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Committee on the Peaceful Uses of Outer Space

Space and climate change

Special report of the Inter-Agency Meeting on Outer Space Activities on the use of space technology within the United Nations system to address climate change issues

I. Introduction

1. The Inter-Agency Meeting on Outer Space Activities has been serving as the focal point for inter-agency coordination and cooperation in space-related activities since 1975, with the aim of promoting inter-agency coordination and cooperation and preventing duplication of efforts related to the use of space applications by the United Nations.

2. At its thirtieth session, held in Geneva from 10 to 12 March 2010, the Inter-Agency Meeting agreed that a special report addressing climate change and the use of space technology within the United Nations system should be prepared under the leadership of the World Meteorological Organization in cooperation with the Office for Outer Space Affairs of the United Nations Secretariat and with contributions from the secretariat of the United Nations Framework Convention on Climate Change and other United Nations entities, for endorsement by the Meeting at its thirty-first session, in 2011, and for submission to the Committee on the Peaceful Uses of Outer Space at its fifty-fourth session, also in 2011.

3. The present report was compiled on the basis of submissions from the following global observing systems: Global Climate Observing System (GCOS), Global Ocean Observing System (GOOS) and Global Terrestrial Observing System (GTOS); the following United Nations entities: secretariat of the United Nations Framework Convention on Climate Change, Food and Agriculture Organization of the United Nations (FAO), International Telecommunication Union (ITU), Economic Commission for Africa (ECA), United Nations Educational, Scientific and Cultural Organization and its Intergovernmental Oceanographic Commission (UNESCO/IOC), United Nations Environment Programme (UNEP), Office for Outer Space Affairs of the Secretariat, World Food Programme (WFP), World

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Health Organization (WHO) and World Meteorological Organization (WMO); and the following international organization: International Council for Science (ICSU).

II. Background

4. Climate change has been called the defining challenge of our time. Its impacts are already showing and will intensify over time if left unaddressed. There is overwhelming scientific evidence, as shown in the fourth assessment report of the Intergovernmental Panel on Climate Change (IPCC), that climate change will threaten economic growth and long-term prosperity, as well as the very survival of the most vulnerable populations. IPCC projections indicate that if emissions continue to rise at their current pace and are allowed to double from their pre-industrial level, the world will face an average temperature rise of about 3°C in this century. Serious impacts are associated with this scenario, including sea-level rise, shifts in growing seasons and increasing frequency and intensity of extreme weather events such as storms, floods and droughts.

5. The impacts of climate change are also expected to have consequences for the availability of freshwater around the world. The lack of information on water represents a critical drawback that hinders the ability of Governments to completely understand the status of water resources at the basin and continental levels, identify the impacts of climate change on water availability and set up adaptation and mitigation measures to cope with existing and future crises.

6. The use of satellites to monitor processes and trends at the global scale is essential in the context of climate change. Activities foreseen in this context are: continued observations and long-term monitoring of solar spectral irradiation to improve our knowledge and understanding of the influence of solar electromagnetic radiation on the Earth's environment, including the climate; continued observations to characterize changes in the atmosphere, oceans and land surface, and the use of such information for climate change modelling; and continued observations of changes in the ozone layer and their effects on the environment and human health.

7. Land cover and land cover change assessment and its dynamics are recognized as essential for the sustainable management of natural resources, environmental protection, food security and climate change and humanitarian programmes. The strengths of remote sensing when applied to assessments of land cover and land cover change stem from its ability to provide spatially explicit information and repeated coverage, including the possibility of covering large and/or remote areas to which access is otherwise difficult. Archives of remote sensing data span several decades and can therefore be used to reconstruct past time series of land cover and land use.

8. 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. However, for satellite data to contribute fully and effectively to the determination of long-term records, it is important to ensure that satellite-based data are climatically accurate and homogeneous. To meet this requirement,

national and intergovernmental space agencies have agreed to address several climate-observing requirements.

9. The present report provides an overview of space-based technologies used to monitor the various manifestations of climate change and its impacts undertaken by individual United Nations entities and other international organizations, and presents information regarding the three global observing systems, GCOS, GOOS and GTOS, which are co-sponsored by United Nations entities.

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

10. The United Nations Framework Convention on Climate Change provides the global framework within which countries cooperate to address climate change. Its ultimate objective is to stabilize greenhouse gas concentrations in the atmosphere at a level that will prevent dangerous human interference with the climate system.

11. The United Nations climate change negotiations serve as the international platform for stepping up international action on climate change. A comprehensive, ambitious and effective agreement is essential to the global transition to a green economy and sustainable development and, most urgently, to helping the world's population, especially the most vulnerable, to adapt to impacts that are now inevitable.

12. The sixteenth session of the Conference of the Parties to the United Nations Framework Convention on Climate Change, held in Cancun, Mexico, from 29 November to 10 December 2010, resulted in the adoption of a package of decisions known as the Cancun Agreements.

13. The preamble of decision 1/CP.16 of the Cancun Agreements recognizes that climate change represents an urgent and potentially irreversible threat to human societies and the planet, and thus must be urgently addressed by all parties. With particular regard to adaptation, relevant multilateral, international, regional and national organizations have been invited to undertake and support enhanced action on adaptation at all levels, including under the Cancun Adaptation Framework, in a coherent and integrated manner and building on synergies among activities and processes.

14. In the context of enhanced action on mitigation, developing countries are encouraged to contribute to mitigation actions in the forest sector by undertaking the following activities, as appropriate: reducing emissions from deforestation; reducing emissions from forest degradation; conservation of forest carbon stocks; sustainable management of forests; and enhancement of forest carbon stocks (known as REDD-plus activities). International organizations are invited to contribute to the above-mentioned REDD-plus activities, their coordination and their support.

15. In addition, the Conference in Cancun advanced work under the Subsidiary Body for Scientific and Technological Advice (SBSTA), which regularly considers issues relevant to climate change science, research and systematic observation. A decision on systematic climate observations (decision 9/CP.15) adopted by the Conference of the Parties at its fifteenth session, held in Copenhagen in December 2009, contains provisions to further enhance climate observations,

including through observations from space, coordinated through the Committee on Earth Observation Satellites, and refers to activities to be undertaken by GCOS and GTOS. In particular, the decision encourages the Committee on Earth Observation Satellites to continue coordinating and supporting the space-based component of GCOS and other related activities to meet relevant needs set forth in the Convention.

16. At its thirty-third session, held during the Cancun Conference, SBSTA considered a number of issues relevant to the systematic observation of the climate, in particular in relation to work undertaken by GCOS, GTOS and the Committee on Earth Observation Satellites. In this regard, SBSTA welcomed the update of the Implementation Plan for the Global Observing System for Climate in Support of the United Nations Framework Convention on Climate Change and requested parties to work towards the implementation of that plan. It also welcomed the Committee's coordinated response to relevant needs of GCOS and the Convention and the progress and commitment by space agencies involved in global observations to improve climate-monitoring capabilities on a sustained basis. Parties that support space agencies in such observations are encouraged to continue and to respond to the relevant needs identified in the updated GCOS plan.

III. Global observing systems

Global Climate Observing System

17. GCOS, co-sponsored by UNEP, UNESCO/IOC, WMO and ICSU, was established in 1992 with the aim of ensuring that observations needed to address climate-related issues are obtained and made available to all potential users.

18. In 2010 the GCOS programme published an update of the Implementation Plan for the Global Observing System for Climate in Support of the United Nations Framework Convention on Climate Change, in which it called for sustained observations of the essential climate variables (ECVs) that are needed to make significant progress in the generation of global climate products and derived information. In total, 50 ECVs are required to support the work of the Framework Convention and IPCC. Most observations of ECVs are space-based.

19. To help national and intergovernmental space agencies involved in observing ECVs, the GCOS programme has prepared a detailed set of requirements for more systematic and coordinated observation of climate from space. Meeting the GCOS requirements will provide a vastly improved information basis from which nations can make more informed decisions on how to respond and adapt to climate change.

20. The GCOS satellite requirements were developed in collaboration with the World Climate Research Programme (WCRP), WMO and the climate community at large. Laid down in the 2006 publication entitled Systematic Observation Requirements for Satellite-based Products for Climate (GCOS-107, WMO/TD-No. 1338), which is currently being updated, the GCOS satellite requirements consist of detailed specifications on accuracy, stability over time and spatial/temporal resolution of satellite data and derived products. They also include the 10 satellite-specific GCOS climate monitoring principles. Satellite climate data records that meet the GCOS requirements would have significant added value for

climate monitoring, studies of trends and variability, assimilation in models and, ultimately, decision-making in many societal sectors, including agriculture, water resource management, forestry and marine applications.

21. National and intergovernmental space agencies have taken coordinated action in responding to the GCOS requirements, both individually and collectively through the Committee on Earth Observation Satellites and the Coordination Group on Meteorological Satellites (CGMS). This applies to climate-proof operation of satellite systems and of coordinated exploitation of acquired datasets, for example, in the Sustained Coordinated Processing of Environmental Satellite Data for Climate Monitoring (SCOPE-CM) initiative. WMO, for its part, has incorporated GCOS needs in the redesign of its Global Observing System, to take place over the next two decades.

22. GCOS reported to the thirty-third session of SBSTA, introducing the completed update of the Implementation Plan, which is expected to increase the capacity to enable significant progress in modelling, prediction and the provision of climate services. SBSTA invited the GCOS secretariat to report on progress made in the implementation of the updated plan on a regular basis, at subsequent sessions of SBSTA, and emphasized the urgent need to secure funding to meet the essential needs of global climate observations under the Convention on a long-term basis.

Global Ocean Observing System

23. The ocean is an integral part of the global climate system. The ocean absorbs 50 per cent of the excess heat of global warming, controls weather systems and influences decadal climate variations by slowly transporting heat around the world. IPCC has emphasized the role the oceans play in controlling climate and how important understanding ocean processes is for informed decision-making about societal responses to climate change.

24. Sea-level change has been identified as one of the most obvious results of climate change, and has been monitored from space since 1992. Sea-level rise is driven by expansion of the upper ocean layers due to increases in subsurface ocean temperature and slightly modified by the transfer of water between the oceans and land-based reservoirs. Local sea level is also strongly influenced by regional and local effects, including natural earth movements and human-induced land subsidence due to freshwater extraction. These factors are of critical importance for densely populated low-lying coastal regions prone to storm flooding, such as Bangladesh and the deltas of the Nile and the Mississippi.

25. An essential element of GOOS for climate change studies is satellite data streams. Sea surface temperature is vital for weather prediction and for understanding coupled ocean-atmosphere dynamics required for climate prediction. Ocean colour is an indicator of biological activity. Ocean life is dependent on the biogeochemical status of the ocean, which is affected by changes in its physical state and circulation. Sea ice extent is important as an indicator and as a driver of climate change and because of its important role in polar ecosystems and navigation.

26. UNESCO/IOC began planning for GOOS in 1990 at the request of member States that recognized the importance of a unified ocean observation system. GOOS is led by IOC and co-sponsored by WMO, UNEP and ICSU.

27. With the advent of GOOS, for the first time in history the world's oceans are now beginning to be routinely and systematically observed, and the data processed in time to make useful decisions. By its very nature, climate change studies require long-term observation records. A sustained and complete GOOS is absolutely necessary to understand the impact of changing climate, assess regional vulnerability and monitor the efficacy of adaptation and mitigation efforts.

28. Notable GOOS milestones in recent years include reaching the target of 3,000 Argo profiling floats, which record temperature and salinity in the upper ocean, and 1,250 surface-drifting buoys, which record surface currents, temperature and atmospheric pressure. There has been a substantial increase in the number of tide gauges now reporting in near-real time and providing tsunami-detection capability. Several new reference-site moorings have been deployed, and the tropical moored array of buoys, already operational in the Pacific, continues to develop in the Atlantic and Indian Oceans. Recent agreements by the Committee on Earth Observation Satellites to support the continuity of critical satellite observations of sea level, surface winds, sea ice extent and ocean colour offer the hope of sustained provision.

29. The requirements for ocean observations for climate monitoring, research and forecasting are set by the Ocean Observations Panel for Climate (OOPC), reporting to GOOS and WCRP, and through GCOS to the Framework Convention on Climate Change.

30. An ongoing dialogue with the Committee on Earth Observation Satellites and CGMS ensures continuity of key ocean data streams from satellite observations.

31. During the thirty-third session of SBSTA, parties noted that the future work plan of GOOS includes emerging essential climate variables on ocean chemistry and ecosystems and noted the relevance of those variables in tracking the impacts of climate and acidification on ocean ecosystems.

Global Terrestrial Observing System

32. GTOS — an inter-agency programme of FAO, UNEP, UNESCO, WMO and ICSU — has worked towards raising awareness regarding the utilization of remote sensing data in supporting sustainable development during statutory meetings of the Convention on Biological Diversity, the Framework Convention on Climate Change, the United Nations Convention to Combat Desertification, the Ramsar Convention on Wetlands and the Convention on the Conservation of Migratory Species of Wild Animals.

33. The utilization of remote sensing data, together with in situ data and information, has generated great interest among the States parties to those Conventions in terms of reporting and overall monitoring of the sustainable use of natural resources. Particular emphasis has been placed on very fragile ecosystems, such as those in coastal areas that are rich in biodiversity and greatly affected by population pressure.

34. The Framework Convention on Climate Change has welcomed the efforts of the GTOS secretariat to develop a framework for the preparation of guidance materials, standards and reporting guidelines for terrestrial observing systems for climate in response to an invitation from SBSTA. SBSTA also encouraged GTOS to continue its work and to assess the status of the development of standards for each of the ECVs in the terrestrial domain.

35. GTOS has been playing a leading role in defining the terrestrial ECVs within its overall mandate of improving the understanding of the terrestrial components of the climate system, the causes of changes in the system and consequences in terms of impact and adaptation.

36. The conclusions of the thirty-third session of SBSTA further noted the increased usefulness of the terrestrial ECVs beyond observations on climate in such areas as biodiversity and desertification, and encouraged the GTOS secretariat to increase synergy with ongoing relevant initiatives.

IV. Activities of United Nations organizations

Food and Agriculture Organization of the United Nations

37. In the context of climate change, it is well known that deforestation leads to emissions of greenhouse gases, and reforestation is an option to store carbon.

38. Reducing emissions from deforestation and forest degradation allows developing countries to contribute to mitigation actions in the forestry sector and reduce emissions from forested lands. The Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (UN-REDD), a partnership between FAO, the United Nations Development Programme and UNEP, was launched in 2008 and supports countries in developing capacity for REDD-plus and in implementing REDD-plus activities in a post-2012 climate regime. The programme works at both the national and the global scale, through support mechanisms for country-driven REDD-plus strategies and international consensus-building on REDD-plus processes.

39. FAO helps countries to establish satellite forest monitoring systems (SFMS) based mainly on the technology developed by the Brazilian National Institute of Space Research (INPE) to support Amazon monitoring systems. There is a strong collaboration between FAO and INPE in capacity-building in the UN-REDD pilot countries in terms of remote sensing and satellite-based forest monitoring.

40. In the context of national forest inventories to assess carbon stocks and carbon stock changes, implementation and interpretation include remote sensing tools that will be harmonized with SFMS. In UN-REDD countries (e.g. Ecuador and the United Republic of Tanzania), FAO has made extensive use of remote sensing data to set up the field plots for the national forest inventory. Both high-resolution (CBERS2B, SPOT, Landsat) and low-resolution (e.g. MODIS) imagery is used, as well as digital terrain models. The use of optical data will be complemented with radar data in the future in order to overcome the problem of cloud cover.

41. FAO uses data from Earth observation satellites for the food security early warning system now known as the Advanced Real Time Environmental Monitoring

Information System (ARTEMIS), an automated hardware/software configuration capable of receiving and processing about 100 MB of satellite data per day. The ARTEMIS archives, dating to 1982, contain a wide variety of environmental monitoring information products. The main use of these products is in the field of early warning for food security, in particular by the Global Information and Early Warning System on food and agriculture, run by FAO, and for agriculture production forecasts.

42. The FAO Rainfall Estimation (RFE) is a new, independent method of estimating rainfall amounts, particularly for certain regions where the coverage of weather stations is limited. FAO RFE methodology is transferred to national meteorological agencies on demand.

43. The FAO methodology of combining information derived from historical disasters with current remote sensing data improves anticipation of tropical cyclone system impact and supports special actions to be taken both during and immediately following an event. The FAO Rapid Agricultural Disaster Assessment Routine (RADAR) has been used, for example, in the assessment of the impact of Hurricane Mitch on the Honduras agricultural production system. This approach combines pre- and post-impact data available through remote sensing to model impacts and generate preliminary assessments very quickly, which enhances the effectiveness and accuracy of planning for emergency operations.

International Telecommunication Union

44. 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.

45. As the steward of the radio-frequency spectrum and satellite orbits, and as the global telecommunication standardization body, ITU creates regulatory and technical bases for the development and effective operation of satellite climate monitoring and data dissemination systems by allocating the necessary radio-frequency spectrum and satellite orbit resources; analysing compatibility between new and existing satellite systems; carrying out studies and developing treaty-status (Radio Regulations) and voluntary (ITU recommendations) international standards for space-based and other telecommunication systems and networks; and providing guidance and support for the use of satellite 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 that track the progress of hurricanes and typhoons and weather radar for tracking tornadoes, thunderstorms and the effluent from volcanoes and major forest fires; (b) radio-based meteorological aid systems that collect and process weather data; (c) different radiocommunication systems (satellite and terrestrial) used for the dissemination of information concerning different natural and man-made disasters; and (d) ITU Radiocommunication Sector recommendations, reports and handbooks on radiocommunication systems and radio-based applications operating in Earth-exploration satellite, meteorological-aid and meteorological satellite services, which

today provide most of the data to assist administrations in spectrum planning, engineering and deployment of satellite and terrestrial radiocommunication technologies for environment observation, climate control, weather forecasting and natural and man-made disaster prediction, detection and mitigation.

46. 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, in 2009 WMO and ITU held their first joint seminar, on the theme "Use of the radio spectrum for meteorology: weather, water and climate monitoring and prediction", at WMO Headquarters in Geneva, as an open forum for exchange of views and information between representatives of meteorological and radiocommunication communities. The next such event is planned for 2013.

Economic Commission for Africa

47. ECA, the African Union and the African Development Bank have initiated a programme to ensure that adequate information is available for the development of policies on climate issues, including setting up an African climate policy centre at ECA. As one of its activities, ECA is implementing a geospatial database, which in addition to collecting data directly, relies on datasets being collected by other agencies and national offices of member States, taking into account a distributed database architecture that provides access to the cooperating databases. ECA organized a consultative meeting of partners in September 2009, in which the participants endorsed the provision of assistance to African countries and institutions to implement web-based services to enable the transparent sharing of geospatial data and services on climate change issues.

48. In cooperation with the Institute of Global Mapping and Research of the European Academy of Sciences and Arts, ECA is developing a pan-African atlas, focusing on land- and water-related data in order to address issues such as food security, land degradation, water management, disaster risk management and climate change adaptation, by providing relevant data and information in the different sectors. The main objectives are to establish a data warehouse and an online atlas accessible continent-wide through nodes in subregions, centres of excellence, national focal points and the academic community, to support research, training and decision-making on the continent, and to facilitate risk mapping for prevention and preparedness, disaster management, risk reduction, and mitigation of climate change impacts.

United Nations Educational, Scientific and Cultural Organization and its Intergovernmental Oceanographic Commission

49. The UNESCO International Hydrological Programme develops a scientific knowledge base, assisting water authorities and Governments in responding and adapting to the water-resource challenges brought by climate change, to enhance governance in water resources management and to facilitate education and capacity-building development.

50. The Water and Development Information for Arid Lands — a Global Network (G-WADI) initiative of the International Hydrological Programme and the Center for Hydrometeorology and Remote Sensing of the University of California, Irvine, have developed a GeoServer that provides users worldwide with access to high-resolution satellite-based quasi-global precipitation products in near-real and real time. The products are derived using the Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks (PERSIANN) Cloud Classification System (CCS), whose algorithm uses the gridded infrared images from the global geosynchronous satellites provided by the Climate Prediction Center of the National Oceanic and Atmospheric Administration.

51. The G-WADI products such as online data access and visualization tools that allow hydrologists access to high-resolution precipitation estimates in near-real and real time are customized to suit the needs of Member States in terms of ability to view and categorize the data by country and multiple-scale watersheds. These tools are instrumental for assessing and managing the available and renewable water resources in arid and semi-arid regions.

52. PERSIANN precipitation data are also used at user-defined time and spatial scales through the G-WADI initiative. A prototype of the drought monitor system is now available online for testing and validation over different African subregions. By adding observations, such as soil moisture remote sensing and seasonal climate forecasts, the accuracy of the simulations could be improved and the resolution of the system could be increased to develop an operational-scale system.

53. The international Terrestrial Initiative of Global Environmental Research (TIGER), led by the European Space Agency (ESA) in collaboration with UNESCO, assists African countries in overcoming problems faced in the collection, analysis and use of water-related geo-information by exploiting the advantages of Earth observation technology. The second phase of TIGER (2009-2012) is devoted to supporting African scientists in developing the scientific skills and the technical capacity to make the best use of Earth observation technology to better understand, assess and monitor the status of water resources in Africa, as well as the potential impacts of climate change, thus establishing sound scientific bases for developing effective adaptation or mitigation measures at the political level on the continent. Currently, 20 projects with Earth observation technology components have been identified to assess various aspects of water resources management in Burkina Faso, Chad, the Democratic Republic of the Congo, Egypt, Kenya, Madagascar, Mali, Morocco, Namibia, Senegal, South Africa and Zambia

54. Along with the Arctic and the Antarctic, the Tibetan plateau and surrounding mountains represent one of the largest ice masses on the Earth. The region, referred to by scientists as the Third Pole, covering 5 million square kilometres and including more than 100,000 square kilometres of glaciers, is the most sensitive and readily visible indicator of climate change. UNESCO, the Scientific Committee on Problems of the Environment and the Chinese Academy of Sciences will launch the Third Pole Environment programme, aimed at advancing knowledge of the environmental changes occurring in the Third Pole and their ecological, social and economic impacts.

55. In addition to being the primary sponsor of GOOS, UNESCO/IOC co-sponsors active programmes in climate research that depend on space-based remote sensing

data. These include the World Climate Research Programme, co-sponsored with WMO and ICSU, and an active programme in research and synthesis on the ocean carbon cycle under the International Ocean Carbon Coordination Project, with the Scientific Committee on Oceanic Research. Those programmes are designed to coordinate scientific research using space-based and in situ observations, ultimately generating information of use to society as it plans for climate change mitigation and adaptation.

United Nations Environment Programme

56. In 2005 UNEP published the atlas entitled *One Planet, Many People: Atlas of Our Changing Environment*, which presented hundreds of examples of environmental change through "before and after" comparisons of Landsat images, some of which related directly to regional and global climate change. One example is the area spanning the border between Kenya and the United Republic of Tanzania, an area that is directly dependent on ground-water discharge from Kilimanjaro. Another example is the significant change in Lake Faguibine, which has prompted high-level national action to rehabilitate the lake's supply and to ensure its more sustainable use. The success of the atlas and its proven appeal as a format for communication with policymakers and the general public has spawned numerous follow-on products for Africa, in which satellite images are used to highlight environmental change, climate-related and otherwise.

57. In order to further enhance cooperation and coordination, in particular among the countries sharing the waters of the western Indian Ocean, UNEP, in its capacity as secretariat of the Nairobi Convention, promotes the protection, management and development of the marine and coastal environment by supporting national planning through analysis of coastal zone impacts of climate change on mangrove distribution and health in Kenya, Mozambique and the United Republic of Tanzania. Those studies gauge the extent of impact and the shifting patterns of exploitation from climate-induced changes. Landsat and Quickbird images are being combined with high-resolution aerial survey photos to provide a longitudinal analysis of how those commercially and environmentally important ecosystems are being impacted.

Office for Outer Space Affairs of the Secretariat

58. Efforts on climate change conducted by the Office for Outer Space Affairs are traced to the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III), held in Vienna in 1999, where Member States recognized the contribution of space science and space applications to the well-being of humanity and development in areas such as disaster management, meteorological forecasting for climate modelling, satellite navigation and communications. Such recognition led to the proposal for the nucleus of a strategy to address global changes in the future, which highlighted, among other things, the protection of the Earth's environment, the management of its resources, the use of space applications for human security, development and welfare, including to manage natural disaster mitigation, relief and prevention efforts, and the strengthening of the coordination of space activities in the United Nations system.

59. Some examples of the recent capacity-building and awareness-raising activities organized by the Office in relation to UNISPACE III include the following: the United Nations/UNESCO/Saudi Arabia International Conference on the Use of Space Technology for Water Management, which was held in 2008 and addressed the application of space technologies to target water-related problems and issues induced by climate change; the United Nations/Kenya/ESA Regional Workshop on Integrated Space Technology Applications for Monitoring Climate Change Impact on Agricultural Development and Food Security, which took place in 2008 and promoted the integrated use of space technologies in applications that could contribute to the prevention and mitigation of global climate change-induced issues; and the United Nations/Indonesia Workshop on Integrated Space Technology Applications to Water Resources Management, Environmental Protection and Disaster Vulnerability Mitigation, which was also held in 2008 and focused on the impact of climate change.

60. In 2009, the Office organized the nineteenth United Nations/International Astronautical Federation (IAF) Workshop on Integrated Space Technologies and Space-based Information for Analysis and Prediction of Climate Change, which focused on the use of space technologies to monitor climate change in the atmosphere, on land and in the oceans and its impacts; the United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER) workshop on building capacities to reduce disasters, which included explicit discussions on the impacts of climate change on small island developing States and potential adaptation strategies; and the UN-SPIDER International Workshop on the theme “Disaster management and space technology: from concepts to application”, which included presentations and discussions on the contribution of space-based technologies to mitigate the impact of and enhance adaptation to global climate change utilizing innovative monitoring and analysis tools.

61. In 2010, the Office carried out the United Nations/Bolivia/ESA Workshop on Integrated Space Technology Applications in the Mountain Regions of the Andean Countries, as well as a number of UN-SPIDER events, including the regional workshop on the theme “Building upon regional space-based solutions for disaster management and emergency response for Africa”, held from 6 to 9 July 2010 in Addis Ababa, where applications of space technology to mitigate the impact of climate change were discussed. For 2011, the Office is working on the organization of the second United Nations/Argentina/Prince Sultan bin Abdulaziz International Prize for Water/ESA International Conference on the Use of Space Technology for Water Management and on the United Nations/Syrian Arab Republic Workshop on the theme “Integrated space technology applications: support for monitoring climate change and impact on natural resources”. A special session on the theme “Space for climate” will be organized in cooperation with the Committee on Space Research at the United Nations/IAF Workshop on Space for Human and Environmental Security.

World Food Programme

62. WFP uses vegetation indices and rainfall data from moderate- to low-resolution Earth observation satellites to monitor the agricultural season and identify threats to food security in advance. A key factor for this type of analysis is the availability of medium- to long-term time series of Earth observation data,

which allow for the identification of areas with significant inter-annual variability and trends in key diagnostic factors (biomass productivity proxies, growing-season timing). This ongoing monitoring process generates a critically important data and information platform that allows WFP and its partners (Governments, national and regional institutions and non-governmental organizations) to implement extensive food-security planning.

63. WFP analysis also embraces potential food-security risks emerging from environmental and socio-economic vulnerability to climate variability and projected climate change impacts at the country and regional levels. Low-resolution Earth observation data (for instance, through MODIS) are being used in combination with food-security and vulnerability data to monitor and anticipate the potential impacts of climate-related hazards. Operational decision-making and risk-management action are informed by such information.

64. In collaboration with partners, WFP has been introducing important innovations in risk management at the national level. Working with the Government of Ethiopia and partners such as the World Bank, WFP has recently developed a specialized service supporting national risk management. The Livelihood Enhancement, Assessment and Protection (LEAP) service uses ground and satellite rainfall data to monitor the Water Requirement Satisfaction Index and quantify the risk of drought or excess rainfall in different administrative units of Ethiopia. The information provided through LEAP supports the Government's decision-making and risk-management processes, including the activation of the national safety-net programmes that ensure protection for millions of food-insecure people who may be affected in various parts of the country.

65. More recently, WFP has been exploring, in partnership with the African Union Commission, a new continental mechanism, Africa RiskView, which, through satellite data, monitors and quantifies weather-related food-security risks in Africa. Africa RiskView should provide information about potential crop losses and guide contingency funding allocations to African Union member States through the use of a common risk pool.

World Health Organization

66. WHO has a long-standing programme on health protection related to climate change, now organized under a specific resolution adopted by the World Health Assembly in 2008, and a workplan endorsed by its Executive Board in 2009.

67. Climate change has important implications for human health. Some of the largest contributors to the global burden of disease, including malnutrition, infectious diseases such as diarrhoea and malaria, and weather-related disasters, are sensitive to climate variability and change. WHO therefore works to strengthen the essential health-system functions that can help to protect vulnerable populations from climate-sensitive health impacts, drawing on contributions from a wide range of technical programmes at its headquarters and regional and country offices.

68. WHO works with partners in the developed and developing worlds to promote the integration of remotely sensed environmental and Earth-science data with in situ public health surveillance data for a better understanding of the relationship

between potential risk factors and public health outcomes. This includes collaboration with WMO, the Office for Outer Space Affairs, UN-SPIDER and the United Nations Institute for Training and Research Operational Satellite Applications Programme (UNOSAT).

69. Space-based technologies are used to support WHO operational work, such as mapping of the geographic distribution of meteorological hazards to public health and critical public health infrastructure. For example, the Vulnerability and Risk Analysis and Mapping (VRAM) programme uses remotely sensed and other environmental information and combines it with disaggregated vulnerability and capacity indicators to identify population and health services at risk to hazards such as floods, droughts and heat waves and to enhance disaster risk-reduction efforts.

70. Remote sensing technology is also well suited to the dynamic nature of outbreaks and epidemics of infectious diseases, which may often be triggered by extreme weather. WHO uses these technologies to improve outbreak awareness, preparedness and response, and works with a diverse community of partners to provide information and develop models to support preparedness response and control strategies. The use of remote sensing has significantly advanced the ability of WHO to track and visualize the real-time evolution of local outbreaks and epidemics, providing support to the daily activities of the WHO Centre for Strategic Health Operations.

71. WHO also uses geospatial information in its programmes for specific diseases, such as Rift Valley fever, yellow fever, cholera, plague and leptospirosis. Notably, the Meningitis Environmental Risk Information Technologies project is a collaborative initiative of WHO and other members of the environmental, public health and epidemiological communities. The project is aimed at reducing the burden of epidemic meningococcal meningitis across Africa's "meningitis belt" by integrating knowledge of environmental influences, such as absolute humidity, absorbing aerosols, rainfall and land cover, to develop a decision-support tool and inform the current vaccination strategies. The project also serves as an example to facilitate the use of environmental information in public health decision-making more generally.

World Meteorological Organization

72. 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.

73. In 1979 and 1990 WMO organized the first and second World Climate Conferences. Those two Conferences influenced the establishment of a number of important international scientific initiatives, such as IPCC, co-sponsored by WMO and UNEP, and winner of the Nobel Peace Prize in 2007; GCOS, co-sponsored by UNEP, UNESCO/IOC, WMO and ICSU; the WMO World Climate Programme; and the World Climate Research Programme, which is co-sponsored by IOC/UNESCO, WMO and ICSU. The second World Climate Conference also called for the

establishment of a climate convention, adding momentum to international efforts that resulted in the United Nations Framework Convention on Climate Change, concluded in 1992.

74. The third World Climate Conference, held in Geneva in 2009, led to an agreement to create a global framework for climate services to strengthen the production, availability, delivery and application of science-based climate prediction and services. The continued participation and active involvement of all United Nations organizations having an interest in, or whose activities are affected by, climate variability and change are needed. The global framework is based on a strong foundation of observations, including space-based observations.

75. The WMO Global Observing System (GOS) has grown substantially since 1961, and now includes constellations of operational satellites in geostationary and low-Earth orbit, and of research and development satellites.

76. To address both GCOS and other programme requirements, WMO has developed a new "Vision for the Global Observing System in 2025". The scope and benefits of GOS in the future will encompass the fields of meteorology, climate monitoring, including the oceanic and terrestrial domains, hydrological and environmental services and related disaster detection and monitoring. The space-based component of GOS will continue to rely on the satellite agencies of WMO members, in partnership with CGMS and the Committee on Earth Observation Satellites. The new GOS will continue to serve as one of the major systems in the Group on Earth Observations (GEO) Global Earth Observation System of Systems, thereby serving several of the GEO societal benefit areas. Of particular relevance to climate monitoring is the Global Space-based Inter-calibration System, which will ensure the consistency of satellite measurements from different satellite operators and different programmes over time through cross-calibration against reference instruments and calibration targets.

77. In addition to the physical infrastructure of GOS, WMO works along the entire continuum from observations to users. Activities along this continuum include observations from the contributing space agencies of GOS, inter-calibration efforts for those observations, product-generation activities, such as SCOPE-CM, data-distribution and -dissemination efforts and training and capacity-building efforts, such as the WMO/CGMS Virtual Laboratory for Training and Education in Satellite Meteorology to ensure that WMO members and their partners can benefit from those space-based observations.

V. Activities of other international organizations

International Council for Science

78. ICSU has a long tradition of cooperation with several United Nations organizations in scientific activities and programmes addressing climate change. Most of those activities and all programmes make full use of available space technologies. The most important endeavours in this regard are listed below.

79. ICSU co-sponsors global environmental change research programmes and other related programmes, which address primarily or at least significantly climate

change, including its impacts, using a large amount of data obtained from satellites. Such programmes include the World Climate Research Programme (WCRP), the International Geosphere-Biosphere Programme (IGBP), the DIVERSITAS international biodiversity research programme, the International Human Dimensions Programme (IHDP) on Global Environmental Change, the Earth System Science Partnership established by WCRP, IGBP, DIVERSITAS and IHDP, the Integrated Research on Disaster Risk programme and the Programme on Ecosystem Change and Society.

80. The Committee on Space Research of ICSU encompasses all disciplines of space research, from Earth sciences to astronomy, planetary exploration, solar physics, plasma and magnetosphere studies, life sciences, microgravity and fundamental physics. The Committee's Scientific Commission on Space Studies of the Earth's Surface, Meteorology and Climate is among the most active ones.

81. The Assemblies of the Committee on Space Research provide an opportunity for the regular exchange of up-to-date scientific information on all disciplines of space research. The thirty-eighth Scientific Assembly, held in Bremen, Germany, from 18 to 25 July 2010, with over 3,000 scientists attending, ascribed special importance to Earth and climate science. The programme included a keynote inaugural lecture on climate change, a space-agency round table on space and global change, a session on science and technology in global Earth observation and a symposium on solar variability, cosmic rays and climate.

VI. The way forward

Delivering as one within the United Nations System Chief Executives Board for Coordination Climate Change Action Framework

82. In the context of the United Nations system and under the leadership of the Secretary-General, the United Nations, System Chief Executives Board for Coordination (CEB) has established a framework to coordinate the work of United Nations agencies to respond to the global and multifaceted challenge of climate change. The initiative brings together expertise and ongoing work in diverse areas ranging from science and technology to agriculture, transport, forestry and disaster risk reduction, to address both mitigation and adaptation, with particular emphasis on implementation. It brings together the normative, standard-setting and knowledge-sharing capacities of the system with its operational reach in order to support the most vulnerable.

83. The framework has been structured in terms of five focus areas and four cross-cutting areas. The focus areas are: adaptation; technology transfer; forestry and agriculture; financing mitigation and adaptation action; and capacity-building. The cross-cutting areas are: climate knowledge: science, assessment, monitoring and early warning; supporting global, regional and national action; climate-neutral United Nations; and public awareness.

84. Taking into consideration the role of CEB in coordinating the efforts of United Nations entities to deliver as one on climate change, it is recommended that the

Office for Outer Space Affairs, as the secretariat of the Inter-Agency Meeting on Outer Space Activities, report to CEB, through the High-level Committee on Programmes, on efforts conducted by United Nations agencies in the use of space-based technologies to monitor climate change and its impacts.

85. Furthermore, taking into consideration the role of the Inter-Agency Meeting on Outer Space Activities in facilitating the exchange of experiences and lessons learned among United Nations agencies, and as a platform to enhance coordination and cooperation among those agencies, the Inter-Agency Meeting agrees to:

(a) Promote the establishment and operation of a global repository of satellite-based data to ensure access to such data by all United Nations entities through inter-agency mechanisms, such as the United Nations Geographic Information Working Group;

(b) Contribute to the enhanced use of space technology to address relevant needs identified under the United Nations Framework Convention on Climate Change and support actions to implement the Convention, such as in the context of the Cancun Agreements and work under SBSTA;

(c) Facilitate, through existing mechanisms, the exchange of experiences and lessons learned regarding space applications in the context of climate change, and the benefits and limitations of emerging technologies;

(d) Support the needs identified through ongoing initiatives, such as the Global Framework for Climate Services; the ARTEMIS and RADAR initiatives; and efforts conducted by other United Nations entities.