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## Space for climate action

### **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**

#### **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 has addressed a wide range of themes. These have included 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](#)); 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 that to the attention of UN-Space for the development of such a report.



4. At its fortieth session, held online 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 prepared on the basis of contributions from the following United Nations entities: International Telecommunication Union (ITU), Economic Commission for Africa (ECA), Economic and Social Commission for Asia and the Pacific (ESCAP), Economic and Social Commission for Western Asia (ESCWA), United Nations Office on Drugs and Crime (UNODC), Office of Legal Affairs of the Secretariat, Office for Outer Space Affairs of the Secretariat and United Nations Satellite Centre (UNOSAT) of the United Nations Institute for Training and Research (UNITAR).

## II. Background

6. Sustainable Development Goal 13 (Take urgent action to combat climate change and its impacts) is one of 17 Sustainable Development Goals, designed to serve as a blueprint for achieving a better and more sustainable future for all.

7. The targets under 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 held in Paris in 2015, Governments agreed that mobilizing stronger and more ambitious climate action was urgently required to achieve the goals of the Paris Agreement. The Agreement formally acknowledges the urgent need to scale up the global response to climate change, which supports a more ambitious response from Governments.

9. In 2021, States adopted the Glasgow Climate Pact, aiming to turn the 2020s into a decade of climate action and support. In the Pact, States emphasized the need for strengthened efforts to build resilience to climate change and curb greenhouse gas emissions, as well as provide the necessary financing for those purposes.

10. Climate change is the most significant challenge to achieving sustainable development, and it threatens the 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 level. 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 using space technology, as well as the mandates of the respective bodies, with a view to 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 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 to the Convention, 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 that 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 on the basis of the best available science and ensuring climate finance are critical domains of emphasis in the area of climate action.

15. Focusing, in its early years, largely on facilitating the intergovernmental climate change negotiations, the secretariat of the United Nations Framework Convention on Climate Change 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 strategies for mitigating and adapting to climate change, facilitate access to finance, share knowledge and technology, support the reporting and review of information for purposes of 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 exchange views and draw on wide-ranging expertise to design cutting-edge climate solutions.

#### **Assessing the status of global climate observations of the atmosphere, land and oceans**

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, the United Nations Environment Programme and the International Science Council. GCOS regularly assesses the status of global climate observations of the atmosphere, land and ocean and produces guidance for the improvement of such observations.

17. GCOS expert panels maintain definitions of essential climate variables, which are required to systematically observe Earth's changing climate. The observations supported by GCOS contribute to solving challenges in climate research and underpin climate-related 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 in planning and implementing adaptation and mitigation measures.

18. GCOS regularly reviews the state of global climate observations and releases reports on its findings. After being issued, GCOS status reports are followed by an implementation plan that outlines the improvements needed in the global system.

19. In the status report for 2021, entitled *GCOS Climate Observing System 2021: the GCOS Status Report* it was recognized that, since 2015, satellite observations had improved, allowing near-global coverage of many variables and providing open access to the data collected. There have also been many enhancements to the archiving of and online access to the observations and derived information, as well as access to the surface-based observations of individual essential climate variables across the atmospheric, oceanic and terrestrial domains, with new technologies and approaches being developed, especially in relation to the oceans. According to the report, there are four main areas still needing improvement: (a) ensuring the sustainability of observations; (b) addressing gaps in the system; (c) ensuring permanent, cost-free and unrestricted access to the observations; and (d) 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, the 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), as the new overarching framework for all WMO observing systems, is one of the top priorities of WMO. 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 partnerships, engaging the regional and national actors essential for successful integration of these systems. These national and international WIGOS partnerships enable 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 in the 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 report entitled *State of the Global Climate 2021* highlights how climate change has an impact on food insecurity 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 acidification, glacial retreat and ice melt, as well as socioeconomic impacts. The past

seven years are on track to be the warmest on record globally, according to the report. The rise in the global sea level has been accelerating since 2013, reaching a new high in 2021, with ocean warming and acidification continuing to increase.

### **The ocean-climate nexus and the role of ocean observation in climate change action**

24. The world's oceans are being severely impacted by the effects of climate change. They are warming at increasing rates, experiencing density stratification and deoxygenation, and becoming acidified as a result of carbon dioxide absorption. The mean global sea level is rising and extreme weather events are becoming more frequent. Moreover, the composition and abundance of marine species are being affected, as are marine and coastal ecosystems. The oceans are 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 for understanding climate change. Ocean observation tools include both in situ and remote instrumentation, the latter including space-based satellite instrumentation used to collect a variety of data on ocean-related variables, including ocean surface temperature and salinity, ocean surface height and sea level, ice coverage, wind vectors and ocean colour. Such data contribute to the monitoring of climate change and to adaptation responses, including the forecasting of extreme events and related early warning systems.

26. The Division for Ocean Affairs and the Law of the Sea of the Office of Legal Affairs of the Secretariat 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 the development and transfer of marine technology.

27. The Division also supports several processes mandated by the General Assembly involving activities related to ocean observation, including through the use of space technology, in support of climate action, in particular the United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea, which was established pursuant to General Assembly resolution [54/33](#) of 1999 to facilitate the annual review by the Assembly 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. The twenty-second meeting of the Informal Consultative Process, held from 6 to 10 June 2022, was dedicated to the theme "Ocean observing". The discussion panels at the meeting considered, inter alia, the contributions of ocean observation, using both in situ and satellite technology, to science-based decision-making, including with regard to climate change, as well as how ocean observation could be advanced and related challenges could be addressed through international cooperation and coordination. Documentation relevant to the meeting, including the report of the Secretary-General on oceans and the law of the sea ([A/77/68](#)), has been made available on the Division's website ([www.un.org/Depts/los/index.htm](http://www.un.org/Depts/los/index.htm)). Other meetings of the Informal Consultative Process in recent years have also involved consideration of 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 mechanism established under the auspices of the General Assembly that involves the undertaking of regular assessments of the state of the world's oceans, informed by hundreds of scientists worldwide. The first and second World Ocean Assessments (World Ocean Assessment I and II) were issued in 2016 and 2021, respectively, and the third cycle of the Regular Process is currently under way. The assessments consider, inter alia, the impact of climate change on the oceans, using knowledge

generated from, among other sources, satellite observations. They provide an important scientific basis for policymaking.

29. The United Nations Ocean Conference, to be held in Lisbon from 27 June to 1 July 2022, is also of relevance. The Conference will bring together stakeholders to advance science-based innovative solutions to the threats facing the oceans, under the overarching theme “Scaling up ocean action based on science and innovation for the implementation of Goal 14: stocktaking, partnerships and solutions”. Particular consideration will be given to issues relating to climate change and the oceans and to increasing scientific knowledge, developing research capacity and the transfer of marine technology. The 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 entities of the United Nations system and the International Seabed Authority in matters within their mandates relating to ocean and coastal areas. Areas of cooperation have included matters relating to ocean science. Members of UN-Oceans are, for instance, represented on the Decade Advisory Board, a body that 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 carbon dioxide absorbed by the oceans causes acidification, influencing the health of oceans and those whose livelihoods and nutrition depend on them.

32. The Food and Agriculture Organization of the United Nations (FAO) supports countries in both mitigating and adapting to the effects of climate change through a wide range of research-based, practical programmes and projects. For the early warning and monitoring of agricultural droughts, FAO developed the Agricultural Stress Index System, 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 initiative to support the exchange of knowledge and collective action with a view to improving adaptation to climate change and water scarcity, including through drought management and water harvesting for agriculture. A key area of the Organization’s work to enhance resilience is supporting efficient water management in irrigation to optimize the retention of water in soil and its uptake by plants, water harvesting for household and societal use, and efficient water distribution among water users.

34. The FAO portal known as “Water productivity through open access of remotely sensed derived data (WaPOR)” monitors and reports on agricultural water productivity in Africa and the Near East. It is a vital new tool for addressing water scarcity and adapting to changing weather patterns.

### **Ensuring food security in conditions of climate change**

35. To help vulnerable countries and communities, the World Food Programme (WFP) supports analysis that highlights the links between food security and climate risks, as well as the present and potential impacts of climate change on food security and nutrition. This helps Governments to identify which communities are most at risk

and integrate food security considerations into national policy and planning. WFP uses remote sensing data for seasonal drought monitoring and prediction, analysis of climate and hotspots, mapping of crop types and land-cover change, monitoring the impact of conflict on agriculture, monitoring population movements, damage assessments, and monitoring of camp dynamics, informal settlements and the impact of asset-building.

36. PRISM, a climate risk monitoring system developed by WFP, provides access to the latest available climate hazard information, as well as 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, enabling 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, in particular those in low- and middle-income countries. The system is particularly relevant to Earth observation data, which typically require specialized skills and technology infrastructure to make them useful for practitioners. PRISM is open-source software that has been developed by WFP since 2016 but that underwent a major technology overhaul in 2020. Although the project is led by WFP, as open-source software, PRISM is open for collaboration and use by anyone.

38. PRISM is aimed at empowering Governments that collect and maintain data and information on climate risk to support risk-informed decision-making. The software 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 ministries, to collectively monitor risks, prioritize responses and inform programmes and policies. Increasingly, WFP has focused on deploying PRISM in cooperation with national weather and meteorological offices to monitor climate risk and share data from ground observations, as well as value-added weather and climate information, with 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, response and 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 reinforcement of the full disaster management cycle. The Office for Outer Space Affairs of the Secretariat, 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 impacts of meteorological hazards, including tropical storms, floods and droughts, and hydro-meteorological hazards and some of their cascading effects.

41. In that connection, step-by-step procedures or recommended practices have been developed by UN-SPIDER regional support offices in Brazil, Germany, Iran (Islamic Republic of), Mexico, Pakistan and Ukraine that focus on flood hazard

mapping,<sup>1</sup> mapping the extent of floods using open software tools such as the European Space Agency (ESA) Sentinel Application Platform (SNAP) software, 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 derived from Moderate Resolution Imaging Spectroradiometer (MODIS) sensors and mapping debris flows such as those triggered by intense rainfall.<sup>2</sup> Such tools are usually developed and provided by UN-SPIDER partners and regional support offices and are published on the UN-SPIDER knowledge portal.

42. UN-SPIDER encourages the use of these recommended practices in the operation of drought early warning systems in Africa, Asia and Latin America and the Caribbean. In that regard, specific efforts have been carried out in recent years in the context of the Central American drought corridor, a region that has been a focus of collaboration between UN-SPIDER, FAO, the secretariat of the United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa, the International Research Centre on El Niño and regional organizations such as the Central American Agricultural Council and the Central American Coordination Centre for Natural Disaster Prevention, as well as the UN-SPIDER regional support offices in Colombia and Mexico. One project targeted Central American countries and the Dominican Republic.<sup>3</sup>

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 in Ghana, Guatemala, Mexico, Nigeria, Peru and South Africa, to incorporate impact-based forecasts derived from the combined use of data and information from the Global Flood Awareness System of the European Earth Observation Programme (Copernicus) and data on impacts of historic floods to improve flood early warning systems.

### **Reducing emissions resulting from deforestation and forest degradation**

44. In 2008, FAO, the United Nations Development Programme and the United Nations Environment Programme established the United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (UN-REDD), a collaborative partnership to support countries wishing to participate in efforts to reduce emissions resulting from deforestation and forest degradation.

45. The Programme supports partner countries in strengthening and innovating their national forest monitoring systems, establishing forest reference emission levels, improving governance and advancing national policy and institutional systems to safeguard forests and mitigate climate change. So far, more than 30 Governments have been able to submit critical baseline data on forest carbon stocks and forest-related greenhouse gas emissions to the secretariat of the United Nations Framework Convention on Climate Change. Together, those countries account for 1.4 billion hectares of forest, or 36 per cent of the planet's forest area. These data serve as an essential basis for developing countries to tailor their actions under REDD-plus, a framework developed by parties to the United Nations Framework Convention on Climate Change, and contribute to the fight against climate change by informing efforts to halt deforestation and forest degradation under the framework.

46. Technical expertise and support from FAO, provided through UN-REDD, has helped countries to identify drivers of deforestation and forest degradation while

<sup>1</sup> For an example, see [www.un-spider.org/advisory-support/recommended-practices/recommended-practice-flood-hazard-assessment](http://www.un-spider.org/advisory-support/recommended-practices/recommended-practice-flood-hazard-assessment).

<sup>2</sup> For an example, see [www.un-spider.org/advisory-support/recommended-practices/recommended-practice-mudslides-and-associated-flood](http://www.un-spider.org/advisory-support/recommended-practices/recommended-practice-mudslides-and-associated-flood).

<sup>3</sup> See [www.un-spider.org/projects/SEWS-D-project-caribbean](http://www.un-spider.org/projects/SEWS-D-project-caribbean).

making significant advances in modernizing forest monitoring. FAO support for new technologies, satellite data and open-source software has enabled 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 most significant threat to human health**

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, a 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 as a result of malnutrition, malaria, diarrhoea and heat stress. It is estimated that the direct costs of the damage to human health caused by climate change will be between \$2 billion and \$4 billion per year by 2030. Areas with weak health infrastructure, mostly in 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 and displaced persons, older populations, and those with underlying health conditions.

50. Although there is no doubt 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 have progressively enabled increases in morbidity and mortality to be attributed to human-induced warming and have enabled the risks and scale of these health threats to be determined more accurately.

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

### **Providing technical and advisory support in Africa**

52. 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 amounts of Earth observation satellite data collected over Africa. Digital Earth Africa continuously synthesizes both satellite images collected over the last 30 years (taken every two weeks at a resolution of 25 square metres) and recent images (taken every five days at resolution of 10 square metres) over the entire African continent. The programme provides these images and derived products freely on a platform that can be accessed by any user and that will offer unique capabilities to process the images. The programme is implemented

through a network of distributed nodes of technical institutions empowered to develop analysis-ready data, products and services in areas such as climate change, water resources and flood risks, agriculture and food security, land degradation and coastal erosion, and urbanization.

53. ECA is also partnering synergistically with the African Union in the implementation of the Global Monitoring for Environment and Security and Africa programme, which is aimed at supporting organizations, policymakers and practitioners in Africa in the more effective use of Earth observation data for the development of relevant operational information services in support of the sustainable management of natural resources and efforts to address climate change. In relation to technical aspects, the programme uses, reuses and adapts data and services from the Copernicus programme to the African context. The programme is implemented through 13 consortiums of technical institutions working to strengthen local capacities and institutional, human and technical resources to facilitate access to and exploitation of Earth observation-based services at the operational level. Currently, the programme is specifically focused on developing Earth observation data and information products and services relating to natural resources, water, marine and coastal areas, the environment and climate change for use by relevant institutions in Africa.

54. ECA has carried out a study in support of mitigating the impact of the coronavirus disease (COVID-19) crisis on deforestation in the Congo Basin. The spatial data used for the study was derived from Earth observation data 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 using a spatial decision-support system informed by data covering the forest areas of the Congo Basin for environmental and natural resource analysis and forecasting in the context of COVID-19. The geospatial analysis exercise has enabled participating countries to determine the suitability of and prioritize various sectors for investment in the post-COVID-19 recovery period. The spatial data used for the analysis, including real-time data such as Sentinel-2 satellite imagery and weather data, are combined in a geoportal that displays the spatial patterns of key thematic features, including logging, agriculture, mining, afforestation, infrastructure and utilities, roads and urbanization.

### **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 by climate change. For different climate scenarios, such as representative concentration pathways 4.5 and 8.5, as adopted by the Intergovernmental Panel on Climate Change, 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 of each country in the Asia-Pacific region. To strengthen capacity, build resilience, identify gaps in implementation and provide solutions for the achievement of the disaster-related Sustainable Development Goals, the Portal also provides estimates of costs and recommendations on key adaptation measures.

56. In line with the ESCAP regional road map 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) is a blueprint for countries to harness geospatial and space applications and digital innovations to achieve the Sustainable Development Goals. It includes 188 actions contained within six thematic areas, including climate change. The actions relating to climate change are focused on the use of innovative geospatial information for climate studies and scenario development, including impact and vulnerability mapping, carried out under various programmes.

57. The ESCAP secretariat collaborates with ESCAP member States and other partners to enhance the capacity of developing countries to use geospatial information integrated with sectoral metadata. For example, greenhouse gas concentrations are measured using meteorological and Earth observation data in combination with space applications for climate modelling and scenario development. Countries have access to the archives of Earth observation data, as well as to in situ measurements and other products derived from space data, which they can use to effectively map floods, monitor droughts and wildfires, plot air pollution or measure the amount of plastic waste in rivers.

### **Building capacities to address climate change in Western Asia**

58. ESCWA helps to inform policymaking by using space technologies to highlight natural resource-related challenges in the Arab region posed by climate change. To inform its ninth water development report, on groundwater in the Arab region, ESCWA used an integrated data approach to monitor the change in groundwater storage in the region over time. For example, data from the Gravity Recovery and Climate Experiment mission were used to monitor groundwater storage dynamics. The Climate Hazards Group InfraRed Precipitation with Station (CHIRPS) data set was used to collect precipitation data, while MODIS was used to identify spatio-temporal changes in vegetation dynamics and their relationships with climate extremes across different climate zones in the region. This integrated approach helps to ensure the certainty of analysis results by relating precipitation change to groundwater storage change and changes in vegetation.

59. Through its Arab Centre for Climate Change Policies, ESCWA has been working with its member States to conduct integrated assessments of vulnerability to climate change at the country and watershed levels to enhance climate resilience and inform climate action. The vulnerability assessment indexing methodology developed under the ESCWA-led Regional Initiative for the Assessment of the Impact of Climate Change on Water Resources and Socioeconomic Vulnerability in the Arab Region draws upon remote sensing data from sources such as the Sentinel-2 satellites, the Advanced Spaceborne Thermal Emission and Reflection Radiometer and other space technologies to inform climate adaptation as it relates to water, agriculture, ecosystems, urban settlements and people.

60. ESCWA has also been collaborating with regional and global partners to launch an Arab groundwater digital knowledge platform aimed at providing 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 investment decisions. 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 in the Arab region, ESCWA is promoting the integration of geospatial information and big data for monitoring the environmental dimension of the 2030 Agenda for Sustainable Development. In 2020, the ESCWA 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 from Google Earth Engine, in cooperation with the Group on Earth Observations, granting technical support and training on the use of remote sensing data and data analytics in the implementation of the project. The project enables policymakers in Egypt to improve damage assessment, reduce disaster risk and strengthen resilience, allowing for more effective monitoring of and reporting on the implementation of the Sendai Framework for Disaster Risk Reduction 2015–2030 and the Sustainable Development Goals. The project's approach and findings can be replicated in other countries.

## **Coordinating the necessary radio frequency spectrum for climate observation satellites**

62. ITU focuses on the use of telecommunications and other forms of information and communications technology to prevent and avert climate change, with the objective of providing Governments and the private sector with ways and means to use such technology as a vital component in climate monitoring, climate change mitigation and adaptation to climate change.

63. ITU works to ensure regulatory certainty in 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 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, in the form of ITU recommendations, for telecommunication systems and networks. In particular, the recommendations provide guidance and support for the use of ground and space systems, including Earth observation satellites, radio-based meteorological aid systems, and satellite and terrestrial radiocommunication systems used in the dissemination of information concerning natural and human-made disasters, for environment monitoring and the prediction and mitigation of negative effects of disasters caused by climate change.

64. Recognizing the crucial importance of the 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 the negative effects of climate change, in 2012, the World Radiocommunication Conference adopted resolution 673 (Rev. WRC-12), on the importance of Earth observation radiocommunication applications. In the resolution, the Conference recognized the value of Earth observation data and the underlying spectrum usage for the international community as a whole, and resolved to urge administrations to take into account Earth observation radio frequency requirements and, in particular, the protection of the Earth observation systems in the various frequency bands used.

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” as an opportunity for representatives of meteorological and radiocommunication communities to exchange views and information. In addition, in 2017, ITU published the *Handbook on Use of Radio Spectrum for Meteorology: Weather, Water and Climate Monitoring and Prediction*. The handbook 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 information and communications technologies and radiocommunication as means to reduce global energy consumption. On a continuous basis, ITU Radiocommunication Sector (ITU-R) Study Group 7 conducts studies on radiocommunication applications, including space systems, relevant to climate change.

## **Monitoring the impact of climate conditions in countering illicit crop cultivation**

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

67. Areas under illicit crop production and the yields in such production are impacted by weather conditions and changes in climate. Remotely sensed data for rainfall estimates (e.g. from CHIRPS) are used to explain trends in crop cultivation and yields, for example, in the case of droughts.

68. The expansion of illicit crop cultivation, as well other illicit activities, including illegal mining, has been linked to deforestation and thus to climate change. The satellite-supported monitoring by UNODC of areas subjected to illicit crop cultivation and illicit mining is paramount in the design and implementation of programmes aimed at curbing such illicit activities and preventing 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 cultivation areas. The outcomes of these analyses are used as a basis in sampling surveys to estimate the extent of areas and production.

70. UNODC conducts research in cooperation with academia, intergovernmental organizations such as the European Union and ESA, and United Nations entities such as 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 crop cultivation.

71. UNODC can benefit from climate, land-use and land-cover data produced by other United Nations entities and can share its own land-use and spatial analysis data, which it produces regularly.

72. UNODC can also benefit from research on the impact of climate change on crop yields and on areas suitable for the cultivation of illicit and replacement crops, as conducted by specialized agencies, such as 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 are further exacerbated by climate change.

### **Supporting Member States with satellite imagery analysis**

73. UNOSAT is a technology-intensive programme that promotes the practical application of space technology, provides Member States and 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, and supports humanitarian action and sustainable development policies.

74. In his report on UNITAR (E/2021/49), the Secretary-General recommended that Member States recognize 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 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. Subsequently, the Economic and Social Council, in its resolution 2021/16, noting with appreciation the recommendation of the Secretary-General, decided to recognize UNOSAT as such.

75. UNOSAT focuses on applied research and innovation to keep abreast of the use of emerging 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 the preservation of cultural heritage. UNOSAT uses Earth observation data and satellite imagery for a wide range of climate services, such as the monitoring of rainfall patterns and variabilities, surface waters, including trends in lake coverage and the evolution of wetlands, changes in coastline erosion, and air pollution, the mapping of

mangrove forests and seasonal floods and droughts, and the provision of information systems for improved access to climate finance and to enhance climate resilience.

76. To promote and enable access to cost-free and open data services, including risk- and climate-related data sets derived from Earth observation, UNOSAT designs, develops and delivers innovative and tailor-made learning solutions. Activities implemented by UNOSAT to develop capacity and transfer knowledge in United Nations Member States include practical training courses, awareness-raising events and technical backstopping activities. In addition to supporting United Nations Member States, UNOSAT also supports United Nations entities, as well as academic institutions and regional organizations.

77. To bridge gaps between science and policy with a view to improving disaster and climate resilience, UNOSAT implements custom-tailored GIS-based tools and services to access Earth observation-derived climate data sets for use in near-real-time satellite-based flood monitoring and forecasting and early warning, including ad hoc spatial decision support platforms to inform policies, planning and decision-making related to disaster risk reduction. Geospatial platforms and web-based GIS applications are increasingly used by Governments, international and regional organizations, the private sector and the general public in many different domains. As part of its capacity development activities, UNOSAT also provides 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, UNOSAT provides planners and decision makers with seamless access to custom-tailored decision support platforms, enabling them to obtain contextual analyses of the variety of hazards, risks and vulnerabilities and socioeconomic indicators to enhance their knowledge thereof and foster early action in relation to climate change.

78. To boost climate resilience, but also to respond to disasters caused by weather- and climate-related hazards, UNOSAT provides a 24/7, year-round rapid mapping service to United Nations Member States, United Nations sister agencies, and humanitarian organizations operating in line with United Nations guiding principles. The services provided by a team of experienced analysts ensure the timely delivery of maps, reports and data derived from satellite imagery that are ready for direct inclusion in GIS according to needs. To accelerate and automate satellite-derived mapping efforts for the benefit of national and international humanitarian actors, UNOSAT has developed a fully automated artificial intelligence-based tool for flood detection. The UNOSAT artificial-intelligence flood monitoring dashboards apply deep learning to process satellite imagery for the rapid mapping of flooded areas and the assessment of potential impacts. Apart from flooding, typical hazards and purposes for which UNOSAT rapid mapping is activated also include earthquakes, storms, landslides, volcanic eruptions, oil and chemical waste spills, the mapping of refugee and internally displaced persons' camps, conflict damage assessment and situation analysis. The UNOSAT rapid mapping service is free of charge for United Nations sister agencies and humanitarian entities operating in line with United Nations guiding principles and uses satellite imagery from a variety of sources, including cost-free and open sources, commercial providers, the International Charter "Space and Major Disasters" (which is only applicable to natural and technological hazards) and in-kind donations.

### **Bringing the benefits of outer space to humanity and 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 of the Secretariat 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 agenda item on space

and climate change. In its deliberations, the Committee has noted 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 capacity in the areas of basic sciences, basic space technology and human space technology, and promotes the use of 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 tangible climate action through demonstrations of applications that use space-based technology solutions. The Symposium provided a platform for specific policy discussions and the exchange of experience and expertise relating to the integration of space applications and tools into the domain of space and climate action. At the United Nations/Austria Symposium on Space Applications for Food Systems, held in 2021, participants considered the need for and ways to ensure substantive support for 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 the management of all types of disasters, including those 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, implemented 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 them to tap into the full potential of space assets in addressing water issues.

83. To promote the exchange of information between stakeholders about their current and future activities, actionable solutions and cooperation in support of Sustainable Development Goal 13, the Office organized the United Nations/Austria World Space Forum on the theme “Space 4 climate action”, which explored successful partnerships, initiatives and activities in leveraging space technologies for climate action, amplified the voices of young people and provided an opportunity for both providers and users to share their perspectives and participate in international networking and matchmaking.

84. The Office also worked towards amplifying the voices of young people in efforts to address climate change through the Space4Youth essay competition for 2021, 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 working with the Space Climate Observatory to raise awareness of the transformative power of space tools and 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 of 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 relating to the use of space for climate action, aiming at building synergies and facilitating coherence among existing activities.

#### **IV. United Nations system-wide cooperation in the areas of climate change and science, technology and innovation, 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 Sustainable Development Goals and in promoting synergies and avoiding duplication in the use of space-related activities across the system.

86. Article 7, paragraph 2 (1), of the United Nations Framework Convention on Climate Change states that the Conference of the Parties 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 the Convention 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. As requested by the Subsidiary Body for Scientific and Technological Advice at its thirtieth session, the secretariat of the Convention regularly prepares notes 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 documents provide 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; science, research and systematic observation to enhance climate knowledge; gender; the Local Communities and Indigenous Peoples Platform; the 2030 Agenda for Sustainable Development; the global climate action agenda; and cross-cutting areas of cooperation.

88. In support of the implementation of the Sustainable Development Goals, the launch of the Technology Facilitation Mechanism 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 Mechanism, the United Nations inter-agency task team on science, technology and innovation for the Sustainable Development Goals 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 civil society, the private sector and the scientific community to prepare the meetings of the multi-stakeholder forum on science, technology and innovation for the Sustainable Development Goals to discuss cooperation in specific thematic areas of science, technology and innovation, and in the development and operationalization of the 2030 Connect online platform, which serves as a gateway for information on existing initiatives, mechanisms and programmes in the area of science, technology and innovation, both within and beyond the United Nations.

90. For the coordination of efforts related to the use of space technology and applications in the work of United Nations entities, UN-Space organizes regular United Nations system-wide coordination sessions. The inter-agency mechanism prepares its special reports (see para. 2 above), and reports of the Secretary-General on the coordination of space-related activities within the United Nations system. Topics addressed in the reports of the Secretary-General include the use of space-derived geospatial data for sustainable development ([A/AC.105/1014](#)), addressing the post-2015 development agenda ([A/AC.105/1063](#)), meeting the 2030 Agenda for Sustainable Development ([A/AC.105/1115](#)), a United Nations that delivers

(A/AC.105/1179) and megatrends and realization of the Sustainable Development Goals (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).

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