ANNUAL REPORT 2019





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UNITED NATIONS OFFICE FOR OUTER SPACE AFFAIRS





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FOREWORD



UNOOSA Director Simonetta Di Pippo. Credit: UNIS

This year's annual report focuses on building resilience. Resilience is a holistic and multifaceted concept, and UNOOSA contributes to it in many ways.

Space data and applications give us access to unique images and data that help us monitor and mitigate climate change, reduce disaster risk and accelerate recovery when disasters occur.

Space tools also promote resilience and sustainable development in a range of areas, from water management to telemedicine and precision agriculture.

Moreover, space applications provide the backbone that enables the United Nations to deliver on its mandate, enhancing crisis relief and humanitarian efforts through tools such as telecommunications, earth observation and satellite navigation. In 2019, UNOOSA helped increase resilience in all of these areas. We partnered with space agencies from all over the world to form the Space Climate Observatory (SCO), which will help monitor regional, national and subnational climate change impacts. SCO will leverage satellite-based Earth observation to inform strategic decisions on climate change preparedness, adaptation and mitigation.

Our United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER) programme continued to help disaster risk communities all over the world access and leverage the space data and applications they need to prevent and mitigate disasters. The programme has a rapidly increasing network of users and provides a growing number of recommended practices that can be adapted to local contexts and needs. We continued to advance our work in the Pacific region through our Space Solutions for the Pacific project. We are working with both regional entities such as the Pacific Community (SPC) and the Pacific island countries themselves to enhance the use of space applications to counteract challenges such as rising sea levels and illegal fishing.

Our Space4Water portal continued to grow, providing new tools and practices to improve water management through space applications. The number of site users and visitors from both the water and space communities has grown rapidly since its launch, showing the platform has filled a gap in the field.

UNOOSA is at the forefront in establishing partnerships with the private sector to help all countries access the benefits of space: one of this report's highlights showcases some of the innovative opportunities we are providing for Member States in partnership with leading companies operating in space.

Space brings opportunities but also challenges that require us to build resilience: UNOOSA contributes to increasing knowledge-sharing and education on space weather, which can affect infrastructure, satellites and air travel, and work with space agencies and international networks to mitigate the risk of near-Earth object (NEOs) impacts.

On the policy and legal side of our work, 2019 marked a resounding success for multilateralism and international cooperation. The Committee on the Peaceful Uses of Outer Space (COPUOS) adopted a preamble and 21 guidelines for the long-term sustainability of outer space activities. These provide guidance on a policy and regulatory framework for space activities; safety of space operations; international cooperation, capacity-building and awareness; and scientific and technical research and development. This is the result of more than eight years of work by the Committee and of efforts by experts from its now 95 Member States, with support provided by the Office.

We launched our innovative Space Law for New Space Actors project, which offers United Nations Member States tailored capacity-building to help them draft national space legislation and policies in line with international space law, promoting the long-term sustainability of outer space activities. As more and more countries, as well as private actors, enter space activities, and as the nature of these activities rapidly evolves, this project is particularly timely.

While space helps us build resilience and accelerate sustainable development, we need to ensure it remains sustainable as a global commons. One problem that we are working to address is the increasing amount of space debris: to strengthen global awareness and international cooperation, we signed a joint statement on space debris mitigation with the European Space Agency (ESA).

These highlights show that UNOOSA is working on many levels to tackle the challenges we face as a species – both on Earth and in space. Through the breadth and depth of our activities, we are helping create a future in which the next generations can have happier, healthier and longer lives.





UNOOSA group picture. Credit: UNIS

> This chapter introduces the mandate and programmatic activities of UNOOSA, from helping all countries leverage space technologies to achieve the SDGs, to increasing awareness and adherence to international space law and maintaining the United Nations Register of Objects Launched into Outer Space.



UNOOSA: WHAT WE DO

UNOOSA is the only United Nations Office entirely dedicated to outer space affairs.

The Office manages and implements the programme on the peaceful uses of outer space, strengthening international cooperation in space activities and in the use of space science and technology for achieving sustainable development. The Office represents the United Nations in promoting international cooperation in the peaceful uses of outer space for economic, social and scientific development, in particular for the benefit of developing countries.

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

Through its Access to Space 4 All initiative, UNOOSA helps bridge the gap among countries in their capacity to access and benefit from space. In partnership with leading space agencies and private sector companies, the initiative provides competitive research and orbital opportunities to help more countries, particularly developing ones, access space and its benefits.

UNOOSA works closely with the six Regional Centres for Space Science and Technology Education around the world affiliated to the United Nations to increase space-related education. These provide unique training and education programmes, particularly for talent in developing countries.

Through the UN-SPIDER programme, with offices in Beijing, Bonn and Vienna, UNOOSA helps countries use space data and technologies, such as satellite imagery, to prevent and manage disasters. UN-SPIDER is implemented through the generous financial support of China and Germany. UNOOSA serves as the Secretariat for the only committee of the General Assembly dealing with international cooperation in space: COPUOS. 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 enhances understanding of the fundamentals of international space law, helping countries increase their capacity to draft or revise national space law and policy in line with international normative frameworks on space.

UNOOSA supports the implementation of existing normative frameworks, such as the Outer Space Treaty, the Liability Convention, the Registration Convention and the United Nations Space Debris Mitigation Guidelines. This is particularly important as more countries and nongovernmental organizations than ever are entering space activities. In this framework, the UNOOSA Space Law for New Space Actors project offers capacity-building to Member States to help them draft national space legislation and policies in line with international space law.

UNOOSA discharges the Secretary General's responsibilities under international space law, including maintaining the United Nations Register of Objects Launched into Outer Space, created in 1961 at the request of Member States. The Register is a treaty-based mechanism that promotes transparency and confidencebuilding in outer space; it identifies the State that is responsible for a space object.

UNOOSA is the Executive Secretariat of the International Committee on GNSS (ICG), which brings together all global navigation satellite system (GNSS) providers to promote their improvement and use for sustainable development.



Scandinavian snows. Credit: ESA

The ICG Programme is being successfully implemented thanks to the generous financial contributions of the United States of America and the European Commission.

UNOOSA is Secretariat to the Space Mission Planning Advisory Group (SMPAG), which works with space agencies worldwide on planetary defence. UNOOSA also cooperates with the International Asteroid Warning Network (IAWN) in strengthening international coordination and cooperation in case of NEO impact hazards. The work of UNOOSA with SMPAG is supported by the contribution of ESA as chair of SMPAG. UNOOSA leads the United Nations system-wide cooperation and coordination on space-related issues and activities through the Inter-Agency Meeting on Outer Space Activities (UN-Space). This is a mechanism 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.

Through the breadth of its activities, UNOOSA addresses all stages and aspects of space law, exploration, research and applications, helping all countries leverage the benefits of space for sustainable development.





Novaya Zemlya archipelago, Arctic Circle. Credit: ESA

> From the launch of our Space Law for New Space Actors project to the addition of exciting new orbital and research opportunities to the portfolio of our Access to Space 4 All initiative, this chapter presents the main highlights for UNOOSA in 2019.



21 HIGHLIGHTS OF 2019

Space Law for New Space Actors project

In November 2019, UNOOSA launched the "Space Law for New Space Actors: fostering responsible national space activities" project. This project offers United Nations Member States tailored capacity-building to facilitate their drafting of national space legislation and policies in line with international space law, thus promoting the long-term sustainability of outer space activities. Such capacity-building will particularly support new and emerging spacefaring nations in conducting space activities in a responsible and sustainable manner. Furthermore, the project will increase adherence to the existing normative framework governing outer space activities.

The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (Outer Space Treaty), which celebrated its fiftieth anniversary in 2017, serves as the foundation of international space law. This normative framework has been instrumental in supporting over half a century of exponential growth in space activities and the global space economy while ensuring safe, secure and sustainable outer space activities.

This project was made possible through the generous support of the Governments of Chile and Luxembourg, and the Secure World Foundation.



UNOOSA Director Simonetta Di Pippo and the Minister for Development Cooperation and Humanitarian Affairs of Luxembourg Paulette Lenert sign the funding agreement for the Space Law for New Space Actors project. Credit: Luxembourg Space Agency



Hypergravity Experiment Series Fellowship with the European Space Agency

2019 saw the addition of an exciting research opportunity to the UNOOSA Access to Space 4 All initiative portfolio: the chance for teams from all over the world to apply to conduct their own experiments at the Large Diameter Centrifuge at the European Space Research and Technology Centre (ESTEC). Located in Noordwijk, the Netherlands, ESTEC is a unique ESA facility that simulates a hypergravity field through centripetal forces during rotation. In cooperation with ESA, this fellowship, named the Hypergravity Experiment Series fellowship – HyperGES – will open these top-class facilities to the best researchers globally, with particular attention to applications from developing countries. The Large Diameter Centrifuge at the European Space Research and Technology Centre. Credit: ESA



The core module of the China Space Station. Credit: CMSA

Winners of the opportunity to fly experiments onboard the China Space Station

UNOOSA and the China Manned Space Agency (CMSA) announced the winners of the opportunity to conduct space experiments on the China Space Station (CSS), which is expected to be operational around 2022. Out of 42 applications received from organizations in 27 countries, nine winning teams were selected, composed of participants from Belgium, China, France, Germany, India, Italy, Japan, Kenya, Mexico, the Netherlands, Norway, Peru, Poland, the Russian Federation, Saudi Arabia, Spain and Switzerland. The research areas proposed include space medicine, space life science, biotechnology, microgravity fluid physics, microgravity combustion, astronomy and space technologies. All applications were carefully evaluated by a team of around 60 experts from UNOOSA, CMSA and the international space community.

This cooperation, which will open the unique space laboratory on board the CSS to the selected teams, is part of the UNOOSA Access to Space 4 All initiative.

The Space4Youth competition winners at the International Astronautical Congress with Ayami Kojima from UNOOSA. Credit: Antonio Stark, SGAC



Space4Youth competition winners attend the International Astronautical Congress in Washington D.C.

In April 2019, UNOOSA and the Space Generation Advisory Council (SGAC) launched the Space4Youth competition, that asked young people all over the world for ideas on how space could help achieve the SDGs. Over 135 young people from 40 countries took part in the competition and, in June 2019, UNOOSA and SGAC announced three winners, from Greece, the Philippines and Serbia. The competition aimed at supporting the United Nations Youth Strategy, specifically its number one priority: "Engagement, participation and advocacy to amplify youth voices for the promotion of a peaceful, just and sustainable world". The winning proposals were presented at a side event on Space4Youth during the main session of COPUOS in June 2019.

In October 2019, the three winners travelled to Washington D.C., where they were rapporteurs in the twentyseventh Workshop on Space Technology for Socio-Economic Benefits, organized by the International Astronautical Federation (IAF) and UNOOSA.

They then participated in the seventieth IAC from 21 to 25 October, where they were the protagonists of a special Space4Youth event. At the event, they pitched their ideas to a panel of global space leaders who provided the young winners with mentoring advice to help them take their projects to the next level. The panel included the Director of UNOOSA and professionals from the German Aerospace Agency (DLR), ESA and retired astronaut Jean-François Clervoy.

After the Congress, the winners had the chance to visit space-related sites in Washington D.C., and meet with Department of State Officials. Their participation at the IAF and IAC, and the subsequent visit, were made possible through the generous support of the United States Mission to International Organizations in Vienna and the United States Department of State.



Arthur Demain, Philippines

It does not matter if you're from the far regions of the Pacific or you live in a booming city, or whether you have a degree in aerospace engineering or not. The Space for4 Youth Competition provides an equal opportunity for any eligible participant to contribute to advancing youth perspectives within the global space dialogue. As an educator, I am keen to return to the Philippines and implement creative pedagogies in my tiny classroom to make my country's space initiatives more accessible and fun to learn for my students.

Arthur Demain, Milica Milosev and George Profitiliotis. Credit: Ant<u>onio Stark, SGAC.</u>



Milica Milosev, Serbia

I would definitely recommend to all young people to participate in the Space4Youth Competition. It is a wonderful experience where you can improve your knowledge, expand your interests, and show your passion, skills and talents in order to help humanity and our planet achieve the SDGs.



George Profitiliotis, Greece

It is a wonderful opportunity to give a voice to the younger generation to promote their ideas on how space-related research and sustainable development are not mutually exclusive but can and must interact in a constructive way to solve the most pressing issues of our time.

An image from the special event on Space4Youth, with the panellists and winners.

From left to right: Ayami Kojima, Space Expert, UNOOSA; Arthur Demain, Space4Youth winner; Kai-Uwe Schrogl, IISL President; Simonetta Di Pippo, UNOOSA Director; Jean-François Clervoy, French and ESA astronaut; George Profitiliotis, Space4Youth winner; Clementine Decoopman, Executive Director of SGAC; Pascale Ehrenfreund, Chair of DLR; Milica Milosev, Space4Youth winner; and Josef Aschbacher, **Director of Earth Observation** Programmes at ESA ESRIN. Credit: UNOOSA



UNOOSA Director Simonetta Di Pippo and ESA Director General Johann-Dietrich Wörner sign the agreement. Credit: UNOOSA



Many space applications offered today, or being developed by agencies, research institutions and companies, can significantly help countries achieve the SDGs. One obstacle to their wider implementation, however, is lack of knowledge: often potential users such as Governments are not aware of applications that can be adapted and leveraged in their context.

To address this issue, UNOOSA and ESA signed an agreement to work together on producing a Space Solutions Compendium (SSC), which will be a practical tool for all countries to identify how space can support their efforts towards sustainable development. In particular, it will help developing countries incorporate space solutions in their strategies. UNOOSA and ESA will leverage their expert knowledge and networks to identify relevant space applications and show how these can be used in a variety of contexts. The SSC will be hosted by UNOOSA.





UNOOSA Director Simonetta Di Pippo speaking at the World Space Forum. Credit: UNIS



Inaugural World Space Forum in Vienna

In November 2019, UNOOSA hosted the first edition of the World Space Forum (WSF) in Vienna, which attracted over 300 participants from 66 countries. As the complexity of the space sector continues to increase, with new participants from both Governments and the private sector from all over the world, sustained international dialogue such as the one enabled by WSF is increasingly essential. Participants discussed all areas of space activities and their implications for sustainable development, particularly around the four pillars of space economy, space diplomacy, space society and space

accessibility. The event led to numerous recommendations on topical areas, such as mitigating space debris, improving space traffic management and ensuring the long-term sustainability of outer space activities. WSF saw strong private sector participation, with the presence of representatives from companies such as SNC, Virgin Galactic, Avio S.p.a. and PricewaterhouseCoopers among others.

WSF was organized by UNOOSA and the Federal Ministry of the Republic of Austria for Transport, Innovation and Technology, co-sponsored by ESA and supported by the Federal Ministry of the Republic of Austria for Europe, Integration and Foreign Affairs and by the Austrian Research Promotion Agency.





World Space Forum. Credit: UNIS



UNOOSA support to the implementation of the Sendai Framework for Disaster Risk Reduction

In his report to the General Assembly on the implementation of the Sendai Framework for Disaster Risk Reduction in July, the Secretary-General recognized the contribution of UNOOSA to this important field of activities for the United Nations system. In particular, the report stated: "The United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER) has developed – and provided to national disaster management agencies in 13 countries – relevant information, compiled using Earth observation technologies, on impacts of droughts triggered by the El Niño/Southern Oscillation phenomenon on crops and vegetation". Gosses Bluff crater in the Northern Territory of Australia. Credit: ESA The United Nations International Conference on Space-based Technologies for Disaster Risk Reduction and the tenth anniversary of UN-SPIDER in Beijing

The Conference, titled "A policy perspective", focused on helping Member States meet target E of the Sendai Framework for Disaster Risk Reduction 2015-2030, which calls for an increase in the number of countries with national and local disaster risk reduction strategies. Participants presented strategies that included space-based information in national geospatial infrastructure, as well as policies on data generation, sharing and interoperability, and demonstrated the positive impact of institutionalizing the use of spacebased information in this field.

The two-day conference, attended by 112 individuals from 27 countries, was co-organized by UNOOSA and the Ministry of Emergency Management of the People's Republic of China, in collaboration with the Ministry of Foreign Affairs, China National Space Administration (CNSA) and the Asia Pacific Space Cooperation Organization (APSCO).

The ninth Beijing conference also marked the tenth anniversary of the UN-SPIDER office in Beijing. To celebrate this special occasion, we published a booklet on the achievements and impact of the Beijing office over the past decade. As highlighted in the publication, since its establishment, the UN-SPIDER office in Beijing has been making strides towards helping all countries, especially in Asia, leverage space applications for disaster risk reduction.

> A group picture from the conference. Credit: UNOOSA



DEEPENING COLLABORATION WITH THE PRIVATE SECTOR IN SPACE

UNOOSA is continuously strengthening its collaboration and expanding its partnerships with the private sector, particularly in the framework of the Access to Space 4 All initiative.

The value of the commercial sector in space is increasing at unprecedented speed and currently represents around 80 per cent of the whole industry. Overall, the space industry is worth more than \$400 billion and several analysts expect it to reach trillions of dollars by 2050. This rapid growth presents us with exciting opportunities to involve the private sector in leveraging space for sustainable development.

As highlighted by the Secretary-General, the SDGs cannot be achieved without the active participation of the private sector. This section presents some of the innovative ways in which UNOOSA works with private sector companies to bring the benefits of space to everyone, everywhere.



From left to right: Oliver Juckenhöfel, Senior Vice President, Airbus; Simonetta Di Pippo, UNOOSA Director; and Johannes von Thadden, Senior Vice President, Airbus, at the signature of the agreement at the International Astronautical Congress. Credit: UNOOSA

Opportunity to access the International Space Station with Airbus

At the IAC held in Washington D.C. in October 2019, UNOOSA and Airbus announced the opportunity for institutions from all over the world to apply for the chance to accommodate and operate a payload on the Airbus Bartolomeo external platform attached to the European Columbus Module of the ISS. This cooperation, which will be part of the Access to Space 4 All initiative, will help selected teams develop their capacities in space, supporting in particular SDG 4 "Quality Education" and SDG 9 "Industry, Innovation and Infrastructure". It will also promote international cooperation in the peaceful uses of outer space. Rendering of the Bartolomeo platform. Credit: Airbus





Agreement with Avio for satellite slots

On the sidelines of the seventy-fourth session of the General Assembly, UNOOSA and Avio S.p.a. announced an agreement to cooperate on providing institutions from all over the world, in particular from developing countries, with the opportunity to apply to use satellite slots free of charge for three U1 CubeSats or aggregates on a launch vehicle scheduled for October 2020. The opportunity fosters technological learning and capacity-building, especially for developing countries with no or emerging space capabilities.

An image from the call for interest announcement at the 2019 International Astronautical Congress. From left to right: astronaut Jean-François Clervoy; Sierra Nevada Corporation President Eren Ozmen; UNOOSA Director Simonetta Di Pippo; and Sierra Nevada Corporation CEO Fatih Ozmen. Credit: SNC

Call for interest for a landing site with the Sierra Nevada Corporation

UNOOSA and the Sierra Nevada Corporation (SNC) are working on an opportunity for selected participants to fly payloads or experiments in low-Earth orbit using the SNC Dream Chaser® vehicle. The opportunity will prioritize payloads that contribute to the attainment of one or more of the SDGs. At the IAC 2019, UNOOSA and SNC announced the opening of a call for interest to provide a landing site for the SNC Dream Chaser® on its return from the mission.

UNOOSA side event on the United Nations and the private sector in space

Alongside the High-Level week of the seventy-fourth session of the General Assembly, on 23 September, UNOOSA organized a side event in New York on how the United Nations and the private space sector can increase their collaboration in the space sector. The event was co-hosted by Italy, the United States and Zambia.

From joint operational activities with commercial entities through the Access to Space 4 All initiative to supporting industry perspectives in policy discussions at the WSF, UNOOSA is at the forefront in establishing collaborations with private sector stakeholders.

The event was attended by high-level representatives including the Italian deputy Minister for Foreign Affairs, the Executive Secretary of the National Space Council from the White House, the NASA Deputy Administrator and the Permanent Representative of Zambia, as well as the Director of UNOOSA and CEOs from the commercial space sector, including Virgin Galactic, Maxar Technologies and Avio S.p.a. It displayed the potential that increased collaboration with the private sector offers for space policy, capacitybuilding and increasing access to space, particularly for developing countries.

Mar in





A view of Siberia. Credit ESA

> This focus chapter shows how UNOOSA is stepping up its contribution to increasing the resilience of our planet in several key areas: from planetary defence to disaster risk reduction and climate change mitigation. It starts by presenting how we help countries leverage the potential of space across the entire disaster management cycle through UN-SPIDER.

3 FOCUS: BUILDING RESILIENCE FOR OUR PLANET

3 | FOCUS: BUILDING RESILIENCE FOR OUR PLANET



Christina Koch of NASA captured this image of Hurricane Dorian from the International Space Station on September 2, 2019. Credit: NASA

The focus of this Annual Report is on building the resilience of our planet.

Resilience in systems and infrastructure, particularly in preparations for and responses to hazards, is a concept that is crucial not only to the mandate of UNOOSA, but to all United Nations offices and agencies.

Resilience, as defined by the United Nations Office for Disaster Risk Reduction (UNDRR) is: "the ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management." United Nations entities recognized the importance of resilience in the 2030 Agenda for Sustainable Development, the Paris Agreement and the Sendai Framework for Disaster Risk Reduction 2015–2030, which were all adopted in 2015. These agreements exemplify the importance of resilience not only for mitigating the effects of natural disasters, but also for responding to climate change and achieving the 17 SDGs, which are the overarching objectives of the United Nations in this decade.

In each aspect of sustainable development, resilience is key: when actors are well-prepared and informed, with strengthened capabilities to respond to hazards, then not only are lives saved, but progress is preserved and built upon.

SPACE FOR DISASTER MANAGEMENT AND EMERGENCY RESPONSE: UN-SPIDER

Space is essential for increasing the resilience of communities all over the world to disasters. UN-SPIDER is a UNOOSA programme that helps developing countries find, access and use space-based information in activities conducted in all phases of disaster management – from preparedness to response and recovery. This work is more important than ever as humanity faces more frequent and intense extreme weather events caused by climate change. Space provides us with powerful tools to respond to these challenges.

The work of UN-SPIDER is backed by a global network of 23 regional support offices (RSOs) hosted by space agencies, universities, research institutions and civil protection entities that provide a wide range of expertise and services. Besides Vienna, where UNOOSA is based, UN-SPIDER also has offices in Bonn and Beijing.

UN-SPIDER carries out technical advisory missions at the request of Member States, which focus on assessing existing capacity for leveraging space for disaster management and emergency response. Over the years, UN-SPIDER has conducted 37 technical advisory missions, resulting in unique recommendations to help countries institutionalize the use of space-based information in disaster management. These recommendations address questions of policy and coordination; data access, availability and sharing; capacity-building; institutional strengthening; early warning; and preparedness and emergency response efforts. Through this work, UN-SPIDER has established long-term cooperation with disaster management stakeholders all over the world.

UN-SPIDER follows up on missions with training activities that are customized to each country's needs and strengthen local capacity for using Earth observation and remote sensing. This work helps countries implement the Sendai Framework for Disaster Risk Reduction, the Paris Agreement and the 2030 Agenda for Sustainable Development.



as of end of 2019

Knowledge management is a cornerstone of UN-SPIDER: its Knowledge Portal (www.un-spider.org) hosts information on all activities conducted by the programme and provides easy digital access to resources and recommended practices on using space technologies for disaster management. Since its launch, the number of visitors to the Portal has been constantly rising: in 2019, average monthly visits increased by almost 40 per cent compared to 2018, jumping from 22,000 to around 30,000.

When a disaster strikes, UN-SPIDER supports emergency response efforts by facilitating access to space-based information products provided by regional and global emergency mechanisms. These have been set up by the space community to support disaster response through maps derived from satellite imagery. They include the International Charter "Space and Major Disasters", Sentinel Asia and the Copernicus Emergency Management Service. While UN-SPIDER can request the activation of these mechanisms in the case of disasters, it also helps disaster management agencies around the world become authorized users able to activate them on their own.

Technical advisory support to Member States

Myanmar

Upon the request of the Government of Myanmar, UN-SPIDER carried out an institutional strengthening mission to the country from 11 to 15 March. This activity was jointly organized by UN-SPIDER and the United Nations Human Settlement Programme (UN-Habitat), under the auspices of the Ministry of Social Welfare, Relief and Resettlement (MSWRR) of Myanmar.

During the five-day mission, UN-SPIDER held an advocacy meeting at ministerial level and carried out two training programmes: one for 25 officials of the Department of Disaster Management of MSWRR and one for 25 officials from key line ministries. The mission improved the participants' capability to use spacebased technologies for sustainable development and disaster management, and deepened the engagement of UN-SPIDER with MSWRR and its Emergency Operation Centre, United Nations agencies and other stakeholders in the country.

> A moment from the training in Myanmar. Credit: UNOOSA



Lao People's Democratic Republic

From 18 to 22 March, UN-SPIDER carried out an institutional strengthening mission to the Lao People's Democratic Republic upon the request of the Ministry of Science and Technology. Experts from two UN-SPIDER RSOs – the International Water Management Institute and the Asian Disaster Preparedness Centre contributed to the mission. During the five-day mission, UN-SPIDER participated in an ASEAN workshop on "The Application of Geospatial Information on Statistic Data for Sustainable Development" and conducted a three-day national training programme on "Earth Observation-based Mechanisms and Tools for Assessing Flood Risk and Rapid Response During Floods". The training strengthened the skills of its 25 participants from ministries and the National University in the use of emergency response maps.

Peru

At the request of the National Civil Defence Institute (INDECI) and the National Space Commission of Peru (CONIDA), UN-SPIDER carried out a technical advisory mission to Peru from 1 to 5 April. During the mission, UN-SPIDER experts held meetings with high-ranking officers of INDECI and CONIDA, conducted institutional visits to 13 government agencies and universities, and carried out an inter-institutional workshop with government agencies, universities and NGOs. The mission benefited from the support of experts from the National Commission on Space Activities of Argentina, the Agustin Codazzi Geographic Institute of Colombia (IGAC), DLR, the Mexican Space Agency and the Federal University of Santa Maria (UFSM) in Brazil. Through the mission, UN-SPIDER learned of progress by CONIDA and INDECI in institutionalizing the use of spacebased information in disaster management, including by other government agencies.

View of the Quelccaya Ice Cap in Peru. Credit: ESA



Ecuador

UN-SPIDER carried out an institutional strengthening mission to Ecuador from 8 to 12 April upon the request of the National Risk and Emergency Management Service. The Military Geographic Institute of Ecuador, IGAC and UFSM and the Ecuadorian Space Institute supported the mission. The mission included a training course conducted at the Military Geographic Institute, which targeted 21 participants from various institutions convened by the National Risk and Emergency Management Service. Participants were trained in the use of three UN-SPIDER recommended practices for generating useful information regarding floods, droughts and forest fires.

Cameroon

Upon the request of the Ministry of Territorial Administration of Cameroon, UN-SPIDER carried out a week-long institutional strengthening mission to Yaoundé from 15 to 19 July. The mission strengthened the capacities of the Department of Civil Protection of Cameroon to use space-based information in all phases of the disaster management cycle. A two-day workshop on "Emergency Operations Centres", organized by the Department of Civil Protection and UN-SPIDER, brought together 52 participants from 36 institutions including ministries, government agencies, United Nations agencies, humanitarian organizations and the private sector.



Mount Cameroon, an active volcano in Cameroon near the Gulf of Guinea. Credit: NASA



Galapagos Islands, Ecuador. Credit: NASA

Ethiopia

Upon the request of the Government of Ethiopia, UN-SPIDER carried out an institutional strengthening mission to Addis Ababa from 26 to 30 August to help the country leverage space technology for drought early warning. As part of the mission, UN-SPIDER and the Ethiopian Space Science and Technology Institute (ESSTI) convened a national workshop on "Drought Monitoring, Forecasting and Prediction in Ethiopia Using Satellitedriven and In-situ-based Measured Products". The workshop brought together around 40 participants from a wide range of national and international institutions. UN-SPIDER followed up with stakeholders on these efforts during an expert mission to the country in December, when it met with ESSTI and the National Disaster Risk Management Commission.

Mongolia

From 2 to 4 September, UN-SPIDER conducted an institutional strengthening mission to Mongolia. The mission focused on the use of space-based and geospatial systems by the National Emergency Management Agency (NEMA). It reviewed progress on recommendations provided in the technical advisory mission's report; developed ideas for assistance in 2020; proposed NEMA as an authorized user of the International Charter "Space and Major Disasters"; and strengthened the capacity of NEMA in emergency response. UN-SPIDER also conducted a one-day workshop for stakeholders from various ministries and met with high-level officials of NEMA. Delta State University, a UN-SPIDER RSO, sponsored one expert to support the mission.



The Uvs Nuur Basin in Mongolia and the Russian Federation. Credit: NASA

Lake Tana in Ethiopia. Credit: ESA



Mapping support for volcanic activity in Guatemala

At the request of the National Coordinating Agency for Disaster Reduction and the National Institute for Seismology, Volcanology, Meteorology and Hydrology of Guatemala, UN-SPIDER developed a high-resolution digital elevation model of the Fuego volcano to identify areas near the summit of the cone that experienced a massive erosion process and where material was deposited. The model was developed based on high-resolution satellite images donated by Mexican company GEOSARMEX.

Mapping support for landslides and slope instabilities in Cameroon, Colombia and Guatemala

At the request of the Department of Civil Protection of Cameroon, UN-SPIDER conducted a radar interferometry assessment to detect the geological instability of the city of Bafoussam, where a landslide killed 50 people in November 2019.

In Colombia, UN-SPIDER responded to a request from the National Disaster Risk Management by mobilizing a team of experts to use radar interferometry to assess the instability of a mountain that triggered a large landslide in May.



Copernicus Sentinel-2B picture of Egg Island in the Bahamas. Credit: ESA

In Guatemala, to support the National Coordinating Agency for Disaster Reduction, UN-SPIDER undertook a multitemporal radar interferometry assessment to detect the geological instability of the Peronia City neighbourhood of Guatemala City, which was affected by a series of landslides.

Through private sector partnerships with UNOOSA, UN-SPIDER supported the World Food Programme in obtaining high-resolution satellite imagery of the Bahamas collected by Maxar Technologies after Hurricane Dorian. UN-SPIDER also helped the Pakistan Space and Upper Atmosphere Research Commission (SUPARCO) access high-resolution radar imagery from Airbus Defence and Space to assess damage caused by an earthquake in the eastern part of the country.



Cyclone Idai captured from the International Space Station on 16 March 2019. Credit: NASA

> of Humanitarian Affairs reported that at least 60 out of 110 villages in the Zina district – 19,359 people – were affected, while 15 villages with a population of 16,215 were affected in the Kai-Kai district.

In October 2018, UN-SPIDER helped the National Disaster Management Agency (NADMO) of Ghana become an authorized user of the International Charter "Space and Major Disasters". In November 2019, NADMO participated in project management training led by DLR and ESA and hosted by the UN-SPIDER Bonn office. Following these capacity-building activities, NADMO activated the Charter and assumed the role of project manager for floods in the Central African Republic and landslides in Kenya.

Besides raising awareness of the International Charter "Space and Major Disasters" and its Universal Access initiative among disaster management agencies worldwide, UN-SPIDER also hosted project management training on the Charter prior to the UN-SPIDER Beijing and Bonn conferences.

Activations of the International Charter "Space and Major Disasters"

As part of its activities, UN-SPIDER facilitates the activation of the International Charter "Space and Major Disasters", a worldwide collaboration through which satellite data are made available for disaster relief efforts. In 2019, the Charter was activated on four occasions:

- On behalf of the United Nations Development Programme (UNDP) Country Office in Zimbabwe for tropical Cyclone Idai, which passed over eastern Zimbabwe on 14 March, killed 98 people and left hundreds more missing.
- On behalf of the Iranian Space Agency, an RSO of UN-SPIDER, after flooding in the south-western provinces of Golestan and

Mazandaran. The flooding killed at least 45 people and injured many more as flash floods and mudflows damaged thousands of buildings.

- On behalf of the National Disaster Management Centre of South Africa for floods and mudslides in Durban and the surrounding KwaZulu-Natal province of South Africa, which killed over 60 people and displaced more than 1,000.
- On behalf of the Department of Civil Protection of Cameroon, following heavy rains in the far north of Cameroon that caused the Logone river to overflow and inundate the Zina, Maga and Kai-Kai districts. The United Nations Office for the Coordination

New resources on the UN-SPIDER Knowledge Portal

To support Member States in developing information products for monitoring natural hazards, several step-by-step procedures for downloading, processing and mapping space-based information – called recommended practices – were created by UN-SPIDER and its partners in 2019. They bring the total number of recommended practices available on the UN-SPIDER Knowledge Portal to 12; many of them are available in several programming languages and GIS applications.

SUPARCO, which hosts a UN-SPIDER RSO, provided two recommended practices: "Flood Mapping and Damage Assessments Using Sentinel-2 Optical Imagery" and "Flood Hazard Modelling".

IGAC, the Colombian RSO of UN-SPIDER, provided an updated recommended practice to assess the severity of forest fires, along with its translation into Spanish.

UN-SPIDER welcomed a visiting scientist from Mexico to its Bonn office, sponsored by the Government of Mexico, who developed a recommended practice on "Mudslides and Associated Flood Detection Using Sentinel-1 Data".

Under a memorandum of understanding signed with UNOOSA in 2018, Airbus Defence and Space developed a recommended practice on the "Use of Digital Elevation Data for Storm Surge Coastal Flood Modelling". This showcases how high-resolution digital elevation models, such as the World Digital Elevation Model of Airbus Defence and Space, can help map storm surges on coastal areas.

In 2019, three background information pages on using space-based technologies for addressing specific hazards were published. These covered practices to increase resilience to soil erosion, land degradation, and for locust monitoring.

Other activities on space for disaster management

UN-SPIDER–Republic of Korea expert meeting

The expert meeting was organized on 10 July at the Korea Aerospace Research Institute and attended by representatives from the Ministry of the Interior and Safety, the Ministry of Environment and its Environmental Satellite Centre, the Ministry of Foreign Affairs and the Ministry of Science, Technology and Information and Communication Technology. Discussions focused on streamlining activities related to space and disaster management in the Republic of Korea.

International training course on space-based technologies for disaster risk assessment

Attended by 30 participants, the training was part of UN-SPIDER efforts to build disaster management capacity in developing countries. It took place at the Regional Centre for Space Science Technology Education in Asia and the Pacific (RCSSTEAP), based at Beihang University, Beijing, from 5 to 9 September.

UN-SPIDER Bonn international conference: space-based solutions for disaster management in Africa: challenges, applications, partnerships

Over 100 participants from 20 countries discussed the use of space technologies to confront challenges posed by floods, droughts and other natural hazards across Africa at this conference, which took place from 6 to 8 November in Bonn, Germany. The event provided insights on some of the challenges faced by disaster management agencies in Africa and on potential solutions by the space community that could support them. The conference encouraged collaboration between these two communities in making use of space-based information, big data more generally and artificial intelligence techniques. Participants also had the opportunity to attend hands-on sessions on cloud-based GIS applications and UN-SPIDER

step-by-step procedures for mapping natural hazards. Through the conference, UN-SPIDER also identified capacity-building needs and opportunities for leveraging spacebased information for future activities.

India – International training course on space-based information systems for ecosystem-based disaster risk reduction

The course took place from 25 to 29 November at the Indian Institute of Technology in Roorkee, India. It focused on the use of satellite remote sensing image analysis for monitoring ecosystem health. It also explored the potential of space-based information in ecosystem-based disaster risk reduction.

Workshop and international training programme at the South Asian Association for Regional Cooperation Disaster Management Centre

This second regional event in South Asia, co-organized by the Disaster Management Centre (Interim Unit) of the South Asian Association for Regional Cooperation (SAARC) and UN-SPIDER, brought together 25 participants from disaster management authorities and space agencies in SAARC member States. The workshop was held in Ahmedabad, India, from 4 to 8 December. It enhanced cooperation and the sharing of best practices among disaster management agencies and experts, and strengthened their skills in utilizing space-based and geospatial information.

Second multi-hazard early warning conference

UN-SPIDER co-chaired the second multi-hazard early warning conference, hosted by the World Meteorological Organization (WMO) at its headquarters in Geneva from 13 to 14 May. The conference took place prior to the 2019 Global Platform for Disaster Risk Reduction. Three hundred and twenty participants from all over the world highlighted how better governance, partnerships, communication, and science and technology are needed for multi-hazard early warning efforts to translate into early action that saves lives. At the conference, UN-SPIDER also co-organized a side event on "Big Data and Space Applications".

United Nations Senior Leadership Group on Disaster Risk Reduction

UNOOSA participated in this annual meeting in New York, where the Office presented the recent work of UN-SPIDER and its RSOs in this area.



Participants at the training in Roorkee, India. Credit: UNOOSA

PLANETARY DEFENCE

UNOOSA works to advance planetary defence mechanisms, increasing the resilience of our planet to threats such as asteroid impacts. In what follows, we present our work in this area. Building resilient societies is one of the key challenges of the twenty-first century, and space capabilities play a crucial role in this effort. One of the hazards coming from space is possible damage from an asteroid or comet impact. Acting as a gateway to space in the United Nations system, UNOOSA is uniquely positioned for advancing international cooperation in planetary defence.


The International Asteroid Warning Network and the Space Mission Planning Advisory Group: Global mechanisms for coordinating action in the area of planetary defence

UNOOSA acts as the secretariat to the Space Mission Planning Advisory Group (SMPAG) and cooperates with the International Asteroid Warning Network (IAWN) in strengthening international coordination and cooperation in case of a NEO impact hazard.

SMPAG and IAWN are two global entities established in 2014 as a result of recommendations endorsed by COPUOS and welcomed by the General Assembly. These recommendations aim to address the global challenge posed by NEOs, beginning with their detection and tracking, and subsequently, deflection and planetary defence.

IAWN brings together institutions with planetary defence functions, such as discovering, monitoring and physically characterizing potentially hazardous NEOs from all over the world. Its objectives are to maintain an internationally recognized clearing house for the receipt, acknowledgment and processing of all NEO observations; to recommend policies regarding criteria and thresholds for notification of an emerging impact threat; and to assist Governments in analysing impact consequences and plan mitigation responses, using strategic communication plans and protocols (iawn.net).

SMPAG (pronounced "same page") brings together space agencies worldwide. Its responsibilities include laying out the framework, timeline and options for initiating and executing response activities, informing the civil defence community about the nature of impact disasters and incorporating that community into the overall mitigation planning process through an impact disaster planning advisory group.

UNOOSA works with both IAWN and SMPAG in areas such as communication and capacity-building, and increasing awareness among Member States, as well as the general public, on NEO risks. One such opportunity is International Asteroid Day, proclaimed by the General Assembly in 2016. This global observance is held annually on 30 June, the anniversary of the Tunguska NEO impact over Siberia that took place in 1908. The anniversary is an occasion to sensitize and inform the public about NEOs and the work of SMPAG, IAWN and UNOOSA in preparing an international response to a potential impact hazard. UNOOSA also plays a facilitating role in disseminating

information to Member States in case of early warning related to NEO events, such as meteorite impacts on their territories.

UN-SPIDER works with IAWN to include a NEO definition in an updated Hazard Terminology and Classification, currently under review by UNDRR and the International Science Council Expert Group.

Both IAWN and SMPAG report annually to COPUOS and its STSC on their progress and efforts to discover, monitor and physically characterize potentially hazardous NEOs under the agenda item "near-Earth objects". IAWN and SMPAG agreed on initial criteria and thresholds for impact response actions, which have direct relevance for Member States in terms of information-sharing and timelines for preparedness. In the event of an actual impact warning by IAWN, SMPAG would propose mitigation options and implementation plans for consideration by Member States.



Credit: Marat Ahmetvaleev

Planetary Defence Conference and links to disaster response communities

The 2019 International Academy of Astronautics Planetary Defence Conference (PDC) was held from 29 April to 3 May at the College of Maryland in the United States. This was the eighth in a series of conferences that began in 2004 to discuss advancements in the characterization and discovery of NEOs and in cutting-edge technologies for mitigating a NEO impact on Earth. The Conference also addressed international coordination and cooperation efforts in this area, impact consequences and disaster preparedness, and how to communicate with the public and decision makers in the event of an impact.

The Conference saw a strong interest from national disaster preparedness institutions, such as the Federal Emergency Management Agency of the United States, to deepen their collaboration with the UNOOSA UN-SPIDER programme in disaster preparedness. The aim is to leverage existing UN-SPIDER work to raise awareness among Member States of NEOs as potential natural hazards and help them increase resilience to these risks as part of national emergency response and preparedness strategies. UN-SPIDER would also help in sharing best practices.

The 2021 PDC will be held at the Vienna International Centre (VIC), from 26 to 30 April, hosted by UNOOSA.

DECLARATION ON THE SPACE CLIMATE OBSERVATORY

Space is crucial for monitoring and fighting the impact of climate change: satellites provide consistent, highresolution and broad-scale monitoring that enables us to understand in detail the changes that affect our planet. In fact, more than half of the essential climate variables that allow us to analyse climate change are dependent on space. For example, space applications help us map biodiversity, monitor glaciers, measure deforestation, track desertification and much more. These tools are particularly helpful for achieving SDG 6 "Clean Water and Sanitation", SDG 13 "Climate Action", SDG 14 "Life below Water", and SDG 15 "Life on Land".

On 17 June 2019, at the Paris Air Show in Le Bourget Airport, UNOOSA signed a joint declaration of interest for the creation of a Space Climate Observatory (SCO). The main goal of SCO is to study and monitor the impacts of climate change, especially on the local scale, using satellitebased Earth-observation tools in combination with field data and models. This will complement and extend existing initiatives, boosting them at national and local levels.

The declaration was signed by 18 space agencies and the signatories had the opportunity to share their commitment to SCO with French president Emmanuel Macron, who is the figurehead of the initiative.



In October 2019, UNOOSA participated in the first steering committee meeting of SCO. Members agreed to deliver, in two years' time, a document defining a sustainable working scheme.

SCO is a major opportunity to respond to the need for international coordination in the precise assessment and monitoring of the impact of climate change using space. It will be crucial for decision-making on preparedness, adaptation and resilience at local levels. UNOOSA will be the bridge between SCO and the United Nations Secretariat, supporting the efforts of the entire United Nations system to mitigate climate change.



Top: The President of France Emmanuel Macron and other leaders at the signing of the Space Climate Observatory. Credit: SCO

Bottom: A view of Paris from space. Credit: ESA

SPACE4WATER

Space research and applications, particularly satellite imagery, are essential for strategic water management, which aims at a fair distribution of our limited freshwater resources. Moreover, aquatic life, oceans and coastal ecosystems are affected by activities that can be observed from space.

The Space4Water project, which UNOOSA created in partnership with the Prince Sultan Bin Abdulaziz International Prize for Water (PSIPW), is a unique initiative to help the water community benefit from space science and technologies. In 2018, the project launched the Space4Water portal, which provides training material, research, information on conferences and initiatives, articles and networking opportunities on the synergies between the water and space sectors. The portal was developed through the generous financial support of PSIPW. It promotes SDG 6 "Clean Water and Sanitation" and SDG 14 "Life Below Water".

In 2019, the project made progress in strengthening its community of practice and in raising awareness and outreach, as well as in further developing and maintaining the Space4Water Portal as one of the top outlets in its field for quality of content and interoperable services.

In 2019, the Space4Water Portal attracted almost 10,000 users from 169 countries, who consulted over 25,000 pages. Access statistics rose



Algae blooms over the Baltic Sea. Credit: ESA

from 239 users and 392 sessions in November 2018, the first month after the launch of the Portal, to 1,342 users in 1,576 sessions over the same period in 2019.

The Space4Water Portal currently has 37 stakeholders who have a profile and actively share content on the platform. In 2019, they shared information on 15 software tools and six projects. Software tools include cloud-based computing of highresolution satellite imagery, the tracking of surface water reservoirs and their long-term changes or the rapid and automatic production of floodwater maps. Shared projects include satellite missions to measure global precipitation or to enable continuous global observation of climate change parameters.

UNOOSA has also continued to develop a glossary of space and environmental terms available on the Portal, containing approximately 600 terms and counting.

Visit www.space4water.org to learn more about how space technologies contribute to the sustainable management of water bodies and drinking water.



UNOOSA Director Simonetta Di Pippo with the President of the National Centre for Space Studies of France Jean-Yves Le Gall, Austrian Minister for Sustainability and Tourism Maria Patek, Earthrise Alliance CEO Lori Garver and other participants at the event in New York. Credit: UNOOSA

SIDE EVENT ON SPACE APPLICATIONS FOR CLIMATE ACTION

On 22 September, on the margins of the seventy-fourth General Assembly and alongside the Secretary-General's Climate Action Summit, UNOOSA organized a side event in New York on space applications for climate action. Satellite data and applications offer high-resolution, continuous monitoring of our planet, including in remote areas, which facilitate informed decision-making, help raise awareness about and understand the changes affecting our Earth.

The event was co-hosted by Austria, France and UNDP. Experts from Brazil, Ethiopia, Uganda, UNDP, WMO, the Earthrise Alliance and CANEUS International, as well as UNOOSA, participated in the panel discussion. Participants identified concrete measures and presented existing actions to support the Paris Agreement and the 2030 Agenda through space applications. The event contributed to mapping gaps and scaling up ambitions for global climate action, as well as to identifying "low hanging fruit" that current space technologies can help us access.

JOINT STATEMENT WITH THE EUROPEAN SPACE AGENCY ON SPACE DEBRIS

In May 2019, UNOOSA and ESA released a joint statement on their wish to cooperate on mitigating the challenge of space debris. The two organizations agreed to work together to increase global understanding and the consolidation of knowledge on space debris; to disseminate information on the latest relevant research; to support the implementation of existing space debris mitigation guidelines; and to strengthen international cooperation and global awareness on space debris mitigation. On the sidelines of the sixty-second session of COPUOS in June, UNOOSA and ESA held a joint side event on space debris mitigation where they presented their joint efforts.

SPACE SOLUTIONS FOR THE PACIFIC

The Sendai Framework for Disaster Risk Reduction 2015–2030 acknowledges that disaster risk reduction requires empowerment and inclusive participation, with special attention to people disproportionately affected by disasters, especially the poorest.

The Asia-Pacific region, and small island developing States (SIDS) in particular, face complex disaster risks, as vulnerable populations and critical infrastructures are exposed to climaterelated hazards of increasing intensity. According to the United Nations, a person in Pacific SIDS is three to five times more at risk from such hazards than those in other parts of the region.

In 2019, the Office, with the generous support of the Government of New Zealand, continued its work on the Space Solutions for the Pacific project, which promotes resilience in the region. UNOOSA has already begun delivering some initial services to Pacific island countries and is working with national focal points to secure authorized user status for their countries to activate the International Charter "Space and Major Disasters".

With the support of the Permanent Mission of New Zealand to the United Nations in Vienna, UNOOSA organized an event to raise awareness about the project on the sidelines of the sixty-second COPUOS session.

The Office also organized a session on "Space Accessibility: User Needs – Space for Small Island Developing States (SIDS)" during the twenty-fifth United Nations/Austria Symposium "Space: a tool for Diplomacy, Accessibility and Cooperation". During the session, UNOOSA presented the development of the Pacific project and invited speakers from SIDS, including a representative of the Pacific Community, to present on access to space technologies in their local context.

Banks Peninsula in New Zealand photographed from the International Space Station by ESA astronaut Alexander Gerst. Credit: ESA

BUILDING RESILIENCE TO SPACE WEATHER THROUGH THE INTERNATIONAL COMMITTEE ON GLOBAL NAVIGATION SATELLITE SYSTEMS

Space weather monitoring, prediction and research are fundamental for advancing space weather science, thereby improving resilience against its adverse effects and impacts. Space weather phenomena can damage satellites or interfere with the radio signals with which they operate. Space weather can also cause damaging surges in long-distance transmission lines and expose aircraft and their passengers to radiation. ICG, of which UNOOSA is Executive Secretariat, works with the International Space Weather Initiative (ISWI) to facilitate the use of GNSS receivers to understand the impact of extreme space weather and solarterrestrial interaction on the Earth's atmosphere. UNOOSA is a liaison office to the ISWI Steering Committee. The Office coordinates workshops, training sessions and education and outreach activities around the globe to increase understanding and share knowledge on space weather, often in collaboration with ISWI. Examples of this are presented in chapter 5 of this annual report on space education.



Left: A moment from the conference. Credit: UNOOSA

Right: A view of southern-central Romania from space. Credit: ESA

UNITED NATIONS/ROMANIA INTERNATIONAL CONFERENCE ON SPACE SOLUTIONS FOR SUSTAINABLE AGRICULTURE AND PRECISION FARMING

As part of our work to increase the resilience of our planet, UNOOSA helps all countries boost the sustainability of agricultural practices through space applications. Together with the Romanian Space Agency, UNOOSA organized this conference in Cluj-Napoca, Romania, from 6 to 10 May. The event focused on how space technologies can improve the management of agricultural resources and enhance food security globally to contribute to SDG 2 "Zero Hunger". Participants also discussed the importance of new space technologies and international cooperation to combat climate change.



The conference was hosted by the University of Agricultural Sciences and Veterinary Medicine and supported by the Office for Soil Science and Agrochemistry and the Romanian Society for Photogrammetry and Remote Sensing.





Summer ice in the Arctic. Credit ESA



Space technology provides unique images, data and applications that are essential for achieving and monitoring progress towards the SDGs, as well as for modern daily lives. This chapter presents the main activities of UNOOSA in helping countries leverage space for sustainable development.



4 SPACE4SDGS

Space technologies are essential allies in fighting disease and supporting populations at risk from rising seas or advancing desertification. They enhance the safety of refugees and victims of the impact of war as well as helping counteract terrorism, piracy and crime worldwide. Furthermore, these technologies play an important role in the preservation of biodiversity and cultural heritage. Simply put, we would not be able to address the fundamental challenges of our time without space. As we enter the last decade of action for Agenda 2030, it is increasingly crucial that we fully leverage the opportunities provided by space data and applications.

To highlight the importance of space technologies for the SDGs, in 2019 UNOOSA introduced new pages on its website dedicated to Space4SDGs, where readers can find information on how space supports each of the 17 Goals.

All the work of UNOOSA contributes to achieving the SDGs. In this chapter, we provide some highlights of ways in which UNOOSA directly supports the 2030 Agenda for Sustainable Development. These are featured throughout this report, particularly in the chapters on Resilience, Space Education and International Cooperation.

UNITED NATIONS/CHINA FORUM ON SPACE SOLUTIONS: REALIZING THE SDGS

The Office and CNSA, in cooperation with the Industry and Information Technology Department of Hunan Province, organized this Forum, held in Changsha, China, from 24 to 27 April. The event attracted over 500 participants from 46 Member States. The main objective was to bring together space solution providers and users to enhance international space cooperation and forge new partnerships to contribute to the SDGs.

Participants recommended that the international community should devote more attention to promoting space science and technology and their applications, with the aim of increasing interest and subsequent investments in the space industry, which is fundamental for sustainable development.

The Forum was supported by APSCO, the Regional Centre for Space Science and Technology Education in Asia and the Pacific (RCSSTEAP) affiliated to the United Nations, the Municipal People's Government of Changsha and Hunan University.



Participants in the United Nations/ China Forum admire the posters detailing what space can do for each of the SDGs. Credit: UNOOSA NASA astronauts Christina Koch and Jessica Meir in space. Credit: NASA

SPACE4WOMEN

Leveraging the talent of women and girls all over the world is essential for humanity to seize the benefits of space and reach new frontiers in space technology and exploration. UNOOSA supports these objectives through our Space4Women project, which helps women succeed in the space and STEM sectors. In 2019, we continued to build on this project, whose online website was launched in February 2020. The platform will create a global "Space4Women Champions" network, linking young women with female role models who will advise and guide them throughout their career journey from education to occupation in STEM sectors.

The Space4 Women platform will also be the central hub for global initiatives and for research on various aspects of women's involvement in the space and STEM sectors, under the umbrella of the United Nations. Through Space4Women, UNOOSA will also provide data, research and evidencebased policy advice to institutions and Governments to increase opportunities for women and for recognizing their contributions. In particular, this project



supports SDG 4 "Quality education" and SDG 5 "Gender equality".

The Space4Women project is being implemented thanks to generous contributions from the Governments of Austria and Israel, ESA and Women in Aerospace Europe. In 2019, UNOOSA held side events on Space4Women at the STSC and the main session of COPUOS.

Female scientist to conduct experiment on China Space Station – Tumours in Space

One of the nine winning experiments selected by UNOOSA and CMSA to be flown on the CSS is led by a female scientist, Tricia LaRose. The experiment will explore how microgravity can help us reduce tumours.

"The plan is to send three-dimensional stem cells from both healthy cells and cells with cancer from the same person into space. Here we will study mutations and look at how the cell's DNA is affected by weightlessness and cosmic radiation," said Tricia L. Larose, who is research director for the Tumours in Space project at the K.G. Jebsen Centre for Genetic Epidemiology at the Norwegian University of Science and Technology.

ACCESS TO SPACE 4 ALL

This unique initiative offers a wide range of opportunities in micro- and hypergravity research, satellite development, launch and deployment, in-orbit research and access to laboratories in low Earth orbit, such as the ISS and the future CSS. It is based on partnerships between the United Nations and a diverse group of stakeholders such as Governments, space agencies, private space entities, civil society and academia. The initiative focuses on bridging the gap among nations in their capacity to access and benefit from space, and on helping all countries leverage space to advance the SDGs, in particular SDG 4 "Quality education", SDG 8 "Decent work and economic growth", SDG 9 "Industry, innovation and infrastructure", SDG 10 "Reduced inequalities" and SDG 17 "Partnerships for the goals".

In 2019, UNOOSA continued to expand the Access to Space 4 All portfolio. Updates on some of the opportunities under the initiative have already been presented in chapter 2 of this report on collaboration with the private sector, and others are detailed below.

> Cube satellites released from the ISS. Credit: JAXA/NASA





The DropTES tower in Bremen, Germany. Credit: Springerlink

DropTES Fellowship

The DropTES Fellowship is run by UNOOSA in collaboration with the Centre of Applied Space Technology and Microgravity (ZARM) at the University of Bremen, Germany, and DLR. The programme, which started in 2013, enables researchers to carry out microgravity experiments at the Bremen Drop Tower. The experiments, which consist of four drops or catapult launches, can build capacity for both hardware and human space missions. The team selected for the sixth cycle of the DropTES in 2019, from the Department of Aerospace Science and Technology of the Politecnico di Milano, conducted their experiments in November. They focused on the sloshing of magnetic liquids in microgravity, an almost unexplored phenomenon that may have important applications in space.

A CubeSat being deployed from the ISS. Credit: JAXA/NASA

KiboCUBE

UNOOSA and the Japan Aerospace Exploration Agency (JAXA) are continuing their collaboration to offer the opportunity for institutions from developing countries to develop a cube satellite (CubeSat) and deploy it from the ISS Japanese Experiment Module (Kibo).

In 2019, UNOOSA and JAXA announced the selection of a team from the National Centre of Space Technologies of Technical University of Moldova as winners of the fourth round of KiboCUBE. The Moldovan team will join the ranks of distinguished winners from past rounds of KiboCUBE, namely the University of Nairobi; Universidad del Valle de Guatemala; the Mauritius Research Council and Surya University in Indonesia.

Through KiboCUBE, the Moldovan team will be able to deploy their first

satellite "TUMnanoSat". The primary objective of "TUMnanoSat" is to provide hands-on practical training to the students participating in the project, developing their capacity in the space technology field. Scientific and research objectives include testing the CubeSat sensors, as well as the communication link for the CubeSat. With an on-board camera, the CubeSat will capture Earth images, the



first step for the Republic of Moldova towards eventually developing its own Earth observation satellite.

In 2019, the winners of the second round of KiboCUBE, the team from Universidad del Valle de Guatemala, announced the completion of their CubeSat, which was handed over to JAXA for the deployment phase.

SDG 17: NEW PARTNERSHIPS

SDG 17 emphasizes that Agenda 2030 cannot be achieved without productive partnerships between the United Nations and a range of stakeholders from the public and private sectors. Through the variety of its partnerships, UNOOSA contributes to mobilizing resources and efforts for sustainable development through space. New partnerships in 2019 are presented below.

Cooperation agreement with the University of Bonn

In June 2019, a five-year cooperation agreement was signed between the University of Bonn, Germany, and the UN-SPIDER office in Bonn, funded by DLR. Within the scope of this agreement, UN-SPIDER will organize international conferences and expert meetings, carry out knowledge management efforts and provide technical advisory support to Member States, especially in Africa.

Under the project "Spaceborne Earth Observation Applications for Emergency Response and Disaster Risk Reduction" (SPEAR), UN-SPIDER and the Centre for Remote Sensing of Land Surfaces at the University of Bonn will work together to understand user needs, develop solutions and strengthen institutional capacities in using space-based information for disaster monitoring and prevention. SPEAR is supported by the Government of Germany and DLR.

Memorandum of understanding with the Space Generation Advisory Council

To work jointly in elevating the voices of young people in space policy, in line with the Secretary General's "Youth 2030 strategy". In 2019, UNOOSA and the Advisory Council delivered the first edition of the global Space4Youth Competition to engage youth in the discussion of how space science and technology can foster the SDGs (see the highlights of this report in chapter 2).

Memorandum of understanding with the Asteroid Foundation

To enhance understanding and deliver educational activities on asteroids and raise awareness of International Asteroid Day, which in 2016 was recognized at the highest levels by the General Assembly through the adoption of General Assembly resolution 71/90. This memorandum of understanding further supports the implementation of the General Assembly's call to raise global awareness about the asteroid impact hazard and to increase education and knowledge about asteroids and other celestial bodies.

Memorandum of understanding with the Ministry of Digital Development, Defence and Aerospace Industry of the Republic of Kazakhstan

To cooperate in the use of space-based information, space science, technology and applications for advancing the SDGs, the two parties will work together on the use of space-based information to support the full disaster management cycle. They will jointly support innovation in the space sector and work together on capacity-building activities, including through enhancing the skills of scientists, students and other specialists in the space sector, as well as facilitating their participation in common scientific research activities and projects.

Memorandum of understanding with the China National Space Administration on lunar and deep space exploration

On the occasion of the United Nations/China Forum on "Space Solutions: Realizing the SDGs", held in April in Changsha, China, UNOOSA and CNSA signed a memorandum of understanding to cooperate in extending to the international community the benefits of, and access to data from, the lunar and deep space exploration missions undertaken by China. In particular, the parties will work together to encourage countries to actively participate in such lunar and deep space missions and promote the development of technological capabilities and scientific progress in these fields at the global level, in line with the UNOOSA mission to bring the benefits of space to all of humankind.

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Memorandum of understanding with the Keldysh Institute of Applied Mathematics

The Keldysh Institute, part of the Russian Academy of Sciences, manages the International Scientific Optical Network (ISON). ISON is one of the largest observation systems in the world, with more than 50 telescopes in 20 observatories in different countries.

UNOOSA and the Keldysh Institute are working together on an announcement of opportunity for academic and research institutions in developing countries to receive small telescopes, as well as training in their operation. The opportunity will be part of the UNOOSA Access to Space 4 All initiative.

Selected institutions will benefit from the experience of the Keldysh Institute and the ISON network and have the chance to take part in global observation campaigns and contribute observation data to the Open Universe initiative. This aims to broaden, promote and facilitate the visibility, free accessibility and ease of utilization of astronomy and space science for everyone, everywhere. Acquiring a small telescope can help receiving institutions contribute to scientific progress and join international exchanges in the observation field.

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

The Centre for Space Science and Technology Education in Asia and the Pacific (CSSTEAP) is one of the Regional Centres for Space Science and Technology Education affiliated with the United Nations. Through this agreement, UNOOSA will continue to provide the Centre with expert advice and financial and technical support for its activities in advancing education in space-related fields in its region. In particular, UNOOSA will support the implementation of the nine-month postgraduate course on Remote Sensing and Geographic Information Systems. Memorandum of understanding with the Mohammed Bin Rashid Space Centre

The Mohammed Bin Rashid Space Centre (MBRSC) is a government organization working on the United Arab Emirates space programme. Through this memorandum of understanding, the parties will deepen their collaboration on promoting the peaceful uses of outer space and the long-term sustainability of outer space activities.

UNOOSA and the MBRSC share the belief that space science and technology and their applications provide indispensable tools for viable long-term solutions for development. The collaboration will help other countries build their capacity in space activities and leverage space for sustainable development.

Memorandum of understanding with the International Civil Aviation Organization The purpose of the memorandum of understanding is to facilitate collaboration and promote dialogue between the Office and the International Civil Aviation Organization, and with the broader aerospace community, in the fields of suborbital flights and commercial space transportation.

OTHER SPACE4SDGS ACTIVITIES

UNOOSA/United Nations Department of Economic and Social Affairs Forum on Science, Technology and Innovation side event on Space4SDGs

On 14 May, on the sidelines of the Forum on Science, Technology and Innovation for the SDGs (STI Forum) organized by the United Nations Department of Economic and Social Affairs, UNOOSA held a side event at United Nations Headquarters in New York on Space4SDGs, with the participation of LIU Zhenmin, Under-Secretary-General for Economic and Social Affairs. Participants discussed how international cooperation in innovation and capacity-building in space could support sustainable development.

COPUOS side event on space and disability – Inspiring Stars

On the sidelines of the sixty-second session of COPUOS, UNOOSA co-hosted, together with the International Astronomical Union (IAU), a side event to promote the equal participation of people with disabilities in outreach and teaching, as well as at the professional level, in the field of astronomy. The event featured statements by UNOOSA Director Simonetta Di Pippo and Advisor to IAU Piero Benvenuti, as well as a presentation on inclusive astronomy by IAU scientist Wanda Díaz Merced.

Parallel to the event, UNOOSA hosted an exhibition with interactive displays that help people with disabilities connect with astronomy. The exhibition, entitled Inspiring Stars, included tactile models of celestial bodies, books, posters and telescopes, as well as software that translates astronomical data into audio output.



IAU scientist Wanda Díaz Merced (far right) at the Inspiring Stars exhibition at the VIC. Credit: UNIS

United Nations/Austria Symposium on Space: A tool for Accessibility, Diplomacy and Cooperation

The Symposium was held in Graz, Austria, from 2 to 4 September and attracted 80 participants, including many from the Vienna-based diplomatic community. The 2019 edition celebrated the twenty-fifth anniversary of the first Symposium with the title "Enhancing Social, Economic and Environmental Security through Space Technology", marking a milestone in the cooperation between UNOOSA and Austria.

The Symposium fostered dialogue between the diplomatic community and users of space science and applications, on topics ranging from precision agriculture to space law and policy. It advanced knowledge on space-related activities and services as a tool for diplomacy and cooperation.

The Symposium was supported by: Joanneum Research Forschungsgesellschaft mbH; Graz University of Technology; Austrospace; City of Graz; State of Styria; Austrian Federal Ministry for Transport, Innovation and Technology; Austrian Federal Ministry Europe, Integration and Foreign Affairs; National Point of Contact Space Law Austria; ESA; and DLR.

R20 Austrian World Summit

In May, UNOOSA participated in the R20 Austrian World Summit, an event aimed at raising ambitions to combat climate change. The United Nations Champion for Space, retired NASA astronaut Scott Kelly, delivered a keynote presentation with UNOOSA Director Simonetta Di Pippo, highlighting the fragility of our planet and the importance of scaling up preservation and recovery efforts, especially through the innovative tools offered by space. Activist Greta Thunberg, former Governor of California Arnold Schwarzenegger and Austrian President Alexander Van der Bellen also participated in the event.



UNOOSA Director Simonetta Di Pippo and the United Nations Champion for Space Scott Kelly at the Austrian World Summit. Credit: Austrian World Summit

During his visit to Vienna, Mr. Kelly also participated in the celebrations of the fortieth anniversary of the United Nations presence in Vienna, held at the VIC in the presence of Secretary-General Antonio Guterres.

United Nations High-Level Political Forum on Sustainable Development

In July, UNOOSA participated in the HLPF, which focused on "Empowering people and ensuring inclusiveness and equality". On 16 July, under the general debate of the Economic and Social Council and HLPF, Austria delivered a statement on behalf of the UNOOSA Group of Friends, underlining the important role of space and of science, technology and innovation for the achievement of the SDGs and the commitment of the Group of Friends to supporting the work of the Office.

The Group of Friends was created in 2017 as an initiative of the Permanent Representatives of Austria and Zambia to the United Nations (New York) to raise awareness of the Office and its work.

Workshop on space technology for socioeconomic benefits: Ensuring inclusiveness through space-based applications and space exploration

The workshop was co-organized with IAF in Washington D.C., from 18 to 20 October, in conjunction with



A moment from the High-Level Political Forum. Credit: UNOOSA

the seventieth IAC. The event promoted exchanges on space science, technology, applications and exploration in support of economic, social and environmental development, with a focus on inclusiveness. It provided opportunities for emerging space nations to consider space as a contributor to inclusive growth, as a catalyst for empowering people and ensuring inclusiveness and equality.

The workshop was attended by 105 participants from 46 countries. Participants noted the need for renewed international cooperation, particularly to help developing countries access space, and promote the equal participation of women and girls in the sector and in science more widely.





Kazakhstan and the Caspian Sea as seen by Envisat. Credit: ESA

> The work of UNOOSA on space education, presented in this chapter, ranges from providing unique research opportunities on nano-satellite technologies to delivering training on space weather and GNSS to fostering education in space science and technology through its Regional Centres.

5 SPACE EDUCATION

5 | SPACE EDUCATION



UNOOSA works to increase access to education and research opportunities on space science and technology, in line with SDG 4 "Quality education". In this framework, we offer fellowships on space-related topics; provide advisory services to space agencies and research institutions in developing countries to expand their knowledge of space applications; organize international conferences and workshops on space applications; and provide online educational resources and directories of educational opportunities on space topics.

UNOOSA also regularly opens its doors to and engages with young people at its offices in Beijing, Bonn and Vienna, providing lectures and organizing visits and other activities on our work.

Selected educational initiatives and the latest news about them from 2019 are presented below.

A recent student visit to UNOOSA. Credit: Jaymes Regualos, English International School of Bratislava







Astronaut Luca Parmitano captured this image of the Kingdom of Bahrain from the International Space Station. Credit: ESA

REGIONAL CENTRES FOR SPACE SCIENCE AND TECHNOLOGY

In order to foster education and research on space science and technology, UNOOSA established the Regional Centres for Space Science and Technology Education, affiliated with the United Nations and hosted at existing research and higher education institutions around the world.

There are six centres so far, located in China, India, Jordan, Mexico/Brazil, Morocco and Nigeria. The aim of the Centres is to develop the skills and knowledge of university educators, scientists and government officials through rigorous theory, research, applications, field exercises and pilot projects in aspects of space science and technology that can contribute to sustainable development.

To ensure a common standard of teaching at the Centres, UNOOSA developed education curricula in all major fields of space applications, such as satellite meteorology and global climate, satellite communications, space and atmospheric science, remote sensing and geographic information systems, and GNSS. The curricula have been used at the Regional Centres and are available for other educational institutions and training initiatives across the world. The 2030 Agenda for Sustainable Development and the Sendai Framework promote opportunities to reduce disaster risk and build a resilient future for our planet. The Regional Centres actively contribute to these objectives by working with UN-SPIDER to foster the development of professionals skilled in space-based technologies for resilience.

More specifically, CSSTEAP, based in Dehradun, India, regularly provides experts for the technical advisory missions and capacity-building programmes organized by UN-SPIDER in Asia. In 2019, CSSTEAP participated in three such programmes in India, Myanmar and Nepal. The Centre also offers an annual two-week training course on the use of advanced space-based information in disaster risk reduction to develop local and regional capacities.

Similarly, RCSSTEAP, hosted by Beihang University of Beijing, organizes annual one-week training courses on space-based technologies for disaster management and emergency response. Since 2014, six such courses have been organized with the support of UN-SPIDER.

Finally, the regular activities of the Regional Centres, with postgraduate programmes including items related to the SDG framework in their curricula, contribute to promoting the importance of building resilience for our planet. The main activities conducted by the Regional Centres in 2019 are presented here.

Algerian Sahara. Credit: ESA



ARCSSTE-E, located in Ile-Ife, Nigeria, held nine-month postgraduate courses on remote sensing, GIS, satellite communications, GNSS and basic space science from January to September 2019. UNOOSA supported the attendance of six participants from five countries in the courses.



African Regional Centre for Space Science and Technology Education in French

CRASTE-LF, located in Rabat, held nine-month postgraduate courses on remote sensing and GIS, satellite meteorology and global climate and GNSS from September 2018 to June 2019. Thirteen students from eight countries attended these courses.



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

CSSTEAP, located in Dehradun, India, held the twenty-third Remote Sensing and GIS course from July 2018 to March 2019. The course was attended by 24 participants from 11 countries, including officials in disaster management agencies that have worked with UN-SPIDER in the past. UNOOSA funded a portion of their travel expenses and contributed to the content of the course.

Several of the professionals trained by CSSTEAP over the past 24 years are now working for their countries' Governments. Past participants have also helped introduce space technology in the curricula of local universities, helping to create a new generation skilled in their use.

The following courses are ongoing at the Centre:

- The twenty-fourth Remote Sensing and GIS course from July 2019 to March 2020 with 22 participants from 10 countries
- The twelfth Satellite
 Communication course from
 August 2019 to April 2020 with
 16 participants from 8 countries

 The third Global Navigation Satellite Systems course from August 2019 to April 2020 with 14 participants from 7 countries

Furthermore, CSSTEAP provided faculty support to UN-SPIDER for a one-week training programme on "Post Rapid Disaster Assessment of Natural Disasters" held in Myanmar from 11 to 15 March.

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

RCSSTEAP, hosted by Beihang University of Beijing, held three masters programmes (Satellite Communication and GNSS, Remote Sensing and Geo-Information System, Micro-satellite Technology) attended by 38 participants from 14 countries. It held one doctoral programme (Space Technology Applications) attended by 11 participants from eight countries, and four short training programmes attended by 128 participants from 33 countries. UNOOSA contributed to course content and recruited some of the participants for our internships. These courses help young people in China and beyond enhance their careers in the space sector.

RCSSTEAP also hosted an international training course on "Space-based Technologies for Disaster Risk Assessment", from 5 to 10 September, attended by 28 participants. This was co-organized by UN-SPIDER, APSCO and the National Disaster Reduction Centre of China.

Regional Centre for Space Science and Technology Education for Western Asia

Under the patronage of His Majesty King Abdullah II Ibn Al Hussein, the permanent location of the Regional Centre for Space Science and Technology Education for Western Asia in Amman was inaugurated in August by Awni Khasawneh, Director-General of the Centre. From its new home, the Centre will help provide more opportunities in space education for students and practitioners in the Western Asia region.

RESEARCH AND TRAINING OPPORTUNITIES

United Nations/Japan long-term fellowship programme for postgraduate study on nano-satellite technologies

In 2012, UNOOSA and the Government of Japan, in cooperation with the Kyushu Institute of Technology (Kyutech), established a fellowship programme on Nanosatellite Technologies (PNST) for nationals of developing countries or non-spacefaring nations. The programme provides selected masters and doctorate students with 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. This fellowship equips students with knowledge of space science and technology to help their countries access the space sector and its benefits.

The 2019 round of applications for the PNST closed in January 2020.

Training course on Global Navigation Satellite Systems

UNOOSA, in its capacity as the executive secretariat of ICG and its Providers' Forum, promotes the use of GNSS throughout its programme on GNSS applications and related capacity-building activities. As part of these activities, a number of GNSS workshops are delivered, such as this one.

The Centre for Spatial Information Science at the University of Tokyo, in cooperation with the ICG, organized this course to increase knowledge of GNSS applications in Asia and the Pacific. It was held from 14 to 18 January at the Geoinformatics Centre of the Asian Institute of Technology, with 95 participants from 21 countries. Lectures included: introduction to GNSS; general overview of signal processing in receiver performances; introduction to an open source programme for GNSS positioning (RTKLIB) and to a free mobile mapping app (SW Maps).

The Japanese archipelago. Credit: ESA





The Mekong Delta in Viet Nam. Credit: ESA

A view of Italy from space. Credit: ESA



Technical seminar on reference frames in practice

The seminar, attended by 43 participants from 22 countries, was held on 20 April in Hanoi, in conjunction with the International Federation of Surveyors (FIG) Working Week. It was organized in cooperation with the ICG Working Group D "Reference Frames and Timing" and the FIG Commission 5, "Building Information Modelling".

The seminar focused on reference frames, kinematics and dynamic datums. It emphasized that countries are increasingly building networks of continuously operating GNSS reference stations (CORS) that can make surveys more efficient. The Seminar looked at how information from CORS can be linked to global reference frames.

The International Space Weather Initiative Workshop

The workshop was held at the Abdus Salam International Centre for Theoretical Physics (ICTP) in Trieste, Italy, from 20 to 24 May. It was organized by ICTP, supported by UNOOSA and sponsored by ESA, the Scientific Committee on Solar Terrestrial Physics, Boston College, the United States Institute of Navigation and the ICG. The goals of the workshops were to raise awareness of the impact of space weather and to discuss methods for analysing space weather data. The workshop highlighted the potential and uses of GNSS for monitoring the activity of the ionosphere and the importance of promoting aggregation and standardization of such data across regions.

Workshop on Ionospheric Forecasting for Global Navigation Satellite System Operations in Developing Countries: Findings and challenges

Forty-five participants from 26 countries participated in this workshop, held in Trieste, Italy, from 27 to 31 May, in cooperation with the ICTP, the Institute for Scientific Research of Boston College and the ICG. The workshop introduced GNSS operations and the impact of the ionosphere on them. It concentrated on forecasting ionosphere conditions with a focus on total electron content, and its relevance for developing countries.



Lake Baikal in the Russian Federation. Credit: ESA

Building information and communication technologies and the environment: Geospatial technologies and remote sensing for monitoring the SDGs

UNOOSA funded the attendance of four participants from four developing countries at this workshop in Budapest from 22 to 26 July. It was organized by the In-Service Information and Communication Technologies Training for Environmental Professionals project in cooperation with United Nations entities and run under the organizational framework of the Central European University summer programme.

Budapest from space. Credit: ESA



Future Space Technologies and Experiments in Space: XV Summer School

UNOOSA funded three participants from three developing countries to attend the fifteenth Summer School "Future Space Technologies and Experiments in Space", organized by Samara University and the Volga Branch of the Russian Academy of Cosmonautics in Samara, Russian Federation, from 17 to 29 June.

ICG Workshop on Global Navigation Satellite System applications

This workshop, organized by the University of the South Pacific and supported by UNOOSA, was held in Suva, from 24 to 28 June 2019, with 96 specialists from 23 countries participating. The workshop aimed at reinforcing the exchange of information among countries and scaling up the region's capacities to leverage GNSS solutions; share information on the national, regional and global initiatives that could benefit the region; and enhance cross-fertilization among them.

The workshop underlined the importance of further understanding issues of GNSS signal protection and its vulnerabilities, the impact and detection of GNSS interference, and methods to protect GNSS signals and mitigate interference. Workshop on NeQuick Ionospheric Electron Density Model: Latest developments and new implementations

The workshop, attended by 34 participants from 17 countries, was organized by ICTP in cooperation with the ICG. It took place in Trieste, Italy, from 8 to 11 October. Participants learned about new developments of the NeQuick model for trans-ionospheric propagation applications, which can be used to study the impact of space weather on GNSS.





A view of the coast of Kenya and Somalia from space. Credit: NASA

Training course for African participants with the Italian Space Agency

UNOOSA funded participants drawn from the African space sector to travel to Malindi, Kenya as part of our collaboration to deliver a training course on remote sensing, space sciences and space policy organized by the Italian Space Agency in partnership with the Kenya Space Agency, from 9 to 13 December.





Algerian Sahara. Credit: ESA

> UNOOSA is the Secretariat of the Committee on the Peaceful Uses of Outer Space (COPUOS), the main global forum for countries to discuss the scientific and legal aspects of outer space activities. This chapter presents the work of UNOOSA towards advancing international cooperation in outer space and building capacity in international space law.

6 INTERNATIONAL COOPERATION IN OUTER SPACE

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UN-SPACE

The UN-Space poster designed for its thirty-ninth session. Credit: UNOOSA

The thirty-ninth UN-Space Meeting, organized by UNOOSA, was held in New York on 28 October: it considered opportunities for cooperation and the need for increased coordination.

A session of UN-Space also took place on 20 November during the World Space Forum, held in Vienna; participants shared information on how space applications and technology are used to support their work.

WHAT IS COPUOS?

COPUOS was set up as a permanent committee by the General Assembly in 1959 to address the exploration and use of outer space for the benefit of all humanity.

Owing to rapid advances in space science and technology, the space agenda is constantly evolving. Comprised of both well-established spacefaring nations and nations with emerging space programmes, the Committee provides a unique multilateral platform to monitor and discuss these developments. Its work is also supported by many permanent observer organizations.

As the benefits of space technologies become increasingly interconnected with everyday life on Earth, there is growing interest in, and value placed on, Committee membership. In fact, COPUOS is one of the fastest-growing committees in the United Nations system: it started with 18 Member States in 1959 and now includes 95 countries and 42 observer organizations.

In 2019, by decision of the General Assembly, the following new Member States were admitted: the Dominican Republic, Rwanda and Singapore. One new permanent observer was also admitted to the Committee: the Moon Village Association.



A moment from the sixty-second session of COPUOS. Credit: UNIS

As shown in the table below, the number of members has increased by more than five times since the inception of COPUOS. Together, the current 95 Member States represent 87 per cent of global population.



COPUOS membership* by World Bank income level				
High income	36			
Upper-middle income	32			
Lower-middle income	19			
Low income	8			
Total	95			

Growth in COPUOS membership over time by World Bank income level

* As of January 2020

Source: World Bank income classification as of December 2019

COPUOS members

Albania	China	Indonesia	Nicaragua	Singapore
Algeria	Colombia	Iran (Islamic Republic of)	Niger	Slovakia
Argentina	Costa Rica	Iraq	Nigeria	South Africa
Armenia	Cuba	Israel	Norway	Spain
Australia	Cyprus	Italy	Oman	Sri Lanka
Austria	Czechia	Japan	Pakistan	Sudan
Azerbaijan	Denmark	Jordan	Paraguay	Sweden
Bahrain	Dominican Republic	Kazakhstan	Peru	Switzerland
Belarus	Ecuador	Kenya	Philippines	Syrian Arab Republic
Belgium	Egypt	Lebanon	Poland	Thailand
Benin	El Salvador	Libya	Portugal	Tunisia
Bolivia (Plurinational State of)	Ethiopia	Luxembourg	Qatar	Turkey
Brazil	Finland	Malaysia	Republic of Korea	Ukraine
Bulgaria	France	Mauritius	Romania	United Arab Emirates
Burkina Faso	Germany	Mexico	Russian Federation	United Kingdom of Great Britain and Northern Ireland
Cameroon	Ghana	Mongolia	Rwanda	United States
Canada	Greece	Morocco	Saudi Arabia	Uruguay
Chad	Hungary	Netherlands	Senegal	Venezuela (Bolivarian Republic of)
Chile	India	New Zealand	Sierra Leone	Viet Nam

HIGHLIGHTS FROM COPUOS SESSIONS

Adoption of the voluntary guidelines on the long-term sustainability of outer space activities

In June 2019, the international community agreed to conduct space activities in ways that meet the needs of the present generation while preserving the outer space environment for future generations.

During its sixty-second session, COPUOS adopted a preamble and 21 guidelines for the long-term sustainability of outer space activities. The guidelines provide guidance on the policy and regulatory framework for space activities; safety of space operations; international cooperation, capacity-building and awareness; and scientific and technical research and development. The consensus reached at the Committee in 2019 is the result of more than eight years of work by a working group of the Scientific and Technical Subcommittee and of extensive multilateral efforts by experts from its Member States, with support provided by UNOOSA.

The Committee encouraged States and international intergovernmental organizations to voluntarily take measures to implement the guidelines. The Committee also agreed to continue work on this important topic, deciding to establish a new working group under the long-term sustainability agenda item of the Scientific and Technical Subcommittee.

The General Assembly further addressed this area of work in resolution 74/82, welcoming with appreciation the adoption by the Committee of the preamble and 21 guidelines for the long-term sustainability of outer space activities and the establishment of the new working group, and emphasizing that the Committee serves as the principal forum for continued institutionalized dialogue on issues related to the implementation and review of the guidelines.



Some of the participants at the end of the sixty-second session of COPUOS. Credit: Christopher Sto. Domingo, UNOOSA

Agenda item on space exploration and innovation considered for the first time at COPUOS sixty-second session

The Committee considered space exploration and innovation as the newest item on its agenda at its sixty-second session. Under the item, States shared information on, among other things: research and development activities; astronaut programmes; a space exploration innovation hub centre; the planned establishment of a Mars scientific city; activities in connection with ISS and CSS; the use of a satellite as a multiwavelength observatory; various missions to the Moon, Mars, Venus, Jupiter and asteroids; the planned Lunar Orbital Platform-Gateway; a new spacecraft with the potential to be utilized as a deep-space logistics carrier to the cis-lunar region; a dedicated solar mission with a focus on studying the inner solar corona; a tracker of electromagnetic counterparts of binary neutron star merger events; a mission to examine the atmospheric composition of exoplanets; and satellites launched for the purpose of deep space exploration.



A moment from the sixty-second session of COPUOS. Credit: UNIS

Fiftieth anniversary of the Moon landing

On the opening day of its sixty-second session, the Committee celebrated the fiftieth anniversary of the Apollo 11 mission with a panel discussion on the historic event and its significance for space exploration. The landmark mission placed humans on the surface of the Moon for the first time, inspiring all countries to pursue even more ambitious space endeavours. The related panel discussion, held for the benefit of members and observers of the Committee, considered, among other things, the future of space exploration.

Working Group on the Space 2030 Agenda

The working group that was established by COPUOS in 2018 continued to meet during the year to develop a Space 2030 Agenda and implementation plan. The Agenda is envisioned as a forward-looking strategy for reaffirming and strengthening the contribution of space activities and space tools to the achievement of the 2030 Agenda for Sustainable Development. It will be submitted to the General Assembly for consideration at its seventy-fifth session in 2020.





Some of the exhibitions at the VIC during COPUOS. Credit: UNOOSA

Space exhibitions at the Vienna International Centre during COPUOS

During the June session of COPUOS, UNOOSA hosted a series of spacerelated exhibitions in the Rotunda of the VIC. These included an exhibition on the legacy of Apollo 11 and the future of space exploration, organized by the Permanent Mission of the United States to international organizations in Vienna with the support of NASA; an exhibition on the history of Chinese navigation technology organized by the Chinese Satellite Navigation Office and the Permanent Mission of China to the international organizations in Vienna; an installation of planet models by Austrian artist Wolfgang Semmelrock; a selection of objects that help people with disabilities engage with astronomy and space science, the Inspiring Stars exhibition, organized by IAU; and a satellite launcher model by the aerospace company Avio S.p.a.

Highlights from the Legal and Scientific and Technical Subcommittees

Space resources

The 2019 session of the Legal Subcommittee (LSC) saw continued debate among Member States on potential legal models for activities in the exploration and utilization of space resources. It was advocated that such activities should be undertaken in conformity with international space law as a guiding principle, and that the establishment of a dedicated working group under the LSC would be useful to examine the issue in greater detail.

The Working Group on Space and Global Health

At its fifty-sixth session, the Scientific and Technical Subcommittee (STSC) convened the Working Group on Global Health for the first time. The Working Group, which held meetings and extensive informal consultations at the session, agreed on a workplan for the period 2019–2022, including working methods. The Working Group also agreed on a questionnaire on policies, experiences and practices in the use of space science and technology for global health. The questionnaire solicits information from Member States and international intergovernmental and nongovernmental organizations on timely topics such as telemedicine and tele-health; tele-epidemiology and environmental health; space life sciences; and disaster and health emergency management.

National activities reports

The STSC also saw a spike in the number of Member States reporting on their space activities through national activities reports. Nearly double the number of States provided written submissions in 2019 as compared with the previous year. These voluntary reports increase transparency and build confidence on space activities.

OTHER INTERNATIONAL COOPERATION ACTIVITIES

Committee on Space Research

In its capacity as Vice-Chair of the Committee on Space Research (COSPAR) Planetary Protection Panel, UNOOSA organized two sessions of the Panel in Vienna in January and December 2019. The Panel reviews planetary protection measures for planetary missions and guides the application of the international COSPAR Planetary Protection Policy and implementation guidelines. COSPAR maintains and promulgates the Policy as a reference for spacefaring nations, both as an international standard to avoid organic constituent and biological contamination in space exploration, and to provide guidelines in this area to ensure compliance with article IX of the Outer Space Treaty and other relevant international agreements.

United Nations/Turkey/Asia Pacific Space Cooperation Organization Conference on space law and policy

The conference was held in Istanbul, Turkey from 23 to 26 September 2019. It was co-organized by UNOOSA and the Government of Turkey, the TUBITAK Space Technologies Research Institute (TUBITAK UZAY), the Turkish Space Agency and APSCO. The Conference focused on policy and regulatory frameworks in support of space activities and national space programmes. Participants discussed topical issues such as global governance of outer space and best practices in sharing remote sensing data.



A moment from the United Nations/ Turkey/Asia Pacific Space Cooperation Organization Conference. Credit: UNOOSA


An image from the field trip to Wadi Rum that was part of the programme of the United Nations/Jordan Workshop. Credit: Tanya Keusen, UNOOSA

United Nations/Jordan Workshop

The United Nations/Jordan Workshop on Global Partnership in Space Exploration and Innovation was held in Amman in from 25 to 28 March. Hosted at the new premises of the Regional Centre for Space Science and Technology Education for Western Asia, affiliated with the United Nations, it was the first workshop co-organized by the Office devoted to the topic of space exploration and innovation. The workshop built upon the intergovernmental work previously undertaken by the COPUOS Action Team on Exploration and Innovation and included cross-sectoral capacitybuilding and strategic components. It also allowed the Office to further develop and support relationships in the Arab region. Support for the workshop was provided by the Arab Union for Astronomy and Space Sciences, the Inter-Islamic Network on Space Sciences and Technology, and the Royal Jordanian Geographic Centre.



Launch of Long March 7 Carrier Rocket. Credit CMSA

> 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 in light of the rapidly increasing number of launches globally. In 2019, 409 functional and non-functional objects were registered with the Secretary-General.



7 SPACE OBJECTS REGISTRATION

The last decade of space exploration has seen an unprecedented amount of activity in Earth orbit and beyond. Declining launch costs and advancing small satellite technology have made outer space more accessible, enabling an increasing number of Governments, private sector actors and academic institutions to conduct orbital missions. This profusion of space activity, especially in low Earth orbit, has raised concerns over safe space operations and has highlighted the increasing importance of transparency in activities conducted in outer space.

Since 1961, Member States of the United Nations have requested the Secretary-General to maintain a Register of Objects Launched into Outer Space, based on information provided by Governments. Originally voluntary, a mandatory registration mechanism was subsequently established in 1976 following the entry into force of the Convention on Registration of Objects Launched into Outer Space. States and organizations that agree to abide by the Convention are required to establish their own national registries and provide information on space objects to the Secretary-General for inclusion in the United Nations Register of Objects Launched into Outer Space.

This unique register, maintained by UNOOSA, is available on its website in the six United Nations official languages. The register is an important transparency and confidencebuilding mechanism among countries, as it identifies which State bears international responsibility and liability for each object. The Register also helps countries better understand what is happening in outer space, enabling more productive discussions through COPUOS, and raises global awareness on objects in space.

In 2019, COPUOS noted that "proper registration of space objects is a key factor in the safety and the long-term sustainability of space activities. Inadequate registration practices may have negative implications for ensuring the safety of space operations."



Earth seen from space by CMSA astronaut Jing Haipeng. Credit: CMSA



Who is responsible for a satellite in space?

Under article VI of what is considered the "Magna Carta of Outer Space", the 1967 Outer Space Treaty, the government of each State shall bear international responsibility for national activities in outer space whether such activities are carried out by governmental agencies or by non-governmental entities, such as private companies. Under the treaty, the activities of non-governmental entities are clearly cited as those that shall require authorization and continuing supervision by Governments.

In total, since 1957, over 80 States and international intergovernmental organizations have submitted registration information on around 7,900 satellites, lunar/planetary probes and landers, crewed spacecraft, uncrewed supply craft and space station flight elements (functional space objects).

In 2019 alone, 28 States and one international intergovernmental organization registered over 400 space objects with the Secretary-General in 70 submissions. This is 2.4 times the number of submissions received in 2009. In addition to established space nations submitting regular notifications on their space launches, new space nations such as Bhutan and Kenya – the latter through the UNOOSA Access to Space 4 All initiative – submitted information to the Secretary-General on their first satellites. In 2019, registrations were received from all populated continents (with the exception of Antarctica), underlining the rising importance of space all over the world. States also provided notifications on the re-entry of 145 previously registered functional space objects. At the time this report went to print, an additional 326 functional objects launched prior to 2020 had been registered with the Secretary-General.

As recommended in General Assembly resolution 62/101, States also informed the Secretary-General of the change of status (i.e., decommissioning of a satellite, deorbiting, change in geostationary position, change of ownership) of 25 functional space objects.

Technical advisory services on space object registration

As part of its responsibilities in discharging the Secretary-General's obligations under international space law, UNOOSA not only maintains the register but also provides technical advisory services on space object registration to States and international intergovernmental organizations. In 2019, UNOOSA provided these services to 32 States and intergovernmental organizations. UNOOSA also provides more comprehensive technical advisory services on space law under its "Space Law for New Space Actors" project (see p.6). As per the table below, in 2019, 357 functional space objects and 52 non-functional space objects, a total of 409, were registered with the Secretary-General.

Space object registration in 2019

State of registry	Functional	Non- functional	Re-entry	Change	Total
Argentina	1	0	0	0	
Australia	7	0	0	1	
Azerbaijan	1	0	0	0	
Belarus	1	0	0	0	
Belgium	0	0	19	0	
Bhutan	1	0	0	0	
China	88	0	0	0	
Colombia	1	0	0	0	
Denmark	1	0	0	0	
Egypt	1	0	0	0	
European Space Agency	4	0	0	1	
Finland	5	0	0	0	
France	2	11	4	7	
Germany	16	0	1	1	
India	13	7	1	0	
Indonesia	1	0	0	0	
Israel	1	0	0	0	
Japan	8	1	3	3	
Kenya	1	0	0	0	
Lithuania	2	0	0	0	
Mexico	1	0	0	1	
New Zealand	0	13	6	0	
Norway	0	0	0	5	
Poland	1	0	0	0	
Russian Federation	34	0	17	0	
South Africa	1	0	0	0	
United Arab Emirates	2	0	0	0	
United Kingdom	18	0	0	6	
United States	145	20	93	0	
Functional registered	357				
Non-functional registered		52			
Satellite re-entry notifications			144		
Change in status (decommissioning, GSO, orbit, owner)				25	
Total objects registered in 2019					409





Nazca K2, Peru. Credit ESA

> The following provides an overview of the UNOOSA budget, expenditure, voluntary contributions and staff numbers in 2019.



8 UNOOSA IN NUMBERS

Budget overview



Expenditure





Voluntary cash contributions – donors

Staff overview



Regular budget funded posts

Extra-budgetary funded posts

Non-reimbursable Ioans

Associate experts

Temporary/consultants/ contractors

LIST OF ABBREVIATIONS AND ACRONYMS

APSCO	Asia Pacific Space Cooperation Organization
CMSA	China Manned Space Agency
CNSA	China National Space Administration
COPUOS	Committee on the Peaceful Uses of Outer Space
CORS	Continuously operating GNSS reference stations
COSPAR	Committee on Space Research
CRASTE-LF	African Regional Centre for Space Science and Technology Education
CSS	China Space Station
CSSTEAP	Centre for Space Science and Technology Education in Asia and the Pacific
DLR	German Aerospace Centre
DropTES	Drop Tower Experiment Series
ESA	European Space Agency
ESSTI	Ethiopian Space Science and Technology Institute
ESTEC	European Space Research and Technology Centre
GNSS	Global Navigation Satellite System
HLPF	High-Level Political Forum
IAC	International Astronautical Congress
IAF	International Astronautical Federation
IAU	International Astronomical Union
ICG	International Committee on Global Navigation Satellite Systems
IGAC	Instituto Geografico Agustin Codazzi (Colombia)
ICTP	Abdus Salam International Centre for Theoretical Physics
ISON	International Scientific Optical Network
ISS	International Space Station
ISWI	International Space Weather Initiative
JAXA	Japanese Aerospace and Exploration Agency
Kyutech	Kyushu Institute of Technology (Japan)
LSC	Legal Subcommittee (of COPUOS)
MBRSC	Mohammed Bin Rashid Space Centre
MSWRR	Ministry of Social Welfare, Relief and Resettlement (Myanmar)
NADMO	National Disaster Management Organization (Ghana)
NASA	National Aeronautics and Space Administration (United States of America)
PDC	Planetary Defence Conference
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
RSOs	Regional support offices (of UN-SPIDER)

SDGs	Sustainable Development Goals
SGAC	Space Generation Advisory Council
SIDS	Small island developing States
SMPAG	Space Mission Planning Advisory Group
SPEAR	Spaceborne Earth Observation Applications for Emergency Response and Disaster Risk Reduction
SSC	Space Solution Compendium
SUPARCO	Pakistan Space and Upper Atmosphere Research Commission
UNDP	United Nations Development Programme
UNDRR	United Nations Office for Disaster Risk Reduction
VIC	Vienna International Centre
WMO	World Meteorological Organization

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THE UNITED NATIONS OFFICE FOR OUTER SPACE AFFAIRS (UNOOSA)

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