

# Space for the Great Reset

Outcome Report

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# INTRODUCTION

## THE SPACE FOR THE GREAT RESET SERIES

The past two years have seen a global health crisis unravel at a rapid speed, disrupting economies, societies and political processes worldwide. The pandemic has built momentum to re-think our future, identify ways forward and act on the priorities that will help us promote sustainability, equality and innovation. The Great Reset Initiative of the World Economic Forum<sup>1</sup> embraces this philosophy with the aim to advance shared goals and improve the state of the world.

Space technology is the driving force behind numerous services and products that have become indispensable in our daily life and even more during the pandemic. Earth Observation, Global Navigation Satellite Systems and satellite communications have played a key role in addressing the COVID-19 crisis, for example enabling us to work from home and track the impacts on our environment. All attempts to reset and shape a better future must embrace the value of space to ensure that we can build more resilient and sustainable economies with equal and inclusive societies. As the world builds back better, space continues to contribute both directly and indirectly to socio-economic development and help achieve the Sustainable Development Goals (SDG). This goes to the heart of UNOOSA's mission.

To further examine the crucial role that space science and technology play in the post-pandemic recovery, UNOOSA launched the virtual events series "Space for the Great Reset". Experts and representatives of the space sector were invited to share their insights on Economic Growth, Climate Action and Access to Space during the following events:

- 1. Space for the Great Reset: Boosting Sustainable Economic Growth for a Resilient COVID-19 Recovery (5 May 2021)** **p. 3**
- 2. Space for the Great Reset: Harnessing the Power of Space Technology for Climate Action (14 July 2021)** **p. 10**
- 3. Space for the Great Reset: Towards a fair, responsible and sustainable Access to Space (20 December 2021)** **p. 21**

This summary report captures the remarks and experiences shared during the Space for the Great Reset series of virtual events.

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<sup>1</sup> See: "[The Great Reset](#)", World Economic Forum, 2021.

# 1. Boosting Sustainable Economic Growth for a Resilient COVID-19 Recovery



The virtual event "Boosting Sustainable Economic Growth for a resilient COVID-19 recovery" was held on 5 May 2021 as a side event of the United Nations Multi-Stakeholder Forum on Science, Technology and Innovation for the SDGs (STI Forum). Experts shared their insights on the impact of the COVID-19 pandemic on the global economy, and the role that the space sector plays to foster sustainable economic growth in the recovery process.

## SPEAKERS

**Simonetta Di Pippo**, Director of UNOOSA

**Aarti Holla**, Secretary General of GSOA

**Nick Shave**, Chair of UKspace

**Abimbola Alale**, CEO of NIGCOMSAT

**Mohamed E. Al-Aseeri**, CEO of Bahrain National Space Science Agency

## OVERVIEW

The space economy is rapidly expanding as more and more governmental and commercial actors engage in space activities. The space industry is currently worth more than \$400 billion and analysts expect the global space industry to become a trillion-dollar industry by 2040<sup>2</sup>. Never before has there been so much interest and investments in the sector, with the *New Space* reaching its next giant leap.

As more businesses venture into the space industry and more applications of space technologies are developed, their footprint in the global economy is growing. Space-based infrastructure plays a vital role in supporting critical societal functions such as telecommunications, financial transaction, security and defense, energy, health, agriculture and climate to mention a few. Not only are highly qualified employment opportunities created, but a flourishing space economy attracts more investment, generates more research and development opportunities, and therefore directly contributes to the GDP and national economies.

The global COVID-19 pandemic adversely affected livelihoods, businesses and global economies across the world. The consequences of COVID-19 will have a long-term impact on economic processes, supply chains and business models. In the short- to medium-term, the outlook remains highly uncertain. Policymakers are looking into ways to sustain the recovery and transform economies by increasing resilience and harnessing new technologies, such as artificial intelligence, machine learning and big data.

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<sup>2</sup> ["The Space Report 2021 Q2"](#), Space Foundation, 2021.

As many sectors are struggling to recover, the pandemic shed a light to what extent the space industry has become backbone of modern economies. The growing need for real time data and connectivity during lockdowns revealed the importance of space-enabled services that made it possible e.g. for millions of people to work and learn from home and for governments to monitor mobility and provide emergency services - no matter how remote the location. Satellite navigation, communication, observation and technologies in general are more sought for than ever.

In this more digitized and online world, satellite applications are directly contributing to the Great Reset, the global post-pandemic recovery. The contributions of the space sector will be central in capacity-building, investment, entrepreneurship. This in turn will be driving innovation, create new markets, providing industrial capabilities, and opportunities whilst support a sustainable and resilient COVID-19 recovery, and therefore represents an effective pathway of inclusive action towards sustainable economic growth.

## PRESENTATIONS

### **Simonetta Di Pippo**

Director of UNOOSA

*Simonetta Di Pippo has been Director of the UN Office for Outer Space Affairs since 2014. Prior to joining UNOOSA, she served as Director of Human Spaceflight at the European Space Agency and as Director of the Observation of the Universe at the Italian National Space Agency. She has been an Academician of IAA and a member of WEF Global Future Council on Space Technologies since 2016 and its co-chair since 2020.*

Di Pippo opened the event with a stark reminder that the pandemic is not over and is continuing to take a toll on human lives. Yet, the international community needs to think of the way ahead and we are fortunate to have science and technology that enable us to better address the economic, social and health crisis. Calling it a “make-or-break moment”, she highlighted that the pandemic offers an opportunity to re-think our future and “be a better shepherd to planet Earth”. In this recovery process, space and therefore also science, technology and innovation play an important role. The ubiquity of space technology helped us in these challenging times, whether it is through telemedicine, remote working arrangements or monitoring the spread of the virus. There are many more thinkable applications and services to be developed for agriculture, security, climate action and energy, that will drive the progress towards a more sustainable world.

With the growing importance and size of the space industry, the impact on our economies and societies will multiply, predicted Di Pippo. Space drives innovation, provides highly-skilled jobs, creates new markets and industrial capabilities - all central factors for the post-pandemic recovery. She also underlined that there is a need to advocate for the importance of space-based data in order to be influential in policy-making process. The 54 Essential Climate Variables (ECV) provide the empirical evidence needed to understand and predict the evolution of climate, to guide mitigation and adaptation measures, to assess risks and enable attribution of climate events to underlying causes, and to underpin climate services.

More than half of the ECVs can only be monitored from space. Data has become key for economic growth if used in a certified and responsible manner.

Through a concerted, coordinated and multilateral effort, and with the right interplay of other breakthrough technologies, we can unlock its full potential for the benefit of everyone. Stakeholders have to come together to properly understand the need of the users, operators, public-private sector, providing the right data and advancing for the future.

All this will work in our favor, if we consider safety, security and sustainability as key factors in upcoming space activities. To ensure the sustainable use of space, Di Pippo said the involvement of more players, especially new ones, is central. UNOOSA's initiative "Space Law for New Space Actors" supports Member States, especially new players in starting their activities in the space arena with a responsible behavior. This multi-donor project helps them gain an understanding of the treaties, principles, guidelines, and also support them in developing their specific needs of their national space legislations. Regulatory framework is key in maintaining long-term sustainability, especially with commercial activities blooming, hence a prerequisite to enable a safe environment. The Committee on the Peaceful Uses of Outer Space (COPUOS) counts 95 members<sup>3</sup> out of the 193 Member States of the UN and there is a need for more members to join.

Finally, Di Pippo focused on the concept of resilience. Space technologies and space-based data are fundamental to build resilient societies and economies. By providing a well-defined picture of our planet, space supports tackling the most difficult challenges of our times such as the climate crisis. To achieve this, it is important to focus on STEM education and to work in an inclusive manner, providing access to space to everyone across the globe.

## **Aarti Holla-Maini**

Secretary General of Global Satellite Operator's Association (GSOA)

*Aarti Holla-Maini has been Secretary General of the GSOA since 2004. She is a Member of the World Economic Forum's Global Future Council on Space Technology, Global 5G Coalition Network and Essential Digital Infrastructure & Services Network. Since joining the association, Holla led the expansion of GSOA from a European association to one that represents the interests of 29 global and regional satellite operators. She previously worked at Aerospace/EADS in Germany and Belgium.*

During her remarks, Holla highlighted her work and the role of GSOA that represents 22 global and regional satellite operators. The association is currently driving international advocacy efforts for the satellite communications sector on multiple issues, from 5G, SDGs, including emergency communications and more.

She emphasized the relevance of the space sector in addressing today's global challenges and how the Great Reset is hugely underestimated and taken for granted. A key point was the need for continuing dialogues, so that policymakers can realize the value and take

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<sup>3</sup> 95 members as of May 2021. At the time of the publication, the number of members was 100.

decisive actions that will enable to have an impact on society, environment, and other aspects.

There are many examples of how the space sector has supported the COVID-19 recovery in terms of bringing more individuals online, providing connectivity by satellite broadband. Data traffic and new subscriptions rose by 70% globally. Additionally, satellite applications were used in new and innovative ways such as dedicated educational channels, as well as health and safety information. Space technology has been used to connect medical facilities from health centers and mobile clinics to testing facilities, which all proved critical in identifying infections, referrals, and exchange of information between central hospitals and monitoring sites.

Overall, satellite communication is bridging the gap between digital, education, health, and social divides across diverse geographies and economies. It ensured safety and security in times of crisis by enabling solutions powered by satellite based on revenue sharing models where everyone benefited from operators, retailers to users. Overall, the fact that “satellite signals are blind to man-made borders meant that they also do not discriminate between the rich and the poor”, Holla said. In terms of the general outlook, she highlighted that the pandemic has put a spotlight on the digital divide and there is a need to bring connectivity everywhere. “Satellite communications and the work of GSOA is at the heart of this debate”. Holla added.

Finally, there is a need for policymakers to take bold and pragmatic steps based on real user needs, so that connectivity can be brought to remote areas - sustainably, affordably and for the long-term.

## **Nick Shave**

Chair of UKspace

*Nick Shave is the Chair of UKspace, the trade association of the UK space industry. He previously served as the VP for Strategic Programs at Inmarsat and held a range of engineering, business development and managerial roles at leading organizations across Europe. In addition to his UKspace role, he serves as co-chair of the National Cyber Security Centre Space Information Exchange. He is a Fellow of the Royal Aeronautical Society where he is also a Council Member.*

During his remarks, Shave introduced UKspace, the industry trade association of the space sector in the United Kingdom, representing over 150 space companies from established players to new operators. He discussed how small satellites have been a strength of the United Kingdom since the early 1980s and the contributions that the sector can offer in terms of economic growth and building back better following the COVID-19 pandemic.

Shave highlighted three key elements that are crucial to ensure a thriving space sector:

1. An attractive regulatory environment that protects space activities (satellite operators, manufacturers, launch companies) and supportive legislations (launch licenses, protection of frequency spectrum satellite communication, navigation & application).
2. Access to finance - both private and public sector funding.



3. Viable mechanisms in place to connect space companies to other sectors, which in turn can generate an overall benefit for the economy.

According to Shave, in order to build back better, investments into new initiatives or programs that support the national strategic objectives are key. The British government is already assessing how it can develop a national program to enhance resilience of satellite navigation. It is considering an Earth Observation program to support both security applications and climate monitoring, and continued participation with space agencies and programs such as Copernicus.

Last, Shave presented the “LaunchUK” initiative that was created to address the growing market for small satellite launches. It eventually developed into five spaceports, a number of different launch companies (vertical and horizontal) and the prime ministerial commitment to launch the first satellite from the United Kingdom by 2022.

## **Abimbola Alale**

CEO of Nigerian Communication Satellite Limited (NIGCOMSAT)

*Abimbola Alale is MD and CEO of Nigerian Communications Satellite Limited (NIGCOMSAT). She holds a PhD from Nasarawa State University, Keffi-Nigeria, a Master’s degree in Space Studies and an MBA from the International Space University. Alale is a Fellow of the African Scientific Institute, Certified Forensic Investigation Professional, and a current Council Member of the 2021 World Economic Forum for Global Future Council on Space.*

During her remarks, Alale presented the work of the Nigerian Communication Satellite from the Ministry of Communications and Digital Economy that drives digitalization within Nigeria. She discussed the recent release of a “National Digital Economy” policy and strategy that puts Nigeria on the map of global digital countries.

Alale highlighted how space managed to support the COVID-19 recovery, what had actually worked, but also what could have been done better. During the peak of the pandemic, NIGCOMSAT provided satellite broadband services to the Nigerian Presidential task force on COVID-19. The task force was set up to provide daily reports, updates and precautionary measures. It supported the National Health Insurance team connecting remote areas, front liners, testing activities over 79 centers using satellite connectivity to support universal aid coverage. Other activities touched upon educational connectivity trainings that were provided to over 600 youths in remote areas. This enhanced job opportunities and enable communities to stay connected during the pandemic period. “Connectivity is currently the currency for communication”, Alale said. Out of this emergency situation, a newly skilled workforce becomes key for economic growth and to safeguard the future success of the next generation. She underlined that there are positive lessons learnt in terms how the crisis has enabled the space sector and the potential of space applications to be more recognized especially in Africa and in Nigeria.

Given the demonstration of the importance of the space sector, the local government has been supportive for another satellite and a new mission. Alale mentioned the importance for collaborators to increase partnerships and manage available resources, joint missions,

infrastructure sharing and delivering together in improving the global economy. Finally, cooperation and diplomacy are the way forward and UNOOSA has a key role to play in it.

## **Mohamed E. Al-Aseeri**

CEO of the Bahrain National Space Science Agency

*Mohamed Al-Aseeri is the CEO of the National Space Science Agency. He previously served as CEO for Bahrain Polytechnic, in the Higher Education Council, in the Ministry of Education and as Project Director of the King Hamad Library. He was Assistant Professor of Chemical Engineering at the University of Bahrain and represented the Kingdom of Bahrain in the GCC for the exploitation of atomic energy in the production of electricity and desalination.*

During his remarks, Al-Aseeri discussed the work of the Bahrain National Space Science Agency. He highlighted that during the pandemic, the overall number of projects had increased at national level which was a positive sign in terms of technology and science advancement. One example is the “BeAware” app that was developed for contact tracing and uses space technologies to retrieve location data. This same application has now been used to monitor the vaccination campaigns and promote public health information.

The Bahraini government strongly believes in the importance of space science and technology to achieve the SDGs, Al-Aseeri said. Several regional and international collaboration programs are in development such as the Earth Observation and Global Navigation Satellite System, which will support a variety of sectors in Bahrain and create sustainable economic growth. With regards to stimulating the national space economy and building back better, he mentioned the importance of national capacity-building and awareness programs to highlight the importance of the space sector in decision-making. There is also the need to create the appropriate regulatory framework to meet the requirements of investors and attract more investments into space technologies. Lastly, building strategic partnerships across the public and private sector is important to achieve the optimum benefit from space and science applications for the betterment of nations.

## **CONCLUSION**

In their contributions, the speakers highlighted the central role that space technology and space-derived applications have played during the pandemic. Whether it is through monitoring, location services or the provision of connectivity, satellites have helped in mitigating the consequences of the crisis. With the momentum created, the importance of space will be carried over into the post-pandemic era, where it will contribute to sustainable socio-economic growth in a more resilient, digitized and connected world. What all of the participants agreed on is that there will be more space. Future-oriented national economies that will harness the potential of new technology and become more digitalized will rely on space infrastructure and applications. However, unless governments create a regulatory framework which will promote investment and research and development activities, it will be hard for space economies to take off. Missing this chance will therefore also endanger the recovery process.



For now, the future looks very promising. The pandemic with its political, economic and social disruptions has fundamentally changed our traditional perspective, giving us time to re-think our societal priorities, business models, and most importantly economies. Space is uniquely placed to support life on Earth; and the Space for the Great Reset initiative does not only demonstrate that, but also concretely show how the global space sector can boost economic growth to support the COVID-19 recovery.

## 2. Harnessing the Power of Space Technology for Climate Action



This part of the report captures the remarks and experiences shared during the second event of the 'Space for the Great Reset' series. "*Space for Climate Action: space technologies as enabler for climate mitigation, adaptation and resilience*" was held on 14 July on the margins of the United Nations High-Level Political Forum, a central UN platform for follow-up and review of the 2030 Agenda for Sustainable Development and the SDGs. With the support of the Permanent Mission of Austria to the UN in New York, the event saw valuable contributions from representatives of space agencies across the globe.

The recording of the webinar is available online and can be viewed [here](#).

### SPEAKERS

**Simonetta Di Pippo**, Director of UNOOSA

**Kathy A. Hibbard**, Climate Scientist at NASA

**Masami Onoda**, Director of JAXA's Washington DC Office

**Carlos Roberto de Jesús Duarte Muñoz**, Coordinator of Human Capital Development at the Mexican Space Agency

**Clement Albergel**, Climate Applications Scientist at ESA

**Margit Mischkulnig**, Head of Department at the Austrian Ministry for Climate Action

### OVERVIEW

Climate change has serious impacts on the world's population, agriculture, water and food security, disaster risks, biodiversity, and much more. The importance of adaptation and mitigation to the fallout of climate change-related consequences is increasingly recognized worldwide, most prominently captured in the 2015 Paris Agreement. To meet this global challenge, it is imperative to use all available assets and develop new solutions.

Space based technologies play a crucial role in understanding climate change: more than half of the Essential Climate Variables (ECVs) defined by the Global Climate Observing System (GCOS) are derived from space observations, making space assets a key element in providing information and data that are real-time, global, uniform and consistent over years. Beyond their role in climate science, space-based infrastructure plays a significant role in climate action. They support science-based decision-making and enable the formulation of targeted policies tailored to achieve the target goals of the Paris Agreement.

The COVID-19 pandemic created momentum to turn around many practices and rethink the way we live and operate. As the world transitions into the post-pandemic recovery phase, it is imperative to maximize both the direct and indirect contributions that a strong space sector can make to tackle climate challenges and build back better. However, space assets remain widely underutilized and many applications for space-derived data are yet to

be explored. There is a lot of room to raise awareness, broaden the use case for space technologies and bring space to previously untapped opportunities.

The event looked at how space capabilities can support climate action and evidence-based decision-making, and how UNOOSA can provide a platform to create synergies in increasing the use of space technologies. This side event serves as a prequel to the World Space Forum 2021, which UNOOSA organizes jointly with the Austrian Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK) and the Austrian Federal Ministry for Europe, Integration and Foreign Affairs (BMEIA) from 6 to 9 December 2021 under the theme “Space4Climate Action”.

## PRESENTATIONS

### **Simonetta Di Pippo**

Director of UNOOSA

*Simonetta di Pippo has been Director of the UN Office for Outer Space Affairs since 2014. Prior to joining UNOOSA, she served as Director of Human Spaceflight at the European Space Agency and as Director of the Observation of the Universe at the Italian National Space Agency. She has been an Academician of IAA and a member of WEF Global Future Council on Space Technologies since 2016 and its co-chair since 2020.*

The post-pandemic recovery needs to prioritize policies that take into account climate challenges according to Di Pippo. Space technology and space-derived information are more relevant than ever to help expand climate knowledge, science and early warning, but they remain underutilized. The continuous, reliable and consistent collection of data supports addressing climate change by enabling mitigation, adaptation and resilience. It monitors not only live developments but also the effectiveness of adaptation strategies to support effective decision-making in developing the right policies.

The climate challenge is a global one and Di Pippo called for more solidarity, trust and multilateralism. There are many remarkable organizations and joint initiatives working on tackling climate change, from the World Meteorological Organization to the UN Framework Convention on Climate Change (UNFCCC) and the Global Climate Observing System (GCOS) program. Governments, organizations, businesses and the civil society are all engaged through this collective processes. Not to mention the programs and initiatives that ESA and NASA have launched and are developing, such as the Digital Twin Earth. These initiatives show that there are many efforts undertaken at different levels, but a lot of untapped opportunities remain.

Di Pippo mentioned that there are a lot of awareness-raising efforts to be undertaken to fully leverage the momentum. UNOOSA has been working to promote, strengthen and deliver targeted capacity-building and technical advisory activities, and is committed to facilitating multi-stakeholder collaboration and promoting efforts to encourage the use of space for climate action. The 2021 edition of the World Space Forum dedicated to “Space4Climate Action” is one of many initiatives that further explores this link and bring

together national and international actors to build an inclusive and effective path in the decade of action.

## **Kathy A. Hibbard**

Climate Scientist at NASA

*Kathy Hibbard is a Program Manager at NASA's Research and Analysis Program in the Earth Science Division at NASA's HQ. She received a PhD from Texas A&M University in Rangeland Ecology and Management, funded by NASA. She has experience in international coordination in earth system modelling and carbon cycle dynamics with the international Geosphere/Biosphere Program (IGBP).*

Opening her remarks, Hibbard started off by presenting NASA's Research and Analysis Program, which is a dedicated to understanding processes and consequences of, among others, climate weather natural hazards, climate change applications, and agricultural forecasting.

She further provided the audience a detailed overview of the Disaster Program and its applications. The goal of NASA's Disasters Program is "elevating the interconnected nature of technology, flight, research, data and applications to reduce risk and develop resilience to the impacts of disaster" using Earth System Observation to increase situational awareness, informed choices and support for decision-making, as well as develop sustainable resilience and support preparedness response and recovery. For these, NASA uses airborne (G-LiHT visible near/infrared imaging spectroscopy and thermal imagery) and satellite capabilities (global GPS array of satellites, receivers, ground stations). This allows them to quantify changes in elevations due to coastal erosion (e.g. impact on Southern Florida during Hurricane Irma in 2017), to measure changes in Earth's surface elevation to an accuracy of a few millimeters, and to track daily changes of transient water storage (e.g. inundation during Hurricane Harvey in Louisiana and Houston Area in 2017). All the data collected by G/LiHT and derived data products are available and freely accessible online. Additional satellites and machine learning outputs via NASA's CloudSat are used by the National Hurricane Center to monitor and forecast hurricanes.

Further projects included the use of satellites for the detection of sea surface salinity for which the SMAP surface moisture mission was deployed in the Amazon Orinoco River Plume after the passing of Hurricane Irma in 2017. Other products of the Disaster Program were posted online on the Disaster Portal and an ASP disaster support page: data collected from the ISS to monitor Hurricane Elsa; a new experimental SAR/satellite data web-map of flood impact; and a flood forecast map from the UMD Global Monitoring System (GFMS). Other activities as part of the Monitoring Global Risk pillar are the integration of local data and NASA data to provide downscaled assessments for understanding risks relative to local communities and their impacts. Additionally, with the Applied Remote Sensing Training Program (ARSET), NASA developed a set of webinars providing fundamentals about remote sensing for everyone regardless of the background knowledge with modules on water resource and land management.

Going forward, NASA will be expanding its mission in Earth Observation in line with the research priorities outlined in the Earth Science Decadal Survey 2017. Its Earth System Observatory will focus on five areas over the coming years: aerosols; cloud, convection and precipitation; mass change; surface biology and geology; and surface deformation and change. In its approach, NASA International Community Recommendations (as extracted from NASA's Draft Climate Strategy) prioritize data accessibility, stakeholder interaction, interagency activities, research and technology, and communication. The joint program planning group between ESA and NASA is one example; another one is the project jointly executed by NASA, ESA and JAXA on the Earth Observing Dashboard<sup>4</sup> that helped visualize the COVID-19 impact. To promote the use of satellite data information, NASA has offered online trainings for effective communication and challenges to reduce carbon footprints across different agencies and teams.

## **Masami Onoda**

Director of JAXA's Washington DC Office

*Masami Onoda was appointed Director of the JAXA Washington D.C. Office in July 2018. She previously served as Scientific and Technical Officer at the intergovernmental Group on Earth Observations (GEO) Secretariat and as a seconded officer at UNOOSA. She holds a PhD in Global Environmental Studies and a master's degree in Environmental Management from the Kyoto University Graduate School of Global Environmental Studies.*

Ever since the publication of the SDGs in 2015, Japan has been committed to their achievement, said Onoda. A strong mandate was established for this: the Japanese government established the SDGs Promotion Headquarters headed by the Prime Minister and consisting of all Ministers. Its SDG Action Plan 2021 includes a number of actions in relation to space and Earth Observation. Additionally, the Basic Plan for Space Policy sets forth contributions to achieving SDGs as one of the core targets of Japan's space activities.

Onoda presented an example for activities executed in support of SDG 13 (Climate Action) and 15 (Life on Land). The collaborative JICA-JAXA Forest Early Warning System in the Tropics (JJ-FAST) monitors tropical forests in 77 countries in e.g. Sub-Saharan Africa, Latin America and South-East Asia with updates every 1.5 months in open access. Its goal is promoting biodiversity conservation and climate change mitigation using multi-stakeholder partnerships. Another project is the Global Rainfall Watch System (GSMaP) that visualizes hourly global precipitation data using the dual frequency radar aboard JAXA's GPM Satellite. Open data sources like this can contribute to a broad area of application, Onoda highlighted, naming disaster management, education and public health as some prominent examples. The decade-long Global CO<sub>2</sub> Observation with the Greenhouse gases Observing Satellite (GOSAT) has been monitoring global CO<sub>2</sub> distribution since 2009. It has continuously provided CO<sub>2</sub> concentration changes for more than 11 years with a frequency of updates every three days. The data indicates that global and local CO<sub>2</sub> concentration is increasing year by year. A successor GOSAT 2 and another third satellite for this series are already in planning.

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<sup>4</sup> Earth Observing Dashboard (available at [eodashboard.org](http://eodashboard.org)), NASA/ESA/JAXA, 2022.

Space is also contributing to SDG 4 (Quality Education). To showcase this, Onoda presented KiboCUBE, a joint program between UNOOSA and JAXA. It promotes capacity-building by providing opportunities for developing and emerging countries to deploy CubeSats from the Kibo module of the ISS. Past deployments were Kenya (2018), Guatemala (2020) and Mauritius (2021). Further deployments are already planned with Indonesia, Moldova and SICA.

Still, the impact of space technology does not stop here; especially in these challenging times of the pandemic it offers opportunities for society to build back better, Onoda said. Space will drive these changes that are already visible now, especially in the fields of telemedicine, telework, remote control, GPS and telecommunication. Even indirect space contributions to the recovery will shape the post-pandemic world, such as the ISS that holds not only scientific, but also business opportunities, and eventually space transportation and space travel. The international response to COVID-19 saw a number of cooperative projects emerge. Here, Onoda mentions the Earth Observing Dashboard as well, which bundles data collected by ESA's, NASA's and JAXA's satellites to analyze changes in the global environment and socio-economic activities before and after the COVID-19 global pandemic, displaying over 150 indicators.

Onoda closed her remarks by underlining that climate change relates to all SDGs, which is why it is more important than ever to work together for this and leave no one behind.

## **Carlos Roberto de Jesús Duarte Muñoz**

General Coordinator of Human Capital Development at the Mexican Space Agency

*Carlos Roberto de Jesús Duarte Muñoz is the Coordinator of Human Capital Development in the space field at the Mexican Space Agency. He is in charge of developing education strategies for the next generation of space professionals in Mexico. He holds a master's degree in Scientific Instruments from the University of California, US, and a bachelor's degree in Mechanical Engineering from the National Autonomous University of Mexico.*

Under the title "Space Assets as Transformative Tools for Climate Action", Duarte presented the example of a project that the Mexican Space Agency has been developing, using space technology to manage droughts - MexiCorn. The goal is the implementation and validation of the Soil Water Deficit Index (SWDI) to infer drought conditions using satellite data through the development of a tool to monitor soil moisture over corn fields in agricultural regions in Mexico. This will help reduce the impact of climate change effects on corn yields through monitoring, early warning, vulnerability assessment and risk mitigation.

The interest in agricultural drought research and monitoring are increasing, drought being a major cause limiting agricultural productivity and crop yield. In this equation, Duarte says, soil moisture is the key variable to define the agricultural drought index. However, many areas are inaccessible to conduct in situ soil moisture observation. Satellite remote sensing enables us to obtain not only frequent but also global data on soil moisture that can be directly used to assess agricultural drought.

The data is provided by two satellites: the first one, SMOS (Soil and Moisture and Ocean Salinity), was launched in 2009 by ESA, with open and freely available data and visualization tools. The second one, SMAP (Soil and Moisture Active Passive), was launched in 2015 by NASA, but is not operational anymore. An issue here is that the data is not fine enough for agricultural application (~45 km). The project overcomes this by adapting the data set, i.e. downscaling. In order to be able to do so, field work was executed in Mexico (terrestrial hydrology experiments in Mexico over Agricultural areas - ThexMex) to calibrate the satellite data to downscale it to the size of actual corn fields. Duarte presents the work done in Humantla, where two areas of a size of 40 km<sup>2</sup> and 15 sites were measured. The data obtained covered different indicators, such as vegetation water content, soil moisture and precipitation. This data was correlated to the satellite data sets and indexes such as the normalized difference vegetation index (NDVI). A downscaling algorithm was then devised to calculate the soil moisture from satellite data at the desired scale, in this case 1 km and 3 km.

As a result of this work, the team found out that the use of the series of soil moisture (recorded from satellite or in situ) may be a suitable tool for the monitoring of agricultural drought. The calculated SWDI with data from the satellites revealed to be very similar to the field observations. With these findings and this data, Duarte added, the Mexican Space Agency is able to offer a number of products, such as monthly mapping of corn-growing areas and weekly mapping of soil moisture, in free access to users - from farmers to local authorities and federal government. Duarte gave an outlook on prospects that will take this project further: the calibration for other Latin American regions, the development of APIs and interactive visualization tools, and greater participation of private companies.

Duarte also took the opportunity of this occasion to reflect on how space technology can be used to adapt and mitigate the effects of climate change as extreme weather events progressively threaten populations across the globe. Satellite technology is an excellent alternative for drought monitoring, assessment and mitigation. In the long run, Duarte said, the objective is to promote water balance services. In order to achieve that, drought managing systems should be integrated to handle multiple parameters, not only water and soil, but also socio-economic indicators.

## **Clément Albergel**

Climate Applications Scientist at ESA

*Clément Albergel is a Climate Applications Scientist at the ESA Climate Office in Harwell Campus, UK. He holds a PhD in Land Service Modeling, Remote Sensing and Data Assimilation. Prior to joining ESA, he worked in the Research Department of the European Center for Medium-Range Weather Forecast and at the French Meteorological Service, leading the activities on land service analysis.*

For Albergel, space technology and climate action are "meant together". Climate change is a centennial challenge high on political and social agendas. However, in order to achieve the objectives set by the UNFCCC and the Paris Agreement, systematic observations of the climate system are required. Here, the role of space agencies for climate action is crucial. ESA dedicated itself to observation ever since the launch of its first weather satellite in 1977.



The launches of a wide range of satellites to better understand the complexities of the planet, providing different data and insights for various applications, from agriculture to maritime monitoring, have only further demonstrated the need for information from satellites that is growing, ESA is dedicated to developing cutting-edge technologies to further understand the planet, improve daily lives and improve policy-making for a more sustainable future. Albergel dived into two ESA initiatives to highlight how.

In 2010, ESA established its Climate Change Initiative (CCI), a coordinated research and development program. The CCI generates satellite-derived datasets for the 36 Essential Climate Variables, which benefit from space observations with several ones exclusively derived from Earth Observation. This data can be used to track the impact of climate change. Out of many examples, the most prominent one is the retreat of the Austrian Glacier Area, for which ESA has retrieved data over the period from 1969 to 2016 via Sentinel-2A, observing a reduction by more than 200 km<sup>2</sup>, which equals more than half the area of Vienna, Albergel stressed. ESA also supports activities in the framework of the Global Stockage of the UNFCCC Secretariat pooling information on emissions from different countries and creating a greenhouse gas inventory. For this, satellite information has been added as a consistency check. The RECCAP2 project evaluates the feasibility of producing regularly updated estimates of GHG balance (natural and anthropogenic) at country level. This would improve consistency between estimates of and promote dialogue among national inventory agencies.

Another initiative Albergel presented was in the field of development cooperation: within the framework of Earth Observation for Sustainable Development (EO4SD), ESA has been exploring the use of satellite-enabled Earth Observation in the operation of development assistance activity to consolidate requirements and engage via regional demonstrations of Earth Observation applications. Since 2018, the EO4SD Climate Resilience (CR) cluster supports climate-related decision-making through space-based information. For example, together with the International Fund for Agricultural Development (IFAD), a project is planned to monitor wetland and land degradation for restoration and rehabilitation plans in Lesotho, analyzing annual soil loss changes over the past 20 years and evaluating degradation due to climate variability. For this, the EO4SD CR cluster derived the soil loss rate due to erosion collecting data on rainfall, soil type, land cover and vegetation density as inputs for the Revised Universal Soil Loss Equation, to analyze annual soil erosion trends in different periods on a national scale. A monthly monitoring of wetlands, aggregated at sub-catchment level, facilitated the identification of hot spots. The impact and added value of the project was important: the products provided evidence related to soil erosion and wetlands condition that supports the prioritization of catchment and sub-catchment areas for landscape and wetlands restoration and rehabilitation

A different project with IFAD and the FAO was centered about assessing rangeland degradation due to climate change in Tajikistan and identifying climate vulnerable pastoral communities. This in turn would insert in the bigger picture, stimulating inclusive economic growth and reducing poverty in these rural communities by improving access to productive infrastructure and services that are expected to lead to sustainable agricultural products and equitable returns. The CR cluster provided Earth Observation on rangeland condition

changes over the period from 2000 to 2020 along with climate indicators over the degraded pastures, which enabled the assessment of climate change impact and soil erosion rates.

A more recent partnership exists with Future Earth to develop four demonstrator projects to be showcased during COP26. One is podcast demo, web-based visualization and analysis tool for climate-driven hotspots of cholera in the Indian ocean using AI to predict cholera outbreaks, using CCI datasets and clinical information for coastal communities and health authorities in the area.

Concluding his remarks, Albergel emphasized that ESA's role in the international response to the climate challenge is focused on research and development and pre-operational development activities required to support climate science. ESA also focuses on services with space based observational evidence they need to deliver actionable information for policy formulation, decision making and public communication.

## **Margit Mischkulnig**

Head of Department at the Austrian Ministry for Climate Action

*Margit Mischkulnig is Head of the Department for Space Affairs at the Austrian Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology. She previously served in different positions at the Ministry of Finance, the European Commission and the World Bank Group. Mischkulnig holds a master's degree in economics from the University of Vienna.*

In her remarks, Mischkulnig outlines the close partnership that the Austrian government has with UNOOSA on the promotion of space technology, in particular in Climate Action. The World Space Forum (WSF) is one result of the cooperation. The goal of the conference is for it to become a driver for dialogue between governments, international organizations, industry, academia and civil society to use the full potential of space technologies for achieving the 2030 Agenda.

"Climate change is here, everybody can feel it, everybody can see it", said Mischkulnig. Therefore, a holistic and broad approach is necessary within which space assets play an important role. In particular Earth Observation can provide significant contribution to the collection of the Essential Climate Variables that gives us a precise understanding of climate change and its drivers - critical information for policymakers. However, Mischkulnig noted that space technologies are underutilized. Space-derived data cannot only help in climate change mitigation (e.g. reduce emissions and pollution, enable precision farming, identify the best locations for solar and wind farms), but also in climate adaptation and resilience, (i.e. identification of areas at risk of flooding, early warning for natural disaster, critical communications infrastructure and impact assessment for first responders).

According to Mischkulnig, what is needed is a joint, cooperative and coordinated approach. Here, she highlighted the unique role that UNOOSA plays as capacity-builder, convener and gateway coordinating UN activities using space-related technology to support the Agenda 2030 including SDG 13. Because of the urgency, the 2021 edition of the WSF convenes under the overarching theme of "Climate Action".

At the end, Mischkulnig underlined that space activities are essential for climate resilience and there is further need of space to monitor, prepare and act. Additionally, it will be a monumental task to provide access and capacity-building opportunities to countries that cannot use space-based technologies yet. The Space4Climate Action Initiative to be presented at COPUOS supports space-based approaches to climate change it builds capacity to use space technologies in local contexts by including space technologies and applications in climate action projects; and brings together COPUOS Member States, space agencies, international organizations, companies and academic institutions to jointly tackle climate change mitigation, adaptation and resilience. For this, Mischkulnig is convinced that UNOOSA is the best body “to put words into action”.

## QUESTIONS AND ANSWERS

### **How do we move from the academic and research perspective to the entrepreneurial activities using space for climate action?**

**Kathy Hibbard:** It is difficult for NASA to go from providing information to decision-making; NASA is required to maintain a policy-neutral profile. This said, back in 2010 for instance, the [United States] Congress directed NASA to develop a prototype carbon monitoring system. It has evolved and became really successful. Congress does not provide money for this project anymore, but a request for a contribution of \$10m a year for this activity was placed. NASA has had very successful engagement with different stakeholders, not only from the United States, but also in Mexico and in Southeast Asia. For example, NASA engages with entrepreneurs that are trying to maintain their system, their economies and carbon systems. It is a small step, but there are activities that are feasible without compromising on the agency’s mission.

**Carlos Duarte:** Involving the private sector is very important in the efforts to adapt and mitigate climate change. One thing that can be done is to promote entrepreneurship among young graduate students. There are a lot of brilliant young people graduating all over the world who need to be encouraged to establish companies and startups. There is a lot of free data available. Education is key for this process.

**Clément Albergel:** It is a process that started to develop a decade ago with the Climate Change Initiative. It is really about science and bringing a data set to a professional level where it can be - if successful - taken by a climate service such as C2S, for example. And on the other side, there are initiatives like the EO4SD with the Climate Resilience cluster that is targeting private companies utilizing Earth Observation.

**Masami Onoda:** At JAXA, there is a whole department working on collaboration with the industry, including Earth Observation, and a number of startups JAXA supports by promoting investment. It is a global trend for space agencies.

**Margit Mischkulnig:** Space agencies and governments should use the business case of space activities to promote entrepreneurship. There is so much data available waiting to be

processed. And the establishment of new companies means that new sustainable jobs are created!

**Regarding Member States activities that can be part of UNOOSA's Space4Climate Action Initiative: what would be the core elements of the program? What could be the main features, the niche area and key features that would not duplicate efforts already undertaken by GEOS and CEOS, but be of added value?**

**Carlos Duarte:** It is important to start disseminating the tools and data that already exist. Especially in countries like Mexico there is a lot of ignorance about the availability of data. It would be important to start organizing educational workshops and share experiences among different actors, so they can explore all these tools and data and use them for climate action.

**Masami Onoda:** UNOOSA and COPUOS are the only place where all spacefaring and non-spacefaring nations get together and have a voice directly transmitted to the General Assembly. So, it would be very valuable for the initiative to be a bridge between the global community and the space community, a coordinator and a persistent voice of the value of space. It is also important to promote the real values and societal benefits of space activities.

**Clément Albergel:** More knowledge action and knowledge-transfer to the public is necessary. Initiatives such as the "Climate for Space" app are being developed, including a nice demonstrator tool.

**Kathy Hibbard:** The UN is a good agent to think about this. Education is key, bringing up our young researchers and students. Another possible way in the United States and beyond is the United States Global Change research program. There is a proposal going around about developing an advanced training module for the assessment cycle style of the Intergovernmental Panel on Climate Change (IPCC). USAID and [the Department of] State are engaged and want to focus on Latin America and the Caribbean. This opportunity can be brought to other agencies, which should increase their profile to make sure it is clear that space technology is necessary for addressing climate change.

**Margit Mischkulnig:** It is important not to duplicate; cooperation is needed. Education, capacity-building, promotion are important - so that everybody knows what space technology can bring to climate action. Involving only the space agencies is not enough. The private sector, NGOs, academia and society need to be involved. Opening the door and cooperating, providing capacity-building and technical assistance, building strong networks would be the main ideas for this initiative. It is important to act on climate together - this is the biggest target.

## CONCLUSION

The fruitful discussion on the power of space technology in tackling climate change highlighted the number of both small-scale and big-scale projects and applications that are already being implemented to drive climate action. The speakers presented ongoing joint

efforts for dashboards and applications in agriculture and development that find a concrete use case for space technology and the data collected by space assets. The global scale of the projects requires this collaborative approach.

In order to harness the full potential of space-based assets for climate action, the speakers agreed that in future, a focus on strengthening the use of space-derived data and broadening its application will bring the benefits to those who need it the most and are as of now not even aware of the use cases. Secondly, for a global challenge like climate change it will take greater international cooperation and cooperation to pool efforts and multiply the impact. “You can walk alone, but together you can walk further”, said speaker Margit Mischkulnig. This applies both to space agencies and public institutions, but the private sector needs to be brought to the table too.

What the exchange among the experts also highlighted is that space technology is a tool that addresses all the SDGs. UNOOSA is in an ideal position to promote the incorporation of satellite data in all UN agencies to support them in the monumental task of achieving the SDGs together.

### 3. Towards a fair, responsible and sustainable Access to Space



This section of the report captures the experiences shared during the third virtual event of the 'Space for the Great Reset' series held on 20 December 2021 on the topic of "*Towards a fair, responsible and sustainable Access to Space*". The speakers talked about their personal backgrounds and stories about how they benefitted from having access to space or how they provide access to space to others.

The recording of the webinar is available online and can be viewed [here](#).

#### SPEAKERS

**Simonetta Di Pippo**, Director of UNOOSA

**Mahlak Abdallah**, Winner of the 2021 UNOOSA/SGAC Space4Youth Competition

**Beatriz Garcia**, Astronomer and Coordinator of the International Comparative List of Astronomical Terms in Sign Language, International Astronomical Union

**Jorge del Rio Vera**, Scientific Affairs Officer, UNOOSA

**Susan Murabana Owen**, CEO and Co-founder of "The Traveling Telescope" and Space4Women Mentor

**Jose Eduardo Mendoza Torres**, Project Coordinator and Awardee of the UN/China Cooperation on the Utilization of the China Space Station

**Carlos Enrique Alvarado**, Project Coordinator and Awardee of the UN/Japan Cooperation Program on CubeSat Deployment from the ISS - KiboCUBE

#### OVERVIEW

Inequality is a key element that the Great Reset aims to address. For many years, space has been dominated by few players. Recent developments showed that space has become more accessible worldwide as more countries are involved in space activities, with over 80 national space programs now established around the world. The benefits of space must reach everybody, everywhere. As we look at increasing access to space, we aim to bridge the divide not only between nations, but also regions, communities and individuals, and contribute to the Great Reset's aim to build more inclusive and equal societies.

The last event of the series focused on how access to space can support the reduction of global inequalities. Since the obstacles are of different nature, forms and dimensions, the panel featured speakers from different backgrounds who shared their stories about how they promote and/or benefit from the access to space, and how this contributes reducing inequalities.

## PRESENTATIONS

### **Simonetta di Pippo**

Director of UNOOSA

*Simonetta di Pippo has been Director of the UN Office for Outer Space Affairs since 2014. Prior to joining UNOOSA, she served as Director of Human Spaceflight at the European Space Agency and as Director of the Observation of the Universe at the Italian National Space Agency. She has been an Academician of IAA and a member of WEF Global Future Council on Space Technologies since 2016 and its co-chair since 2020.*

In her introductory remarks, Di Pippo described the COVID-19 pandemic not only as a health and economic crisis, but a tragedy and sad story for inequalities; not all countries and communities have been impacted the same way, and experiences diverged greatly. Whether it is direct access to healthcare or technology, inequality is a multi-dimensional challenge that represents an impediment for progress at local, regional and global level. This also transcends to space, despite all of us looking up to the same sky at night. For instance, with a share of only 20-22%, women are underrepresented in the space industry. Likewise, people with disabilities are encountering considerable challenges to working in and with space. Not to mention the broader lack of access to space-related infrastructures and advantages in some countries.

UNOOSA is devoted to advancing SDG 10 (Reducing Inequalities). Its core mission is to provide access to space, capabilities, knowledge and expertise on space science and space technology and its application to everyone, everywhere. Through programs run under the auspices of the Access to Space for All initiative it has been able to achieve milestones: three UN Member States launched their first-ever satellites, and more are to come. With Space4Women, UNOOSA created a network of over 70 female mentors; Space4Youth amplifies the voices of the youth; and Space for People with Disabilities fully embraces the UN motto "Leave No One Behind".

Despite its vastness, Di Pippo is convinced that space has the vocation to reduce inequalities and help us build back better in the post-pandemic world.

### **Mahlak Abdallah**

Awardee of the 2021 edition of the UNOOSA Space4Youth essay competition

*Mahlak Abdallah is a student of Human Biology at the University of California in San Diego. Originally from Kuwait, she engaged in space science research early on: as a participant of the first local competition "Experiments in Space!" organized by Orbital Space together with DreamUp and Nanoracks, she had the opportunity to send her experiment "E.coli Consuming CO<sub>2</sub> to Combat Climate Change" to be implemented on the ISS. With her essay on "[Synthetic biology for climate change](#)", she won the 2021 edition of UNOOSA's Space 4 Youth essay competition.*

Mahlak Abdallah named the combination of technology, biology and space science as the reason for her personal interest in space activities. Her story begins in high school in Kuwait, where she participated at the first edition of a local competition by Orbital Space,



“Experiments in Space!”, which would send a scientific experiment designed by students to the International Space Station (ISS). Together with her team, she developed a research proposal implementing bacteria E. Coli for carbon-scrubbing technology used on the ISS. The winning project was flown to space and implemented by Shannon Walker in 2021. Abdallah was at the Kennedy Space Center to watch the launch herself, which impressed her even more. The experiment proved that E. Coli was actually able to sequester carbon dioxide in space.

As part of the next steps in taking the research forward, Abdallah submitted an essay to UNOOSA’s Space4Youth competition on the topic of “Climate Change Mitigation and Adaptation in Space”, exploring the application of the results of her experiment for Climate Action. Her central thesis was that E. Coli could be applied for reducing global warming by decreasing the carbon dioxide concentration in the air, whether at the ISS or regions with higher quantities of carbon dioxide. This way, she wanted to share to what extent one can benefit from the access to space, which is greater than she initially thought.

Abdallah stressed that she was fortunate to have been exposed to the opportunity and that getting the chance to send the probe to the ISS motivated her to pursue her interest in space further. She was surprised to have come across this opportunity in such a small country, but the recent developments of Kuwait’s space activities prove that there is a lot of potential in the space sector and that besides doubts, it is possible to make it. There are many local competitions out there that are especially devoted to youth.

## **Beatriz García**

Coordinator of the International Comparative List of Astronomical Terms in Sign Language at the International Astronomical Union (IAU)

*Beatriz García is an astronomer with the Instituto de Tecnologías en Detección y Astropartículas Mendoza in Argentina. A member of the IAU, she is chairing the working group on key initiatives in Education, Outreach and Development and co-chairing the working group on Astronomy for Equity and Inclusion. Furthermore, García coordinates the development of the International Comparative List of Astronomical Terms in Sign Language within the IAU.*

Beatriz García presented “Hands in the Stars”, a long-term project developed by the IAU’s Executive Working Group for Equity and Inclusion, devoted to make space more accessible for deaf people. The overarching idea is to include more people in science and technology by reducing barriers. This has been an ongoing effort at the IAU that has been funding the “Universal Encyclopedic Dictionary in Sign Language”. Dominique Proust proposed the first edition of a dictionary containing astronomical terms in sign language in French (“Les mains dans les étoiles - Dictionnaire encyclopédique d'astronomie pour la Langue des Signes Française”), and with the help of the IAU it was translated into English and Spanish. In a second step, it was important to develop a comparative list of astronomical terms. The first Comparative List of Astronomical Terms was released in 2017 and contained 47 terms in 31 languages, such as “Light”, “Sun” and “Eclipse”. García described that especially in the field of astronomy, the expression in sign language is “both rigorous and poetic”. The updated Second Comparative List, published in 2021, saw additional more complicated terms resurface. This advanced list contains signs for e.g. “black hole” and “space station”.

Despite many deaf artists and scientists, such as Annie Cannot, who established the stellar classification system, sign language has not been officially recognized as a common language in Europe until the end of the 20<sup>th</sup> century.

For García, the main takeaway is that the impact of the project is more than it initially seems: it is as useful to general audience as it is for the deaf community. Deafness is not a barrier to working in the space sector anymore. Everything can be expressed with hands now thanks to the universal dictionary that gives deaf people tools to do so. The experience in the design and implementation of the inter-disciplinary project demonstrated how far it contributed to the facilitation of cooperation and mutual learning among different stakeholders. García's message is that space is accessible for everyone - including the deaf community. The access to space reduces inequalities and supports building more inclusive and fairer societies.

## **Jorge del Rio Vera**

Scientific Affairs Officer at UNOOSA's Access to Space for All Initiative

*Jorge Del Rio Vera is a telecommunication engineer and holds a PhD in Earth Observation. He started his career in the Group of Physical Oceanography of the University of Malaga, where he went on a research stay at the NASA Goddard Space Flight Centre. After that, he joined ESA, working on Envisat and Copernicus. He has also worked for the NATO Underwater Research Centre, European Maritime Safety Agency, the European Global Navigation Satellite Systems Agency, until he joined UNOOSA as a scientific affairs officer, promoting international cooperation in the peaceful uses of outer space.*

The goal of the Space for All Initiative is in its name - provide opportunities to access facilities and research infrastructures to institutions all over the world that encounter difficulties in accessing them. The initiative targets countries that do not have experiences in space to develop space capabilities. It touches upon individual fates and Del Rio Vera highlighted how he witnesses first-hand its impact: the Office receives direct feedback from people that have accessed space via these opportunities, such as a letter that was received from Mauritius including a stamp picturing the first satellite that the country launched thanks to the Access to Space for All Initiative.

Del Rio Vera himself developed an interest for the outer space after watching the launch of the Space Shuttle. He recalled when, as a child, he wanted to become an astronaut and read magazines about space. In a way, he admits, he already had access to space in some way. As a student, Del Rio Vera went to a conference and presented a poster next to a NASA employee, who he got into a conversation with. One year later, this encounter enabled him to go to the United States to conduct research at NASA.

Today, there are more ways of accessing space, more learning opportunities and initiatives such as UNOOSA's Access to Space for All, but this is only one of many. As space becomes more important and relevant, Del Rio Vera hopes that more opportunities to access space will open up to spark the interest for space from an early age on.

## **Susan Murabana Owen**

CEO and Co-Founder of "The Traveling Telescope" and Space4Women Mentor

*Susan Murabana Owen is the co-founder and CEO of The Travelling Telescope, a social enterprise dedicated to promoting astronomy in Africa. Her organization introduces school kids to astronomy and STEM through mobile and planetarium-based educational programs across Africa. Murabana Owen has a degree in social sciences Economics and Sociology and in Astronomy. She is the President of the African Planetarium Society and serves on the board of the International Planetarium Society. She is also a UNOOSA Space4Women mentor.*

Originally from Kenya, where many people do not get the chance to look at the night sky up close, Susan Murabana Owen has been interested in astronomy ever since looking through a telescope. Telescopes have been developed 400 years ago, but many children dream of reaching the stars. Her first time looking through a telescope and seeing Saturn was a water-shed moment and changed her perspective. With "The Traveling Telescope", Susan wants to share this moment with schoolchildren and bring the stars closer to them by visiting different parts of the country and bringing a 12 inch-telescope with her. Another part of her work is promoting Kenya as an astrotourism destination, being close to the Equator and limited light pollution. The Star Safaris and other tours she organizes link astronomy to Kenyan traditional communities and sky knowledge, giving back to the country.

Education will bring the African continent forward, Owen said, but to get children first interested in science, you need to get them to dream about what they can be and what they can do. She believes that each child should have at least one lesson under the night sky.

Among the challenges that Owen encounters in her project work, there is of course the fact that the equipment is expensive. Telescopes are imported and difficult to repair and find replacement. To build a planetarium, the first permanent one in Kenya, Owen and her team sourced locally and used bamboo.

For everyone aspiring to join the space sector, Owen shared some advice: be patient and persistent. Owen started without much, but it's the longer-term picture that motivated her to inspire people to get into science through astronomy. And now, she is very moved when receiving letters from students and young professional that participated in her programs.

## **Jose Eduardo Mendoza Torres**

Project Coordinator of the winning team of the UN/China Cooperation on the Utilization of the China Space Station

*Jose Eduardo Mendoza Torres is a researcher in Astronomy at the National Institute of Astrophysics, Optics and Electronics (INAOE) in Mexico. He served as the project coordinator of the winning team of the 2019 UNOOSA Access to Space for All opportunity organized in cooperation with the Chinese Mannes Space Agency. The project "Mid-infrared platform for Earth observations" implemented jointly by the INAOE and the Benemérita Universidad Autónoma de Puebla (BUAP) was installed at the Chinese Space Station.*

After having engaged in a project on satellite subsystems, bringing together students of different institutions and ages for workshops, the participation in the opportunity was “a dream come true” for Eduardo Mendoza and his team. The CSS opportunity opened up new information for the study of the land temperature and allows Mendoza’s team to share the data with other researchers and reach more institutions in Mexico. The activities in the project are also a way to help students to improve their academic experience and contribute to raising the level of education overall.

Mendoza acknowledged that the present conditions in Mexico make it difficult to access space: there are few facilities for space technology and only few universities offer courses in this field. An OECD survey, however, showed that 41% of Mexican students want to be scientists because they like space science and technology, so that space can serve as a way to motivate students. To make it easier for them to learn concepts in Maths and Physics, Mendozatries to incorporate astronomy in homework. For example, he designed stickers and postcards that contain basic Maths concepts and represent a fun and interactive activity for children to learn by doing. One task was the estimation of the earth radius by measuring the shadow of a pole at the same day - a challenge several schools participated in and Mendoza fondly recalled how invested and interested the students were.

## **Carlos Enrique Alvarado**

Project Coordinator of the winning team of the UN/Japan Cooperation Program (KiboCUBE)

*Carlos Enrique Alvarado is the former President and founder of the Central American Association for Aeronautics and Space (ACAE), and Director General of the Costa Rican Society of Engineers and Architects (CFIA). A Costa Rican native, Alvarado holds a degree in Construction Engineering from the Costa Rica Institute of Technology and a masters degree in Public Policy from Harvard University. As a project coordinator, his team was selected as winners of the 5<sup>th</sup> round of the KiboCUBE program organized jointly by UNOOSA and JAXA in 2020.*

Back when Carlos Enrique Alvarado first got interested in space, two people motivated him: Sandra Kofman, a Costa Rican scientist, who is also a role model for young girls, the next generation of scientists; and Franklin Chang-Díaz, a Costa Rican mechanical engineer and former NASA astronaut. It was Chang-Díaz brother Ronald who proposed to Alvarado back in 2009 to develop the first Costa Rican and Central American satellite. For this, they founded the NGO “Central American Association for Aeronautics and Space” and worked together with different sectors and industries to build the capabilities to deliver the project. It seemed like a “crazy idea”, Alvarado said, because back then no one believed that his country could launch its own satellite. In 2018, the day came and the satellite was deployed from the ISS.

When he talked to a friend from Honduras, Alvarado realized that to succeed as a whole, the entire region needs to share and pool the knowledge. The joint participation in the KiboCUBE project with universities from Costa Rica, Honduras and Guatemala was an answer to this showing that inter-regional cooperation can lead to greater successes. The satellite will help tackle three regional challenges: it will provide an early-warning system for floods in remote regions; communication for emergency events like this; and as part of

an educational mission take pictures of different parts of the world and made accessible to the three participating universities.

## QUESTIONS AND ANSWERS

### **What concrete challenges do you experience in your daily work when trying to bring space to everyone?**

**Beatriz Garcia:** One of the challenges is to show that access to space is a challenge for everyone equally. The next generation needs to be reach earlier in school; currently, access to space is given quite late, young people need to reach university level at least. To change the world, the mindset needs to change. It is not only about inclusion of women or people with disabilities. The international community lives under the same sky and there is a need to show everyone that it is possible to access space, but also give people the tools and knowledge they need to get there.

**Susan Murabana Owen:** The obvious challenge is to access as many kids as possible in remote villages. Travelling there is difficult and requires funds. So many schools and children, especially those with visual impairments, are still left out or forgotten unfortunately. This poses the question of how everyone can get to have a look through the telescope and go to the planetarium. In addition to that, women are underrepresented in the space sector, so for me it is important to reach out and support girls. The formalization of the Kenyan Space Agency helps in this regard, as it represents a concrete and reachable goal. This gives me hope that things will be better for the future generations in Kenya.

### **What helped or would have helped you to access space sooner or more easily?**

**Carlos Alvarado:** What helped me enter the space sector was the international collaborations network, my participation at congresses at the International Astronomical Union, and information that UNOOSA shares, not to mention having role models. We need to leverage this and create more opportunities and mentorship. It is a global challenge that needs a global response.

### **Are there any particular instruments that we can leverage to bring individuals and communities closer to space?**

**Eduardo Mendoza:** The main problem is that the leaders of the world do not cater enough to underserved communities, in particular girls. If they get provided more opportunities to get involved, more ideas will be generated. In Mexico, girls that live in the mountains are untapped potential and can become scientists and surgeons, only if given the opportunity. A central part of our project is involving students from different levels. The instrument should be sharing experiences like these.

### **What advice would you like to share with somebody who would like to enter the space sector?**

**Jorge del Rio Vera:** The advice is to try! This sounds simple, but it is not. I found myself presenting my poster next to a NASA employee. If I didn't talk to that person that day, I would be a different person now. Approach the people that might help you! Nowadays, it just takes one second to write an e-mail to people and projects, and there are social

networks. Another advice is: access the regional networks. Without doubt, there are people in your country that went the same path or might be working on a relevant project.

**Mahlak Abdullah:** My first advice would be: go for it and do it! Come up with a game plan to approach it, find what you are interested in, and develop a project proposal and how it might have an impact on a local or global level. Keep your eyes open for local opportunities, companies that are offering internships or institutions that are organizing challenges.

## CONCLUSION

The webinar highlighted different backgrounds, pathways and sectors that young and well-established space professionals accessed - and help other to do so as well.

There are three main takeaways from the webinar:

### **1. Working in space does not necessarily mean becoming an astronaut.**

The space industry covers many different disciplines, from engineering to sciences, law and business management. There are numerous opportunities to engage in space-related projects - even on earth. As space activities increase and new use cases for space technology and applications emerge, more positions will open, whether in the public or private sector, on a local, national or international level. No matter the disabilities, gender or age - there is space for everyone.

### **2. There is not "the one right way" into the space sector.**

The variety of opportunities to get involved in space was reflected by the unique stories of our speakers. Whether it is by starting off through the participation in local competitions, the involvement in related projects or the study of space sciences - there are many paths to consider when debuting a career in space. Networking (e.g. at events and conferences), associations and organizations (e.g. UNOOSA, SGAC) and mentors (e.g. teachers, professors), can help find new opportunities and define the next steps.

### **3. It is important to get young students and children involved in space early on.**

Kids develop their interests quite early in their lives. Space can inspire a whole new generation of space professionals, teaching them the importance of STEM and help them formulate personal and professional aspirations. Drawing young girls into science and technology will furthermore contribute to a more inclusive and diverse sector. This can be achieved by promoting role models (e.g. astronauts, astronomers) or have them engage in space activities early on via initiatives such as "The Traveling Telescope".

For the future, expanding international cooperation and networks can further leverage the knowledge and technology to allow more people, especially underserved communities, to access space. Bringing the benefits of space to everyone helps drive sustainable and inclusive socio-economic growth, but it will take a joint effort and cross-sector partnerships to have an impact and reduce inequalities. Here, UNOOSA, as a facilitator and convener, is ideally placed to bring stakeholders together and promote space activities and technologies, for a more equal, sustainable and inclusive post-pandemic world.

# GENERAL CONCLUSIONS

The crisis has affected the lives of the international community. It is not over, yet, but as the world prepares for a post-pandemic era, countries can use this momentum to determine a road to recovery that will bring a more inclusive, prosperous and sustainable future.

The Space for the Great Reset event series provided a deep dive into three dimensions of the recovery process, highlighting the concrete role space can play in it. It is thanks to insights from speakers from all over the world, representatives from different sectors, ages, countries and backgrounds, experts and young professionals, that this series can produce the following conclusions as outlooks on the further development:

- 1. Space can spur economic growth through its numerous applications, use cases and services, ranging from broadband connectivity to Earth Observation.**
- 2. Space-derived data enables evidence-based climate action by providing real-time information for decision-making and forecasting.**
- 3. Broadening the access to space will bring new ideas and a skilled workforce in the expanding space sector, reducing inequalities worldwide.**

Space technology ensured safety and security at times of crisis with political, economic and social disruptions. As we look towards the future, the space sector will continue to contribute to the recovery process by introducing advanced technology, digitalization and automation in many traditional and new sectors such as transport, healthcare, tourism, energy, security, education and more. These can take the form of environmentally sustainable solutions for mobility, telemedicine services, application of artificial intelligence in data analysis, remote learning solutions and more. Space holds a lot of promises and untapped potential. Still, in order for space to effectively support the recovery, a number of factors will need to be addressed regarding the resilience, sustainability, inclusiveness and innovation of the infrastructure that has become so central in the running of our lives, economies and efforts to tackle climate change.

Countries can build back better. For this, space technology and international cooperation have to go hand in hand to support a sustainable and resilient COVID-19 recovery. Space will help achieve this and the SDGs as a cross-disciplinary, ubiquitous and promising stage for innovative ideas, solutions and inspiration.



## ACKNOWLEDGEMENTS

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Moving forward, UNOOSA will continue to host webinars regrouping representatives from space agencies, businesses and public institutions, and facilitate the dialogue on the contribution of space to inclusive and sustainable socio-economic development. For initiatives funded entirely by voluntary contributions, donor support is crucial to realizing this vision. Should you be interested in contributing to this work, please get in touch with Veronica Cesco at [veronica.cesco@un.org](mailto:veronica.cesco@un.org).