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Sixty-fifth session
Vienna, 1–10 June 2022
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Use of space technology in the United Nations system

Special report of the Inter-Agency Meeting on Outer Space Activities on coordination of space-related activities within the United Nations system for climate action

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Space for climate action

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I. Introduction

1. The Inter-Agency Meeting on Outer Space Activities (UN-Space) was established in the mid-1970s with the aim of promoting synergies and avoiding duplication of efforts related to the use of space technology and applications in the work of United Nations entities. In its resolution 76/76, the General Assembly urged UN-Space, under the leadership of the Office for Outer Space Affairs of the Secretariat to continue to examine how space science and technology and their applications could contribute to the 2030 Agenda for Sustainable Development, and encouraged entities of the United Nations system to participate, as appropriate, in UN-Space coordination efforts.

2. In its special reports, UN-Space addresses a wide range of themes. These include new and emerging technologies, applications and initiatives for space related inter agency cooperation (A/AC.105/843); space benefits for Africa: contribution of the United Nations system (A/AC.105/941); the use of space technology within the United Nations system to address climate change issues (A/AC.105/991); space for agriculture development and food security (A/AC.105/1042); space for global health (A/AC.105/1091); and the role of the United Nations in supporting Member States in the implementation of transparency and confidence building measures in outer space activities (A/AC.105/1116); space weather (A/AC.105/1146); and Partnerships (see A/AC.105/1200).

3. At its sixty-fourth session held from 25 August to 3 September 2021, the Committee on the Peaceful Uses of Outer Space noted that the next report on the coordination of space-related activities within the United Nations system could focus on the use of space technologies to support climate action, mapping existing activities in the United Nations system, the mandates of the respective bodies, and identifying possible future synergies and avoiding duplication, and that the Office for Outer Space Affairs would bring this to the attention of UN-Space for the development of such a report.

4. At its fortieth session, held in online format on 14 December 2021, UN-Space agreed that the focus of the present report should be on the use of space technologies to support climate action.

5. The present report was compiled on the basis of submissions from the following United Nations entities: International Telecommunications Union (ITU), United Nations Commission for Africa (UNECA), United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), United Nations Economic and Social Commission for Western Asia (ESCWA), United Nations Office on Drugs and Crimes (UNODC), United Nations Office of Legal Affairs, Office for Outer Space Affairs of the Secretariat, and United Nations Satellite Centre (UNOSAT) of UNITAR.

II. Background

6. The Sustainable Development Goal 13 is about climate action and is one of 17 Sustainable Development Goals (SDGs), designed to be a "blueprint to achieve a better and more sustainable future for all". The official mission statement of this goal is to "Take urgent action to combat climate change and its impacts".

7. Targets under the Goal 13 are the following:

Target 13.1. Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries

Target 13.2. Integrate climate change measures into national policies, strategies and planning

Target 13.3. Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning

Target 13.a. Implement the commitment undertaken by developed-country parties to the United Nations Framework Convention on Climate Change to a goal of mobilizing jointly $100 billion annually by 2020 from all sources to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation and fully operationalize the Green Climate Fund through its capitalization as soon as possible

Target 13.b. Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States, including focusing on women, youth and local and marginalized communities

8. At the United Nations climate change conference in Paris, COP 21, governments agreed that mobilizing stronger and more ambitious climate action is urgently required to achieve the goals of the Paris Agreement. The Paris Agreement formally acknowledges the urgent need to scale up the global response to climate change, which supports even greater ambition from governments.

9. In 2021, States adopted the Glasgow Climate Pact, aiming to turn the 2020s into a decade of climate action and support. The package of decisions consists of a range of agreed items, including strengthened efforts to build resilience to climate change, to curb greenhouse gas emissions and to provide the necessary finance for both.

10. Climate change is the most significant challenge to achieving sustainable development, and it threatens long-term prosperity of humanity. Serious impacts of climate change include sea-level rise, shifts in growing seasons and increasing frequency and intensity of extreme weather events such as storms, floods and droughts.

11. In the context of climate change, space science, technology and applications offer solutions to monitor processes and trends at the global scale. Satellites, as part of the global array of networks of systems to monitor climate change, now provide a vital and important means of bringing observations of the climate system together for

a global perspective. Satellites contribute to the monitoring of carbon emissions, the changing of ice in polar caps and glaciers, and temperature changes.

12. The present report provides an overview of the existing activities in the United Nations system undertaken with the use of space technology, as well as the mandates of the respective bodies, with the view of identifying possible future synergies in the area of climate action.

III. Overview of space-related activities within the United Nations system for climate action

Climate change in the context of the United Nations Framework Convention on Climate Change

13. The United Nations Framework Convention on Climate Change (UNFCCC) provides the global framework within which countries cooperate to address climate change. The important milestones in the United Nations climate change negotiations include the adoption of the Convention, the Kyoto Protocol, the Paris Agreement, and the Glasgow Climate Pact.

14. The ultimate objective of these instruments is to stabilize greenhouse gas concentrations in the atmosphere at a level that will prevent dangerous human interference with the climate system, in a time frame which allows ecosystems to adapt naturally and enables sustainable development. Raising ambition to address climate change by urgently reducing greenhouse gas emissions, building resilience to the unavoidable impacts of climate change based on the best available science and ensuring climate financing are critical domains of emphasis in the area of climate change.

15. Focusing in its early years largely on facilitating the intergovernmental climate change negotiations, the UNFCCC secretariat today supports a complex architecture of bodies that serve to advance the implementation of the Convention, the Kyoto Protocol and the Paris Agreement. The secretariat works with countries to build technical expertise and capacity, develop national climate change strategies for mitigation and adaptation, facilitate access to finance, share knowledge and technology, support the reporting and review of information for transparency, and operate the mechanisms of the Kyoto Protocol. The secretariat provides legal oversight for the implementation of the Convention, the Kyoto Protocol and the Paris Agreement, and supports policymaking in the context of these legal instruments. It also creates a space for thousands of stakeholders and coalitions to dialogue and draw on wide-ranging expertise to design cutting-edge climate solutions.

Assessing the status of global climate observations of the atmosphere, land and ocean

16. The Global Climate Observing System (GCOS) was established in 1992 to ensure that the observations and information needed to address climate-related issues are obtained and made available to all potential users. It is co-sponsored by the World Meteorological Organization (WMO), the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization (IOC-UNESCO), the United Nations Environment Programme (UN Environment), and the International Science Council (ISC). It regularly assesses the status of global climate observations of the atmosphere, land and ocean and produces guidance for its improvement.

17. GCOS expert panels maintain definitions of Essential Climate Variables (ECVs) which are required to systematically observe Earth`s changing climate. The observations supported by GCOS contribute to solving challenges in climate research and also underpin climate services and adaptation measures. As the impacts of a

warming climate become more evident, there is an ever-increasing demand for more detailed information on climate change, both to explain and project changes and to help planning and implementing adaptation and mitigation.

18. GCOS regularly reviews the state of global climate observations and releases reports on its findings. GCOS Status reports are followed by an Implementation Plan that outlines the improvements that are needed in the global system

19. The GCOS Status Report 2021 recognized that since 2015, satellite observations had improved, allowing near-global coverage of many variables and providing open access to the data. There also have been many enhancements to archiving and online access to the observations and derived information, as well as to the surface-based observations of individual ECVs across the atmospheric, ocean and terrestrial domains, with new technologies and approaches being developed, especially in the oceans. According to the report, there are four main areas still needing improvements: ensuring the sustainability of observations, addressing of gaps in the system, ensuring permanent, free and unrestricted access to the observations, and increasing support for policies driven by the Paris Agreement.

Providing weather and climate observations, products and services

20. Through the network of national meteorological and hydrological services, WMO plays an important role in weather and climate observation and monitoring, understanding of climate processes, the development of clear, precise and user-targeted information and predictions, and the provision of sector-specific climate services, including advice, tools and expertise, to meet the needs of adaptation strategies and decision-making.

21. The WMO global observing system has grown substantially since 1961, and now includes constellations of operational satellites in geostationary and low-Earth orbit, and of research and development satellites. The WMO Integrated Global Observing System (WIGOS) is one of WMO's top priorities as the new overarching framework for all WMO observing systems. Current global challenges demand a significant worldwide upgrade of space- and surface-based observations and predictions. In response, WIGOS provides a new, integrated approach incorporating the most recent scientific and technical advances.

22. The WIGOS framework promotes network integration and partnership outreach and engages the regional and national actors essential for successful integration of these systems. These national and international WIGOS partnerships allow WMO Members to: build observing capabilities; achieve better national, regional and global coverage; and improve economic efficiency. WIGOS is enhancing the understanding of the Earth System by supporting improved weather and climate products and services, and providing significantly more, improved observations. High priority is given to assisting WMO Members with development and implementation of national WIGOS plans, with special emphasis on the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States where the needs are the highest.

23. The WMO State of the Global Climate 2021 report highlights impacts on food security and population displacement, harming crucial ecosystems and undermining progress towards the Sustainable Development Goals; and provides a snapshot of climate indicators such as greenhouse gas concentrations, temperatures, extreme weather, sea level, ocean warming and ocean acidification, glacier retreat and ice melt, as well as socioeconomic impacts. The past seven years are on track to be the seven warmest on record, according to the provisional. Global sea level rise accelerated since 2013 to a new high in 2021, with continued ocean warming and ocean acidification.

The ocean-climate nexus and the place of ocean observation in climate change action

24. The ocean is being severely impacted by the effects of climate change. The ocean is warming at increasing rates, density stratification and deoxygenation are occurring, and carbon dioxide absorption is leading to ocean acidification. Global mean sea-level is rising and extreme weather events becoming more frequent. The composition and abundance of marine species is being affected, as are marine and coastal ecosystems. The ocean is also critical in providing opportunities to mitigate and adapt to the impacts of climate change.

25. The data derived from ocean observation tools is essential to understanding climate change. Ocean observation tools include both in situ and remote instrumentation, the latter including space-based satellite instrumentation which collects a variety of data on ocean-related variables, including ocean surface temperature and salinity, sea surface height and sea-level, ice coverage, winds, and ocean colour. Such data contributes to monitoring climate change and to adaptation responses, including forecasting of extreme events and related early warning systems.

26. The Division for Ocean Affairs and the Law of the Sea of the United Nations Office of Legal Affairs (the Division) discharges the functions of the Secretary-General, other than treaty depository functions, under the United Nations Convention on the Law of the Sea, which provides the framework for, inter alia, the protection and preservation of the marine environment, the conduct of marine scientific research in the different maritime zones, and for the development and transfer of marine technology.

27. The Division also supports several General Assembly processes that have undertaken activities related to ocean observation, including from the use of space technology, for climate action. In particular, the United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea (ICP) was established by the General Assembly in 1999 in order to facilitate its annual review of developments in ocean affairs and the law of the sea, with an emphasis on identifying areas where coordination and cooperation at the intergovernmental and inter-agency levels should be enhanced (A/RES/54/33). The forthcoming twenty-second meeting of the ICP, to be held from 6 to 10 June 2022, will be dedicated to the theme “Ocean observing”. The discussion panels will consider, among other things, the contributions of ocean observation, from both in situ and satellite technology, to science-based decision-making, including with respect to climate change, as well as how ocean observing and related challenges may be advanced through international cooperation and coordination. Relevant documentation, including a report of the Secretary-General is available on the Division’s website. Other meetings of the ICP in recent years have also considered issues related to climate change.

28. The Regular Process for Global Reporting and Assessment of the State of the Marine Environment, including Socioeconomic Aspects is an intergovernmental process established by the General Assembly which undertakes a regular assessment of the state of the oceans globally, informed by hundreds of scientists worldwide. The First and Second World Ocean Assessments were released in 2016 and 2021 respectively, with the third cycle now underway. The Assessments consider, among other matters, the impact of climate change on the oceans, using knowledge generated from, among other tools, satellite observations. They provide an important scientific basis for policymaking.

29. It is also relevant to mention the upcoming United Nations Ocean Conference, to be held in Lisbon from 27 June to 1 July 2022. The Conference will bring together stakeholders to advance science-based innovative solutions to the threats facing the ocean, under the overarching theme “Scaling up Ocean Action Based on Science and innovation for the Implementation of Goals 14: Stocktaking, Partnerships and Solutions”. Particular consideration will be given to issues relating to climate change and the ocean and to increasing scientific knowledge and developing research

capacity and transfer of marine technology. Miguel de Serpa Soares, Under-Secretary-General for Legal Affairs and United Nations Legal Counsel, serves as Special Adviser to the Presidents of the Ocean Conference on the ocean and legal matters.

30. The Division also acts as the focal point for UN-Oceans, the inter-agency mechanism that seeks to enhance the coordination, coherence and effectiveness of competent organizations of the United Nations system and the International Seabed Authority on matters within their mandates relating to ocean and coastal areas. Areas of cooperation have included matters relating to ocean science. Members are, for instance, represented on the Decade Advisory Board, which provides advice on the implementation of the United Nations Decade of Ocean Science for Sustainable Development (2021–2030), which offers a historic opportunity to stimulate new partnerships and mobilize resources for transformative ocean science solutions for sustainable development.

Early warning and monitoring of agricultural droughts and floods

31. Climate change threatens the ability to ensure global food security, eradicate poverty and achieve sustainable development. It has both direct and indirect effects on agricultural productivity including changing rainfall patterns, drought, flooding and the geographical redistribution of pests and diseases. The vast amounts of CO_2 absorbed by the oceans causes acidification, influencing the health of oceans and those whose livelihoods and nutrition depend on them.

32. FAO is supporting countries to both mitigate and adapt to the effects of climate change through a wide range of research based and practical programmes and projects. For early warning and monitoring of agricultural droughts, FAO developed the Agricultural Stress Index System (ASIS), which uses satellite-based remote sensing data to detect agricultural areas with a high likelihood of water stress.

33. FAO leads the Global Framework on Water Scarcity in Agriculture to support knowledge exchange and collective action in order to improve adaptation to climate change and water scarcity including through drought management and water-harvesting for agriculture. A key area of FAO's work to enhance resilience is to support efficient water management in irrigation to optimize soil water retention and plant uptake, water harvesting for household and societal use, and efficient water distribution among water users.

34. The FAO Portal entitled Water Productivity through Open access of Remotely sensed derived data (WaPOR) monitors and reports on agriculture water productivity for Africa and the Near East. It is a vital new tool to address water scarcity and adapt to changing weather patterns.

Ensuring food security in climate change

35. To help vulnerable countries and communities, WFP is supporting analysis which highlights the links between food security and climate risks, as well as the present and future impacts of climate change on food security and nutrition. This helps governments identify which communities are most at risk and integrates food security considerations into national policy and planning. The remote-sensing data are used in WFP for seasonal drought monitoring prediction, climate analysis, crop type mapping, land cover change, hot spots analysis, impact of conflict on agriculture, population movements, damage camp assessments dynamics, informal settlements, impact of asset-building.

36. A climate risk monitoring system, called PRISM, provides access to the latest available climate hazard information alongside vulnerability data through an intuitive, map-based dashboard. PRISM combines information from satellites and other remote sensing sources with WFP data on vulnerability to create actionable

climate information for decision makers, allowing them to prioritize assistance to those most in need.

37. PRISM is designed to improve utilization of the wealth of data available but not fully accessible to decision makers particularly in low and middle income countries. This is especially true of Earth Observation data which typically requires specialized skills and technology infrastructure to make it useful for practitioners. PRISM is open-source software which has been developed by WFP since 2016 but with a major technology overhaul in 2020. Though the project is led by WFP, as open-source software it is open for collaboration and use by anyone.

38. PRISM aims to empower governments with data and information on climate risk to support risk-informed decision-making. The platform provides tools to understand where to direct resources to reach populations most in need of protection and assistance. PRISM brings together national disaster management organizations, national hydro-meteorological services and key line ministries such as agriculture, health, and social welfare to collectively monitor risks, prioritize responses and inform programmes and policies. Increasingly, WFP has focused on deploying PRISM in cooperation with national weather/meteorological offices to monitor climate risk, and to share data from ground observations as well as value-added weather and climate information to users of climate and weather data across government agencies and the broader public.

39. PRISM mitigates the impact of climate-driven hazards by presenting decision makers with the most up to date risk and impact analytics available. This information feeds into a number of programme areas including climate risk monitoring and climate-informed decision-making in the agriculture sector, disaster preparedness, disaster response, disaster recovery, and adaptive social protection – also referred to as shock-responsive social protection.

Building resilience to climate change

40. The resilience of communities depends on an interplay of data and information, technologies and policy developments. Space assets are crucial for evidence-based decision-making, tailored and targeted policies and reinforcing the full disaster management cycle. The Office for Outer Space Affairs, through the United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER), helps developing countries find, access and use space-based information to confront the challenges of climate change, including in the context of loss and damage, as well as early warning, to map the impact of meteorological hazards including tropical storms, floods, and droughts; and to map the impacts of hydrometeorological hazards and some of their cascading effects.

41. These step-by-step procedures or recommended practices, developed by UN-SPIDER Regional Support Offices in Brazil, Germany, the Islamic Republic of Iran, Mexico, Pakistan and Ukraine, focus on flood hazard mapping,[1] mapping the extent of floods using open software tools like the ESA software SNAP, Google Earth Engine and commercial software; mapping the comparative impacts of droughts on vegetation through the combined use of archived and up-to-date composite products from the MODIS sensors; and mapping debris flows such as those triggered by intense rainfall.[2] These products are usually developed and provided by UN-SPIDER's partners and Regional Support Offices (RSO) and are published on UN-SPIDER's website or "Knowledge Portal".

42. UN-SPIDER is encouraging the use of these Recommended Practices in drought early warning systems in Africa, Asia, Latin America and the Caribbean. Specific

[1] https://www.un-spider.org/advisory-support/recommended-practices/recommended-practice-flood-hazard-assessment.

[2] https://www.un-spider.org/advisory-support/recommended-practices/recommended-practice-mudslides-and-associated-flood.

efforts have been carried out in recent years in the case of the Central American Drought Corridor, where UN-SPIDER joined forces with FAO, UNCCD, the International Centre for Research on the El Niño Phenomenon, and regional organizations such as the Central American Agricultural Council and the Central American Coordination Centre for Natural Disaster Prevention, as well as the Regional Support Offices in Colombia and Mexico. This project targeted Central American countries and the Dominican Republic.[3]

43. At the end of 2021, UN-SPIDER joined forces with several international and national partners including national disaster management agencies, space agencies and other institutions from Ghana, Guatemala, Mexico, Nigeria, Peru, and South Africa to incorporate the combined use of data and information from the Global Flood Awareness System of the Copernicus Programme and data on impacts of historic floods to improve flood early warning systems through the incorporation of impact-based forecasts.[4]

Reducing emissions from deforestation and forest degradation

44. FAO, the United Nations Development Programme and the United Nations Environment Programme established a collaborative partnership known as the United Nations Programme on Reducing Emissions from Deforestation and Forest Degradation, and the conservation and enhancement of forest carbon stocks (UN-REDD) in 2008 to support countries wishing to participate in reducing emissions from deforestation and forest degradation.

45. The Programme supports partner countries in strengthening and innovating their National Forest Monitoring Systems, constructing Forest Reference Emission Levels, improving governance and advancing national policy and institutional systems to safeguard forests and mitigate climate change. More than thirty governments have now been able to submit critical baseline data on forest carbon stores and forest-related greenhouse gas emissions to the United Nations Framework Convention on Climate Change. Together, those countries account for 1.4 billion hectares of forest – 36 per cent of the planet's forest area. These data are an essential basis for developing countries to tailor their REDD+ actions and contribute to the fight against climate change by halting deforestation and forest degradation under the UNFCCC's REDD+ scheme.

46. Technical expertise and support from FAO, provided through UNREDD, has helped countries identify drivers of deforestation and forest degradation, while making significant advances in modernizing forest monitoring. FAO support for new technologies, satellite data and open-source software allows countries to collect an unprecedented wealth of data on forests and generate detailed maps, statistics and studies on forest-use that were not previously possible.

Recognizing climate change as the biggest health threat facing humanity

47. Climate change is impacting human lives and health in a variety of ways. It threatens the essential ingredients of good health – clean air, safe drinking water, nutritious food supply and safe shelter – and has the potential to undermine decades of progress in global health.

48. Between 2030 and 2050, climate change is expected to cause approximately 250,000 additional deaths per year from malnutrition, malaria, diarrhoea and heat stress alone. The direct damage costs to health are estimated to be between US$ 2–4 billion per year by 2030. Areas with weak health infrastructure – mostly in

[3] https://www.un-spider.org/projects/SEWS-D-project-caribbean).
[4] https://www.un-spider.org/projects/flood%20GUIDE.

developing countries – will be the least able to cope without assistance to prepare and respond.

49. Climate change may lead to death and illness from increasingly frequent extreme weather events, such as heatwaves, storms and floods, the disruption of food systems, increases in zoonoses and food-, water- and vector-borne diseases, and mental health issues. Furthermore, climate change is undermining many of the social determinants for good health, such as livelihoods, equality and access to health care and social support structures. These climate-sensitive health risks are disproportionately felt by the most vulnerable and disadvantaged, including women, children, ethnic minorities, poor communities, migrants or displaced persons, older populations, and those with underlying health conditions.

50. Although it is unequivocal that climate change affects human health, it remains challenging to accurately estimate the scale and impact of many climate-sensitive health risks. However, scientific advances progressively allow us to attribute an increase in morbidity and mortality to human-induced warming, and more accurately determine the risks and scale of these health threats.

51. In 2022, the Department of Data and Analytics within the Division of Data, Analytics and Delivery for Impact of WHO has established the WHO GIS Centre for Health (GIS Centre) to support various programmes within WHO and its Member States in the areas of geographic information systems and mapping. By expanding its collaboration with partners, the WHO GIS Centre for Health aims to bridge inequalities within and across the Member States and connect remote sensing imagery, maps, apps, data and people to deliver measurable impact in communities. The health sector can benefit from leveraging innovations in GIS technology both during emergency and non-emergency settings to make informed public health decisions faster and to respond to an outbreak, map cases over local geographies, track vaccine delivery, collect samples, and explore spatial patterns in areas of case reporting, among other uses.

Providing technical and advisory support in Africa

52. The Economic Commission for Africa (ECA) is currently providing technical and advisory support to the Digital Earth Africa Programme, an initiative to develop a series of data structures and tools that organize and enable the analysis of large Earth observation satellite data collections over Africa. Digital Earth Africa continuously synthesizes satellite images collected over the last 30 years (taken every two weeks at 25-meter squared resolution), and current images (taken every 5 days at 10-meter squared resolution) for the entire African continent. It provides these images and derived products freely in a platform that can be accessed by any user and will deliver a unique capability to process. The programme is implemented through a network of distributed nodes of technical institutions empowered to develop analysis-ready data, products and services in the areas of climate change, water resources and flood risks, agriculture and food security, land degradation and coastal erosion, urbanization, etc.

53. ECA is equally partnering synergistically with the African Union to ECA in the implementation of the Global Monitoring for Environment and Security and Africa (GMES & Africa) Programme which aims at supporting African organizations, policymakers and practitioners, to make more effective use of Earth Observation data to develop relevant operational information services to support sustainable management of natural resources and tackling climate change. Technically, GMES & Africa use, reuse and adapt the European Copernicus Programme data and services to the African context. The Programme is rolled-out through 13 consortia of technical institutions working to strengthen local capacities, institutional, human and technical resources for access to and exploitation of EO-based services on operational basis. At this stage, the programme is specifically designed to develop Earth observation data,

information products and services on natural resources, water, marine and coastal areas, environment and climate change in relevant African institutions.

54. ECA has carried out a study analysis aimed at mitigating the impact of the COVID-19 crisis on deforestation in the Congo Basin. The spatial data used for the analysis is derived from Earth Observation datasets and other ancillary information. making it possible to link spatial decision-support efforts with other planning efforts. Through the study, it was possible to develop an analytical framework (suitability) using spatial decision-support system from available data covering the Congo Basin Forest for environment and natural resource analysis and forecasting within the context of COVID-19. The suitability geospatial analysis exercise allows participating countries to determine and prioritize the various sectors for investment within the post-COVID recovery period. The spatial data used for the analysis (including real time data such as Sentinel-2 imagery and weather data) are combined to develop a geoportal that displays the spatial patterns of key thematic features: logging, agriculture, mining, afforestation, infrastructure and utilities, roads, urbanization etc.

Implementing the Asia-Pacific Plan of Action on Space Applications for Sustainable Development (2018–2030)

55. Led by ESCAP, the Asia Pacific Risk and Resilience Portal utilizes satellite data and imagery to examine multi-hazard risk hotspots and vulnerabilities caused due to climate change. For different climate scenarios [Representative Concentration Pathways (RCPs), 4.5 and 8.5], the Portal provides an estimation of economic costs due to cascading hazards, relative to global costs and as a percentage of the gross domestic product (GDP) for each country in the region. To strengthen capacity, build resilience, determine implementation gaps and provide solutions for the achievement of the disaster-related Sustainable Development Goals, the Portal also provides adaptation costs and recommends key adaptation measures.

56. In line with ESCAP's Regional Roadmap for Implementing the 2030 Agenda for Sustainable Development in Asia and the Pacific, the Asia-Pacific Plan of Action on Space Applications for Sustainable Development (2018–2030)[5] is a blueprint that harnesses geospatial and space applications and digital innovations for countries to achieve the Sustainable Development Goals. It includes 188 actions contained within six thematic areas, including climate change. The actions for climate change focus on innovative geospatial information for climate studies and scenario development, which includes impact and vulnerability mapping, that are implemented through various programmes.

57. The ESCAP secretariat collaborates with its member States and other partners to enhance the capacity of developing countries by using geospatial information integrated with sectoral metadata. For example, greenhouse gas concentrations are measured through meteorological and Earth observation data using space applications for climate modelling and scenario development. Countries have access to the archives of Earth observation data, to in-situ measurements, and to other products derived from space data, for effectively mapping floods, monitoring droughts and wildfires, plotting air pollution or measuring the amount of plastic waste in rivers.

Building capacities to address climate change in Western Asia

58. The Economic Commission for Western Asia uses space technologies to help inform policymaking through highlighting natural resources challenges in the Arab

[5] United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), "Asia-Pacific Plan of Action on Space Applications for Sustainable Development (2018–2030)". Available at https://www.unescap.org/resources/asia-pacific-plan-action-space-applications-sustainable-development-2018-2030.

Region under a changing climate. In the ESCWA Development Report 9: Groundwater in the Arab region, an integrated data approach was used to monitor the change in groundwater storage over time. The Gravity Recovery and Climate Experiment (GRACE) mission data was used to monitor Groundwater storage dynamics in the region. The Climate Hazards Group InfraRed Precipitation with Station (CHIRPS) was used to collect precipitation data, while the Moderate Resolution Imaging Spectroradiometer (MODIS) was used to capture the spatiotemporal changes of vegetation dynamics and their relationships with climate extremes across different climate zones in the region. This integrated approach improves the certainty of work by relating precipitation change to groundwater storage change and to change in vegetation.

59. Under its Arab Centre for Climate Change Policies, ESCWA has been working with member States to conduct integrated vulnerability assessments to climate change at the country and watershed levels to enhance climate resilience and inform climate action. The vulnerability assessment index methodology developed under the ESCWA-led Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region (RICCAR) draws upon remote sensing data such as Sentinel-2, Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) and other space technologies with the ultimate purpose of informing climate adaptation as it related to water, agriculture, ecosystems, urban settlements and people.

60. ESCWA is also collaborating with regional and global partners to launch the Arab Groundwater Digital Knowledge Platform that aims to provide access to data and information related to groundwater through participatory engagement with member States and the use of remote sensing data. This initiative will enhance the regional knowledge base and empower decision makers to incorporate groundwater considerations in planning, management, transboundary cooperation and investments. The platform will leverage innovative technologies while building on existing resources to provide a user-friendly interface accessible to all stakeholders.

61. Mandated to support the modernization of National Statistical Offices (NSOs) in the Arab region, ESCWA is promoting the integration of geospatial information and big data for monitoring the environmental dimension of the 2030 Agenda. ESCWA's project on the use of remote sensing data and official statistics to monitor the impact of extreme events on people, land, and infrastructure in the Nile Basin in Egypt, received an award by Google Earth Engine in 2020, in cooperation with the Group on Earth Observations, granting technical support and training on the remote sensing data and data analytics in the implementation of the project. The project enables policy makers in Egypt to improve damage assessment, reduce disaster risk, and strengthen resilience, allowing for more effective monitoring and reporting on the Sendai Framework and the SDGs. The resulting analysis can be fairly replicated in other countries.

Coordinating the necessary radio-frequency spectrum for climate observing satellites

62. ITU is focusing on the use of telecommunications and other forms of information and communications technology (ICT) for preventing and averting climate change, with the objective of providing governments and the private sector with ways and means to use ICT as a vital component in climate monitoring, climate change mitigation and adaptation to climate change.[6]

63. ITU creates regulatory certainty for the development and effective operation of satellite and ground-based climate monitoring and data dissemination systems by allocating and coordinating the necessary radio-frequency spectrum and associated satellite orbit resources; carrying out technical and regulatory studies to regularly

[6] https://www.itu.int/en/action/environment-and-climate-change/Pages/climate-change.aspx.

adapt the provisions of the Radio Regulations, the intergovernmental treaty governing the use of the radio-frequency spectrum and associated satellite orbits. ITU also continuously produces international standards (ITU recommendations) for telecommunication systems and networks. In particular, such documents provide guidance and support for the use of ground and space systems for environment monitoring, prediction and mitigation of the negative effects of disasters caused by climate change, by means such as (a) Earth observation satellites; (b) radio-based meteorological aid systems; and (c) different radiocommunication systems (satellite and terrestrial) used for the dissemination of information concerning different natural and man-made disasters.

64. Recognizing the crucial importance of radio-frequency spectrum and radio-based remote sensing systems and applications for meteorological and environmental observations for climate monitoring, disaster risk reduction, adaptation and mitigation of negative effects of climate change, the 2012 World Radiocommunication Conference adopted Resolution 673 (Rev. WRC-12)[7] on "The importance of Earth observation radiocommunication applications". This Resolution recognizes the value of Earth observation data and of the underlying spectrum usage for the whole international community. It further resolves to urge ITU Member States to take into account Earth observation radio-frequency requirements and in particular protection of the Earth-observation systems in the various frequency bands they use.

65. WMO and ITU held a joint seminar in 2017 on the theme "Use of the radio spectrum for meteorology: weather, water and climate monitoring and prediction"[8] for exchanging views and information between representatives of meteorological and radiocommunication communities. In 2017, ITU also published the Handbook[9] on the Use of Radio Spectrum for Meteorology: Weather, Water and Climate Monitoring and Prediction. It provides an overview of the use of radiocommunication systems to monitor the various manifestations of climate change and their impact, as well as the application of ICTs and radiocommunication as a means to reduce global energy consumption. On a continuous basis, ITU-R Study Group 7[10] conducts studies on radiocommunication applications, including space systems, relevant to climate change.

Monitoring the impact of climate conditions in fighting illicit crop cultivation

66. UNODC has a long-standing programme that provides technical support on monitoring illicit crop cultivation with remote sensing data. In addition, UNODC uses satellite images to monitor licit crops in drug producing regions to assess the impact of projects that stimulate alternative sources of income for farmers. UNODC provides support to member States to monitor other illegal activities by using satellite imagery, like the exploitation of alluvial mines in Colombia.

67. Area under illicit crop production and the yields are impacted by weather conditions and changes in climate. Remotely sensed data of rainfall estimates (e.g. from the Climate Hazards Group InfraRed Precipitation with Station data – CHIRPS) are used to explain trends in crop cultivation and yields, e.g. in the case of droughts.

68. The expansion of illicit crop cultivation, as well of other illicit activities including illegal mining has been linked to deforestation and therefore as well to climate change. The satellite supported monitoring of areas with illicit crops and illicit

[7] https://www.itu.int/dms_pub/itu-r/oth/0C/0A/R0C0A00000F00144PDFE.pdf.
[8] https://www.itu.int/en/ITU-R/study-groups/workshops/RSG7-ITU-WMO-RSM-17/Pages/default.aspx.
[9] https://www.itu.int/pub/R-HDB-45.
[10] https://www.itu.int/en/ITU-R/study-groups/rsg7/Pages/default.aspx.

mining by UNODC is paramount in the design and in guiding programmes that aim at curbing illicit activities, and to prevent their expansion into forest areas.

69. The illicit crop monitoring programme uses satellite derived climate and other environmental information in combination with socioeconomic data to conduct multi-factor spatial analyses for the identification of potential illicit crop growing locations. The outcome of these analyses is used as a base in sampling surveys to estimate area and production.

70. UNODC conducts research in cooperation with academia, international organizations like European Union/ESA, and United Nations organizations like FAO to improve the use of remote sensing data for the monitoring of illicit activities, including the impact of climate conditions on potential areas for illicit crops.

71. UNODC can benefit from climate, land use and land cover data produced by other United Nations organizations, and it can share its own land use and spatial analytical data that are regularly produced.

72. UNODC can benefit further from research on the impact of climate change on crop yields and on areas suitable for cultivating illicit and replacement crops, as conducted by specialized agencies (e.g. FAO) using earth observations combined with field data. Multidimensional poverty and lack of access to viable licit economic opportunities have been identified as drivers of illicit crop cultivation – all factors that will be further exacerbated by climate change.

Supporting Member States with satellite imagery analysis

73. The Operational Satellite Applications Programme – UNOSAT is a technology-intensive programme of the United Nations Institute for Training and Research (UNITAR) promoting the practical applications of space technology and providing the United Nations Member States, United Nations funds, programmes and specialized agencies with satellite imagery analysis, training and capacity development in the use of geospatial information technologies and space based applications for improved disaster and climate resilience, support humanitarian action and sustainable development policies.

74. On the occasion of its 75th Session held in June 2021, the Economic and Social Council with he approved resolution E/2021/L.22 recognized UNOSAT as the United Nations Satellite Centre “with a mandate to provide United Nations funds, programmes and specialized agencies with satellite analysis, training and capacity development, at their request, as well as to continue supporting the Member States with satellite imagery analysis over their respective territories and to provide training and capacity development in the use of geospatial information technologies, on the basis of voluntary contributions”.

75. The United Nations Satellite Centre – UNOSAT is focusing on applied research and innovation to keep abreast of new technologies such as Earth Observation, Artificial Intelligence, Machine Learning and Big Data Analytics to support disaster and climate resilience, humanitarian assistance, global health, sustainable water management and cultural heritage. UNOSAT uses Earth Observation (EO) data and satellite imagery for a wide range of climate services, such as monitoring of rainfall patterns and variabilities, surface waters including trends in lake coverage and evolution of wetlands, changes in coastline erosion, mapping of mangrove forests, air pollution monitoring, seasonal flood and drought mapping and information systems for improved access to climate finance and to enhance climate resilience.

76. To promote and enable access to free and open data services including EO-derived risk and climate-related datasets, UNOSAT designs, develops and delivers innovative and tailor-made learning solutions. The implementation of capacity development and knowledge transfer activities in United Nations member countries includes practical training courses, awareness raising events and technical

backstopping activities. In addition to United Nations member countries, UNOSAT also supports United Nations agencies, academia and regional organizations.

77. To bridge science-policy gaps for improved disaster and climate resilience, UNOSAT implements custom-tailored GIS-based tools and services to access EO-derived climate datasets, for near-real-time satellite flood monitoring, flood forecasting and early warning including the implementation of ad-hoc spatial decision support platforms to inform DRR policies, planning and decision-making. The use of geospatial platforms and GIS web-based applications are increasingly used by governments, international and regional organizations, the private sector and the general public in many different application domains. As part of the capacity development activities, UNOSAT is also providing technical backstopping services to line ministries and regional organizations lacking the technical expertise in using GIS tools and satellite data for climate action. For example, by seamless access to custom-tailored decision support platforms, planners and decision makers can access contextual analysis of the variety of hazards, risks and vulnerability, socioeconomic indicators for improved risk knowledge and early action under a changing climate.

78. To boost climate resilience but also to respond to the disaster caused by weather and climate related hazards, UNOSAT provides a 24/7 year-round Rapid Mapping service to United Nations member countries, United Nations sister agencies and humanitarian entities operating in line with United Nations policies. The service done by a team of experience analysts ensure timely delivery of satellite imagery derived maps, reports and data ready for direct inclusion in Geographic Information Systems (GIS) according to needs. To accelerate and automate satellite derived mapping efforts for the benefit of national and international humanitarian actors, UNOSAT developed a fully automated Artificial Intelligence (AI)-based tool for flood detection. The UNOSAT flood AI dashboards applies deep learning (DL) to process satellite imagery to rapidly map flooded areas and to assess potential impacts. Apart from flooding, typical situations for which UNOSAT Rapid Mapping is activated also include earthquakes, storms, landslides, volcanoes, oil spills, chemical waste, refugee and Internally Displaced Person (IDP) camp mapping, conflict damage assessment and situation analysis. UNOSAT's Rapid Mapping service is free of charge for United Nations sister agencies and humanitarian entities operating in line with United Nations policies and uses a variety of satellite imagery sources: free and open-source, commercial providers, International Charter Space and Major Disasters (caused only by natural and technological hazards), and in-kind donations.

Bringing the benefits of outer space to humanity, coping with the impacts and effects of climate change

79. In its capacity as secretariat to the Committee on the Peaceful Uses of Outer Space, the Office for Outer Space Affairs advances international cooperation in the peaceful use and exploration of space and in the utilization of space science and technology for sustainable economic and social development. The Office substantively supports the Committee and its subsidiary bodies in their deliberations on a wide range of issues, including, since 2009, on a dedicated item on space and climate change. In its deliberations, the Committee notes the usefulness of satellite observations and Earth observation applications for monitoring essential climate variables, as well as the benefits of using Earth observations to track changes in sea level, carbon dioxide concentrations, sea ice depletion and terrestrial snow mass and to gather data on remote areas such as deserts, oceans, the polar caps and glaciers.

80. The Office, through the United Nations Programme on Space Applications builds national capability in the areas of basic sciences, basic space technology and human space technology, and promotes integrated space technology applications in areas such as climate change and environmental monitoring. Organized under the programme, the United Nations/Austria Symposium on Space Applications for Sustainable Development Goal 13: Climate Action showcased examples of concrete climate action through demonstrations of applications that use space solutions. The

Symposium provided a platform for specific policy discussions and the exchange of experience and know-how on the integration of space applications and tools into the domain of space and climate action. The 2021 United Nations/Austria Symposium "Space Applications for Food Systems", looked at concrete support of space applications for food systems, including in relation to climate change.

81. The Office also facilitates the provision of universal access to all types of space-based information and services relevant to management of all types of disasters, including the ones induced by climate change. In 2021 the Office, through UN-SPIDER, and the Islamic Republic of Iran organized the "United Nations/Islamic Republic of Iran Workshop on Space Technology Applications for Drought, Flood and Water Resource Management". The workshop, hosted by the Iranian Space Agency, provided an opportunity to deepen awareness and understanding of the possibilities offered by outer space for monitoring floods, drought conditions, and water resource environments.

82. To leverage the potential of space technology and applications in mapping watercourses and aquatic ecosystems, monitoring and mitigating the effects of floods and droughts, and monitoring the water cycle, the Office launched the Space4Water Project, delivered jointly with the Prince Sultan bin Abdulaziz International Prize for Water. The project fosters collaboration and knowledge exchange between stakeholders in the space and water sectors and helps tap into the full potential of space assets in addressing water issues.

83. To promote stakeholder exchange about current and future activities, actionable solutions, and cooperation in support of SDG 13 "Climate action.", the Office organized the United Nations/Austria World Space Forum 2021 on Space for Climate Action, which explored successful partnerships, initiatives, and activities in leveraging space technologies for climate action, elevated the voices of youth, and provided an opportunity for both providers and users to share their perspectives and participate in international networking and matchmaking.

84. The Office worked towards amplifying the voices of young people in climate change through the Space4Youth essay competition, co-organized with the Space Generation Advisory Council, on the theme "Space as a tool to foster climate change mitigation and adaptation". Since 2016, the Office has been involved with the Space Climate Observatory to raise awareness about the transformative power of space tools and to facilitate the adoption of space solutions on the ground by connecting solution providers with users and advancing universal access to space benefits. With the support from the United Kingdom of Great Britain and Northern Ireland, the Office maps global space-related climate action efforts and prepares a comprehensive overview of the broad spectrum of current and planned activities in using space for climate action, aiming at building synergies and facilitating coherence among already existing activities.

IV. United Nations system-wide cooperation in climate change, science, technology and innovations, and in space-related activities

85. Within the United Nations system, mechanisms exist to support coordination and cooperation in the area of climate change; in facilitating the use of science, technology and innovations for attainment of SDGs, and in promoting synergies and avoiding duplication in the use of space-related activities across the system.

86. Article 7, paragraph 2(l), of the United Nations Framework Convention on Climate Change states that the Conference of the Parties (COP) shall seek and utilize the services and cooperation of, and information provided by, competent international organizations and intergovernmental and non-governmental bodies. The secretariat of UNFCCC engages in collaborative activities, initiatives and programmes with other

United Nations entities to support the implementation of the Convention, the Kyoto Protocol and the Paris Agreement in an efficient and effective manner.

87. At the request of the Subsidiary Body for Scientific and Technological Advice (SBSTA), at its thirtieth session, the secretariat of the Convention regularly prepares a note on cooperative activities with United Nations entities and other intergovernmental organizations that contribute to the work under the Convention, the Kyoto Protocol and the Paris Agreement. The document provides an overview of specific areas of cooperation, including technology, climate finance, capacity-building, action for climate empowerment, adaptation and loss and damage, mitigation, transparency, response measures, climate knowledge: science, research and systematic observation, gender, local communities and indigenous peoples platform, 2030 Agenda for Sustainable Development, global climate action agenda and cross-cutting areas of cooperation.

88. In support of the implementation of SDGs, the launch of a Technology Facilitation Mechanism (TFM) was announced in paragraph 70 of the 2030 Agenda. The goal of the mechanism is to facilitate multi-stakeholder collaboration and partnerships through the sharing of information, experiences, best practices and policy advice among Member States, civil society, the private sector, the scientific community, United Nations entities and other stakeholders.

89. As part of the TFM, the United Nations Interagency Task Team on Science, Technology and Innovation for the SDGs promotes coordination, coherence, and cooperation within the United Nations System on science, technology and innovation related matters, enhancing synergy and efficiency, in particular to enhance capacity-building initiatives. The Task Team works with 10 representatives from the civil society, private sector, the scientific community, to prepare the meetings of the Multistakeholder Forum on Science, Technology and Innovation for the SDGs to discuss STI cooperation around thematic areas, as well as in the development and operationalization of the on-line platform that serves as a gateway for, information on existing STI initiatives, mechanisms and programmes, within and beyond the UN.

90. For the coordination of efforts related to the use of space technology and applications in the work of United Nations entities, the United Nations Inter-Agency Meeting on Outer Space activities organizes regular United Nations system-wide coordination sessions. Known as UN-Space, the inter-agency mechanism prepares its special report (see para. 2 above) and reports of the Secretary-General on the coordination of space-related activities within the United Nations system. The Secretary-General's reports addressed the use of space-derived geospatial data for sustainable development (A/AC.105/1014), the post-2015 development agenda (A/AC.105/1063), meeting the 2030 Agenda (A/AC.105/1115), delivery as one (A/AC.105/1179), and megatrends and realization of the SDGs (A/AC.105/1230).

91. UN-Space organizes open sessions that bring together United Nations entities, Governments and other stakeholders to engage in dialogue, exchange ideas and seek solutions and strategies to advance the strategic role of space science, technology and applications for the implementation of the 2030 Agenda. The themes of the most recent open sessions of UN-Space have included space and climate change (2011); space for agriculture and food security (2012); space and disaster risk reduction: planning for resilient human settlements (2013); engaging space tools for development on Earth – contribution of space technology and applications to the post-2015 development agenda (2014); space-based information for development (2015); the transformative potential of space technology for development: approaches and opportunities in the United Nations system (2017); United Nations: reinforcing synergies for UNISPACE+50 and beyond (2018); and "Access to Space4All" (2019).