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Space and global health

Review of responses to the set of questions on the policies, experiences and practices in the use of space science and technology for global health

Note by the Secretariat

I. Introduction

1. At its sixty-first session, in 2018, the Committee on the Peaceful Uses of Outer Space noted the crucial role of space data and technology in the public health domain and welcomed the establishment of a new item entitled "Space and global health" on the agenda of its Scientific and Technical Subcommittee, as well as of a working group under that item, with Antoine Geissbühler (Switzerland) as Chair.

2. In February 2019, the newly established Working Group on Space and Global Health of the Subcommittee agreed on its workplan (A/AC.105/1202, Annex III, Appendix I), and noted that the workplan provided a structured pathway towards enhancing national capacities in harnessing the contribution of space to the global health agenda. The Working Group also agreed on the questionnaire (A/AC.105/1202, Annex III, Appendix II), that would be circulated by the Secretariat to States members of the Committee and international intergovernmental and non-governmental organizations.

3. On the basis of the responses to the set of questions regarding policies, experiences and practices in the use of space science and technology for global health, received from States members of the Committee and international intergovernmental and non-governmental organizations, the Chair of the Working Group prepared an analysis of experiences and capacities in using space science and technology and their applications for global health, with a view of developing a draft set of recommendations on topics of interest within the health and space domains that could provide an orientation for presenting those recommendations to the General Assembly in the form of a draft resolution.

* Second reissue for technical reasons (27 April 2021).
** A/AC.105/C.1/L.387.

II. Review of responses received from Member States and international organizations

Background

4. In line with the workplan of the Working Group on Space and Global Health, the Office for Outer Space Affairs of the Secretariat, in its capacity as secretariat of the Committee and its subsidiary bodies, arranged for communication to be dispatched in 2019 and 2020 with the invitation to provide responses to a set of questions regarding policies, experiences and practices in the use of space science and technology for global health.

5. Responses received from States and organizations are available in six official United Nations languages as follows: Algeria, Australia, Japan, Philippines, Thailand, and the European Union (A/AC.105/C.1/117); the Russian Federation and Switzerland (A/AC.105/C.1/117/Add.1); Canada (A/AC.105/C.1/117/Add.2); Australia, Germany, Japan, Mexico, Paraguay, Turkey (A/AC.105/C.1/119); Hungary, India, Committee on Space Research (COSPAR), Economic and Social Commission for Asia and the Pacific (ESCAP), Space Generation Advisory Council (SGAC) (A/AC.105/C.1/119/Add.1); Argentina, Colombia, Egypt, Malaysia, Peru, Saudi Arabia, International Telecommunication Union (ITU), United Nations Environment Programme (UNEP) (A/AC.105/C.1/119/Add.2); Bulgaria and the Plurinational State of Bolivia (A/AC.105/C.1/119/Add.3).

Question 1

6. Under Question 1, respondents were asked to describe existing or planned formal cooperative agreements and other institutional arrangements (memorandums of understanding (MoU), letters of agreement, frameworks of collaboration, etc.) between the health sector and other sectors directly involved in space activities at the national level.

7. An analysis of responses on cross-sectoral linkages received from twenty-four States and six organizations, demonstrated examples of effective cooperation between the health sector and other sectors involved in space-related issues at different levels and between various actors, including governmental agencies, such as space agencies, Ministry of health, Ministry of information and communication technology, Ministry of environment, disaster management authorities, medical organizations and research institutions.

8. In a number of countries, at the time of providing responses to the questionnaire, there were no formal collaborative arrangements. In such cases, cooperation between the health sector and other sectors directly involved in space activities at the national level was carried out through science and technology projects or other joint activities and initiatives. In countries with existing formal arrangements, cooperation has been formalized through a range of bilateral instruments, such as cooperation notes, MoUs, umbrella MoU with supporting letters of agreements, and cooperation agreements.

9. A model example of multi-stakeholder coordination at the national level is the establishment of a dedicated inter-institutional body that facilitates collaboration among multiple national authorities. The joint collaboration is the eHealth Steering Committee of the Philippines, which connects the Department of Health, the Department of Science and Technology, the Department of Information and Communications Technology and the Philippine Health Insurance Corporation (PhilHealth) and aims to advance the use of information and communications technology, harnessing its utilization in health sectors, including the achievement of universal health care.

10. A broader although less formal mechanism that allows the involvement of a wider range of stakeholders beyond government authorities is a network/communication platform, which establishes cross-sectoral ties and initiates and consolidate synergies between the space and health sectors through the intensive exchange of knowledge and

ideas. In Germany, the “Space2Health” network is established as part of the DLR Space Administration’s “INNOspace” initiative and supports the strategic exchange between the space and health sectors.

11. In some cases, the development of a national space programme has been listed either as a prerequisite for formalizing inter-agency cooperation, or as a mechanism in itself providing a backbone for formalizing inter-institutional linkages. Hungary is currently working on the National Space Strategy of Hungary, which may facilitate the interoperability between space and non-space sectors. In Saudi Arabia, the Saudi Space Commission has started the “Space Generations (Ajyal) programme”, which is focused on nurturing national human capital. In Canada, the “Exploration, Imagination, Innovation:

12. Responses also featured the instrumental role of already adopted space strategies and policies in connecting space and health domains. A New Space Strategy for Canada”, launched in March 2019, outlines the health-related priorities of harnessing space to solve everyday challenges for Canadians, through, for example, improving remote medicine and health care; and ensuring leadership by Canada in the acquisition and use of space-based data to support scientific excellence, innovation and economic growth. In the Philippines, the recently enacted Philippine Space Act mandated the development of the Philippine Space Policy, of which two of the six development areas focused on health sector (e.g., national security and development; and hazard management and climate studies). In Germany, a central element of the space strategy of the Federal Government “Making Germany’s space sector fit for the future”, is to strengthen the links between the space industry and other sectors.

13. Thematically, the existing or planned cooperative agreements and other institutional arrangements could be grouped in the following broad areas: telemedicine and hospital networks connectivity , mapping of health resources and serving communities and remote areas, tele-epidemiology and public health, including in the areas of air quality, climate change and environmental pollution, vector-borne diseases and COVID-19, Space life sciences, disasters and health emergency management.

Telemedicine and hospital networks connectivity

14. In Algeria, a nationwide initiative has been implemented jointly by the telecommunications and health sectors with the aim of connecting 4,000 health-care facilities through the Algerian telecommunications satellite Alcomsat-1, to ensure equity and high-quality public services throughout the country, including in isolated and sparsely populated areas. In Switzerland, the GeoHealth research group of the University of Geneva signed an MoU with United Nations Population Fund aimed at optimizing the network of health facilities in ten African countries so that more women will have timely access to emergency care. The Global Fund to Fight AIDS, Tuberculosis and Malaria is working with the GeoHealth research group to develop new methods – involving the use of high-resolution geospatial data – to ensure better allocation of health resources in a number of African countries.

15. In the Plurinational State of Bolivia, the Bolivian Space Agency and the Ministry of Health and Sports concluded a service contract covering 215 locations throughout the country where tele-health services through the Túpac Katari satellite signal have been established. In Germany, within the DLR Institute of Aerospace Medicine Institute, a digital health working group is studying how modern technologies can be provided locally to patients over a spatial distance. In the Philippines, the eHealth Steering Committee works towards the development of the Philippine Health Information Exchange, which will allow the exchange of information among patients, health providers and health facilities. The group is open to the possibility of harnessing space technologies for Internet connectivity, to reach remote areas, especially geographically isolated disadvantaged areas.

Mapping of health resources and serving communities and remote areas

16. The Indian Space Research Organization (ISRO) of the Department of Space of the Government of India has signed an MoU with the Central Bureau of Health Intelligence of the Ministry of Health and Family Welfare for creation of the National Health Resource Repository, based on geospatial data (2017). ISRO also signed an MoU with National Medicinal Plants Board of the Ministry of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy for the mapping of rare and endangered species (2017).

17. In Thailand, the Faculty of Public Health cooperates with the Geo-Informatics and Space Technology Development Agency (GISTDA) and with the National Electronics and Computer Technology Center (NECTEC) to provide a platform for information on health and health-related issues on the basis of space information, such as for communities and villages.

Tele-Epidemiology and Public Health

18. In Argentine, the National Commission on Space Activities (CONAE) maintains cooperation with national institutes of health research, such as the National Institute of Tropical Medicine (INMET) and the National Centre for Endemic and Epidemic Disease Diagnosis and Research (CENDIE). In Mexico, the Mexican Space Agency currently collaborates closely with the National Academy of Medicine of Mexico, various health institutions and the faculties of medicine of several educational institutions in Mexico. The National Autonomous University of Mexico and the Mexican Space Agency have concluded a cooperation agreement providing for the establishment of a specialized division as part of the University's Faculty of Medicine. In Switzerland, the centre for the prevention of epidemics that is being set up at the University of Geneva will support more accurate epidemiological forecasting by integrating digital technologies into the global health approach and harnessing synergies between the life, social and data sciences.

19. Together with the World Health Organization, ITU has established the Focus Group on Artificial Intelligence for Health. The group is developing a framework for benchmarking artificial intelligence-based health solutions for assessing the quality and clinical relevance of solutions. As part of this initiative, 21 health areas are currently being explored, such as outbreak detections. The United Nations Environment Programme (UNEP) is in the process of developing a global environmental data strategy and implementing a large-scale and distributed data and knowledge platform with environmental data (the World Environment Situation Room). The UNEP data and knowledge platform uses space-derived data as a fundamental input for environmental data representation, supporting decision-making and action on environmental and health-related issues (climate change, nature-based solutions and biodiversity, pollution, etc.).

Air quality, climate change and environmental pollution

20. In Colombia, the Ministry of Health and Social Protection, through its Subdirectorate for Environmental Health, has concluded an MoU with the Clean Air Institute with the aim of providing a framework for technical cooperation in protecting human health and the environment by improving air quality and mitigating climate change. In Bulgaria, the Ministry of Health (resp. National Centre of Public Health and Analyses) took part in an International Project SEE-ERA.NET, in cooperation with the Institute of Space Research: Development of Strategy and Methods for Monitoring of Electromagnetic Pollution in the Environment of the Western Balkans.

21. In Switzerland, the Federal Office for Meteorology and Climatology (MétéoSuisse) works closely with the health sector through the National Centre for Climate Services. The Centre promotes dialogue among the various actors and coordinates the development and provision of climate services in seven priority areas, one of which is human health. The Federal Office of Public Health and the Federal Office for the Environment, which are members of the NCCS network, work together in building

knowledge bases and developing prevention measures to protect the human population from that impact.

22. ESCAP is in the process of establishing a trust fund agreement with the Korea International Cooperation Agency to implement, in partnership with the National Institute of Environmental Research of the Republic of Korea, a project on building the pan-Asia partnership for geospatial air pollution information. ESCAP is also developing a new project aiming at strengthening the capacity of member States of the Association of Southeast Asian Nations (ASEAN) to use satellite-derived data and integrated geospatial information to analyse and monitor air pollution and its negative impact on people in the ASEAN region. The project is being developed jointly with Seoul National University, National Research Institute of Environmental Research and the World Health Organization.

Vector-Borne Diseases

23. In Malaysia, the Ministry of Science, Technology and Innovation, through the Malaysia Space Agency (MYSA) and the Disease Control Division of the Ministry of Health, have signed a non-binding collaboration note on 15 June 2012. As a result of the collaboration, the online Dengue Outbreak Management System (DOMS) has been developed to assist in planning, monitoring and decision-making in the area of tracking and enforcing dengue-related measures throughout the country. A spin-off product, the iDengue Portal, is a medium for disseminating accurate and up-to-date dengue information to increase public awareness and encourage the public to take part in ensuring that their residential area remains free from a dengue outbreak.

24. Starting 2016, the cooperation between MYSA and the Disease Control Division has been expanded to other applications to assist the Ministry of Health in efforts to address malaria problems by developing the Malaria Geo-Reference Information and Coordination System for Malaria Elimination (MAGICs.ME). In addition, MYSA and the Disease Control Division have developed an integrated management system known as the Entomology and Online Pest Information System, or myEntoPest, to address issues related to entomology and pests throughout Malaysia.

25. In Argentine, the National Commission on Space Activities (CONAE), the space agency, maintains cooperation with the Ministry of Health entities such as the Directorate of Epidemiology and its Division for National Coordination of Vector Control (National Chagas' Disease Programme and National Dengue Programme).

26. In India, the Indian Space Research Organization (ISRO) of the Department of Space of the Government of India has signed an MoU with the National Institute of Malaria Research of the Indian Council of Medical Research of the Ministry of Health and Family Welfare for geo-health analytics for vector-borne diseases (malaria, dengue and chikungunya) using geoinformatics (2018).

27. In Paraguay, the Paraguay Space Agency (AEP) is working closely with the Ministry of Health, specifically with the National Malaria Eradication Service (SENEPA), which deals with all vector-borne diseases. The main objective of this collaboration is to provide tools for better decision-making using satellite data and geographic information systems (GIS), learning from the best practices and lessons learned of other countries. The collaboration between AEP, Pacific University and the Center of Geomatic Studies makes it possible for GIS students to develop projects to solve real health-related problems.

28. In November 2018, the Government of Canada created an interdepartmental MoU between the Canadian Space Agency Government Related Initiatives Program and the Public Health Agency of Canada to improve knowledge of determinants of health through Earth observation. Its focus is to provide evidence-based data to support risk modelling and mapping, primarily relating to the development of environmental determinant indicators linked to risk factors for Lyme disease and mosquito-borne diseases.

29. In 2017, the Canadian Space Agency began supporting a consortium of researchers from the University of Montreal, the Université du Québec à Montréal, the Public Health Agency of Canada and the City of Montreal, through its Science and Operational Applications Research programme for the utilization of satellite Earth observation data to identify potential health risks in cities. The project aims to use RADARSAT-2 data to help find areas where vulnerable populations may be exposed to high temperatures, air pollution or infectious diseases (viruses) transmitted by mosquitoes.

30. In the Russian Federation, cooperation between the Central Research Institute of Epidemiology under Rospotrebnadzor (health sector) and the Space Research Institute of the Russian Academy of Sciences began in 2013 as part of the implementation of a project of the Ministry of Education and Science on the impact of climate change, weather conditions and environmental factors on the incidence of vector-borne infections. Data on climate, weather and environmental conditions for the period 2005–2013 were obtained by satellite monitoring, reanalysed and provided to the Space Research Institute in a format suitable for epidemiological modelling and analysis.

31. During the period 2019–2022, these cooperation activities are being formally implemented as part of a Russian Science Foundation project entitled “Creation of a methodology, based on Earth remote sensing data, for analysing and forecasting the impact of climate and environmental factors on the incidence of zoonotic infections”. The Central Research Institute of Epidemiology is the core organization for this project, while the Space Research Institute’s Centre for Collective Use of Satellite Data Archiving, Processing and Analysis Systems in Environmental Research and Monitoring has been designated as the “unique research facility” supplying the essential data.

COVID-19

32. In India, ISRO has signed an MoU with the Government of the State of Bihar on disaster management support through space data (2019). Under this, a geoportal was created for the Health Department of the State of Bihar for identification of coronavirus disease (COVID-19) containment zones, buffer zones and boundaries for effective planning and monitoring. The Focus Group on Artificial Intelligence for Health established by ITU and WHO, has put into place an ad hoc group on digital technologies for the COVID-19 health emergency, which is in the process of collecting best practices covering the use of artificial intelligence and other digital technologies for the entire epidemic emergency cycle, aiming to build upon the experiences gained for preparedness for future emergencies.

Space life sciences

33. The Australian Antarctic Division, an Australian Commonwealth Government agency, signed an MoU with the National Aeronautics and Space Administration (NASA) of the United States of America in 1993, which is still in effect. This MoU specifies the terms for cooperation in the Antarctic between certain programmes within the NASA Life Sciences Division and the Polar Medicine Branch of the Australian Antarctic Division.

34. In Canada, the Canadian Space Agency has signed an MoU with the Institute of Aging of the Canadian Institutes of Health Research in order to collaborate on a space analogue study that uses inactivity (prolonged bed rest) as a model for weightlessness in space. The Institute will support the research projects associated with the study, as inactivity is a recognized health risk among the elderly.

35. Through an umbrella MoU with supporting letters of agreement, the Canadian Space Agency is collaborating, by way of a cost-sharing mechanism, with the National Research Council of Canada to develop an in situ sample-to-answer device for space. The device will enable in situ bioanalysis that will accelerate and facilitate life sciences research, since it will allow the analysis in space of biological samples that would otherwise be too fragile or require transportation to Earth for study.

36. In Germany, a long-standing institutional arrangement for cooperation and exchange between the health and aerospace sectors is the DLR Institute of Aerospace Medicine. The Institute conducts interdisciplinary research into the health and performance of humans in space, in aviation and on the ground. Its biological, medical and psychological research examines the effects that environmental conditions have on the basic mechanisms of human health, living conditions and human performance.

37. The Myotones experiment, a collaborative effort between Charité – Universitätsmedizin Berlin, the University of Southampton, the medical company Myoton AS, the DLR Space Administration and the European Space Agency, was aimed to analyse the basic biomechanical properties of the skeletal muscles in a non-invasive way by measuring and evaluating the changes in human resting muscle caused by the lack of gravity. Insights from this experiment can be applied to optimize rehabilitation and training programmes while enabling the objective evaluation of the effectiveness of such programmes in clinics and in practice.

38. The Crew Interactive Mobile Companion (CIMON), an autonomous astronaut assistant featuring artificial intelligence, is a cooperative effort between the DLR Space Administration, Airbus, IBM and the Ludwig-Maximilian-University (LMU) Hospital in Munich and aims to support astronauts in increasing the efficiency of their work and reducing their exposure to stress. Possible applications on Earth could be in providing everyday assistance to elderly people living alone.

39. In Japan, the Japan Aerospace Exploration Agency (JAXA) and National Center for Global Health and Medicine (NCGM) of Japan signed a cooperation agreement in 2015. Under that agreement, NCGM developed and improved terminals for collecting biological information such as physiological tests from medical institutions in developing countries, established a monitoring system and examined the possibility of improving technologies related to disease diagnosis that could contribute to improving the lifestyle of patients with lifestyle diseases.

40. The Space Medicine and Life Sciences (SMLS) project group is a core group of the Space Generation Advisory Council (SGAC) established in support of the United Nations Programme on Space Applications. Initially founded to provide a forum for students and young professionals to discuss the contributions of space to global health and medicine, SMLS partners with a wide range of stakeholders to deliver science, technology, engineering and mathematics (STEM) outreach initiatives to encourage students from around the world to engage in STEM education.

Disasters and Health Emergency Management

41. In Switzerland, the Hub of Digital Sciences for Environment and Health of the Institute of Environmental Sciences at the University of Geneva brings together researchers interested in the application of information technology, geomatics, statistics and modelling – using satellite as well as other data – to the environment and health. The Hub works closely with the Faculty of Medicine, primarily through the Institute of Global Health, on such cross-cutting issues as climate change, natural disasters and health.

42. In Peru, Agreement 227-2017/MINSA, a specific inter-agency agreement concluded between the Ministry of Health and the National University of Engineering in relation to the drafting of technical documentation for work to reinforce five hospitals in the Lima metropolitan area. The work is being carried out through the Peru-Japan Centre for Seismic Research and Disaster Mitigation.

43. Through its long-standing Regional Space Applications Programme for Sustainable Development (RESAP), ESCAP has made concerted efforts to promote the application of space technology and geographic information systems for supporting disaster risk reduction and inclusive and sustainable development. RESAP serves as a mechanism for regionally coordinated actions. For example, in times of disaster and emergency, and to avoid the loss of life and minimize economic losses, ESCAP responds promptly to requests for support by disaster-affected Member States

Question 2

44. Under Question 2, respondents were asked to provide recommendations regarding the establishment of a dedicated platform for effective coordination among United Nations entities, other international organizations and relevant actors on space and global health issues.

45. Responses demonstrated that having a dedicated platform has been regarded as a welcome development for the health sector, however, it was not advisable to create any new institutions as a platform for coordination. Instead, recommendations were made that more effective use should be made of existing institutions, including WHO, the Working Group on Space and Global Health, the Asia–Pacific Economic Cooperation forum, GEO Health Community of Practice and other international organizations, focusing on the importance of using space based technologies and applications to promote global health. For the Working Group on Space and Global Health, it was stressed that the Working Group should comprise representatives from both the national space agency and health agencies.

46. The importance of involvement of WHO, as a specialized agency of the United Nations, that deals with global health issues, was highlighted in view of that organization's functions and the experience in tackling public health challenges in various social settings and contexts. It was suggested that the dedicated platform could be linked to the activities of the United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER), or could be patterned on the International Telecommunication Union–WHO partnership on e-health, which provides a policy framework for assisting States to build capacities for the development of an e-health national strategy plan.

47. For United Nations system-wide coordination, it was proposed that the Inter-Agency Meeting on Outer Space Activities (UN-Space), as a mechanism with a proven track record of bringing together United Nations entities to discuss matters related to the use of space technologies in their activities, including its excellent special UN-Space report on Space for Global Health (A/AC.105/1091), could explore modalities for closer cooperation and coordination between the Office for Outer Space Affairs and WHO. Regular consultations were recommended among the key stakeholders, such as the Office for Outer Space Affairs, WHO and the Food and Agriculture Organization of the United Nations (FAO). Alternatively, the establishment of a United Nations centre for collaboration on space and global health could create a bridge between the work of the Office and WHO.

48. The dedicated platform could foster coordination among Member States, United Nations entities, international organizations and relevant actors on space and global health issues; share best practices, success stories and lessons learned; issue alerts; pool existing capacity in space and global health and tie that capacity in with the skills sets; create conditions for effective, cross-disciplinary work and comparative research, raise awareness and provide access to capacity-building.

49. The platform could address the following areas: full disaster management cycle, various aspects of environmental health (air quality and health, climate change, chemical safety, water quality, basic sanitation and zoonotic diseases), in monitoring the implications and effects of the coronavirus disease (COVID-19) pandemic (e.g., through Earth observation by satellite) and in adapting to life with the coronavirus (e.g., through space-enabled telemedicine); and space spinoffs and innovations.

50. It has been recommended that the dedicated platform is supported by a centralized online tool to share and access data and methodologies in real time; serve as a repository for health and space documents; incorporate artificial intelligence systems, such as big data, to create health risk, land use and other maps, as well as monitor the emergence of outbreaks; discuss programmes, issues and updates that represent a valuable knowledge base for improving the government response. Such a tool should not be used commercially given its humanitarian role and should enable permanent, unrestricted and timely access by all actors. The online tool could be managed by a secretariat.

51. The establishment of regional platforms was also recommended. The Egyptian Space Agency proposed the establishment, with the cooperation of the African Space Agency, of such a platform for Africa and connecting it to the proposed United Nations platform. UN-SPIDER regional support offices and WHO collaboration centres were proposed as a possible model of supporting network infrastructures at the regional and national levels aimed at connecting the space and health communities.

52. Synergies were seen with the Future Earth Health Knowledge-Action Network ("Health KAN") platform in Japan; an Asia-Pacific Geospatial Information Platform being established by ESCAP in partnership with the United Nations Global Service Centre in Brindisi, Italy, and a proposed Asia-Pacific geospatial data hub of the Group on Earth Observations; and the Epidemic Intelligence from Open Sources (EIOS) platform being developed by the Joint Research Centre of the European Commission with the WHO and other health surveillance communities.

53. Proposal was made that such a platform could be established in Geneva, which is already home to many centres of expertise and to international organizations and academic institutions , such as WHO, Médecins Sans Frontières (MSF), the Global Fund to Fight AIDS, Tuberculosis and Malaria, the World Meteorological Organization (WMO), the Group on Earth Observations (GEO) and the Institute of Global Health (ISG) of the University of Geneva, as well as the Graduate Institute of International and Development Studies (IHEID), which has a centre that is dedicated to global governance and global health diplomacy.

54. International conferences could be organized based on experiences from the DLR's "Space2Health" network activities and the Mexican Space Agency's annual national congress on space medicine in bringing together health and space communities to exchange experiences and establish synergies leading to knowledge and technology transfer from the space sector to the health sector, thus generating solutions to health problems.

55. An insurance fund should be established for all people in need, in order to provide uninterrupted and accessible health-care services worldwide.

56. Additional recommendations included the creation of a task force by COSPAR in cooperation with the WHO and the United Nations to discuss and coordinate on space and health issues; the organization of an informal online events of the Working Group on Space and Global Health to address the coronavirus disease (COVID-19); and mapping of the key stakeholders and the development of a road map for space for global health priorities and collaborative online toolkits.

Question 3

57. Under Question 3, respondents were asked to describe existing or planned policy-enabled environmental and governance mechanisms for removing barriers to the effective use of space-based technologies in support of global health.

58. Identified barriers that affect the use of space-based technologies in support of global health included little scientific research on the subject, fragmented communication among actors in the fields of health, space and applied science, the limited use of satellite data as a result of accessibility, utilization capacity and data quality, trustworthiness of information, and limited awareness of the work that is being done in this field at the international and national levels.

59. In a number of countries, centralized coordination mechanisms are in place to address the barrier and strengthen governance in the space sector to support and improve national and global health coordination. Algeria has fostered a collaborative approach between the Algerian Space Agency – the national body for the promotion and development of space technology – and the different agencies and ministries. In Australia, the health and space are the focus of the Space Health and Life Sciences Working Group of the National Committee for Space and Radio Science (NCSRS) established by the Australian Academy of Science. In Egypt, all space activities are

coordinated through the Egyptian Space Agency. In Malaysia, coordination is carried out through the National Space Committee.

60. In order to ensure the effective use of space technology in various sectors, including public health, States have established or are establishing their national space programme. Such programmes include stocktaking of current and future capabilities, resources and needs in the area; identification of priorities and opportunities; cross-sectoral coordination; establishment of specialized training programmes, alignment of research programmes with national needs; and other strategic components. For more effective use of space data for global health, respondents recognized that legal and administrative arrangements needed to be made first.

61. In Australia, the National Committee for Space and Radio Science will deliver the plan entitled "Australia in space: a strategic plan for space science", which aims to both grow and transform the use of space in the broader areas of the economy, such as the health and medicine sector. In order to meet the growing demand for remote sensing data and the growing need to involve the participation of Indian industry to bridge the gap between the demand and supply, a comprehensive remote sensing policy for India is being worked out to address data access and use issues regarding the effective use of space-based technologies. The governing board of the Mexican Space Agency works to establish mechanisms enabling the effective use of space technologies for the benefit of public health in Mexico and to extrapolate the results to other regions of the world. The Saudi Ministry of Health is in the process of developing governance mechanisms for removing barriers to the effective and efficient delivery of public health in accordance with the Saudi 2030 Programme. Once completed, it will be integrated with other programmes such as the "Space Generations (Ajyal) Programme" and the "Orbital Slots Project".

62. In Japan, the Basic Plan for Space Policy was created pursuant to article 24 of the Basic Space Law (Law No. 43, 2008). The Basic Plan, a comprehensive space policy, includes contributing to global challenges such as climate change, environment, food, public health and large-scale natural disasters by utilizing Japan's space technology. The National Space Policy 2030 of Malaysia on 30 December 2017, provides a clear coordination framework at the national level that involves representatives from various ministries, including the Ministry of Health. One of the pillars of the policy framework is focused on reinforcing governance in optimizing the country's access to space capability. In Switzerland, the national eHealth strategy 2.0 establishes basic, continuous and specialized training programmes to familiarize health workers with digital data and how to use them.

63. In the field of environment, the Directorate for Promotion and Prevention of the Ministry of Health and Social Protection takes part in the activities of the National Intersectoral Technical Commission for Environmental Health (CONASA), which coordinates the work of its member entities in the various thematic areas of environmental health and, in particular, promotes the effective coordination of policies and strategies relating to health and the environment, including environmental degradation.

64. In the field of disasters, Peru, through the Office of the President of the Council of Ministers, has established initiatives on the management of geospatial data, namely the Information System for Disaster Risk Management and the platform for the Peru Space Data Infrastructure. Furthermore, guidelines on the National Early Warning Network, Early Warning Systems, and Permanent Warning Service have been adopted to establish the response measures as part of the National System for Disaster Risk Management.

65. Regionally, the Asia-Pacific Plan of Action on Space Applications for Sustainable Development (2018–2030) has been adopted to promote cooperation to leverage data-sharing and promote big data analytics for the containment of present and future spreads of diseases and epidemics; develop capacity for mapping health-risk hotspots using geospatial information and big data; and pay special attention to the countries that are most vulnerable to emergency health situations.

66. At the international level, recommendation was received that the Scientific and Technical Subcommittee should continue to foster leadership and effective governance mechanisms in removing barriers to the effective use of space technology and information for global health. When appropriate, the World Health Assembly should be engaged in promoting and leveraging the use of space for the broad global health-related targets of the 2030 Agenda.

67. The following international efforts to facilitate access to satellite data that can be used in the health sector were listed: the Global Framework for Climate Services (GFCS), implemented under the auspices of WMO, which promotes climate services, such as systematic climate observations of relevance to the health sector under one of the five priority areas. WMO, WHO and UNEP recently launched a new global coalition for health, the environment and climate change, aiming, inter alia, to reduce the high number of deaths caused by environmental hazards, in particular, air pollution. Also, work in the area is carried out by the GEO secretariat and the Global Earth Observation System of Systems (GEOSS).

68. Non-governmental organizations could contribute to removing the barriers through information- and knowledge-sharing forums, provision of scholarships, dissemination of knowledge, capacity-building events and provision of mentorships.

Question 4

69. Under Question 4, respondents were asked to describe existing or planned policies on open data-sharing and participatory approaches to developing and improving access to geospatial information relevant to global health.

70. Open data policy has been adopted by national agencies in many countries, including Australia, Canada, India, Malaysia, Paraguay, Philippines, Switzerland, and the European Union. Additionally, a number of data sharing mechanisms have been reported. In particular, Algeria, which hosts a UN-SPIDER regional support office, adheres to the principle of sharing geospatial data with the various focal points in the subregion on the basis of the relevant conditions and modalities. In Argentine, information products relating to Chagas' disease and dengue can be found on the CONAE Geoserver and through other geoservices established by entities of the Ministry of Health but maintained and updated mostly by CONAE staff.

71. In Australia, the Australian Institute of Health and Welfare regularly publishes reports and web products from its health and welfare data collections that use data at various geographical levels. The Digital Earth Australia, the digital infrastructure that uses satellite data is being developed to detect physical changes across the country in unprecedented detail. In the Plurinational State of Bolivia, a freely accessible satellite-based Earth observation system (http://sots.abe.bo/) has been set up for the analysis and processing of satellite images. Furthermore, for the period 2016–2017, a landslide monitoring platform for the city of La Paz was developed so that risk management could be performed using that tool.

72. In Bulgaria, the "Informational system of sources of electromagnetic fields in residential areas" uses Google maps as a platform for the placement of the information. In Canada, all data resources of business value held by Government departments, including geospatial data produced by the Canadian Space Agency, are stored on the Government's open data platform. In Colombia, the National Image Bank, established within the framework of the Colombian Space, and managed by the Agustín Codazzi Geographic Institute contains cadastral, geographical, cartographical and agrological information.

73. In Egypt, space-related information is shared through coordination with the Egyptian Space Agency. In Hungary, the full archive and latest recordings of the European Sentinel satellite family are available in the Earth Observation Information System (FIR), the central government infrastructure. In India, ISRO satellite and geospatial information is made available on the Bhuvan geoportal, which has various

tools for visualization, analysis and participatory approaches to analytics and solutions. In Japan, an open and free platform called “Tellus” is aimed at creating a new business marketplace using governmental satellite data.

74. In Malaysia, MYSA provides free access to unrestricted remote sensing satellite data with a spatial resolution of more than 5 metres through the MYSA Open Data Platform. In Peru, an initiative for the publication of geospatial data on the websites of the Office of the President of the Council of Ministers and the Government of Peru has been implemented with the support of the Ministry of Health and its National Centre for Epidemiology and Disease Control and Prevention. In the Philippines, the data-sharing platform under the Open Data Philippines initiative is led by the Department of Budget and Management and the Department of Information and Communications Technology.

75. In the Russian Federation, the Ramzaev Research Institute of Radiation Health is developing systems for the geospatial visualization of data on the radiation health certification, including data on the medical services provided to the population. In Switzerland, the University of Geneva and GRID-Geneva of UNEP are implementing – with support from the Federal Office for the Environment – the Swiss Data Cube project, which makes available several decades of geospatial data for environmental research and monitoring. In Thailand, GISTDA offers a service to provide geospatial information for public use with permission.

76. In Europe, data from projects of Copernicus and the Joint Research Centre are made available, including on the Centre’s open data platform. In Asia and the Pacific, the Asia-Pacific Geospatial Information Platform aims to promote the sharing of open and interoperable data. The ESCAP “One Data–One Map–One Platform” initiative encourages member States to build a system (“One Platform”) that utilizes the frontier technologies and integrates with big Earth data (“One Map”). Ensuring the accessibility and availability of all global climate data, EUMETSAT, GEO and the Global Climate Observing System work to provide, at the international level, observation data on the climate and environment, both of which are determinants of health.

77. Triggered by the coronavirus disease (COVID-19) pandemic, information systems to report and share pandemic related data started to emerge in Saudi Arabia. In Australia, the Australian Government Department of Health has created a COVID-19 resources hub that includes authoritative information on Commonwealth respiratory clinics and national COVID-19 assessment centres. In Mexico, there is currently a platform that uses remote sensing to obtain geospatial information relating to COVID-19, but also to vector-borne diseases such as zika, Chagas disease and dengue.

78. Examples of policies and documents that support or promote sharing of geospatial information relevant to global health at national, regional and international level include: (a) the document of the National Council for Economic and Social Policy (CONPES), entitled “Consolidation of national policy on geographical information and Colombian space data infrastructure”, which sets out the framework of coordination guidelines and standards that govern the processes of production, acquisition, recording and use of, and access to, geographical information; (b) publication *Geospatial Practices for Sustainable Development in Asia and the Pacific 2020: A Compendium;* and (c) WMO resolutions 25 and 40.

Question 5

79. Under Question 5, respondents were asked to describe existing or planned efforts related to the geotagging of all assets relevant to health systems, including health information systems.

80. Geotagging is the process of adding geographical identification metadata to various media such as a geotagged photograph, video, or other media. This data usually consists of latitude and longitude coordinates, though they can also include altitude, bearing, distance, accuracy data, and place names, and perhaps a time stamp. Geotagging can help users find a wide variety of location-specific information from a

device. The geographical location data used in geotagging can be derived from the global positioning system. In public health, the use of geotagged information is particularly relevant for applications involved in outbreak detections. This is also applicable to other applications, such as contact tracing.

81. Respondents submitted information on the following existing national efforts on geotagging:

(a) In Australia, the National Health Services Directory contains geographical information for health facilities and services. Ambulance authorities use geospatial tracking for their assets. Global positioning trackers are also worn by Australian Medical Assistance Teams on deployment overseas. The Australian Institute of Health and Welfare is currently exploring software and application options for geocoding relevant health and welfare data collections.

(b) In India, the project named National Health Resource Repository is aimed at creating a web-based and geomapping-enabled single platform for all the health resources, including hospitals, diagnostic labs, doctors and pharmacies, and will comprise data on health infrastructure, human resources and the availability of medical facilities in each health establishment in the country. The Repository is the first effort in the country in the field of health census, wherein the data are being collected for more than 2 million health-care establishments.

(c) In Japan, there is an existing effort for the geotagging of patients and infections, conducted by National Center for Global Health and Medicine.

(d) In Malaysia, the geotagging of all assets relevant to the health system, including the health information system, is provided by the relevant national data custodian.

(e) The Ministry of Health of Peru, through the Directorate General for Disaster Risk Management and National Defence in the Area of Health, is in the process of implementing mapping methodologies in order to tag data relating to infrastructure and facilities, but is open to using a better methodology to complete that process.

(f) Under the Philippine e-health partnership, the proposed Philippine Health Information Exchange will allow the sharing of information among all stakeholders in the health area, for patient care, surveillance, monitoring and health decision-making. There is also an ongoing initiative of the Department of Health on geotagging its health facilities nationwide under the Health Facility Enhancement programme.

(g) The Unified State Health Information System of the Russian Federation includes a Geoinformation Subsystem on health-care resources, including data on medical organizations (and their subdivisions) and data on the population centres where those organizations are located. Geotagging places of epidemiological importance, such as anthrax-contaminated livestock burial sites, and anthrax risk areas, and sites of culling of animals, could be used for the computer-assisted detection of “hidden” sources of infection.

(h) In Switzerland, the Federal Office of Public Health has published a list and a map of the hospitals. The Swiss Health-care Atlas maps by canton and region the number of in-hospital treatments administered. The Geneva Territorial Information System (SITG), generates interactive maps that identify, inter alia, hospitals, doctors and home-care services in the Geneva region. The GeoHealth research group carries out research and development activities in the area of global health utilizing advanced geospatial modelling tools, geographical information systems, spatial data infrastructure and spatial statistics. The Swiss Tropical and Public Health Institute (Swiss TPH) has plans to apply geotagging in asset management systems, for instance, in the mapping of health facilities in the United Republic of Tanzania.

82. The COVID-19 pandemic demonstrated examples of international coordination in the development of COVID-19 tracing apps and the exchange of testing methods. Integration of geospatial information allows to find correlations between COVID-19 and socioeconomic sectors, as well as identifying hotspot areas in vulnerable countries.

This includes identifying the characteristics of risk hotspots, such as high population density, mobility, poor sanitation, low connectivity and awareness, by conducting geographic information system-based analysis of relevant data, for example, census and household surveys and data on population mobility, sanitation and Internet access.

Question 6

83. Under Question 6, respondents were asked to describe existing or planned intersectoral coordination and cooperation for effective international, regional, national and subnational capacity-building activities relevant to the application of space science and technology in the field of global health. Responses demonstrates both examples of intersectoral coordination and cooperation, and an overview of capacity-building efforts.

84. In Argentina, the Government has launched a programme to link and build capacities in science and technology at the federal level with the participation of CONAE, which is partially involved in two approved projects relating to the coronavirus disease (COVID-19). In the Plurinational State of Bolivia, intersectoral cooperation is carried out among national ministries, international and non-governmental organizations, and scientific bodies within the framework of the National Emergency Operations Committee. In Bulgaria, the National Action Plan on Environment and Health joined the forces of all sectors in Bulgaria - economy, agriculture, communications, energetics, industry, health and safety at work, health status of the people.

85. In Canada, the Canadian Space Agency has supported a special study on tele-epidemiology in close collaboration with the Public Health Agency of Canada to better understand this emerging Earth observation sector. Both entities have jointly led special session on tele-epidemiology at the European Space Agency Living Planet Symposium, and the Earth Observation Summit One Earth – One Health workshop, held in Montreal in 2017. In Colombia, the Ministry of Health and Social Protection has played a key role in intersectoral coordination and cooperation, which has enabled progress in the fulfilment of such policy commitments, as the building of local capacity for estimating the burden of disease associated with air pollution. In Egypt, the Egyptian Space Agency started the Space Medicine Programme initiative in July 2020. In Japan, cooperation is carried out in the field of atmospheric chemistry and health in the Monsoon Asia and Oceania Networking Group.

86. In Malaysia, intersectoral coordination and cooperation at the national level are implemented through the Working Group on Remote Sensing under the National Space Committee. The Space Agencies of Mexico and Paraguay held meetings with the National Commission on Space Activities (CONAE) of Argentina, the European Space Agency and other partners on issues relating to space and health. In Peru, the Ministry of Health coordinates with the National Meteorology and Hydrology Service and the National Centre for Disaster Forecasting, Prevention and Risk Reduction on climate maps and forecasts, to identify hazards, develop health risk scenarios, and propose risk-reduction measures. In the field of capacity-building, in Hungary, national coordination is initiated among universities, which would lead to an institutional cross-fertilizing framework for students of medicine and students of space science and technology, and the general design of a space-focused interdisciplinary post-graduate education.

87. In India, a large number of professionals and officials from ministries are provided with training on utilizing space technology in the field of health. Short-term courses for the same are organized regularly. Similarly, pilot studies are being carried out jointly with relevant ministries. In the Philippines, non-government and international initiatives such as the Asia eHealth Information Network, advocate and work closely with the Government on its capacity-building programme for the use of information and communications technology in the health sector. In Thailand, the Asian Institute of Technology and the geospatial group formed by KMUTT and GISTDA offer several short training courses on spatial technology and spatial health information for the public.

ESCAP is collaborating with GISTDA on integrating georeferenced data on COVI-19 into a comprehensive data hub.

88. In the Russian Federation, the Federal Biomedical Agency has drawn up proposals for the creation of an inter-agency scientific council on space medicine as a standing scientific advisory body of Roscosmos and the Federal Biomedical Agency, which would be tasked with coordinating the activities of medical, scientific and educational organizations concerning the exploration and use of airspace and outer space. In Switzerland, the Swiss School of Public Health is the national coordinating body for the promotion of postgraduate studies and research, which works in partnership with all the major Swiss universities and offers courses on space technology. The University of Geneva offers a course in global health and hosted the Geneva Health Forum on the theme of "Precision global health in the digital age". The UZH Space Hub works in the fields of Earth observation and space life sciences and provides Swiss universities with access to relevant flight platforms for research at Dübendorf and abroad.

89. Algeria hosted the Technical Assistance and Information Exchange workshop on the integration of new technologies in the provision of medical services to ensure the uninterrupted, high-quality care of patients, in particular in remote areas, and a seminar held by the Algerian Society for Telemedicine and e-Health on the status and potential in Algeria of telemedicine. The Algerian Space Agency participated in a panoramic epidemiology training course organized by the space agency of Argentina on the development of a spatio-temporal model for epidemiological risk-mapping based on spatial imagery. In Argentina, interdisciplinary spaces such as the postgraduate training activities of the Latin American Centre for Interdisciplinary Training (CELFI) are being created to brings together health-care professionals, Earth scientists, geoscientists, engineers and data analysts in pursuit of specific objectives focused on health issues. CONAE carried out training, research, projects or advisory assistance for almost all countries in South America.

Question 7

90. Under Question 7, respondents were asked to describe existing or planned mechanisms to engage educational institutions and other capacity-building mechanisms in motivating young health professionals to acquire skills and abilities required to efficiently use advantages provided by space technology, science and applications at an early stage in their careers.

91. Youth-oriented capacity-building mechanisms exist at the school, college- and university-level science programmes, space-related research and development opportunities, online courses, collaboration projects, training and seminars, conferences, outreach and awareness raising events. In the United States, NASA has several outreach programmes for school students. In Australia, high school-level programmes engage students' interest in space and acquire a range of skills to develop and use space technology. An example of such a programme is found at Hamilton College in Adelaide.

92. In Egypt, the Egyptian Space Agency started the University satellite programme to promote space technology among undergraduate students and is planning to extend the target audience and areas of the programme. In Hungary, the Department of Aviation and Space Medicine of the University of Szeged offers education in space science and space medicine, including telemedicine and the use of robotics in certain forms of surgery. The National Autonomous University of Mexico will soon inaugurate, as part of its Faculty of Medicine, a specialized division focused on capacity-building in the area of space medicine and its use on Earth.

93. In Argentina, the Mario Gulich Institute for Higher Space Studies, established through an agreement between CONAE and the National University of Córdoba, offers a master's degree in space information applications. In the Plurinational State of Bolivia, the Bolivian Space Agency has been administering scholarships for master's degrees at Beihang University in Beijing. To date, scholarships were awarded to 15 young professionals. In Bulgaria, postgraduate education in the field of Medical

sanitary physics, Sanitary engineering includes training in the area of new contemporary applied technologies. In the Russian Federation, the Ramzaev Research Institute of Radiation Health is currently licensed to offer a residency programme in radiation health and a postgraduate programme in preventive medicine. The Biomedical University of Innovations and Continuing Education at the A. I. Burnazyan Federal Medical Biophysical Centre (affiliated to the Federal Biomedical Agency) has begun to develop a teaching programme in aviation, space and naval medicine.

94. A wide range of research opportunities is available to young scientists at the medical research facility ":envihab" of the DLR Institute of Aerospace Medicine dedicated to studying human spaceflight problems. In Canada, research activities will be carried out in the framework of cooperation of the Public Health Agency with the University of Sherbrooke and Laval University on the risk of the microbial contamination of recreational lakes using remote sensing and geomatics tools and on improving the spatial scale (downscaling) of massive data in the estimation of microclimatic determinants and risk mapping of emerging vector diseases in Canada.

95. Online training and courses included a course on the management of data on Chagas' disease prepared and conducted by CONAE in collaboration with the National Chagas' Disease Directorate of Argentina and a diploma course in geomatics for health, developed in Argentina as a result of a joint initiative implemented with the Mundo Sano Foundation. The Canadian Space Agency is currently working in close collaboration and cooperation with the University of Jena in Germany, the German Aerospace Centre and Canadian federal departments to develop an educational online course and material on Earth observation data and climate change applications relating to agriculture, coastal ice and floods.

96. In Malaysia, engagement with higher educational institutions and other capacity-building is carried out through space-related research and development collaboration projects, training and seminars. In the Russian Federation, the Russian Plague Research Institute "Mikrob" intends to include information on the use of space science and technology in its training programmes. In Switzerland, a number of educational programmes are offered for health professionals to familiarize themselves with using satellite data in their work, for instance, through the SDES Hub of the University of Geneva.

97. In Algeria, a nationwide project has been launched jointly by the Algerian Space Agency and the ministry in charge of telecommunications to promote telemedicine in southern regions of the country, improve information management and exchange, and optimize the transfer of patients between health-care institutions. In India, linkages between educational institutions can be facilitated using effective satellite communication technology to reach out to professionals located in remote parts of the country, along the lines of telemedicine. ESCAP is collaborating with GISTDA to develop an operational platform and sample dashboard for the integration and analysis of data on the COVID-19 situation to support policymakers in central government agencies and provincial disease control centres.

98. Awareness-raising initiatives include the Junior Astronauts campaign launched by the Canadian Space Agency and space medicine congress organized by the Mexican Space Agency. Additional venues for outreach to young health professionals could be the collaboration with the University of the Philippines on the STAMINA4Space programme, youth (student) forums such as "Realm of Meanings" in the Russian Federation, and the International Astronautical Congress, specifically its youth section. Publications developed by the Joint Research Centre's Disaster Risk Management Knowledge Centre, such as the one entitled "Science for disaster risk management 2017: knowing better and losing less", covers health and space and is increasingly used as an academic syllabus.

99. Capacity-building can be addressed in a standalone policy document or as a pillar in a wider space strategy. In Colombia, the "Space Development Policy: enabling conditions for boosting national competitiveness", provides for coordination among the Ministry of Science, Technology and Innovation, the Ministry of Information and

Communications Technologies, the Ministry of Education and the private sector, to promote education, knowledge and scientific curiosity in space-related topics. A strategic pillar "Inspire" under the Australian Space Agency's strategy entitled "Advancing space: Australian civil space strategy 2019–2028" aims to showcase Australia's achievements in space activities to inspire young people to take up careers in science, technology, engineering and mathematics (STEM) and support growth in the future workforce.

100. The Space Generation Advisory Council, and its Space Medicine and Life Sciences project group, actively engage with educational institutions to provide an environment for young health professionals to acquire skills required to apply space solutions in improving patient care on Earth. As part of this objective carried out in collaboration with the Aerospace Medicine Systematic Review Group and the UK Space Life and Biomedical Sciences Association, affiliated with the UK Space Agency, the project group has recently launched the Space for Health Systematic Review Workshop, which will equip early investigators with the skills to critically appraise and review space technology, science and applications.

Question 8

101. Under Question 8, respondents were asked to describe existing or planned mechanisms to better integrate space-derived data and information into decision-making processes related to global health, and to harmonize and share such data.

102. In Algeria, interconnectivity between the various national hospitals contributes to fast and effective decision-making in remote areas with insufficient health-care staff and resources. In Argentine, CONAE and the Gulich Institute cooperate to address vector-borne viral diseases, neglected diseases and diseases associated with poverty, diseases linked to the environment and extreme events, as well as food security and access to health care. In Australia, AIHW has a geospatial strategy in place to build capability in geographical information systems data, analysis and reporting through the use of web-based products. The Government of Australia is investing to develop better national positioning capabilities.

103. In the Plurinational State of Bolivia, information mechanisms have been created for the management of health risks, including through the use of digital and geospatial climate data that are consolidated through alerts that are issued to the public and to health networks. In Colombia, the Subdirectorate of Environmental Health has been implementing a number of initiatives in the areas of air quality and climate change that require the satellite information analysed by the Institute of Hydrology, Meteorology and Environmental Studies and managed through CONASA. The Egyptian Space Agency started the Space Medicine Programme initiative in July 2020, and is laying the foundation for telemedicine. This programme will be the first step to providing space-derived data for decision-making processes.

104. In Hungary, the Global Navigation Satellite System application "Galileo-based trusted applications for health and sustainability" is a great example of how space-derived data can contribute to the monitoring of health and sustainability. In India, recent examples included customized geoportals to track the COVID-19 pandemic and provide update on the current situation, use high-resolution data to map the hotspots to manage the pandemic, enabling patients under home quarantine to access essential services and medical facilities, and a tool for providing free food to the needy. In Malaysia, MYSA has collaborated with other authorities, including the Ministry of Health, to enhance their services through the use of space-derived data and information access through online application systems.

105. The Mexican Space Agency has sought to hold meetings with various space agencies with a view to exchanging information and experience relating to the use of space technology and existing problems in the health sector. In Paraguay, AEP and other institutions are starting to use more actively space derived data and information. The Ministry of Health has a portal on COVID-19 aimed at improving decision-making in

other epidemics through the use of an open data policy. In Peru, space-derived data are analysed by the National Commission for Aerospace Research and Development. The resulting information is then processed by the National Meteorology and Hydrology Service and used by the Ministry of Health to generate warnings and risk scenarios and formulate specific interventions.

106. In the Russian Federation, mechanisms include regular awareness raising among relevant authorities, the inter-agency scientific council on space medicine, publication of data in scientific journals, and the organization of special sessions (such as round tables) at conferences on medicine and outer space. As mandated by the Government of Switzerland, Swiss TPH has been providing support for the upgrading of the Radiology Department of the Ministry of Health of Egypt since 2002. In support of the work of UNFPA, UNICEF and the Global Fund in 12 African countries, projects by the GeoHealth research group are assisting with increasing the use of high-resolution geospatial data for the mapping and geospatial modelling of health-care services. In Thailand, the Ministry of Public Health uses space data for human resource allocation and the prevention and control of infectious diseases.

107. In Europe, the Joint Research Centre's Global Human Settlement Layer (GHSL) and Database provides statistics of more than 50 databases in areas such as health, air pollution and urban greening The Global Human Settlement Layer is a contribution to the Group on Earth Observations (GEO) Human Planet Initiative. In Asia and the Pacific, RESAP serves as a framework for collaboration and a mechanism to support countries in better integrating space-derived data into decision-making processes related to the global health sector and nearly all other sectors. The ESCAP "One Data–One Map–One Platform" initiative encourages member States to build a system ("One Platform") that utilizes frontier technologies and integrates with big Earth data ("One Map") to support local decision-making, with a focus on locally identified priority needs.

Question 9

108. Under Question 9, respondents were asked to describe how space technology and applications are integrated into health-related emergency planning and management and disaster management plans.

109. Respondents recognized an important role played by space technologies in emergency response by contributing to monitoring and reporting, national-level situational awareness, warning products and integrated risk assessments, as well as national-level planning and response management. The space data and technology are used to provide emergency medical support in remote and hard-to-reach areas, to generate health warnings, analyse risk scenarios, enable the creation of rapid response maps, maps of affected population, epidemiological maps for specific diseases, carry out detailed damage assessment, provide emergency communication, support rescue efforts, evaluate the situation at the site of the emergency, as well as identify sites that are most appropriate for reconstruction efforts and for resilient health facilities.

110. In Argentina, CONAE has established a direct operating procedure for requesting support during emergencies through the emergency registry, to enable a provision of a rapid response. In Australia, briefings of the Bureau of Meteorology providing a weather outlook for natural disasters forecast for the summer season are incorporated into summer-preparedness activities. In the Plurinational State of Bolivia, under the National Programme for Disaster Risk Management in the Area of Health, the application EDAN-SALUD enables the analysis of damage and health needs and the reporting of prevalent diseases in real time. The Bolivian Space Agency makes available cost-free, open-access tools at http://maps.abe.bo/ and http://sots.abe.bo/bolivia-covid19. In Canada, the Health Portfolio Operations Centre of the Public Health Agency of Canada provides an all-hazards integrated federal emergency response to public health events of national interest. During an emergency response, maps and geomatics products can be generated by the broader Government Operations Centre.

111. In Colombia, the Agustín Codazzi Geographic Institute (IGAC), as a regional support office for the UN-SPIDER Programme, has participated in the development of best practices in the use of optical sensor and radar images in relation to floods and droughts and provided training in the region. In India, under the Disaster Management Support Programme of ISRO, the National Remote Sensing Centre of ISRO has developed the National Database for Emergency Management, which hosts and continuously updates the information on health facilities such as hospitals, primary health centres, private clinics and medical shops, including details on location, address, etc., down to the village level. The National Disaster Management Agency of Malaysia utilize the integration of space technology and applications in their operations including the health-related cases. In Paraguay, AEP has been working with the National Emergency Secretariat to provide better data and tools for decision-making, and with the Ministry of Health, including to provide space-related tools to improve the response to dengue fever, as a first step.

112. In Peru, space data processed by the National Meteorology and Hydrology Service to generate health warnings and risk scenarios. In the Russian Federation, the Ramzaev Research Institute of Radiation Health uses a geographic information system to analyse and compile radiation monitoring data during a radiological emergency or incident. The Russian Plague Research Institute "Mikrob" explores the use of space-derive data in epidemiological research on especially dangerous communicable diseases and collaborates with Roscosmos on a cost-free basis. In Switzerland, Swiss Air Rescue (Rega) provides air rescue services using helicopters equipped with the European Geostationary Navigation Overlay Service (EGNOS), which increases the accuracy of GPS data and thus enhances a helicopter's ability to carry out rescue operations in extreme conditions.

113. In addressing the COVID-19 emergency, CONAE participates in a network of scientific and technical bodies for disaster risk management, which recently established guidelines for the publication of products that are useful. The Mexican Space Agency has helped to ensure that telemedicine and/or tele-assistance technologies are applied so that the population receives medical and psychological support. In child health care, under the auspices of the International Committee of the Red Cross Swiss TPH is implementing a project in Afghanistan and Iraq using geospatial data to develop computer algorithms for the management of acute childhood illnesses.

Question 10.

114. Under Question 10, respondents were asked to describe key activities, reference documents and plans relevant to the topic "Space for global health".

115. The YouTube channel of the Gulich Institute of Argentina contains recordings of recent talks given by experts from the Institute and from CONAE in various forums. In Australia, the Australian Space Agency's strategy entitled "Advancing space: Australian civil space strategy 2019–2028" has listed "'leapfrog' research and development" as a national civil space priority area. Space medicine and synthetic biology are areas of opportunity within research and development that can grow and transform Australia's space sector. In Canada, the Exploration, Imagination, Innovation: A New Space Strategy for Canada, under strategy element 3, "Harness space to solve everyday challenges for Canadians", aims to advance autonomous medical systems to support astronaut health in space and health outcomes at home, and prioritizes future Earth observation capabilities under strategy element 5, "Space-based data to support science excellence, innovation and economic growth":

116. In Colombia, work relating to environmental protection, clean air and public health protection is carried out under documents, such as "Policy for the improvement of air quality" and strategies under COVID-19 recovery. In Germany, the DLR Space Administration has initiated and supported initiatives to promote innovation, cross-sectoral technology transfer and commercialization. The INNOspace initiative, founded on behalf of the Federal Ministry for Economic Affairs and Energy, creates

incentives and platforms for the transfer of technology, services and knowledge between the space industry and other sectors of the economy (spin-offs and spin-ins). The Mexican Space Agency organized six Mexican congresses on space medicine; hosted five forums on the theme “Towards new horizons in medicine”; issued books on space medicine and on space nursing, and launched a specialist programme on aerospace medicine at the National Autonomous University of Mexico.

117. In Peru, the two main activities are risk assessment and weather warning. Examples of two technical documents are the Ministry of Health contingency plan for responding to heavy rains, floods and mass movements of people, and the Ministry of Health vulnerability reduction plan for the cold season The integrated health networks (RIS-SALUD) system integrates geospatial information and makes it possible to simulate scenarios relating to the geographical coverage. In the Russian Federation, the Russian Plague Research Institute “Mikrob” plans to use data derived from space science and technology as part of a new strategy for epidemiological monitoring of sources of plague among animals through the use of satellite imagery for epidemiological purposes. In Switzerland, initiatives include the GeoHealth research group and the SDES Hub, the various projects of Swiss TPH and the activities of the UZH Space Hub and the Lucerne University of Applied Sciences and Arts (HSLU). Furthermore, the University of Geneva conducted a study entitled “Applications of space technologies to global health: scoping review” published in Journal of Medical Internet Research.

118. In Asia and the Pacific, ESCAP identifies the following initiatives in its member States: lockdown measure impacts and COVID-19 iMap (intelligent map) dashboard in Thailand; heat maps of vulnerability levels in Indonesia; the ISRO “Bhuvan-COVID-19” geoportal in India; a dashboard and managing disasters during the COVID-19 pandemic in Fiji; the WebGIS dashboard in Malaysia; health Quick Response codes in China; a campaign that supports innovative apps in the Philippines; and the private sector’s role in developing vital platforms in the Republic of Korea. In Europe, work carried out by the European Commission’s Joint Research Centre covers urban green spaces and building on the Urban Centre Database; disaster risks; wildfires and implementing of the European Forest Fire Information System (EFFIS); waterborne health threats and the maintenance of the Global Surface Water Explorer (the maps were created using Landsat satellites data); and study of the impact of environment and climate.

Question 11

119. Under Question 11, respondents were asked to provide an overview of existing and planned practices and initiatives in the current uses of space (technology, applications, practices and initiatives) in support of global health and identify gaps, if any.

120. Gaps in the area of telemedicine and tele-health, identified by respondents, include the limited uptake of information technology (computer equipment; radiological and hospital information systems) in medical organizations, especially those at the lower levels and those located outside large population centres; the low level of competence of most medical staff (such as technicians, surgeons and radiographers) in the use of digital technologies and information systems in health care and for medical diagnosis, in particular, diagnostic radiology; the lack of harmonized data-sharing standards among the various manufacturers of medical equipment (equipment for diagnostic radiology); technical issues such as connectivity and maintenance, especially in peripheral locations, and the need for coordination among all stakeholders.

121. In tele-epidemiology and environmental health, the effective application of Earth remote sensing techniques and data to combat communicable diseases is hampered by limited access to data, and data limitations. Many satellites either do not make it possible to generate high-quality information at the regional level, or are not capable of generating data in thermal infrared spectral bands. In cases when data is available, there

is an opposite challenge: how to pick out from the terabytes of data the values of key indicators that can be used for epidemiological analysis and modelling. In addition, the lack of a relevant regulatory framework, insufficient financial and human resources, the lack of necessary infrastructure (notably in the regions) and the need for an international framework for facilitating government institutions' formal use of such information sources in decision-making make it currently not possible to realize the full potential of benefits offered by space technology.

122. Additional limitations include low awareness among health workers and space experts, a lack of space-related knowledge and skills among health workers, and the absence of cooperation between health and space domains. In the field of space life sciences, there was a need for a platform for advancing research and development for space life sciences through international collaboration. In disaster management and emergency response, there is a need to raise awareness of existing space-based technologies and how they are used in practice, to enhance mechanisms for inter-agency, inter-organizational and interdisciplinary cooperation, to design new – and enhance existing – software and systems that actively use space-based technologies to obtain timely forecasts of health-related events, and to enhance the early warning system for health-related emergencies.

123. In addition to the four main areas, respondents identified the need to pay attention to the necessary structural and technical regulations for the different frequency band models used in satellite communication in order to have a minimal impact on human health; and the importance of planetary biosafety (planetary protection), which aims to prevent the biological contamination both of other celestial bodies and of the Earth.

III. Recommendations on increasing capacities in using space science and technology and their applications for global health

124. Draft recommendations on the policies, experiences and practices in the use of space science and technology for global health are presented in the Working Paper by the Chair of the Working Group on Space and Global Health for consideration during the meeting of the Working Group on Space and Global Health at the fifty-eighth session of the Scientific and Technical Subcommittee in 2021 (A/AC.105/C.1/2021/CRP.8).