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Space and global health

Responses to the set of questions regarding policies, experiences and practices in the use of space science and technology for global health

Note by the Secretariat

I. Introduction

1. At the fifty-sixth session of the Scientific and Technical Subcommittee, held in February 2019, the Working Group on Space and Global Health of the Subcommittee agreed on a questionnaire (A/AC.105/1202, annex III, appendix II), to be circulated by the Secretariat to States members of the Committee and international intergovernmental and non-governmental organizations in accordance with the Working Group's multi-year workplan (A/AC.105/1202, annex III, appendix I). Accordingly, on 18 July 2019, a communication was sent to member States inviting them to provide responses to a set of questions regarding policies, experiences and practices in the use of space science and technology for global health by 16 October 2019, so that the information could be made available to the Subcommittee at its fifty-seventh session.

2. The present document has been prepared by the Secretariat on the basis of information received from the Russian Federation and Switzerland.

* A/AC.105/C.1/L.383.

II. Replies received from Member States

Russian Federation

[Original: Russian]
[21 October 2019]

Question 1

The scientific and applied research organizations and institutions under the Ministry of Health of the Russian Federation, under the Federal Biomedical Agency and under the Federal Service for Monitoring the Protection of Consumer Rights and Human Welfare (Rospotrebnadzor) have not concluded any formal cooperative agreements or other institutional arrangements with representatives of other sectors directly involved in space activities at the national level.

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. The scientific team was made up of staff from both the Central Research Institute of Epidemiology and the Space Research Institute. Data on climate, weather and environmental conditions in all the constituent entities of the Russian Federation 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. That cooperation continued throughout the period from 2014 to 2018 under research projects whose findings were published in a number of papers in peer-reviewed journals.

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”, which was one of the winners of the “Research using existing world class research infrastructure” competition that was organized in 2019 under the Presidential Programme of Research Projects Carried out by Leading Scientists. 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.

Question 2

It would not be appropriate to establish a dedicated platform for effective coordination among United Nations entities and other international organizations. It is the World Health Organization (WHO), as a specialized agency of the United Nations, that deals with global health issues. In view of that organization’s functions and the experience that it has built up over many years in tackling public health challenges in various social settings and contexts, WHO may rightly be counted among the forums that could serve as the basis for a coordination platform for matters related to space and global health.

Accordingly, more effective use should be made of existing forums, including WHO, the Working Group on Space and Global Health of the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space, the Asia–Pacific Economic Cooperation forum and other international organizations, focusing on the importance of using space based technologies and applications to promote global health.

Question 3

Owing to the fact that space-based technologies are currently not being used as much as they could in support of global health, no system of environmental and governance mechanisms for removing barriers to their use has been established as yet.

The effective use of space-based technologies in support of global health is to some extent hampered by the limited availability of information on the work that is being done in this field at the international and national levels.

Question 4

There is currently no policy on open data-sharing. However, the Ramzaev Research Institute of Radiation Health is developing systems for the geospatial visualization of data on the radiation health certification of organizations and specific areas and of data from the Unified System for Monitoring and Recording Individual Radiation Doses, including data on the medical services provided to the population.

Question 5

The Unified State Health Information System of the Russian Federation includes a Geoinformation Subsystem for the consolidation and graphical representation of information on health-care resources, including data on medical organizations (and their subdivisions) that are involved in the implementation of programmes throughout the country for the provision of State-guaranteed cost-free medical assistance to citizens and data on the population centres where those organizations are located. This could become a useful area of "digital" epidemiology, that is, for recording the exact coordinates of places in which there is a high epidemic risk or which are of epidemiological interest. The list of such places is long and includes anthrax-contaminated livestock burial sites and anthrax risk areas; sites of culling of animals that are reservoirs or vectors of pathogens causing zoonotic infections, including particularly dangerous ones; and known areas of infection and/or areas in which people who have fallen ill are living. Such information could be used for the computer-assisted detection of "hidden" sources of infection.

The Unified State Health Information System can be accessed at the following address: https://egisz.rosminzdrav.ru/#firsPage.

Question 6

Representatives of the Federal Biomedical Agency are among the members of a working group of State Space Corporation "Roscosmos" that is promoting the production and use of medical products and services as part of a project on space medicine.

Moreover, 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. The council would be tasked with coordinating the activities of medical, scientific and educational organizations concerning the exploration and use of airspace and outer space, the transition to personalized medicine and health technologies and the development of space medicine. The council's statute has been drafted and suggestions regarding its composition have been made.

The development and adoption of programmes for intersectoral coordination and cooperation that relate to the use of space science and technology to promote global health are not directly relevant to the mandate of Rospotrebnadzor. Nevertheless, Rospotrebnadzor stands ready to work together with Russian and international organizations on effective international, national and subnational capacity-building activities relevant to the application of space science and technology to promote global health, especially the use of Earth remote sensing to monitor and predict outbreaks of communicable diseases and the use of tele-epidemiology to provide scientific, methodological and advisory support.

Question 7

One planned mechanism involves providing medical students and young health professionals – as part of their professional development – with information about existing practices in the application of space-based technologies in support of global health.

Staff members and qualified specialists from the research organizations of Rospotrebnadzor may give lectures at the postgraduate and/or graduate level on the use of Earth remote sensing methods and data to prevent and combat outbreaks of communicable diseases.

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 and provides training both on a numerus clausus basis and a fee-paying basis. The curricula cover the protection of patients and personnel against radiation in diagnostic radiology using telemedicine technologies. Staff members of the Institute act as academic supervisors (mentors) for final-year students at the Faculty of Medicine of Saint Petersburg State University, the North-Western State Medical University named after I. I. Mechnikov and the Faculty of Medical Physics of the Peter the Great Saint Petersburg Polytechnic University. Among the topics covered by students in their coursework and dissertations is the use of medical imaging technologies as part of telemedicine.

Furthermore, 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.

The Russian Plague Research Institute “Mikrob” (affiliated to Rospotrebnadzor) intends to include information on the use of space science and technology in its training programmes for specialists with a view to ensuring hygienic and disease-free conditions among the population and motivating young staff to acquire the professional skills and qualifications required in order to fully leverage the benefits of space technology, science and applications.

Both medical and technical educational institutions that train specialists for the space sector and related sectors could include in their curricula a lecture series on space medicine and on harnessing the benefits of space technology, science and applications in health care.

Leading specialists in space medicine and technology should be encouraged to address youth (student) forums such as “Realm of Meanings”. In addition, the International Astronautical Congress, specifically its youth section, should be used as a platform for promoting the achievements of various countries in the field of space and global health.

Question 8

One possible mechanism for sharing space-derived data and information more effectively in decision-making processes related to global health is regular awareness raising among relevant authorities (tailored to their respective functions and mandates) on the type and content of space-derived information.

The Ramzaev Research Institute of Radiation Health uses a mobile geographic information system for radiation monitoring, comprising both software and hardware, that can be used to perform: (a) radiation monitoring of specific areas and transmission of the data obtained to a single remote centre for compilation and analysis; and (b) radiation mapping of specific areas, with the possibility of real-time recording and monitoring by individual users. Online access to the system’s radiological database is possible from any electronic device with an Internet connection. Using the system’s built-in mapping features, one can display the radiation data for a given area both in real time and as a historical snapshot. The

system makes it possible to transfer radiometric data taking into account the different radiation types as defined in the device protocols (for example, gamma radiation dose; gamma-ray spectra). Information can be exchanged in real time between a remote command centre and users at radiation monitoring sites to enable prompt information management and analysis. Up to 200 radiation monitoring devices can be supported by the system.

Other possible mechanisms for integrating, harmonizing and sharing space-derived data and information more effectively in decision-making processes related to global health include:

(a) The inter-agency scientific council on space medicine mentioned under point 6 and the Working Group on Space and Global Health

(b) The publication of data in the journals *Meditsina ekstremalnykh situatsii* (Medicine in Emergency Situations) and *Aviakosmicheskaya i ekologicheskaya meditsina* (Aerospace and Environmental Medicine) and in other specialized scientific journals

(c) The organization of special sessions (such as round tables) at conferences on medicine and outer space

Question 9

The organizations and institutions of Rospotrebnadzor for the most part do not have any information of relevance to this question. Earth remote sensing can be used to determine the scale and duration of certain types of emergency that greatly increase the risk of outbreaks of communicable diseases and/or the incidence of somatic conditions (such emergencies including floods, typhoons, heatwaves and cold waves). It can also be used to detect the intensification of factors that contribute to the spread of vector borne diseases, in response to which strengthened preventive and disease control measures are required. Lastly, satellite links can be used – including by disease control and treatment institutions – as a temporary replacement for any conventional means of communication that are damaged in an emergency.

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 Institute has access to the Unified Automated State System for Monitoring the Radiological Situation in the Territory of the Russian Federation. In a radiological emergency, the Institute is thus able to obtain data derived from satellite imagery, which it can use to evaluate the situation at the site of the emergency.

Systems for the geospatial visualization of data on the radiation health certification of organizations and specific areas and of data from the Unified System for Monitoring and Recording Individual Radiation Doses – specifically, data on medical irradiation – can be used to plan and optimize protective measures during a radiological emergency in a medical setting.

The Russian Plague Research Institute “Mikrob” is carrying out exploratory studies to assess the potential of using data derived from the analysis of satellite imagery and from Earth remote sensing in epidemiological research on especially dangerous communicable diseases, including for the purposes of ensuring disease control in areas of the Russian Federation where plague is found in animals. In order to address these matters, the Institute is collaborating with Roscosmos on a cost-free basis. During the period 2018–2019, satellite imagery has been used to study the spatial distribution of sources of plague in the northern and north-western parts of the Caspian Sea region. The findings from the interpretation of those images confirm their potential utility in assessing the extent to which human activity is transforming risk areas; in detecting areas of increased epidemic risk; and in retrospectively evaluating the manner in which topography confines outbreaks of plague. It is planned to use satellite imagery for the continuous remote epizootic and epidemiological monitoring

of plague-enzootic areas in the Russian Federation and to identify areas in which the epidemic risk is high.

Question 10

No specific activities related to the topic of “space for global health” are currently being conducted by the Federal Biomedical Agency or Rospotrebnadzor.

However, geographic information system technologies are being used by the Ramzaev Research Institute of Radiation Health (which is affiliated to Rospotrebnadzor) to enhance the radiation health certification of organizations and specific areas and to develop further the Unified System for Monitoring and Recording Individual Radiation Doses, particularly with regard to data on medical irradiation.

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 on the basis of findings from the analysis of satellite imagery for epidemiological purposes. The use of space science and technology makes it possible to reduce significantly the risk of infection in areas where plague is active and to draw up long-term plans for eradication of the disease in source areas. If the above-mentioned new strategy for epidemiological monitoring of plague-enzootic areas in the Russian Federation on the basis of space technology – and also using robots and unpiloted aerial vehicles – is approved, the effectiveness of such work will be significantly enhanced while the level of biological risk in those areas will be reduced. It is planned to use the findings from the interpretation of satellite imagery for epidemiological purposes in order to support well-founded and prompt decision-making with respect to public health measures during emergencies and in emergency management planning.

Question 11

Existing and planned practices and initiatives in the space life sciences that have the potential to support global health include the following.

Question 11 (a)

The research institutions of the Federal Biomedical Agency are carrying out studies of the negative factors affecting the human body during space flights and, on the basis of those studies, are drawing up recommendations for enhancing the medical support systems available to astronauts and improving the performance of those systems during space missions.

The above-mentioned work is focused, in particular, on studying how the human body’s physiological functions are affected over the course of several days in simulated lunar gravity conditions; investigating the effect of galactic cosmic rays on biological organisms; and setting the health and disease control requirements to be met in order to ensure the health and safety of astronauts aboard piloted spacecraft and the safety of the food products intended for consumption by astronauts during missions.

Significant gaps in this area 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; and the lack of harmonized data-sharing standards among the various manufacturers of medical equipment (equipment for diagnostic radiology).

Question 11 (b)

It is currently not possible to realize the full potential of tele-epidemiology and telemedicine – including the use of these techniques to provide scientific, methodological and advisory support to regional epidemiological and medical institutions – because of the lack of a relevant regulatory framework, insufficient financial and human resources and the lack of necessary infrastructure (notably in the regions).

The effective application of Earth remote sensing techniques and data to combat communicable diseases – including on a day-to-day basis – is hampered above all by the lack of a science-based methodology. The volume of climate, weather and environmental data received every day by specialized Russian institutions working in the field of satellite monitoring (such as the Space Research Institute of the Russian Academy of Sciences) exceeds 1 terabyte. The challenge in epidemiological analysis and modelling is to learn how to pick out from this mass of data the values of key indicators that can be used to forecast the evolution of an epidemiological situation and thereby to optimize preventive and disease control measures at both the federal level and the regional and subregional levels.

Specialists from the Federal Biomedical Agency are taking part in biomedical experiments conducted as part of a long-term programme on board the International Space Station, on the Bion satellites and on other space objects with the aim of advancing practical health care.

Question 11 (c)

Specialists from the Federal Biomedical Agency are collaborating with the GSI Helmholtz Centre for Heavy Ion Research (based in Darmstadt, Germany) on an international project to study the effect of electron deceleration on “dry” DNA molecules exposed to accelerated heavy ions in terms of radiation damage and chemical changes.

Question 11 (d)

Research work is planned on the challenges of ensuring radiation safety during space flights and establishing a medical dosimetry register for astronauts. The enhancement of radiation protection during space flights will help to remove some of the obstacles preventing humans from penetrating further into outer space, including obstacles to human flights to the Moon.

The above-mentioned research preparations are being carried out by the Federal Biomedical Agency together with Roscosmos.

With regard to proposals and initiatives, it is also worth noting the following aspects:

- The need to raise awareness of existing space-based technologies and how they are used in practice
- The need to enhance mechanisms for inter-agency, inter-organizational and interdisciplinary coordination in the development of space-related initiatives, including in such fields as space science and technology and the application of space-based technologies
- The need to design new – and enhance existing – software and systems that actively use space-based technologies to obtain timely forecasts of the dispersion of radioactive releases in the atmosphere and to predict the formation of radioactive “hotspots” as a result of atmospheric fallout; and the need to use high-resolution optical images to analyse the propagation of fine dust, yellow dust, smog and smoke, thereby enabling quick predictions of localized heavy rains and the modelling of three-dimensional wind fields so as to help predict the dispersion of radioactive releases
- The need to enhance the early warning system for radiological emergencies

Question 11 (e)

(a) Plans for scientific research on biomedical support for crewed missions to the Moon; specifically, the development of a medical support system for astronauts that is able to run autonomously on the surface of a celestial body in a reduced-gravity environment.

This issue is also being explored by the Federal Biomedical Agency in collaboration with Roscosmos.

(b) Plans for studies on ensuring planetary biosafety during the implementation of the ExoMars programme.

The purpose of planetary biosafety (planetary protection) is to prevent the biological contamination both of the celestial body being studied and of the Earth; it is a mandatory principle in the design of any interplanetary mission. According to the Committee on Space Research, missions to Mars are particularly interesting from the point of view of biosafety because on that planet there are no insurmountable or near-insurmountable obstacles to the emergence of life.

The Federal Biomedical Agency and Roscosmos are exploring the possibility of participation by Agency specialists in the ExoMars programme, specifically in ensuring planetary biosafety under that programme.

(c) As an example of existing practices in emergency management one may cite the work of the institutions of the Federal Biomedical Agency that provide health-related and medical support in connection with the launch of space objects from the Baikonur and Vostochny launch sites. That support includes a set of measures for monitoring the working environment at the enterprises operating on the launch sites and for studying, over time, the health of personnel at the launch sites and of local residents.

If an emergency occurs during preparations for the launch of a space object or during the launch itself, the relevant institutions of the Federal Biomedical Agency perform health-related and disease control measures, including monitoring for chemical or other hazardous contamination of the air inside the working zone and in the atmosphere and of the soil, water and other objects within and beyond the contamination zone; the implementation of procedures to ensure that persons evacuated from the epicentre of the emergency have undergone appropriate health checks; and checks to ensure that emergency management measures are compliant with health and chemical monitoring requirements.

A series of health-related emergency management measures are performed by emergency response teams made up of specialists from the Federal Biomedical Agency. During the launch of a space object, equipped mobile teams of medical staff are assembled in the immediate vicinity of the launching pad so that they can provide appropriate medical assistance to any victims in an emergency (including situations in which the space object falls back to Earth). After such first aid has been provided, the victims are taken to institutions of the Federal Biomedical Agency to receive specialized medical care. A system is in place to deal with emergencies affecting large numbers of personnel at launch sites: the existing medical services are reinforced by clinical toxicology teams from relevant institutions of the Federal Biomedical Agency. Staff from the specialized institutions of the Federal Biomedical Agency take part in the investigation of the causes of an emergency, its effects on the health of personnel and the population and the level of contamination of the working and surrounding environments.

The practice of providing medical support during the launch of space objects has proved to be effective in specific incidents that have occurred at launching pads and can be extended to hazardous operations in any area of activity that involves a high chemical risk.

Switzerland

[Original: French]
[23 October 2019]

Question 1

In Switzerland, cooperation between the health sector and other sectors involved in space-related issues exists at different levels and between various actors, including governmental agencies, medical organizations and research institutions. The following are some examples of formal collaborative arrangements, which in some cases involve international organizations:

- The Federal Office for Meteorology and Climatology (MétéoSuisse) works closely with the health sector through the National Centre for Climate Services (NCCS). 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. Without a doubt, climate change and rising temperatures are having a significant impact on public 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.
- The Hub of Digital Sciences for Environment and Health (SDES) 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. It promotes interdisciplinary teaching and research and endeavours to dispel the conceptual and technical barriers that keep scientific knowledge from being part of decision-making processes.
- 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.
- The United Nations Population Fund (UNFPA) is working with the GeoHealth research group of the University of Geneva to develop innovative methodologies that draw on geospatial data and physical accessibility modelling to support maternal health services. In 2017, they signed a memorandum of understanding aimed at optimizing the network of health facilities in 10 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.

Question 2

The objective of such a platform should be to pool existing capacity in space and Earth observation technologies and tie that capacity in with the skills sets of health professionals while providing support for the training of intermediaries. Awareness-raising and capacity-building should be an integral part of the platform's activity. The platform should create conditions for effective, cross-disciplinary work to be pursued in support of global health. Actors already working in those areas need to be involved in order to ensure the widest possible variety of skills and to learn from their expertise and identify good practices. The platform could be managed by a

secretariat that would underpin the effort to create a global network and ensure a collaborative spirit within the platform.

Such a platform should ideally be established in Geneva, which is already home to many centres of expertise and to international organizations and academic institutions active in the areas of health, humanitarian work, Earth observation, higher education and research on international, humanitarian and health issues. These include the World Health Organization (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.

In 2017, Geneva hosted a preparatory conference for UNISPACE+50 on the theme of strengthened space cooperation for global health. Organized jointly by the Office for Outer Space Affairs of the Secretariat, WHO and the Government of Switzerland, with support from the European Space Agency (ESA), the conference issued recommendations that formed the basis for the present questionnaire.

Question 3

National level

There are three types of barriers to the effective use of space-based technologies in support of global health:

Firstly, there is little scientific research being conducted on the subject, although isolated initiatives have sought to promote interdisciplinary research on these topics. The “space and aviation” innovation cluster of the University of Zurich (UZH Space Hub) uses the Dübendorf airfield to carry out research activities, including in collaboration with the National Aeronautics and Space Administration of the United States.

Secondly, communication among actors in the fields of health, space and applied science should be strengthened. In this connection, the SDES Hub at the University of Geneva states that one of its main goals is to develop teaching and research activities in the broad domain of digital sciences. From observational data, to their representation and integration in models and scenarios, and then their communication to stakeholders, the Hub is aiming in particular to dispel the conceptual and technical barriers that often prevent scientific knowledge from making its way into decision-making processes.

Thirdly, the limited use made of satellite data may be a result of such factors as accessibility, utilization capacity and data quality. As a member of ESA and the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT), Switzerland enjoys access to essential satellite data.

In addition, 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.

International level

Switzerland participates actively in the following international efforts to facilitate access to satellite data that can be used in the health sector:

- The Global Framework for Climate Services (GFCS) is being implemented under the auspices of WMO. Health is one of the five priority areas in which GFCS promotes climate services, such as systematic climate observations of relevance to the health sector.
- WMO, WHO and the United Nations Environment Programme (UNEP) recently launched a new global coalition for health, the environment and climate change.

One of the coalition's main objectives is to reduce the high number of deaths caused by environmental hazards, in particular, air pollution.

- Switzerland also supports the work of the GEO secretariat. For example, the Institute of Environmental Sciences of the University of Geneva has participated both as a coordinator and partner in various projects of the European Union research framework programmes (FP7 and H2020) aimed at strengthening the tools of the Global Earth Observation System of Systems (GEOSS).

Question 4

National level

Switzerland pursues a policy of open access to geospatial data. The Federal Act on Geoinformation seeks to ensure that up-to-date geodata on the territory of the Swiss Confederation are available and of the required quality for general use by the authorities of the Confederation, the cantons and communes, the private sector, the public and the scientific community in a rapid, easy and sustainable manner and at a reasonable cost. The Federal Administration also complies with the ordinance on environmental protection, which provides that environmental information should, to the extent possible, be made available in the form of open digital data sets.

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. The project compiles several decades of geospatial data and makes them available to governmental agencies and research institutions involved in environmental research and monitoring. The use of the Data Cube for public health and environmental applications is currently being considered.

In addition, in collaboration with other States, Switzerland is looking into how to ensure the responsible use of health data.

International level

Ensuring the accessibility and availability of all global climate data requires having a network of international partners and making optimal use of existing structures. Switzerland therefore supports the efforts of EUMETSAT, GEO and the Global Climate Observing System to provide, at the international level, observation data on the climate and environment, both of which are determinants of health. WMO resolutions 25 and 40 are particularly important to the free exchange of meteorological, hydrological and climatological knowledge in pursuit of better well-being for the world's inhabitants.

Question 5

National level

The Federal Office of Public Health has published a list and a map of the hospitals in Switzerland.

The Swiss Health Observatory (Obsan) has established the Swiss Health-care Atlas, which maps by canton and region the number of in-hospital treatments administered. The regions are established on the basis of satellite data.

Efforts at the local level have included the Geneva Territorial Information System (SITG), which 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 group works with various partners, such as the Institute of Environmental Sciences of the University of Geneva, WHO, UNFPA, the United Nations Children's Fund (UNICEF), the Global Fund and the World Bank.

International level

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.

Question 6

Swiss TPH is involved in joint programmes with international organizations and in national education projects and networks such as the Swiss School of Public Health (SSPH+). The School is the national coordinating body for the promotion of postgraduate studies and research in the area of global health. It works in partnership with all the major Swiss universities and offers courses on space technology.

Drawing on its extensive experience in the area, the University of Geneva offers a course in global health that includes a module on digital technologies and innovation. In the spring of 2020, it will host the Geneva Health Forum on the theme of "Precision global health in the digital age" in cooperation with Geneva University Hospitals, the Swiss Agency for Development and Cooperation (SDC) and a number of international organizations, such as WHO, MSF and the European Organization for Nuclear Research (CERN).

The UZH Space Hub works in two fields of study relevant to space flight: Earth observation and space life sciences, the latter involving biomedical research conducted in space conditions. In cooperation with national and international partners, the Hub provides Swiss universities with access to relevant flight platforms for research at Dübendorf and abroad.

Question 7

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.

Question 8

For this question, "decision-making processes related to global health" are understood to mean support for decision-making in health care.

International level

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. This has included the transition from conventional radiology to digital radiology. Various information systems have been introduced that allow for the use of teleradiology and the management of equipment maintenance.

In support of the work of UNFPA, UNICEF and the Global Fund in 12 African countries, projects by the GeoHealth research group are assisting those countries' health ministries in adopting approaches and health standards that reflect the latest developments in the mapping and geospatial modelling of health-care services. High-resolution geospatial data are utilized for that purpose.

Question 9

National level

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.

International level

Under the auspices of the International Committee of the Red Cross, Swiss TPH is implementing the ALMANACH project (ALgorithms for the MANagement of Acute CHildhood illnesses) in Afghanistan and Iraq using geospatial data to develop computer algorithms intended to improve child health care. The algorithms form a decision-making support system that incorporates the WHO guidelines on illnesses affecting children under 5 and thus facilitates decision-making in the treatment of illnesses.

Question 10

To date, there are no national reference documents in the areas of global health and space. However, there are initiatives such as 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).

As a contribution to the work of the Expert Group on Space and Global Health of the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space, the University of Geneva conducted a study entitled "Applications of space technologies to global health: scoping review" (authored by Damien Dietrich, Ralitza Dekova, Stephan Davy, Guillaume Fahrni and Antoine Geissbühler, and published in *Journal of Medical Internet Research*, issue of 27 June 2018).

Moreover, various international organizations have published documents related to space and global health, among them the Office of the United Nations High Commissioner for Refugees, Office for Outer Space Affairs, GEO, WMO, WHO and the Operational Satellite Applications Programme of the United Nations Institute for Training and Research.

Question 11

The study "Applications of space technologies to global health: scoping review", referred to above, identifies barriers that exist in the area of space and global health. These include low awareness among health workers and space experts and a lack of space-related knowledge and skills among health workers. The limited number of environmental monitoring systems in low-income countries is a further barrier.

At the national level, a report commissioned by the Federal Office for the Environment and published in 2016 found that space applications held high potential for innovation in the health field.

Question 11 (a)

- The GeoHealth research group is working with WHO, UNICEF and the Health GeoLab Collaborative on the development and maintenance of the "AccessMod" open-source software, which is used in many countries to model – utilizing high-resolution geospatial data – the physical or geographical accessibility of health services. In particular, the software makes it possible to estimate the percentage of a target population who do not receive physically accessible medical care owing to capacity shortfalls (staff or equipment); to measure the distances and travel times between health facilities; and to identify optimal locations for new health facilities.
- The Telemedicine Network in French-speaking Africa (RAFT) is a telemedicine network that supports the training of health professionals in remote areas and provides them with the right expertise at the right time by making use of affordable technologies and low-bandwidth connections.

Question 11 (b)

- The Global Fund to Fight AIDS, Tuberculosis and Malaria has been working with the GeoHealth research group since 2018 to develop methodologies aimed

at enhancing the effectiveness and impact assessment of their disease control programmes in Africa through geospatial modelling and advanced mapping.

- Swiss TPH is currently planning a project with Ethiopia that will include the use of satellite images for disease surveillance and drought monitoring.
- A study entitled “Localization of physical activity in primary school children using accelerometry and the Global Positioning System” drew on the GPS to identify places where children engaged in physical activity. A total of 119 children participated in the study, which was conducted by the Institute of Human Movement Sciences and Sport of the Swiss Federal Institute of Technology in Zurich (ETHZ).
- Applying the principles of precision agriculture, a GPS-controlled crop-spraying drone is helping to optimize crop protection under the national action plan for crop protection of the Federal Office for Agriculture.

Question 11 (c)

- The UZH Space Hub conducts research in a vast range of areas: gravitational biology and biomechanics, space biotechnology, space medicine, fluid physiology, spinal health (the effects of changes in gravity and axial load on the health of the vertebral column), the musculoskeletal system and extreme environments. Special focus is placed on microgravity research. The innovation potential of biotechnology in conditions of weightlessness is huge, for example, in the areas of biotechnology, regenerative medicine and tissue regeneration.
- HSLU is working on a number of space biology projects, and its Centre of Competence in Bioscience and Medical Engineering prepares experiments for space applications, such as a yeast bioreactor that was on board the International Space Station. In addition, scientists at HSLU, which is a partner of the European Low Gravity Research Association, take part in parabolic flights to further research on osteoarthritis by exploring the effects of microgravity on cartilage cells; they conduct other projects related to microgravity as well.
- As part of a study supported by ESA, the Swiss start-up Gait Up has developed a new algorithm that integrates satellite navigation data with motion data measured by an inertial measurement unit. Incorporated into a commercially available smartwatch, this algorithm has demonstrated a high degree of accuracy in relation to the parameters being measured, specifically, forward speed and the recognition of physical activity.

Question 11 (d)

- At the request of UNICEF, the GeoHealth research group is currently assessing the impact of Cyclones Idai and Kenneth on Mozambique (2019) in terms of loss of access to health networks and quantification of the population affected by that loss.