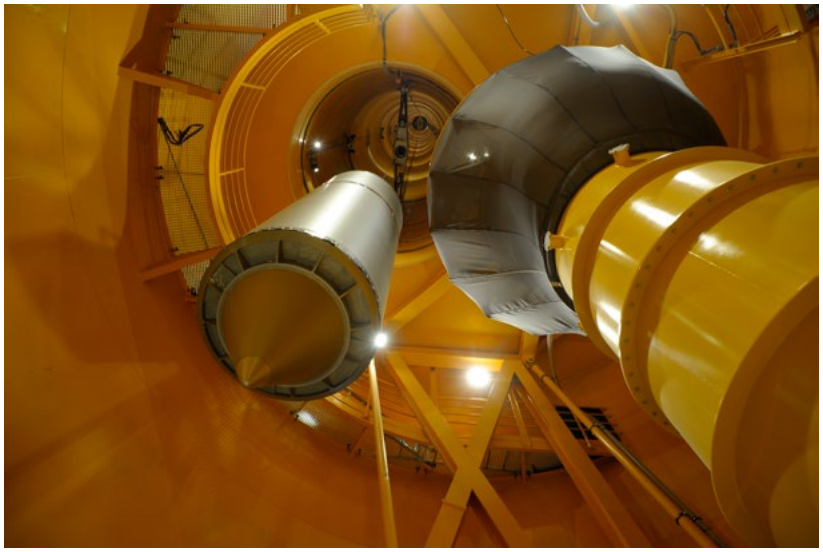
The China Space Station programme with the China Manned Space Agency under the Hypergravity and Microgravity Track is an innovative and future-focused programme to open up space exploration activities to all nations and create a new paradigm in building capabilities in space science and technology. This opportunity enables the utilization of the China Space Station platform for on-orbit experiments. The nine projects selected in the first round involve 23 institutions from 17 Member States and are in development.



The complete structure of China Space Station to be established around 2022
Credit: CMSA

Drop Tower Experimental Series

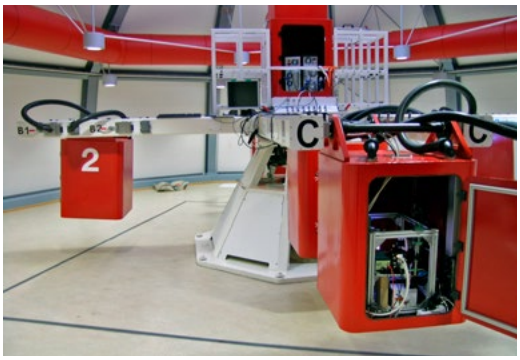
The Drop Tower Experimental Series (DropTES), under the Hypergravity and Microgravity Track of the initiative, is an opportunity to conduct microgravity experiments at the Bremen Drop Tower in collaboration with the Centre of Applied Space Technology and Microgravity (ZARM) at the University of Bremen, Germany and the German Aerospace Centre (DLR). The awardee of the seventh round, Universidad Católica Boliviana "San Pablo" from Bolivia, selected in 2020, postponed their experiment due to the pandemic. Despite the obstacles, the team has continued developing the experiment module. Their material science experiments in microgravity to demonstrate 3D printing technology are scheduled for 2022. In 2021, the partners of the DropTES fellowship also opened the seventh round, with applications currently under review.



Inside the Drop Tower in Bremen
Credit: ZARM

HyperGES

The HyperGES programme, under the Hypergravity and Microgravity Track of the initiative, is an opportunity delivered in collaboration with the European Space Agency (ESA) to conduct hypergravity experiments at the Large Diameter Centrifuge facility at the European Space Research and Technology Centre (ESTEC) in the Netherlands. Mahidol University in Thailand, the first-round awardee, will conduct biology experiments in hypergravity to study the effects of modified gravity on the watermeal plant, which could support space exploration as a source of food and oxygen.



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

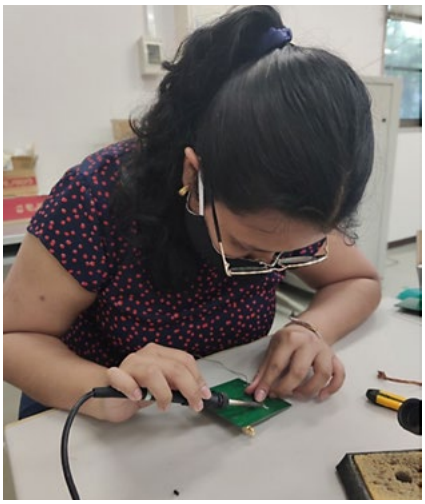
United Nations/Japan Long-term Fellowship Programme for Postgraduate Study on Nano-satellite Technologies

The Postgraduate Study on Nanosatellite Technologies (PNST) fellowship programme established in 2012 by UNOOSA and the Government of Japan, in cooperation with the Kyushu Institute of Technology (Kyutech), offers selected master's and doctoral students from developing countries and non-spacefaring nations extensive research opportunities using the nano-satellite development and testing facilities at Kyutech. The chosen candidates receive a grant from the Government of Japan for the duration of their fellowship. The programme equips students with knowledge of space science and technology to help their countries access the space sector and its benefits.

The 2021 round of applications for PNST closed in January: three students from Bhutan, Cambodia and Zimbabwe were selected for the master's, and three students from Ethiopia, Laos and Trinidad and Tobago for the doctoral programme. The 2022 round opened in August.

UNOOSA and Kyutech conducted a webinar to share experiences from past and present fellows. The presentations and recordings along with an interview with one of the current beneficiaries are available on the UNOOSA website.

"I feel that Kyutech brings the world into your hands. The Space Engineering International Course at Kyutech is truly international and interdisciplinary, with students from diverse backgrounds and numerous countries from around the globe."
Master's student at Kyutech, Fátima Durán from El Salvador.



Soldering some components of a LoRa receiver which was later distributed for testing with ground terminals in various countries
Credit: Fátima Durán

Fátima Durán (left) and Pooja Lepcha (right), PNST awardees
Credit: Fátima Durán

KiboCUBE Academy

In the course of 2021, UNOOSA released a series of live webinars, technical consultations and pre-recorded lectures as part of the KiboCUBE Academy, tailored for future participants of the programme. The Academy is a series of educational activities that address the technical aspects of the design, development and testing of CubeSats and support building better project plans. The Academy also teaches participants about satellite operations and the utilization of the data that they acquire from their CubeSats in order to develop useful applications on Earth. The activity was delivered thanks to the contribution of JAXA and supported by the University Space Engineering Consortium. The webinars are available on the UNOOSA YouTube channel.

The Kibo laboratory module from the Japan Aerospace Exploration Agency
Credit: NASA

Webinar series on "Conducting R&D in hypergravity and microgravity"

In 2021, UNOOSA organized a series of webinars to introduce general aspects of developing and conducting research and development in hypergravity and microgravity. Throughout the series, 45 experts from 40 organizations in 13 countries presented different types of experiments that can be conducted under altered gravity conditions and the implications these might have for different industries. The series of eight webinars is available on the UNOOSA YouTube channel.

SPACE FOR WOMEN

The Space4Women project consists of efforts to raise awareness of issues related to gender equality in space and STEM, identifying the factors that contribute to gender inequality in these fields, and devising solutions to address these issues. To take stock of the work done in 2020 and to discuss a road map for the future development of the Space4Women initiative, UNOOSA organized an "Expert Meeting: Making Space4Women in the Decade of Action" on the International Day of Women and Girls in Science in February. The event was also an opportunity to bring together Space4Women mentors, collect feedback and identify ways forward.

The mentorship programme unites female role models and mentors from different countries, professions and backgrounds to inspire, guide, encourage and support women and men in education and careers in STEM and space. The mentorship programme is based on data indicating that the lack of role models was one of the main obstacles preventing women and girls from pursuing careers in STEM fields. The Space4Women network also brings together space industry leaders – men and women – to break the barriers that prevent future generations from pursuing their dreams.

In a bid to raise further awareness, identify obstacles and find solutions to the issue of gender inequality in the space sector, UNOOSA collected the perspectives of the mentors as part of the "Women in Space" theme selected for World Space Week in 2021. World Space Week is an annual celebration that takes place on 4–10 October.

NASA astronauts Jessica Meir (left) and Christina Koch (right) getting ready for the first ever all-female spacewalk in October 2019
Credit: NASA

Feedback from mentors

"Through Space4Women we have a unique opportunity to reach further, to set the agenda and to change structures, and not least to capture the hearts and minds of women across the world, creating an unstoppable positive force as the sky is no longer the limit.

The initiative is so important in raising the profile of professional women within the space industry and highlighting them as role models to the emerging generations of young women, which is crucial as it waves a big red flag at them saying – yes, dream big, you can do it, it is possible, there is a place for you in the future of space exploration!

Feedback from mentees:

The idea of living in a world where there is no need to fight for gender equality is incredible, however, it is still too far from reality. We should not wait for this change to happen. We need to be the change! The Space4Women programme has given me the honour of being part of this change and, by helping teachers, inspiring a future generation of women in STEM!

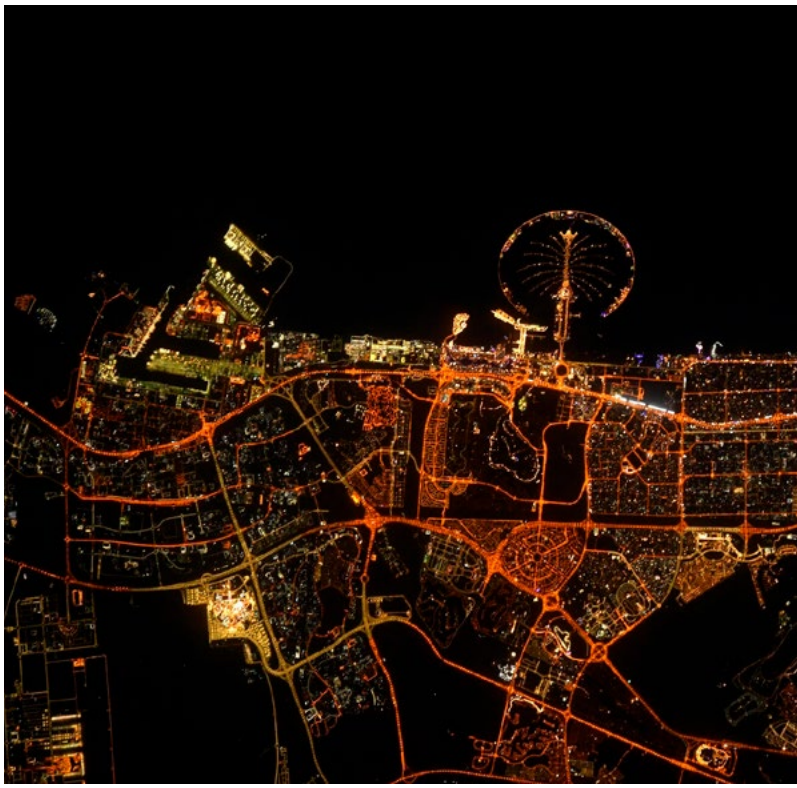
The experience of participating in the Space4Women programme was refreshing to me. Working for girls and women in science has been empowering, encouraging me to persist in a work environment that is sometimes so hostile and not inclusive.

The Libyan Desert stretches towards the Mediterranean Sea
Credit: NASA

SPACE LAW FOR NEW SPACE ACTORS

Responding to the growing number of requests for legal advisory services, UNOOSA established the Space Law for New Space Actors project in 2019 to help Member States enhance their capacity to develop national legislation in line with international space law. In October 2021, UNOOSA delivered a tailored technical advisory mission to Chile, to which it also invited other countries from the region, namely, Colombia, Costa Rica, Ecuador, Paraguay and Peru. The technical mission staff presented a series of 16 lectures to engineering students attending the Space Engineering International Course of Kyushu Institute Technology (Kyutech) to enhance understanding of the importance of national space law. As a subsequent step, UNOOSA plans to conduct in-country missions to the nations that requested support, as soon as the pandemic allows.

In 2021, the Space Law for New Space Actors project was made possible through the generous contributions of the Governments of Belgium, Chile, Japan, Luxembourg, and of Kyutech and the Secure World Foundation.



Dubai at night
Credit: ESA

Part of the Laguna San Rafael National Park in Chile
Credit: ESA

Global Networking Forum on Space Law for New Space Actors – Fostering Responsible National Space Activities

At the seventy-second International Astronautical Congress (IAC) in October, UNOOSA organized a panel to explore the support that the Office, with the help of donors, can offer to emerging spacefaring nations to develop national space law and policy in line with international space law. This gathering offered an opportunity to listen to and gather feedback from beneficiaries who have already received these services, and to identify ways forward for the Space Law for New Space Actors project. The discussion featured, among other speakers, Minister Franz Fayot from Luxembourg, and attracted over 100 participants and more than 30 questions from the floor.

SPACE FOR PERSONS WITH DISABILITIES

An estimated one billion people experience some form of disability, with the prevalence higher in developing countries. Owing to various factors, the figures are predicted to increase over the coming decades.

Recognizing the rights of persons with disabilities in accordance with the United Nations Convention on the Rights of Persons with Disabilities and aligning with the United Nations Disability Inclusion strategy, UNOOSA launched the Space for Persons with Disabilities project in 2021 and worked with specialized associations and agencies to raise awareness of initiatives that promote inclusion in space. With the support of ESA, the webinar "Pushing Frontiers: Human Spaceflight and Disability" was conducted on 31 March 2021 to raise awareness of the opportunities and challenges for the inclusion of persons with disabilities in space exploration through the lens of technology, engineering, physiology and psychology, in particular in light of the ESA Parastronaut feasibility project.

In observance of the International Day of Persons with Disabilities, the Office conducted interviews with stakeholders in space science to explore initiatives towards an inclusive, accessible and sustainable post-COVID-19 world. The interviews are available on the UNOOSA website.

The Office also initiated an internship adapted to support the needs of persons with disabilities and ensure their voices are heard in the development of the project with hopes to provide valuable on-the-job learning opportunities to realize the potential of every individual.

OTHER SPACE4SDGS ACTIVITIES

Group photo of participants to the Workshop
Credit: IAF

Workshop on Space Technology for Socioeconomic Benefits: "Space Exploration – A source of inspiration, innovation and discovery"

UNOOSA, the International Astronautical Federation (IAF) and the Mohammed Bin Rashid Space Centre (MBRSC) organized the twenty-eighth Workshop on Space Technology for Socioeconomic Benefits: "Space Exploration – A source of inspiration, innovation and discovery" in conjunction with the seventy-second IAC. Its main objective was to raise awareness of exploration activities and promote inclusiveness in the field. Attended by 90 participants and 20 space agencies, the workshop also aimed to advance the integration of space into evidence-based policy and decision-making. Space exploration, capacity-building activities and opportunities for emerging space nations were presented and discussed from the national, international, industry and civil society perspectives.

Space for Our Planet was inaugurated in October at the Jardin de l'Observatoire in Paris
Credit: Timkat/Benoît Delplanque

Space for Our Planet exhibition

Throughout 2021, the Office worked with TIMKAT, a visual storytelling company, to put into action an agreement signed the previous year. In this joint effort to advance the understanding of the benefits that space activities offer society, TIMKAT created the "Space for Our Planet" exhibition with the support of UNOOSA to display real-life examples of how space technology helps humanity transition towards a sustainable planet. Testimonials from 28 professionals examine the contribution of space to the attainment of the 17 SDGs. From Brussels to Rome, from Paris to Dubai, this multi-stakeholder effort created under the patronage of UNOOSA and supported by a range of space entities travelled the world to reach new audiences.

UNOOSA/International Telecommunication Union/ Office of the Secretary-General's Envoy on Technology event on "Opportunities of satellite connectivity"

Daily life for a large portion of the world's population now involves sharing information via mobile phones, personal computers and other electronic communication devices. However, many people have been left behind. Space-based technologies, namely communications satellites, present a unique opportunity to bridge the digital divide. On 9 July, during the International Telecommunication Union (ITU) global event on Emerging Technology for Connectivity, UNOOSA in cooperation with ITU and the Office of the Secretary-General's Envoy on Technology organized a webinar on "Opportunities of satellite connectivity." Speakers from both private and public sectors presented recent activities in various world regions designed to connect underserved areas, explained lessons learned and limitations, and discussed further actions in terms of space policies and regulations. This session contributed to the joint effort for the implementation of Key Actions on Global Connectivity outlined in the United Nations Secretary-General's Road map for Digital Cooperation, as well as Sustainable Development Goal 9 that addresses, among other things, universal access to information and communications technology, and the Internet.

UNOOSA and New York Permanent Missions of Italy and the United Arab Emirates host event: "Space Diplomacy for a Growing Global Space Economy."

On 26 May, the Office joined the Permanent Mission of Italy and the United Arab Emirates in New York to organize an event devoted to the role of space diplomacy in the global space economy. With its profound positive impact, space has become a cornerstone of modern society. Despite the significant increase in space solution providers and users, many global communities remain behind, accentuating the need to enhance diplomatic efforts in the space domain. This virtual event highlighted the importance of harnessing the power of space to tackle challenges facing humanity. Leaders of national and international institutions and CEOs from some of the world's leading private entities shared their views on the future of space affairs and the most pertinent priorities for space diplomacy.

New York from above captured by an ESA Astronaut
Credit: ESA/NASA-L. Parmitano

Space for the Great Reset: the central role of space in the post-pandemic recovery process

As humanity battles the COVID-19 crisis, momentum has grown to rethink our future and identify ways to promote sustainable, equal and inclusive growth. Inspired by the Great Reset initiative of the World Economic Forum, UNOOSA launched the virtual event series, "Space for the Great Reset," to examine the contribution of space in building back better and ways to leverage access to space-derived benefits.

Representatives from the international space community underscored the importance of space activities in addressing the pandemic and in our daily lives. Collectively, they emphasized that international cooperation was essential to maximizing the potential of space assets and facilitate the recovery process.

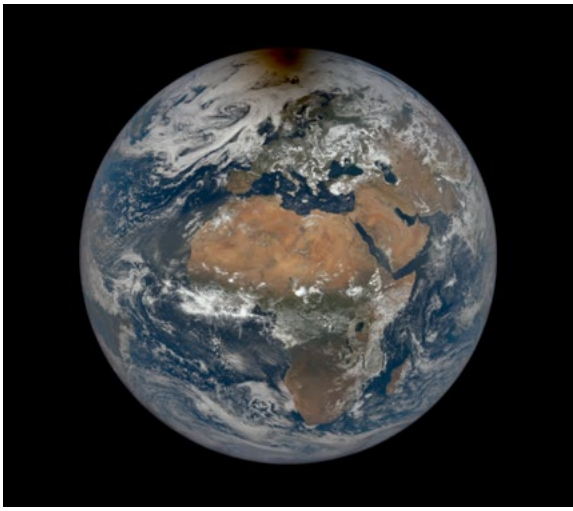
You can read the full report from the event series on the UNOOSA website and watch recordings on our YouTube channel.

Space Economy initiative goes regional: Putting the African space economy in focus

Building on the success of the virtual Space Economy series, UNOOSA continued to provide insights into space economies worldwide as drivers of sustainable development. With the support of the African Union and the Portuguese presidency of the Council of the European Union, UNOOSA hosted a virtual one-day conference dedicated to the African continent, its space economy structure and outlooks. This one-of-a-kind platform brought together 12 representatives of the commercial space entities operating in Africa to discuss the growth of strong, responsible and sustainable space economies.

Participants agreed that the future of space in Africa was bright and pointed out that space entrepreneurs should be aware of the challenges in the African space sector. It is crucial to understand the local environment and key stakeholders to build a thriving space business on the continent.

In addition, the conference encouraged engagement in the regional dimension of space economies and collaboration across sectors and countries. In this context, UNOOSA will continue to provide perspectives from different (regional) space economies and facilitate transdisciplinary exchange among stakeholders through the Space Economy initiative.



Shadow cast by the Moon over the Arctic during a solar eclipse
Credit: The NASA Goddard Space Flight Center/Lisa Poje and Greg Shirah/Ernie Wright/Alison Gold

Newton's space sapling planted at the United Nations in Vienna

The Vienna International Centre (VIC) is now home to a special apple tree grown from seeds taken to the International Space Station in 2015 by the British/European Space Agency astronaut Tim Peake during his "Principia" mission. The sapling, planted during a special ceremony by the Ambassador of the United Kingdom Corinne Kitsell and UNOOSA Director Simonetta Di Pippo, is a descendant of the 400-year-old tree that inspired Isaac Newton's theory of gravity and is still growing at Woolsthorpe Manor in the United Kingdom. Visitors can now admire the tree outside the UNOOSA Space Exhibition.

The sapling of Newton's tree in its new home at the United Nations in Vienna
Credit: UNIS

SUSTAINABLE DEVELOPMENT GOAL 17: NEW PARTNERSHIPS

New opportunity with Mohammed Bin Rashid Space Centre under the Access to Space for All portfolio

On the margins of the seventy-second International Astronautical Congress in Dubai, UNOOSA and MBRSC signed an agreement to provide an opportunity under the Satellite Development Track of the Access to Space for All initiative. Through this agreement, the two parties will provide opportunities in the Payload Hosting Initiative (PHI), which offers a cost-effective and modular satellite platform that can host multi-purpose payloads. PHI is intended to build capacity and broaden space activities and applications.

Agreements with the United Kingdom to promote space sustainability

UNOOSA and the United Kingdom announced a strategic partnership in January 2021 and reinforced the joint effort later in the year to advance global awareness on space sustainability and foster tailored capacity-building services for emerging spacefaring nations.

Memorandum of understanding with the General Secretariat of the Central American Integration System

UNOOSA and the General Secretariat of the Central American Integration System entered into a partnership to advance cooperation in the areas of disaster management, space law and capacity-building to enhance the use of space for sustainable socioeconomic development in the region.

Memorandum of understanding with International Institute for the Unification of Private Law

Within the framework of this memorandum of understanding, the parties will work to advance common interest in international cooperation, economic development and the use of uniform law instruments and standards for the space sector. This partnership aims to generate materials in line with the Space Economy initiative, conduct joint outreach efforts and support States to develop national regulatory frameworks and policy approaches to facilitate commercial activities in the space sector and in broader economy.

UNOOSA joined forces with the International Space University to promote space education

UNOOSA signed an agreement with the International Space University (ISU), a non-profit entity dedicated to the pursuit of excellence in teaching and research for peaceful uses in all fields relating to space activities. UNOOSA and ISU recognize the vital importance of the 2030 Agenda for Sustainable Development for humanity and the crucial role space technology and applications have for the successful attainment of the SDGs. The memorandum of understanding will facilitate cooperation between UNOOSA and ISU to further their shared goals and objectives regarding space education and capacity-building.

Cooperation agreement signed with the Mexican Space Agency

The memorandum of understanding with the Mexican Space Agency (AEM) covers a range of themes with the aim of improving access to space benefits for countries in Latin America and the Caribbean. This memorandum of understanding frames collaboration on capacity-building and the promotion of space solutions, as well as the empowerment of students, researchers and professionals in the region, with special focus on women and girls. AEM reinforced the effort to support UN-SPIDER as its regional support office in Mexico.

Memorandum of understanding with the Philippines Space Agency

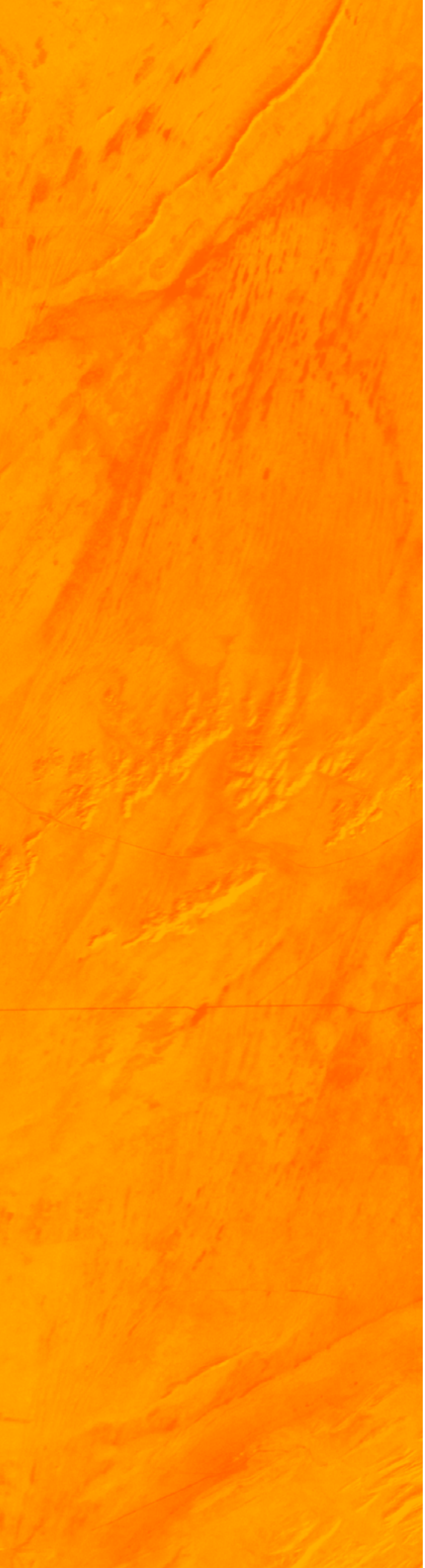
UNOOSA has a long history of joint activities and close relations with the Philippines and the organization shares the objective of advancing international cooperation in the peaceful use of outer space. The memorandum of understanding, signed in 2021, is a testament to the joint effort to take access to space benefits to another level in the country and beyond through capacity-building activities, efforts under the Access to Space for All and Space Economy initiatives, as well as enhanced cooperation in the context of UN-SPIDER.

New UN-SPIDER regional support office in Kazakhstan

The memorandum of understanding, signed in May 2021, incorporated the National Center of Space Research of Kazakhstan (NCSRT) as an UN-SPIDER regional support office (RSO). As an RSO, NCSRT contributes to UN-SPIDER activities in this region of Asia.

Together, the parties promote the use of space-based resources for disaster and emergency response management, facilitate the sharing and use of Earth observation derived data and collaborate in capacity-building activities.

The beauty of frozen Lake Balkhash in Kazakhstan
Credit: NASA



Fimbulheimen mountain range in Antarctica
Credit: NASA/Joshua Stevens

Nurturing a future workforce is integral to building sustainable space economies and expanding access to space benefits. Through space-related education and training opportunities globally, with particular attention to young students and professionals in developing countries, UNOOSA fosters the next generation. Learn more about our activities in this context in this chapter focused on space education.

7

SPACE EDUCATION

7 | SPACE EDUCATION

Access to education and research opportunities in space science and technology is fundamental to nurturing the future workforce and leaders in the space industry. UNOOSA works to advance both the availability and quality of space-related education, targeting a variety of topics. The Office offers fellowship programmes and advisory services to space agencies and research institutions in developing countries to expand their knowledge of space applications. It also provides online educational resources and directories of educational opportunities on space topics. International conferences and workshops on space applications and services are other important parts of this effort.

UNOOSA also engages with children and students to raise awareness of the benefits of space and motivate the next generation to study STEM fields relevant to space exploration and use. For example, UNOOSA staff virtually engaged with a group of 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 2021.

REGIONAL CENTRES FOR SPACE SCIENCE AND TECHNOLOGY EDUCATION

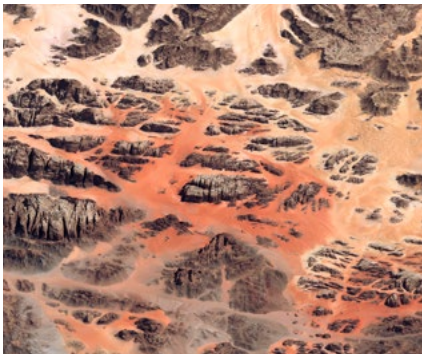
The network of Regional Centres for Space Science and Technology Education, affiliated with the United Nations, fosters education and research on space science and technology. Established by UNOOSA, the Centres are based at existing research and higher education institutions. Currently, six of them located in China, India, Jordan, Mexico/Brazil, Morocco and Nigeria are part of the network. The Centres develop the skills and knowledge of university educators, scientists and government officials through rigorous theory, research, applications, field exercises and pilot projects in space science and technology that contribute to sustainable development.

Ensuring a common standard of teaching at the Centres is vital. In this context, UNOOSA developed education curricula in all major fields of space applications, such as satellite meteorology and global climate, satellite communications, space, atmospheric science, remote sensing, and geographic information systems and GNSS. The curricula used at the Regional Centres are also available for other educational institutions and training initiatives.

The Regional Centres actively work with UN-SPIDER to develop professional skills in space-based technologies for resilience: for example the Centre for Space Science and Technology Education in Asia and the Pacific (CSSTEAP), based in Dehradun, India, regularly provides experts for the technical advisory missions and capacity-building programmes organized by UN-SPIDER in Asia. In addition to supporting UN-SPIDER, the Regional Centres conduct routine postgraduate programmes related to the SDG framework, as presented below, helping to promote the importance of leveraging space applications for the future of our planet. The following section presents highlights from the work of selected Centres in 2021.

African Regional Centre for Space Science and Technology Education

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 2021, the Centre conducted three postgraduate courses, which 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.



Wadi Rum Desert Valley, Jordan
Credit: Airbus

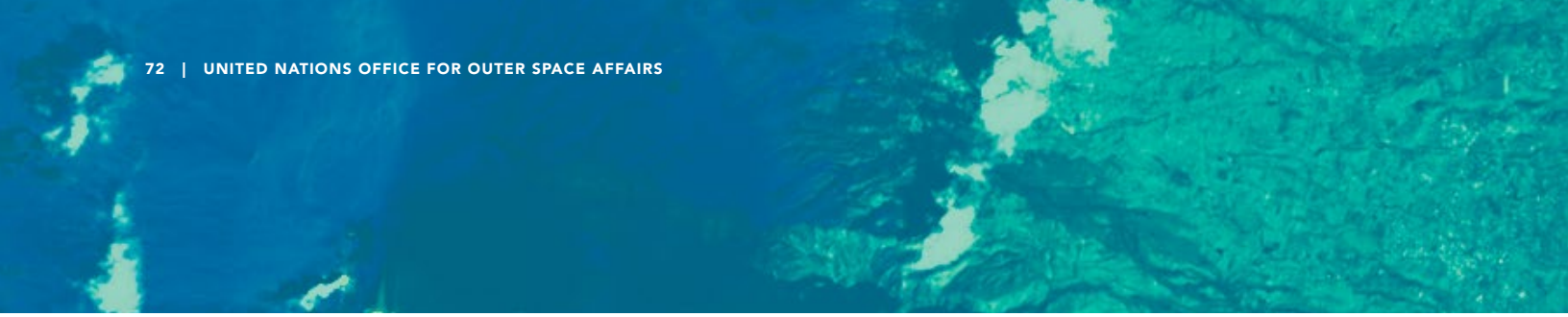
Regional Centre for Space Science and Technology Education in Asia and the Pacific

The Regional Centre for Space Science and Technology Education in Asia and the Pacific (RCSSTEAP), hosted by the Beihang University of Beijing, continued to develop the delivery of its programmes to ensure the continuity of educational activities. Through online broadcasting, recording, MOOC, WeChat and providing learning materials, the Centre strived to carry out virtual teaching, participant self-study and independent research. In 2021, 35 international participants majoring in three academic fields enrolled to study at the Centre. October saw the launch of an APSCO Student Small Satellite-1 developed in a joint effort by Beihang University as the lead institution and the eight member States of the Asia-Pacific Space Cooperation Organization. This achievement is a tribute to the Centre's work in international cooperation, talent training and scientific innovation.

Morocco captured by NASA from the ISS
Credit: NASA

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

In 2021, CSSTEAP continued delivering quality education, training, and knowledge-sharing activities. The six short courses organized throughout the year offered the opportunity to learn about forest monitoring, disaster management, weather, climate and GNSS, among other topics. A special training course on "Remote Sensing Applications for Crop Mapping and Monitoring" was also delivered. In total, these courses attracted more than 300 participants from the region.



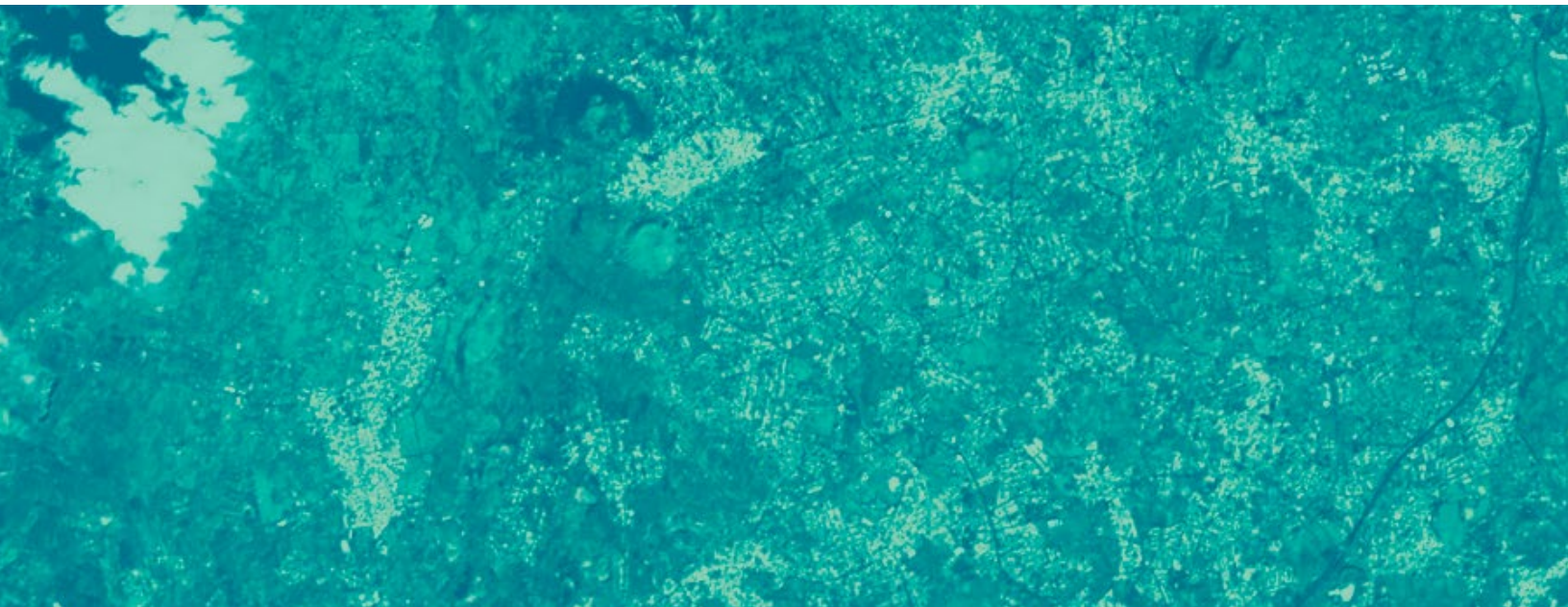
RESEARCH AND TRAINING

The International Space Weather Initiative workshop on space weather: science and applications

The activities falling under the International Space Weather Initiative (ISWI) aim at facilitating collaboration among scientists and promoting research in countries with expertise in building scientific instrumentation. In line with the mission of UNOOSA, workshops convened in the framework of the ISWI and the ICG programme on GNSS applications promote global cooperation in space weather. Jointly with the Vikram Sarabhai Space Centre of the Indian Space Research Organization, this online workshop organized advanced discussions on the physics behind space weather and provided updates on the recent scientific advances made in the field. Those who participated in of the workshop assessed the status of space weather instruments, data, modelling and other efforts to advance space weather research and improve its forecasting. Efforts in space weather education, empowerment of women and girls, and international cooperation and collaboration in addressing space weather-related issues were also among the key topics.

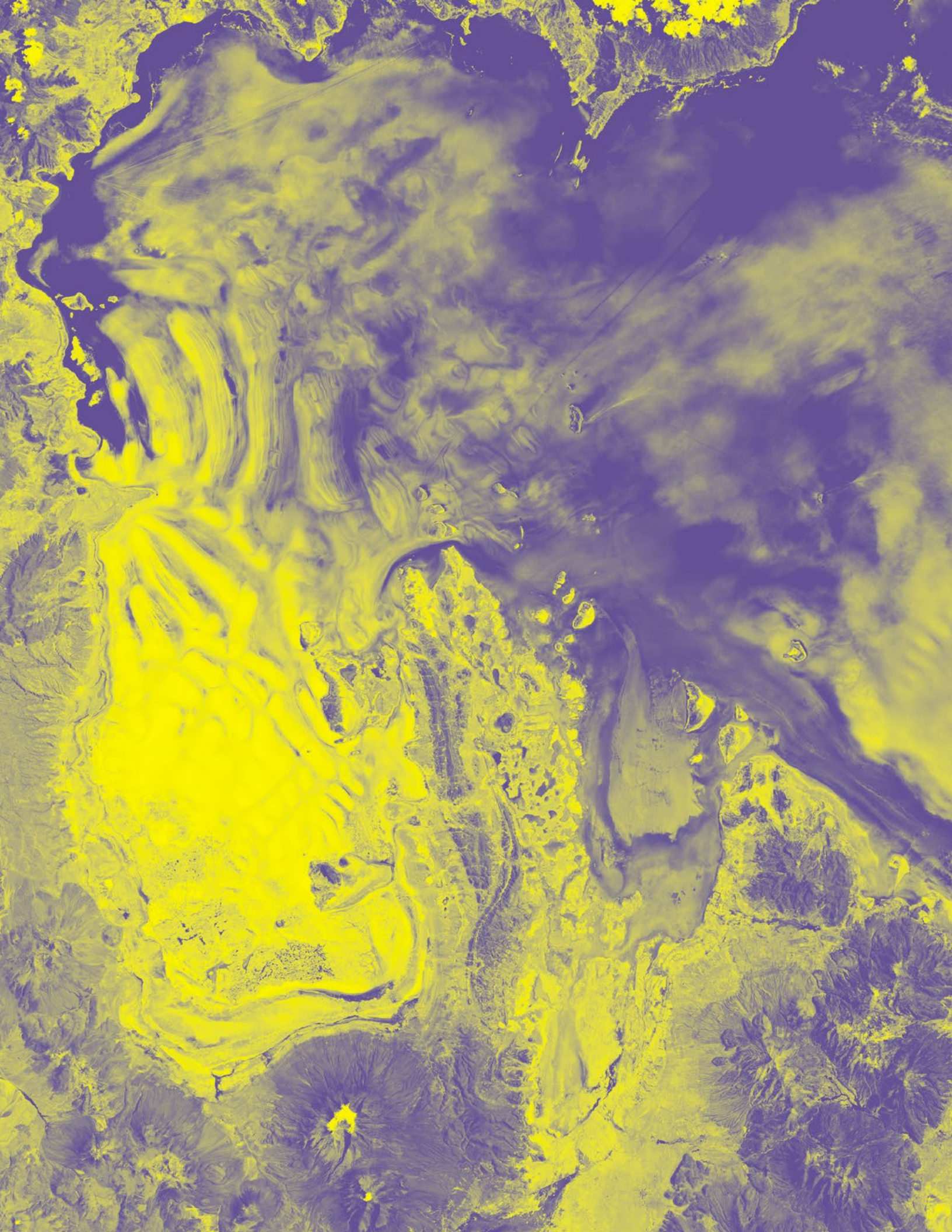
United Nations/Mongolia Workshop on the Applications of Global Navigation Satellite Systems

This workshop was organized by UNOOSA and the Mongolian Geospatial Association and the Agency for Land Administration and Management, Geodesy and Cartography of Mongolia to enhance information exchange between participating countries on the application of GNSS solutions. The workshop's aim was also to scale up capacities in Asia and the Pacific, including through information-sharing on projects that can benefit the regions and enhance cross-fertilization. During the workshop, ICG organized a seminar to describe the importance of spectrum protection, interference detection and mitigation at a national level, and explain how to reap the benefits of GNSS.



A mid-level solar flare captured in 2015
by the NASA Solar Dynamics Observatory
Credit: NASA/SDO

Southern Mongolia captured
by Sentinel-2A in this false-colour image
Credit: Copernicus Sentinel data/ESA



A salt bath in Bolivia
Credit: NASA/Lauren Dauphin

UNOOSA serves as the secretariat to several international coordination bodies and mechanisms, including COPUOS, the main intergovernmental forum for analysing and debating the scientific and legal aspects of outer space activities. This chapter presents the work of UNOOSA in advancing international cooperation in outer space and building capacity in international space law.

8

INTERNATIONAL COOPERATION IN OUTER SPACE

8 | INTERNATIONAL COOPERATION IN OUTER SPACE

COPUOS UPDATES

The General Assembly set up COPUOS as a permanent committee in 1959 to address the exploration and use of outer space for the benefit of all humanity. To this day, it provides a unique multilateral platform for exchanging perspectives, needs and solutions on space affairs. The agenda of COPUOS and its Subcommittees has been evolving to address emerging changes and challenges, and its growing membership is a natural response to democratized access to space and its benefits. COPUOS now includes 100 countries (see more in the Highlights section) representing around 90 per cent of the population, and 45 observer organizations from around the world.

At the fifty-eighth session of the Scientific and Technical Subcommittee, countries elected the new Chair of the Working Group on the Long-term Sustainability of Outer Space Activities and convened the Working Group for the first time. The Working Group on Space and Global Health progressed on the set of recommendations regarding policies, experiences and practices in the use of space science and technology for global health. At the sixtieth session of the Legal Subcommittee (LSC), Member States considered international space law and policy, and related developments. The mandate, terms of reference, workplan and methods for the newly established Working Group on Space Resources were also agreed upon and later endorsed by COPUOS at its sixty-fourth session.

At the sixty-fourth main session of COPUOS in September 2021, the Working Group on the "Space2030" Agenda concluded its three-year-long negotiation process with the final deliverable in the form of a high-level policy document, the "Space2030" Agenda: Space as a Driver of Sustainable Development and its implementation plan (more details in the Highlights section). In 2021, COPUOS also 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 "Space and Climate Change" and proposed new initiatives to strengthen the use of space tools to tackle the climate crisis.

First meeting of the ad hoc COPUOS in 1959 at United Nations Headquarters in New York
Credit: United Nations

PLANETARY DEFENCE

The issue of near-Earth objects has long been on the agenda of COPUOS. UNOOSA works with the International Asteroid Warning Network (IAWN) and the Space Mission Planning Advisory Group (SMPAG) established by COPOUS in 2014. 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.

As part of these activities, UNOOSA and ESA hosted the virtual seventh International Academy of Astronautics (IAA) Planetary Defense Conference from 26 to 30 April, which attracted more than 700 participants. The Conference focused on technical and legal issues, decision-making and preparedness relating to asteroid impact hazards. Speakers presented groundbreaking results from the sample return missions Hayabusa2, led by JAXA, and OSIRIS-REx, led by NASA. They also provided updates on the Double Asteroid Redirection Test (DART), the first-ever mission to demonstrate the capability to deflect an asteroid using the kinetic impactor technique, and the follow-up mission, Hera, to assess the results. Eleven representatives of space agencies delivered statements expressing support for international collaboration on planetary defence.

Barringer Crater in the flat-lying desert sandstones in Arizona, United States
Credit: NASA

UN-SPACE

UNOOSA leads 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 was set up to promote collaboration, synergy, the exchange of information and the coordination of programmes among United Nations entities in the implementation of activities involving the use of space technology and its applications.

On 14 December 2021, UNOOSA convened the fortieth session of UN-Space in a virtual format to continue exploring the use of space technology in the implementation of plans and programmes of United Nations entities. Eleven United Nations entities and related organizations participated in this session. 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 to examine 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.

Three impact craters in the Lunae Planum region of Mars
Credit: ESA/Roscosmos/CaSSIS

COMMITTEE ON SPACE RESEARCH PANEL ON PLANETARY PROTECTION

In 2021, 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.

INTERNATIONAL COMMITTEE ON GLOBAL NAVIGATION SATELLITE SYSTEMS

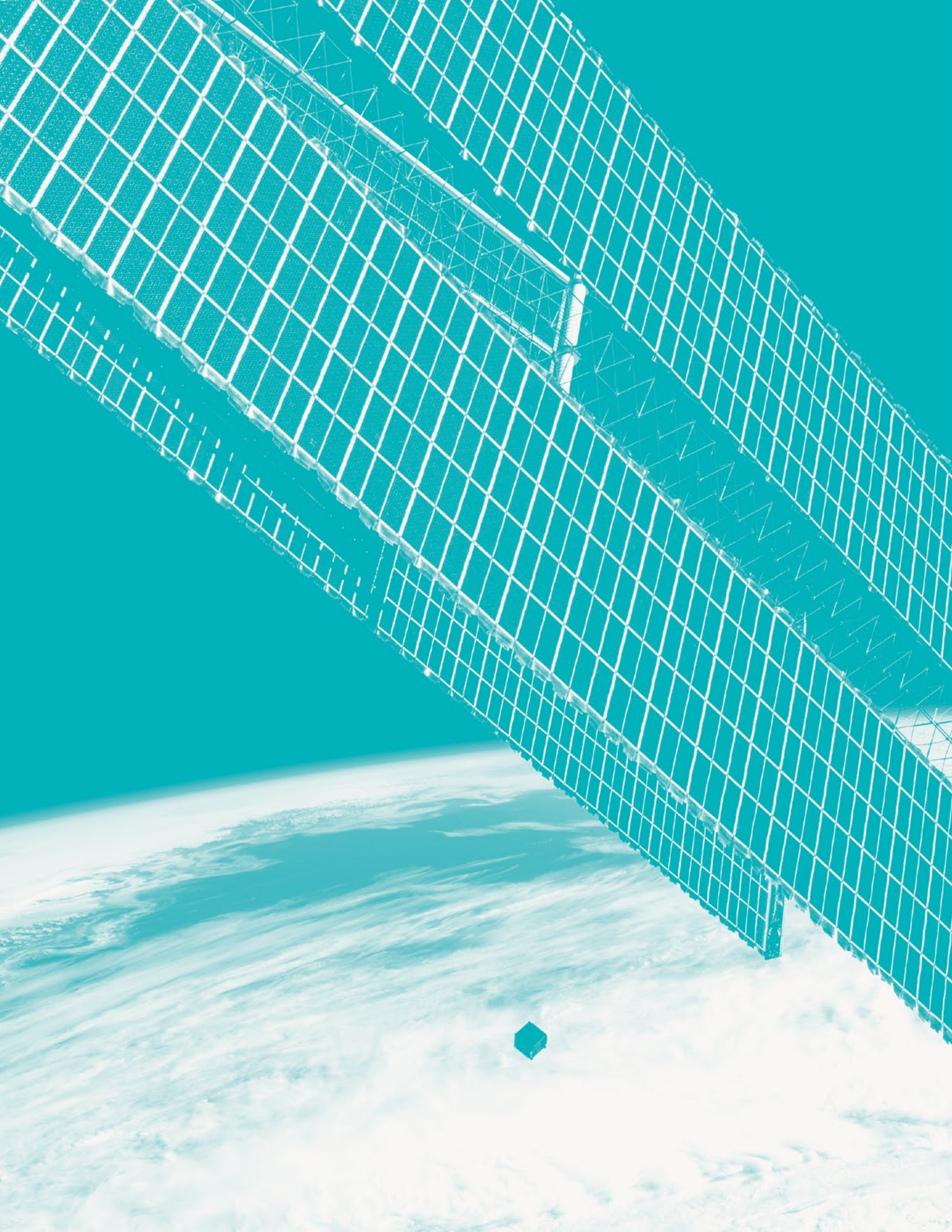
The International Committee on Global Navigation Satellite Systems (ICG), established in 2005, offers an optimal cooperation mechanism and a flexible forum for global navigation satellite system (GNSS) providers and users to discuss matters related to the use of multiple GNSS signals. This multilateral coordination mechanism to which UNOOSA serves as Executive Secretariat 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. In 2021, UNOOSA organized and chaired the fifteenth meeting of ICG in Vienna. In multi-stakeholder partnerships, UNOOSA advanced capacity-building activities in GNSS technology and carried out a series of training courses to boost its use for scientific applications. These activities covered, among other topics, GNSS generalities, space weather, ionospheric monitoring, modelling and irregularities.

In cooperation with the ICG space use subgroup, UNOOSA issued the second edition of the publication entitled "The Interoperable Global Navigation Satellite Systems Space Service Volume" to define, establish and promote an interoperable GNSS space service volume for the benefit of GNSS users and receiver manufacturers.

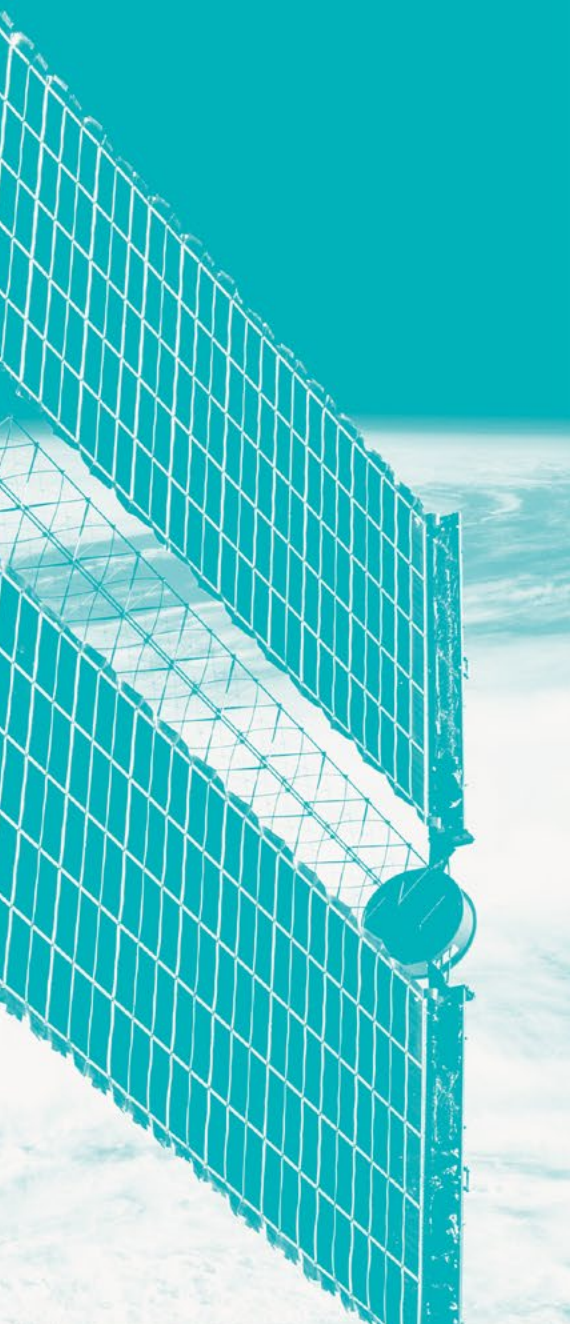
An artistic depiction of the four global and two regional navigation satellite systems surrounding the Earth
Credit: NASA

COMMITTEE ON EARTH OBSERVATION SATELLITES

In 2021, UNOOSA was elected the chair of the Working Group on Capacity-building and Data Democracy (WGCapD) of the Committee on Earth Observation Satellites (CEOS) as the first United Nations entity since the inception of WGCapD. The working group increases 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 pursues a variety of activities to unify CEOS efforts. These include 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 for enabling end users. UNOOSA will be serving this role until 2023.



Deployment of
the MIR-SAT1
from the Kibo
Credit: JAXA/NASA



UNOOSA maintains the United Nations Register of Objects Launched into Outer Space, an important transparency and confidence-building mechanism to increase trust among countries in outer space activities, particularly considering the rapidly increasing number of launches globally. In 2021, 1,936 functional and non-functional objects were registered with the Secretary-General.

9

SPACE OBJECTS REGISTRATION

9 | SPACE OBJECTS REGISTRATION

The increasing realization of the power of space assets coupled with more affordable access to the space environment have led to significant dynamics in satellite figures and truly sparked a new era in space flight operations. 2021 was the third in a series of record-breaking years in terms of objects launched into outer space and 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. As new challenges emerge from the rapid pace of development in the space sector, the Register, as the only treaty-based transparency and confidence-building measure, becomes ever more relevant to safe, secure and sustainable operations in this unique domain.

Throughout the year, 31 Member States submitted registrations on 1,895 objects, an increase of 50 per cent on 2020. The rise was driven predominantly by registrations of mega-constellation satellites by established space nations. First-time registrations were received from Mauritius, the Netherlands and Paraguay. With the addition of 41 rocket stages and other non-functional objects, a total of 1,936 space objects were registered in 2021. In January 2021, Kenya notified the Secretary-General of the conclusion of the life cycle of 1KUNS-PF, the first satellite launched by Kenya through the KiboCUBE programme. The satellite re-entered the atmosphere in June 2020.

At the time this report went to print, an additional 310 objects launched during 2021 or prior had also been registered.

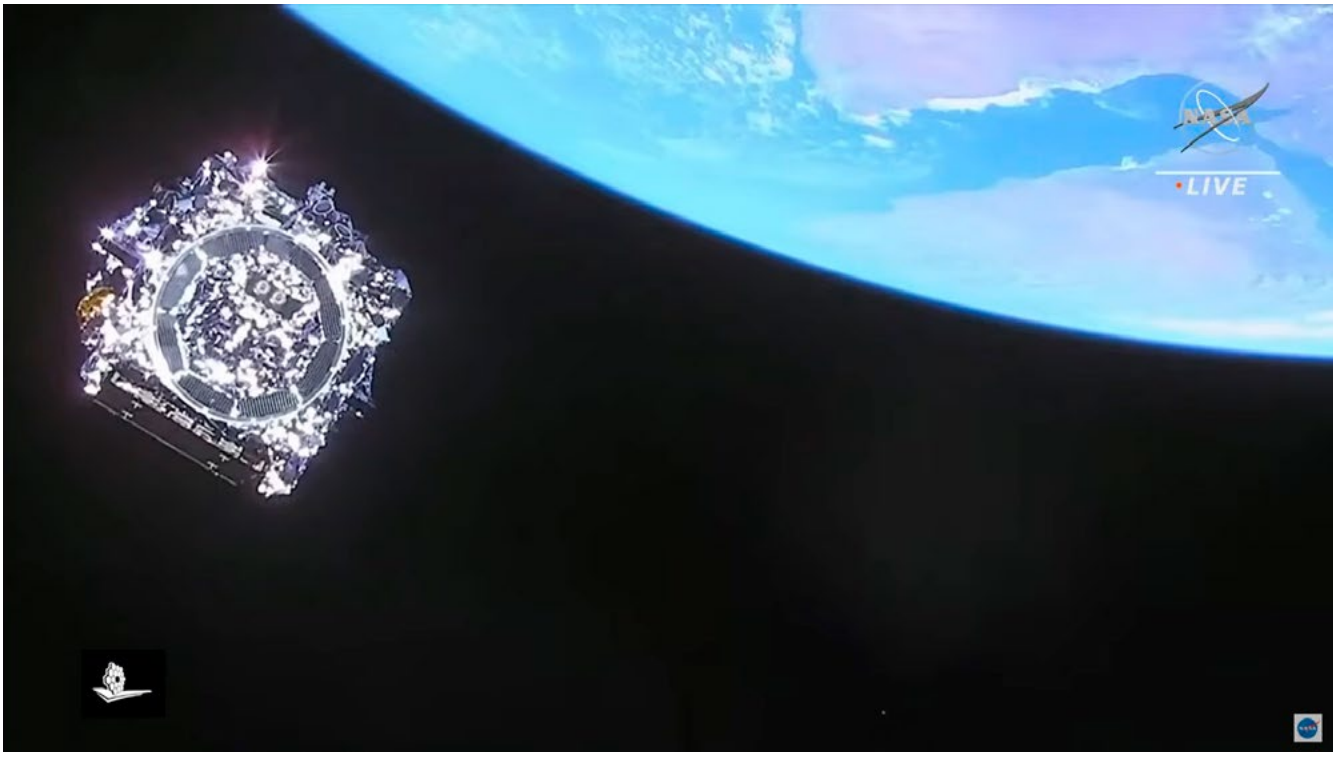
State of registry	Functional	Non- functional	Re-entry	Change	Total
Australia	6	0	0	0	
Belgium	1	0	0	0	
Brazil	1	0	0	0	
Canada	5	0	0	0	
China	98	0	0	0	
Denmark	0	0	1	0	
Finland	8	0	0	0	
France	4	6	9	3	
Germany	13	0	0	0	
Hungary	2	0	0	0	
India	7	3	0	0	
Indonesia	1	0	0	1	
Japan	46	7	4	8	
Kenya	0	0	1	0	
Lithuania	2	0	0	0	
Luxembourg	8	0	0	1	
Malaysia	1	0	0	1	
Mauritius	1	0	0	0	
Netherlands	1	0	0	0	
New Zealand	6	8	4	0	
Norway	1	0	0	0	
Paraguay	1	0	0	0	
Philippines	3	0	0	0	
Poland	1	0	0	0	
Republic of Korea	10	0	0	0	
Russian Federation	30	0	15	0	
Slovakia	1	0	0	0	
Spain	1	0	0	1	
Turkey	1	0	0	0	
United Arab Emirates	4	0	0	0	
United Kingdom	288	0	0	6	
Uruguay	13	0	0	0	
United States	1 330	17	138	2	

Functional registered	**1 895**				
Non-functional registered		**41**			
Total space objects registered in 2021					**1 936**
Satellite re-entry notifications			**172**		
Change in status (decommissioned, GSO position, etc.)				**23**	

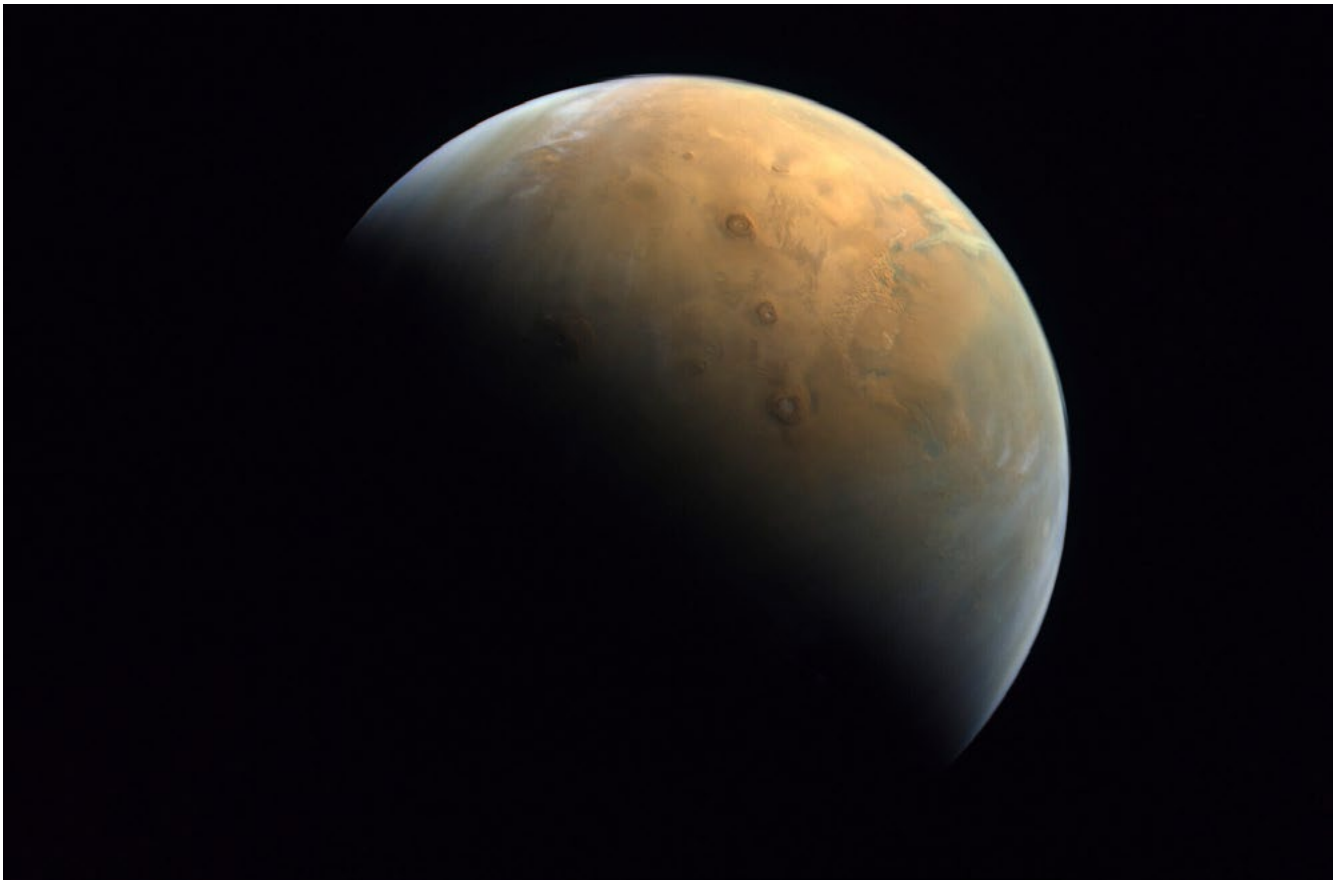
TECHNICAL ADVISORY SERVICES ON SPACE OBJECT REGISTRATION

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 2021, UNOOSA provided assistance and services to 22 governmental entities and other institutions.

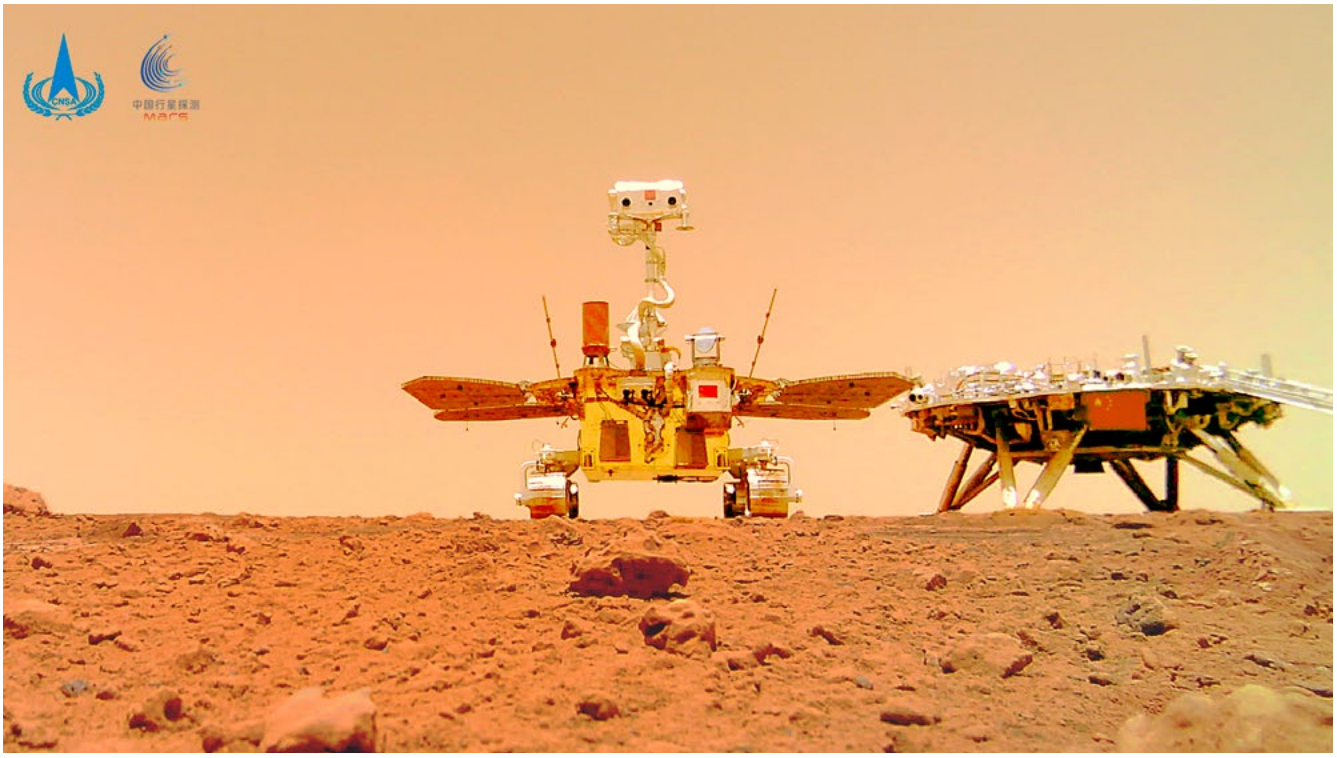
A hundred and forty-three payloads of all sizes went to space in a single record launch
Credit: SpaceX



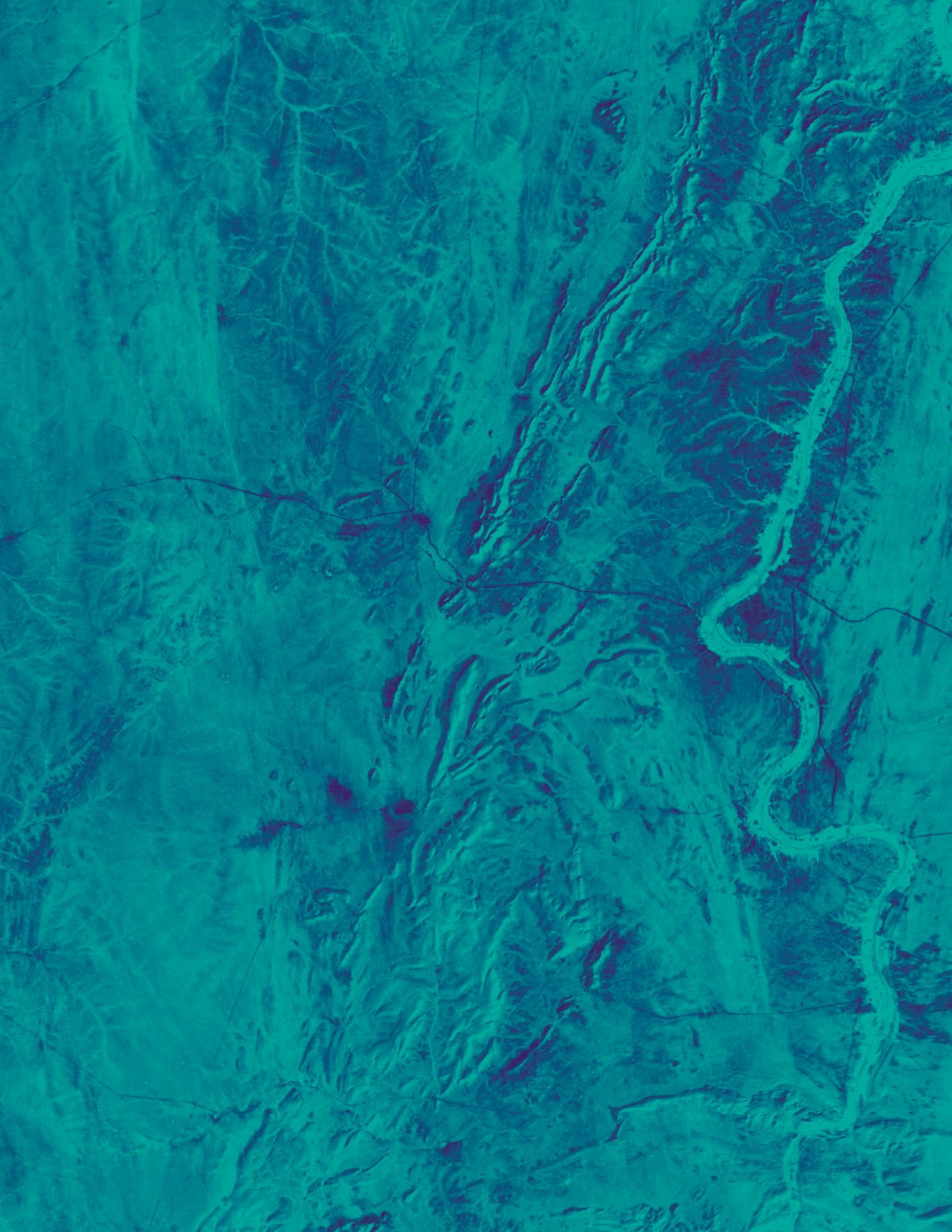
Humanity's last glimpse of the James Webb Space Telescope launched in December
Credit: Arianespace/ESA/NASA/CSA/CNES

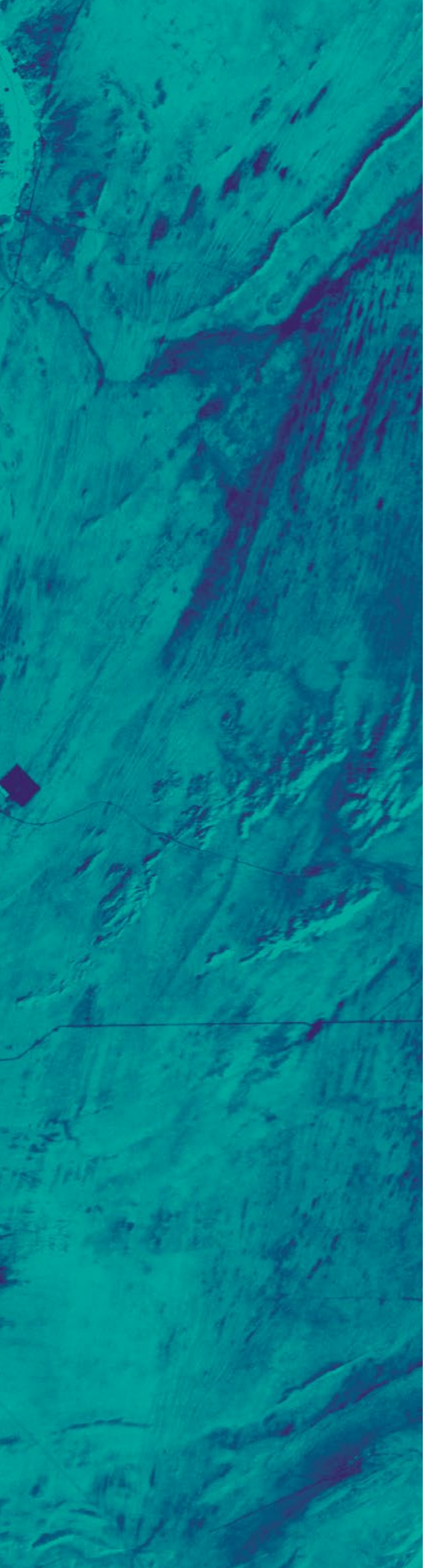


Hope Probe first image of Mars
Credit: Emirates Mars Mission



A selfie of rover Zhurong
Credit: CNSA





Southern Kalahari Desert as seen from the ISS
Credit: NASA

This chapter provides an overview of the UNOOSA budget, expenditure, voluntary contributions and staff numbers in 2021.

10

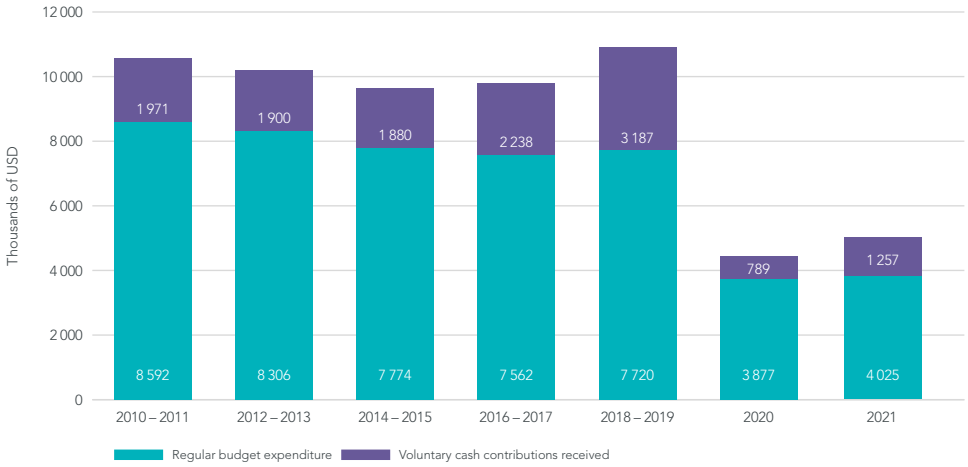
UNOOSA IN NUMBERS

10 UNOOSA IN NUMBERS

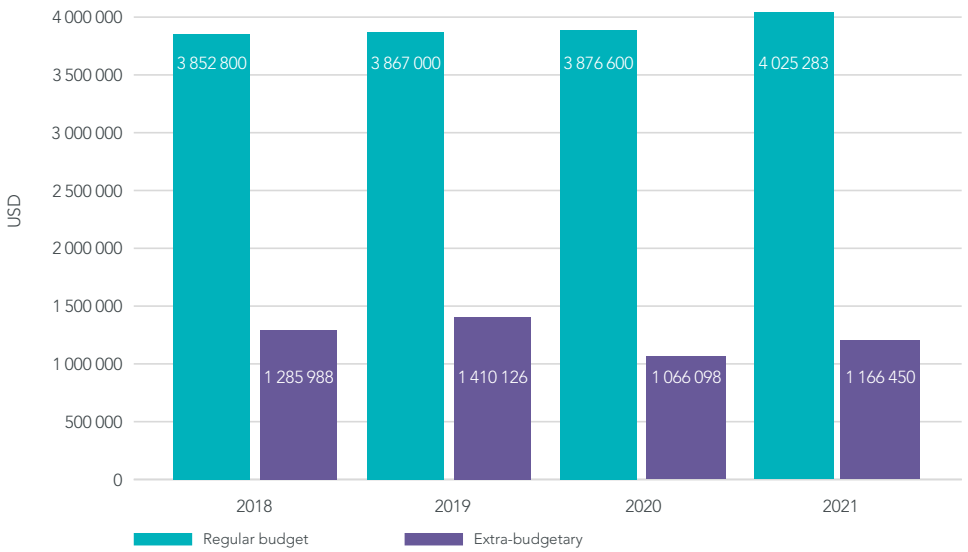
This section presents data on the financial and human resources of UNOOSA covering the period through 31 December 2021. The Office acknowledges and wishes to express its gratitude to all its Member States that continuously support its activities, whether through an in-kind or a cash contribution.

Since January 2022, and at the time of finalizing this report, the Office received additional cash contributions from the following donors: International Astronautical Federation, Japan Aerospace Exploration Agency (JAXA), Prince Sultan Bin Abdulaziz International Prize for Water (PSIPW), and United Kingdom Space Agency (UKSA). The data relating to those and other contributions will be reflected in the Annual Report 2022.

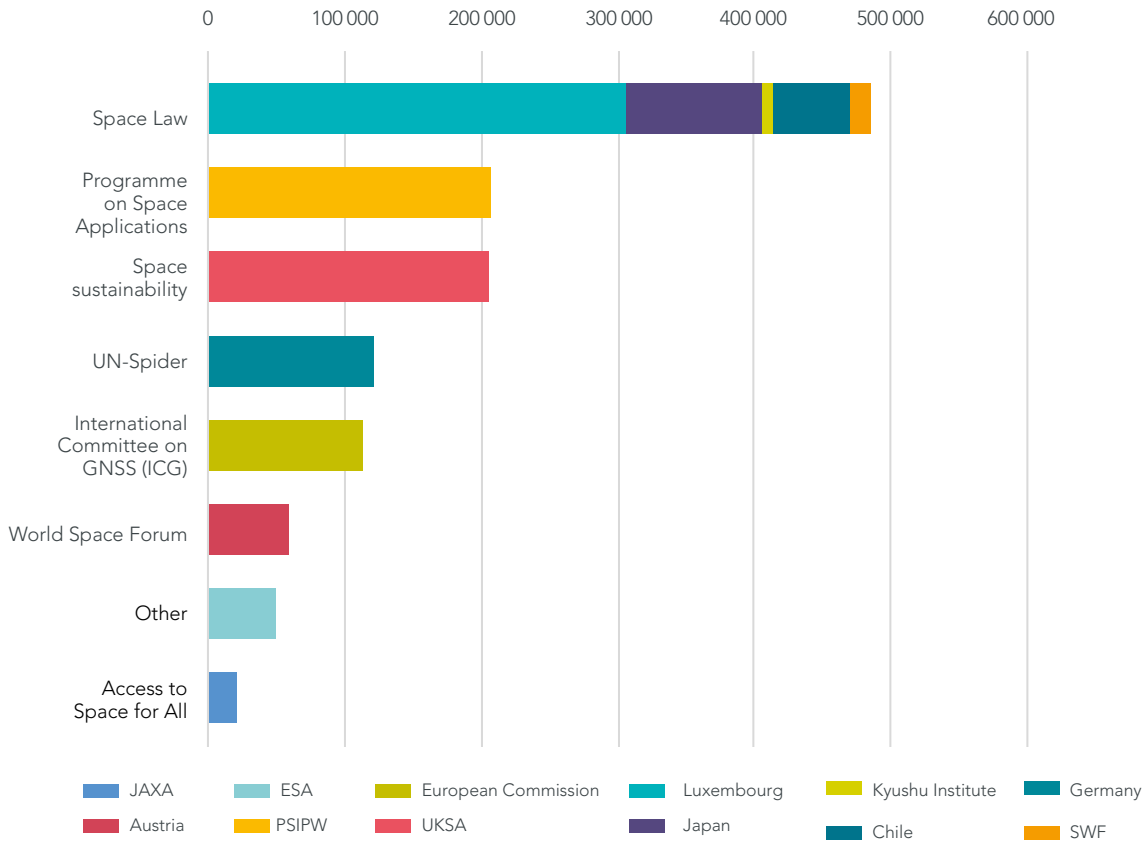
Budget overview



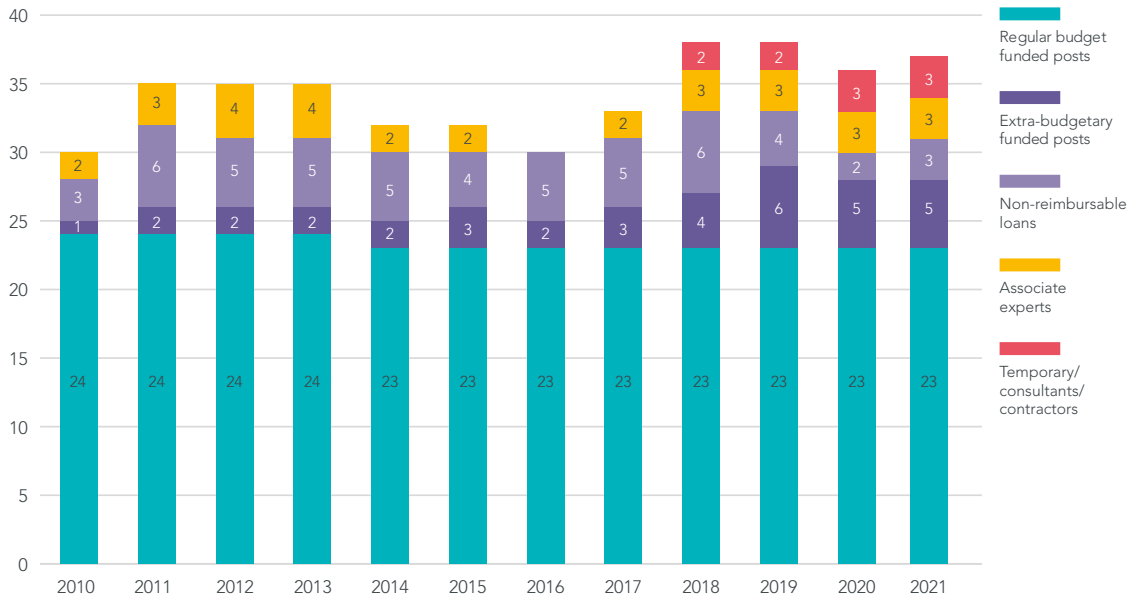
Expenditure



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



Staff overview



LIST OF ABBREVIATIONS AND ACRONYMS

CMSA	China Manned Space Agency
CNSA	China National Space Administration
COPUOS	Committee on the Peaceful Uses of Outer Space
COSPAR	Committee on Space Research
CSSTEAP	Centre for Space Science and Technology Education in Asia and the Pacific (India)
DropTES	Drop Tower Experiment Series
DLR	German Aerospace Centre
ESA	European Space Agency
ESTEC	European Space Research and Technology Centre
GNSS	Global Navigation Satellite System
IAU	International Astronomical Union
IAWN	International Asteroid Warning Network
ICG	International Committee on Global Navigation Satellite Systems
ISS	International Space Station
JAXA	Japanese Aerospace and Exploration Agency
Kyutech	Kyushu Institute of Technology (Japan)
LSC	Legal Subcommittee (of COPUOS)
MOOC	Massive Open Online Course
NASA	National Aeronautics and Space Administration (United States of America)
PNST	Fellowship Programme on Nanosatellite Technologies
PSIPW	Prince Sultan bin Abdulaziz International Prize for Water
RCSSTEAP	Regional Centre for Space Science Technology Education in Asia and the Pacific (China)
RSOs	Regional support offices (of UN-SPIDER)
SDGs	Sustainable Development Goals
SMPAG	Space Mission Planning Advisory Group
STEM	Science, Technology, Engineering and Mathematics
STSC	Scientific and Technical Subcommittee (of COPUOS)
UNIS	United Nations Information Service (in Vienna)
UN-SPIDER	United Nations Space-based Information for Disaster Management and Emergency Response
WSF	World Space Forum

To access the electronic version of this Report, please go to

www.unoosa.org/documents/pdf/annualreport/
UNOOSA_Annual_Report_2020.pdf

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

WWW.UNOOSA.ORG