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Item 5 of the agenda*
Space technology for socioeconomic development in the context of the United Nations Conference on Sustainable Development and the post-2015 development agenda

First Meeting of the expert group on space and global health held on 5 February 2015:

Report on the proposed mandate, workplan and initial considerations

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1. Executive Summary

1. The first meeting of the focused expert group on Space and Global Health was held on the margins of the 52nd session of the Scientific and Technical Subcommittee (STSC, or the Subcommittee) of the Committee for the Peaceful Uses of Outer Space (COPUOS, or the Committee) on 5 February 2015. This meeting enabled States members of the Committee and their experts to exchange views and to discuss the working basis of the new expert group in the context of the many important and evolving subject areas involving space and global health.

2. The expert group successfully agreed on a proposed vision, mandate, timelines and work plan for the activities of the group. The participants also documented important observations to be considered during the future work activities of the expert group. A discussion paper entitled "Space activities and Global health" was also tabled for initiating further reflection on the scope of space activities linked to global health. This discussion paper is attached as an annex to this Conference

* A/AC.105/C.1/L.341.

Room Paper (CRP). The proposed vision, mandate, and workplan included in this CRP are for the consideration of STSC members for approval.

2. Summary of the meeting

3. This report is meant to convey the key highlights of the discussion by participants and is not meant to be an exhaustive record of all interventions provided during the meeting.

4. The first meeting of the focused expert group on space and global health took place in the margins of the 52nd session of STSC on 5 February 2015 and was formatted as a 3-hour workshop. A provisional agenda, a draft mandate for the group and a non-paper scoping the many domains of space linked to global heath were distributed electronically ahead of the meeting to frame the discussion. A total of 14 participants exchanged views during the work of this group. An important point on the agenda was a presentation of the Action Team 6 Follow-up initiative. The group first agreed on the agenda and discussed details relevant to membership, reporting mechanisms and timelines of the expert group. Of note, the group agreed to leave the membership open to allow STSC members to propose other experts to join the group at any time and as appropriate in relation to topics of the workplan.

5. The group also agreed to set a 3-year timeline for implementing the workplan and to meet in the margins of the STSC every year. In addition, the group will seek opportunities between STSC sessions to meet in the margins of another event on a technical subject pertinent to the work of the group. The group reviewed and discussed in detail the mandate and the content of the workplan. It is important to note that, although the elements of the workplan are set over a 3-year period, the members of the group agreed to be active, produce recommendations and respond to needs that may arise in the short term. The group agreed on a mandate and a workplan as reported below.

6. The meeting of the expert group on space and global health was also the occasion for the Action Team 6 Follow-up initiative (AT6FUI) to provide a final report of its activities. Dr Engelbert Niehaus of Germany presented the achievements of the AT6FUI which was led by the University of Koblenz-Landau over the past 3 years. The presentation concluded with the importance of reaching people and having affordable solutions adapted to their needs. The presentation was very well-received and participants noted interesting results of the AT6FUI including a strong participatory and multi-disciplinary approach to problem-solving involving open and low cost solutions. The presentation raised an observation relating to the value of formally analyzing benefits of such initiatives to better document successes. The Koblenz-Landau University and Germany was recognized for their significant contributions related to the success of the AT6FUI. The United Nations Office of Outer Space Affairs (UNOOSA) was also thanked for their support and guidance during the work of the AT6FUI. The AT6 Follow up initiative is now officially closed.

7. The participants were then asked in the a round table to freely express needs, issues and recommendations pertaining to the work of the expert focus group. These are summarized below under “Observations and recommendations”.

8. Finally, the participants agreed to attach the discussion paper that was submitted by Canada summarizing space activities and global health as an annex to

this CRP. This discussion paper includes a matrix analysis mapping out the various key health activities in relation to key space activities. This matrix is meant to help position the different activities related to the vast domain of health and space with the intention of organizing these activities and providing tangible recommendations for structuring actions. Participants agreed to further study the findings of this discussion paper and to return comments and observations to the Chair of the expert group in a timely manner. It is then expected to receive these final comments and observations by Member States before 15 May 2015.

3. Background and vision

9. Background: At the 51st session of the Subcommittee, the Working Group of the Whole under the agenda item "Space Technology for socio-economic development in the context of the United Nations Conference on Sustainable Development and the post-2015 development agenda" agreed on the establishment of a focused expert group on space and global health, and agreed that the group should present, under the leadership of Canada, its method and program of work for consideration at the 52nd session of STSC (A/AC.105/1065, Annex I, para. 6).

10. Since the launch of early satellites and the first days of human spaceflight, developments in the space domain have enabled governmental and non-governmental organizations to address global health issues in new and innovative ways. In particular, Telemedicine, Tele-Health, Tele-Epidemiology and Disaster and Health Emergency Management are the best-known applications benefiting from the unique contribution of space. In addition to these, technological developments and research efforts related to human spaceflight continue to lead to important advances and benefits for health on Earth.

11. Today, significant opportunities are arising to further leverage the use of space to address global health issues and to make such applications and their benefits more widely available thanks to advances in various technologies; the growing availability and affordability of space technologies; and the increasing collaboration among States in this important area.

12. The connection between space and health implies broad and complex linkages among various scientific domains and social benefit sectors. To pursue collective progress in this inter-sectorial area, it is essential to better understand its many facets; to enable States and their experts to focus efforts in areas that are best attuned to national priorities, knowledge and capacities; and to promote collaboration and information sharing.

13. Vision: In this context, there is an urgent need to foster more synergy and promote the convergence of common interests among Member States in this important social benefit area. It is envisioned that the expert focus group will enable collaborative engagement of Member States, international intergovernmental organizations and non-governmental organizations and propose tangible and long lasting solutions regarding the contribution of space to the global health agenda.

4. Mandate

1. The focused expert group reviews and analyses current uses of space (technology, applications, practices and initiatives) in support of global

health needs in order to: identify gaps; propose recommendations; and provide orientation for the future work of the STSC.

2. By holding work sessions on the margin of the STSC, the expert group provides a forum to enable Member States, international intergovernmental organizations, non-governmental organizations and their respective experts to share needs, opportunities, best practices and expertise to actively engage, link and enable use of space (technology, applications, practices, capacity building and initiatives) for global health purposes.

3. By reporting to the STSC through its Working Group of the Whole, the expert group increases awareness, engagement and promotion of collaborative and direct actions by Member States on this topic while concentrating their energy on achieving tangible and long-lasting results.

5. Workplan

14. The activities of the group are planned over the next three years. The group work plan includes:

1. Review of the current and evolving state of affairs relative to the use of space in support of global health needs and a specific scope for the expert group (2015);

2. Compile practices and initiatives, current or planned (concepts, science, capacity building, operations) according to the proposed scope (mainly 2015-16);

3. Analyse gaps and opportunities for future development and to enhance alignment toward global health goals according to current context (mainly 2016-17);

4. Explore possible cooperative and user-driven solutions to address these gaps (mainly 2017-18);

5. Continue efforts to promote active engagement of the United Nations Committee for the Peaceful Uses of Outer Space and other relevant national and international organizations towards tangible actions in this domain (ongoing).

6. Observations and recommendations

15. Here is a summary of key observations collected during the discussion of the expert group:

- Pool of experts in the space and global health interface: A list of people who participated to the first meeting of the focused expert group on space and global health should be created and kept up to-date. Given the vast domain covered by the topic of space and global health, a list of other experts and interested possible collaborators should be created as a start in organization of a so-called “community of practice” (COP). Given the work by AT6FUI, the experts that worked collaboratively in this latter group could be considered founding members of such a COP.

- Expression of global health needs: Participants consistently noted the significant importance of engaging key international health organizations in discussing global health needs. The notion of stimulating the expression of these key global health needs was central to the idea of a “pull” model for discussing appropriate spatial solutions aligned with these needs. It is recommended that participants of the expert group continue active efforts in identifying global health partners and engage them for expression of needs and possible collaborations.

- Active engagement of the World Health Organization (WHO): Given the central role of the WHO as a United Nations leader in global health and given the desire to align space solutions to expressed global health needs, it is recommended to continue efforts to actively include the WHO in all levels of discussions and to consider long lasting mechanisms to have WHO and UNOOSA working closely together in guiding activities at the interface between space and global health. The current option of a “WHO collaborating center” was also discussed for future consideration.

- Active engagement of the United Nations Office of Outer Space Affairs: Given the central role of UNOOSA as a leader in space affairs, and in consideration of its past interest in guiding and supporting capacity building and cooperation for socio-economic benefits including health, participants noted the need for a continued and focused engagement of UNOOSA in facilitating progress towards global health benefits from space through capacity building activities (workshops, trainings, fellowships, etc.).

- From proof of concept to operation and action: Participants noted the need to continue the effort to move research, pilot studies and proof of concepts into ongoing applications and programs supporting global health needs.

- Social issues linked to space solutions for global health: Participants noted issues linked to social-psychological acceptance, social values, legal, ethical and political considerations that are often significant in determining the success of a space solutions for global health. These aspects require further study.

- Formally assessing benefits from initiatives: The need to more formally assess the costs and the benefits of a space solution program toward global health (such as a telemedicine initiative) and the difficulty in defining and measuring performance indicators toward that end was discussed. It is understood that enhanced assessment of cost-benefit of initiatives would provide a strong argument in favour of continued development of such solution but issues relative to methods exist. Further activity such as a consensus conference or other mechanisms should be considered to advance this issue.

- Providing guidance to key subject areas: In addition to providing findings for the consideration of STSC, participants recommended that the expert group be available to provide guidance to key international initiatives such as the discussion on the contribution of space to the post-2015 development agenda.

- Considering opportunities to meet in the margins of other events: Participants noted the desire to take the opportunity to meet and provide progress to the activities of the expert group in the margins of meetings pertinent to the issues linked to space and global health and organized between the STSC sessions. Meetings through electronic means (phone, or video) could also be organized to facilitate communication and work progress.

- Other technical considerations: Throughout the discussion, participants expressed a collection of other technical issues pertaining to implementing projects in the various areas of space and health. These were duly noted and will serve in future discussions and analyses of the expert focus group.

Annex 1

Space Activities and Global Health

Discussion paper

1. Introduction

While the following is not a comprehensive review of all current and ongoing activities, the intent is to provide a framework that could allow states to appreciate the various aspects of space and global health. The framework could be used to organize the future work of the Scientific and Technical Subcommittee (STSC) of the Committee on the Peaceful Uses of Outer Space (COPUOS). It may be expected that States and their experts would assemble along the specialty of their direct interest and competence and draw a work program for that specialty. Those work programs would then be folded into a broader agenda for consideration of the subcommittee.

2. Space Activities

Space activities that have had a demonstrated impact on global health and related issues can be regrouped under two broad headings: Satellite Activities and Human Space Flight Activities.

2.1. Satellite Activities

Tele-communication provides voice, video, data and internet communication between locations throughout a large part of the world. Thanks to recent technological advances, ground station requirements are less demanding and equipment like satellite phones are becoming less expensive, highly portable and thus, more widely available.

Global Navigation Satellite Systems (GNSS) provide signals that make it possible for individuals to pinpoint their location almost anywhere on the globe. There are currently two interoperable GNSS' – the United States' Global Positioning System (GPS) and the Russian Federation's Global Orbiting Satellite Navigation System (GLONASS). Europe (GALILEO), India (IRNSS), China (BNS) and Japan (enhancements to GPS) are also promoting development in this area.

Remote Sensing satellites allow specific properties of the surface of the Earth and its atmosphere to be measured all over the world and provide a practical way to obtain valuable information for a vast majority of the Earth. This information is not, however, available in real-time. Applications of remote sensing require that satellite data be processed and interpreted.

2.2. Human Spaceflight

The unique characteristics of outer space have led to the development of orbiting laboratories. The International Space Station (ISS), where humans live and work in an isolated and remote location and conduct microgravity research, is the most notorious example.

Space Life Sciences are an important aspect of the work done by astronauts during space missions, during which microgravity research is conducted and physiological changes are observed in the human body.

Technology development for human spaceflight is significant and includes a wide range of areas of expertise, including advancements in rocket propulsion, space vehicles, and composition of materials, robotic technologies, as well as innovations to deal with challenges of working in an isolated and remote location.

3. Application of Space Activities for Global Health

Global Health refers to the health of human populations in a global context in a way which transcends the perspectives of individual nations. To date, space activities have contributed to several areas of global health such as medical practice, health services, medical research, prevention and control of infectious and chronic diseases and health security. This wide contribution has been developed and expressed in specialized activities such as telemedicine, tele-health, health sciences, tele-epidemiology and disaster and health emergency management.

3.1. Telemedicine — Clinical Care at a Distance

(Space: Telecommunication, Global Navigation Space Systems, Technology Development)

Telemedicine involves the use of *telecommunication* and information technology to provide clinical care at a distance. Telemedicine benefits from advances in these fields as well as innovative *spin-offs of technologies developed for human spaceflight* to perform health care, including remote diagnosis and tele-surgery. Telemedicine techniques are employed regularly in remote areas in developed countries like Canada and are increasingly being used in developing countries thanks to advances in technologies that have led to cost reduction, heightened capabilities and ease of operation as well as ground infrastructure development. Telemedicine includes:

- Specialist consultation
- Second opinion for physicians
- Remote monitoring and analysis
- Tele-diagnosis
- Tele-consultation
- Peer-to-Peer training
- Tele-robotic diagnosis
- Routing medical emergencies
- Digital applications

Both the European Space Agency (ESA) and the France (CNES) have telemedicine networks in Africa. Other Governmental and non-governmental agencies have developed telemedicine networks which address specific specialties in areas such as dermatology, ophthalmology and HIV/AIDS. These networks are not limited to Africa, but also include SE Asia and Pacific Islands.

In developing countries telemedicine is also used to provide medical support to health practitioners. It enables physicians to acquire a second opinion or specialty advice (i.e. cardio consultations) where none is locally available. In addition to these functions, clinical and bedside monitoring equipment developed based on advancements in technology for spaceflight (such as TEMUS developed in Germany) can be used to relay real time patient data for analysis and clinical decision making.

More recently, advances in space robotic technology have been applied to a variety of applications and fields. Relevant to this discussion are proven robotic surgery techniques (i.e. Canada's NeuroArm) and tele-robotic diagnosis (i.e. ultrasound scanning).

3.2. Tele-Health

(Space: Telecommunication, Global Navigation Space Systems)

Tele-Health is defined as the use of telecommunication and information technologies to deliver a range of public health services, expertise and information, including health education, at a distance. Because of its broad reach, tele-health has the potential to make important changes in the delivery of health services and health education, particularly in developing countries. As health and clinical medicine are not distinct, there is definite overlap and synergy between the branches of tele-health and telemedicine.

Tele-Health currently has two major areas of focus:

- Professional training
- Community health education

Professional training includes both linkages between hospitals and universities and centres of excellence in other countries. Two examples of this are: (1) the Pan African Network connecting locations in Africa with centres in India and (2) RAFT a CNES program of tele-education and tele-consultation with over 18 countries in Africa.

Health education takes place both at the community level and for local, sometimes isolated, community health care workers. Providing information and training rapidly to those working at the front lines of health sectors can have immediate and extensive impact. Recent projects such as RAFT throughout Africa and a joint ESA/European Community project in sub-Saharan Africa as well as collaborations between World Health Organization and JAXA (Japanese Space Agency) in South East Asia demonstrate both the importance of collaboration and the benefits derived from tele-health.

3.3. Health Sciences

(Space: Telecommunication, Space Life Sciences, Technology Development, Remote Sensing)

Space Life Science Research (aboard the ISS and other spacecraft) has led to *knowledge and innovation* applicable to health issues on Earth. Remote Sensing contributes to knowledge of the environment and factors that influence global health.

Health Sciences include:

- Understanding and improving human health;
- Development of health-related technologies;
- Point of care medicine.

Understanding and Improving Human Health: Many aspects of physical adaptation to spaceflight are similar to changes in aging; including muscle and bone loss and cognitive changes. Research in space has led to advances in a numbers of areas of healthcare. Some examples include the testing of new drugs to counter bone loss in a much shorter time; new diagnostic procedures of both heart disease and high blood pressure and the identification of a genetic disorder, particularly common in young women, that causes fainting.

Health Technologies: Technologies developed for spaceflight have potential for application to health issues Earth. The isolated/remote location of astronauts working in outer space has encouraged the development of instruments to monitor the health of astronaut and allow remote diagnosis by physicians on the ground. The same technologies can be used to improve medical care in remote locations on Earth. Remote bedside and clinical monitors, for example TEMUS developed by DLR, are being used to relay patient data in real time to clinical specialists while diagnostic systems will assist isolated health workers in making correct diagnosis.

Robotic technology developed for the construction and maintenance of the ISS is now being applied to highly sophisticated tele-surgery robotics. Such technology is now being used to make previously impossible surgeries, possible (i.e. Neuro-Arm). Robotic ultrasound diagnostic procedures also show considerable promise by allowing highly skilled professionals to make diagnoses in remote locations.

3.4. Tele-Epidemiology

(Space: Remote Sensing of the Earth and Atmosphere)

Epidemiology is the study of the distribution and determinants of health-related states or events (including disease), and the application of this study to the control of diseases and other health problems . Tele-epidemiology applies the methods, technologies and techniques of satellite remote sensing and measurement to epidemiology and allows health issues to be addressed over larger areas and questions to be answered in shorter periods of time. There are two branches of tele-epidemiology applications:

- Prediction of disease patterns throughout the World;
- Analysis of environmental factors affecting human health

Prediction of disease patterns throughout the world: Data from a number of different satellites can be combined with various in-situ data to help predicting climate and ecological conditions that indicate the presence of disease vectors in specific locations. NASA uses space satellite data to predict the possibility of new outbreaks of Malaria up to two weeks in advance in remote areas of Africa and South East Asia. Similar predictions are made for Dengue Fever and Rift Valley Fever. Recently, meningococcal meningitis was linked to dry conditions and high dust levels in specific parts of Africa. In this case, identifying high surface dust levels would allow the prediction of outbreaks and allow for targeted vaccination. And in North and South America satellite determination of local ecology and temperature changes over large areas allow specialists to predict the potential introduction of vector borne diseases such as Lyme disease, Chikungunya and Dengue Fever; making it possible to alert health authorities and put control measures in place.

Environmental Factors Affecting Health: Satellites have been used to collect data on the state of the Earth's atmosphere for a long time. For example, ozone levels have been monitored regularly since 1978 and decreasing ozone levels are linked to increased UV radiation, more case of skin cancer and photochemical pollution which causes respiratory disease. More recent satellites measure small particulate material in the atmosphere as well as near surface NO2 levels. Such information can be collected and analysed for the entire globe rather than for only populated areas in developed countries. This allows specialists to predict a rise in environmentally related medical conditions around the world. Satellite data can also be used to monitor health of oceans and freshwater resources by identifying algal blooms that affect drinking water and indicate changes in water temperature and pollution levels.

It is important to note that remotely sensed data requires considerable processing and analysis before it can be applied to specific questions of global health. In addition to this, some types of satellite data remain expensive for potential user to acquire. Efforts are currently underway to make this data more widely available and provide the training required to interpret the data. NASA through the SERVIR program has established centers at five locations around the globe and JAXA is developing access programs for South East Asia and the Pacific Islands.

3.5. Disaster and Health Emergency Management

(Space: Telecommunication, Space Life Sciences, Space Technology, Remote Sensing)

Space Technologies play a critical role in planning, executing and managing responses to disasters and health emergencies and, as indicated by emergence of the Global Health Security Initiative (2001) and the Global Health Security Agenda (2014), a disaster or health emergency in one part of the world can become a global health emergency. Disaster and medical emergency management calls upon all technologies and all other areas of space or global health and includes:

- Prediction of disasters (environment and disease)
- Support effective relief effort planning (maps, extent of disaster)
- Support coordinated and effective relief efforts on site (location identification, telecommunication, technology)

Prediction of disasters: Satellite data can be used to predict some disasters and health-related emergencies (*Tele-epidemiology*). For example remote monitoring of water levels can predict potential flood disasters and accompanying diseases such as Cholera.

Support effective relief effort planning: The area affected by a disaster can sometimes be visualized using satellite data, for example, the extent of landslides or large scale fires, such as forest or grass fires. *Global information systems* are used to develop maps of otherwise unmapped areas and can be used to support the development of action plans for response teams.

Support coordinated and effective relief efforts on site: Once teams are on the ground, knowing where they are and what they are doing is critical. *GPS technology* allows location of teams and personnel in a sometimes extremely chaotic environment and satellite communication allows coordination between team members and communication with major coordinating centres when no other form of communication is possible. *Telemedicine* techniques allow medical response teams to communicate with specialists, allowing experts to support an extended number of medical teams and actual patient data can be transmitted for further analysis allowing appropriate clinical decisions to be made and unexpected conditions to be diagnosed.

4. Conclusion

This paper purports to describe the interaction of space and global health. High level definitions for space activities and areas of global health have been proposed. As illustrated, several space technologies and capacities contribute to one or many aspects of health, generating significant benefits.

To access those benefits and incite further progress, it is necessary to access and master the corresponding space capacities.

Further work of the STSC could be organized along the activity areas indicated in this paper to further clarify existing capacities and applications with the goal of describing the conditions and future steps necessary to their full implementation and operation.

Appendix 1

The Relationship between Space Activities and Global Health Applications — *at a glance*[1]

SPACE AND GLOBAL HEALTH						
		Individual health	***Individual and Communities***		***Population Health***	
Key HEALTH activities		Medical practice	Health services	Medical Research	Prevention and control of infectious and chronic diseases	Global Health Security
Key Space Activities		**Tele-Medicine**	**Tele-Health**	**Health Sciences**	**Tele-epidemiology**	**Disaster Management**
Satellite Activities	*Tele-communications*	▪ Specialist ▪ Second opinion ▪ Remote monitoring ▪ Tele-diagnostic ▪ Tele-consultation ▪ Peer to peer ▪ Tele-Robotic	▪ Professional training ▪ Community health worker training ▪ Community health education ▪ Tele-education ▪ Peer-to-peer training	▪ Knowledge transfer	▪ Data dissemination through centres of expertise ▪ Water levels & water borne diseases ▪ Emergency communication for outbreak/pandemic management	▪ Flexible and deployable capacities ▪ Strategic planning, coordination and communication among relief workers; coordination sites; experts; individuals
	Global Navigation Space Systems & GIS	▪ Routing Medical Emergencies	▪ Contextual information on site ▪ Health services optimization		▪ Geographic occurrences of diseases ▪ Location of sources of infection/pollution ▪ Tracking animals as disease sentinels	▪ Detailed site information ▪ Response worker location coordination
	Remote sensing of the Earth and Atmosphere				▪ Tracking disease and risk factors ▪ Vector-borne diseases (malaria) ▪ Air-born disease, including dust, air pollution (ex: Asthma) ▪ Waterborne diseases (ex: Cholera) ▪ Food security	▪ Disaster mapping (before and after) ▪ Planning and response ▪ Emergency tele-epidemiology
Human Space Flight	*Space Life Science*			▪ Knowledge of the human body (ex: aging) ▪ Infection prevention		
	Technology Development	▪ Digital Applications		▪ Point of care medicine		

[1] *NOTE*: This is not intended to be comprehensive and there may be additional contributions of space activities to global health; this table should be completed with information from national experts.