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Committee on the Peaceful Uses of Outer Space

Report on the United Nations/Belarus Workshop on Space Technology Applications for Socioeconomic Benefits

(Minsk, 11-15 November 2013)

I. Introduction

A. Background and objectives

1. The Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III), in particular through its resolution entitled "The Space Millennium: Vienna Declaration on Space and Human Development",[1] recommended that activities of the United Nations Programme on Space Applications should promote collaborative participation among Member States at the regional and international levels, emphasizing the development of knowledge and skills in developing countries.[2]

2. At its fifty-fifth session, in 2012, the Committee on the Peaceful Uses of Outer Space endorsed the programme of workshops, training courses, symposiums and conferences of the Programme on Space Applications for 2013. Subsequently, the General Assembly, in its resolution 67/113, endorsed the activities to be carried out by the Office for Outer Space Affairs of the Secretariat under the auspices of the United Nations Programme on Space Applications in 2013.

3. Pursuant to General Assembly resolution 67/113 and in accordance with the recommendations of UNISPACE III, the United Nations/Belarus Workshop on Space Technology for Socioeconomic Benefits was held in Minsk from 11 to 15 November 2013.

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[1] *Report of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space, Vienna, 19-30 July 1999* (United Nations publication, Sales No. E.00.I.3), chap. I, resolution 1.

[2] Ibid., chap. II, para. 409 (d) (i).

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4. The Workshop was jointly organized by the Office for Outer Space Affairs of the Secretariat, as part of the activities of the United Nations Programme on Space Applications in 2013, and the Belarusian State University. It was co-sponsored by the Secure World Foundation (SWF). The Belarusian State University hosted the meeting on behalf of the Government of Belarus.

5. At the Workshop, participants discussed ways to increase awareness among policymakers and planners of the socioeconomic benefits of utilizing space technology, to contribute to international cooperation and to provide opportunities to exchange in-depth information in developing countries.

6. The main objectives of the event were (a) to share information on research and applications studies that have demonstrated the use of space technology for societal benefit; (b) to address principles and mechanisms for enhancing national, regional, and international cooperation in space technology development and applications; (c) to demonstrate the benefits of various space technology applications in priority areas highlighted by the United Nations Conference on Sustainable Development ("Rio+20") (energy, cities, food, water, oceans and disasters); and (d) to promote the integration of space solutions into national development agendas, including building institutional and governance frameworks.

7. The Workshop and the discussions in its working groups also provided an opportunity for direct dialogue between space technology experts, policymakers and decision makers and representatives of the academic community and private industry from both developing and industrialized countries. All participants were encouraged to share their experiences and to examine opportunities for better cooperation.

8. The present report describes the background, objectives and programme of the Workshop. It has been prepared for submission to the Committee on the Peaceful Uses of Outer Space at its fifty-seventh session and to its Scientific and Technical Subcommittee at its fifty-first session, both to be held in 2014.

B. Programme

9. The programme of the Workshop was developed jointly by the Office for Outer Space Affairs and the programme committee of the Workshop, which included representatives of the Belarusian State University and SWF.

10. The programme of the Workshop focused on technologies, applications and services that could help to maximize the benefits of the use and application of space-related tools to support sustainable economic and social development and to enhance the capacity of developing countries in that area by developing human and technical resources at various levels, improving regional and international cooperation, increasing public awareness and developing appropriate infrastructures.

11. The programme of the Workshop included eight technical sessions focusing on the following themes: (a) international and regional cooperation; (b) space technology for national socioeconomic development programmes; (c) Earth observation for land use, environmental monitoring and natural resources management (two sessions); (d) global navigation satellite systems (GNSS) and

satellite communications; (e) space applications for disaster management and emergency response; (f) capacity-building in space science and technology; and (g) development of space technologies, systems and equipment.

12. The Workshop also included discussion sessions of the working groups and a technical tour of facilities of the National Academy of Science of Belarus.

13. At the opening of the Workshop, introductory and welcoming statements were made by representatives of the Ministry of Education of Belarus, the National Academy of Sciences of Belarus, the Belarusian State University, SWF and the Office for Outer Space Affairs. A keynote address was made by the rector of the Belarusian State University.

14. A total of 52 oral technical presentations were made during the technical and special sessions of the Workshop, and three papers were presented at the poster session. All presentations focused on successful applications of space technologies, information and services that provided cost-effective solutions or essential information for planning and implementing programmes or projects in particular thematic areas, and on international and regional initiatives and cooperation, as well as on capacity-building activities.

15. Each technical and special session was followed by an open discussion of specific topics of interest, with additional opportunities for participants to voice their opinions and raise queries. The discussions were continued in-depth and summarized by two working groups established to prepare the observations and recommendations of the Workshop, develop proposals for follow-up projects and examine possible partnerships that could be launched.

16. The detailed programme of the Workshop is available on the website of the Office for Outer Space Affairs (www.unoosa.org).

C. Attendance and financial support

17. Scientists, engineers and educators from developing and industrialized countries from all economic regions were invited by the United Nations and the Belarusian State University to participate in and contribute to the Workshop. Participants were selected on the basis of their scientific, engineering and educational backgrounds and their experience in implementing programmes and projects in which space-related technology, information and services played a leading role in addressing socioeconomic issues. The participation of specialists at the decision-making level from both national and international entities was particularly encouraged.

18. Funds allocated by the United Nations, the Government of Belarus and SWF were used to provide financial support for the participation of 23 participants from developing countries. Twenty-one participants received full financial support, which included international round-trip air travel, accommodation and a living allowance for the duration of the Workshop. Two participants received partial funding to cover their accommodation and living expenses in the host country.

19. The hosting organization, the Belarusian State University, provided room and board for funded participants, conference facilities, secretarial and technical support

and local transportation, including the transportation of all participants from and to the airport, and organized a number of social events for all participants of the Workshop.

20. The Workshop was attended by more than 100 participants from the following 24 States: Angola, Azerbaijan, Belarus, Burundi, Cameroon, Chile, China, Egypt, El Salvador, Germany, India, Iran (Islamic Republic of), Israel, Libya, Malaysia, Nepal, Nigeria, Russian Federation, Spain, Thailand, Tunisia, Turkey, Ukraine and Uzbekistan. International intergovernmental and non-governmental organizations, such as SWF, the International Society for Photogrammetry and Remote Sensing and the Office for Outer Space Affairs, were also represented at the Workshop.

II. Overview of technical sessions

21. The first technical session concentrated on the discussion of international and regional cooperation. Participants were given an update on the activities and mandate of the Office for Outer Space Affairs and on its efforts to promote international cooperation in the use of space science and technology for sustainable economic and social development while strengthening the capacity of developing countries to use that technology and its applications. Participants were also introduced to the history and activities of the International Society for Photogrammetry and Remote Sensing. Furthermore, participants were briefed on the purpose and main goals of the Educational Centre of the Space Research Institute (of the Russian Academy of Sciences), which was established to promote interaction between research and educational communities and support the efforts of scientists while promoting cooperation among other educational entities in order to stimulate interest in space technology among young people.

22. The results of a student nanosatellite research project jointly carried out by the Belarusian State University and the South-West State University of Kursk, the Russian Federation, were presented at the session. The research was aimed at developing and studying the technology of image transfer through satellite communication channels, satellite orientation and stabilization systems, and a satellite radio system and optical methods for ballistic measurements. The nanosatellite model developed had been used for further testing of the reliability and operability of on-board systems and separate modules. Participants were also informed about the creation, development and conclusions of the CHASQUI-1 project, a nanosatellite used for testing and development of a basic platform and fundamental electronic modules for a space educational programme. The project was conducted by the National University of Engineering (UNI) of Lima and South-West State University, in collaboration with the Korolev Rocket and Space Corporation “Energia”, in Korolev, the Russia Federation. Participants were also briefed on the prospective establishment of a pan-African remote sensing centre for forest monitoring.

23. The second technical session discussed the use of space technology for national socioeconomic development programmes. A number of case studies were presented to participants by speakers from Belarus, El Salvador, the Russian Federation and Ukraine. In Belarus, the implementation of the national space system for Earth observation was an important factor for scientific, technical

and socioeconomic development. The national space programme for the period 2008-2012 had been adopted by the Government in 2008, and its main objective was the development and effective use of the scientific and technological potential of Belarus in creating space facilities and technologies for carrying out tasks of social and economic value in the interest of all sectors of the economy, for the safety of the population and for the enhancement of the science and education level in the country. The national space programme was coordinated by the National Academy of Sciences of Belarus, and beneficiaries of the programme's outcomes included a number of the governmental bodies, including the Ministry of Education, the State Military Industrial Committee, the Ministry of Natural Resources and Environmental Protection, the Ministry of Emergency Situations, the Ministry of Agriculture and Food, the Ministry of Forestry and the State Property Committee. The implementation of the national space programme had resulted in the manufacture and successful launch in 2012 of the Belarusian Earth observation satellite; in the construction of ground infrastructure for spacecraft control and facilities for receiving, processing and distributing data; in the development of applications and services for various areas of social and economic activities; and in the development of space-related education and training capabilities. The national space programme also gave Belarus an opportunity to participate in international cooperation programmes in the peaceful uses of outer space. The national space programme for the period 2013-2017 was currently under consideration by the Government, and it would contribute to the further development of the national capacity in remote sensing, in addition to leading to the launch of a Belarusian telecommunication satellite, the development of a national satellite communications system, and the creation of the unified navigation and timing support system in Belarus.

24. Participants were also given an update on the status of the Russian national system for Earth observations, which was one of the most important areas of activities carried out by the Russian Federal Space Agency (Roscosmos). In the thematic area of remote sensing, the main focus of Roscosmos was currently the expansion and improvement of the Russian orbital group of Earth observation satellites; the development of ground infrastructure, including the space data acquisition, processing and distribution system; the improvement of legislation and regulations related to remote sensing of the Earth from space; and the enhancement of international cooperation in that area. Further plans included the development of a complete space system for hydrometeorological monitoring by 2015, the development of a space-borne system for radar observations by the period 2015-2017, the development of a space system for disaster monitoring in the period 2012-2015, the development of the Arctic space system for monitoring of the Arctic region by 2016; and enlarging the national orbital group of the Earth observation satellites to a total of 15-20 spacecraft by 2020. In the area of international cooperation, Roscosmos actively participated in the work of organizations and programmes such as the Group on Earth Observations (GEO), the Committee on Earth Observation Satellites (CEOS), the Charter on Cooperation to Achieve the Coordinated Use of Space Facilities in the Event of Natural or Technological Disasters (International Charter on Space and Major Disasters) and the United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER). Other papers presented at the session demonstrated the effectiveness of the application of space-related technologies,

information and services in forestry, agriculture and land use and in supporting national social and economic policies.

25. The third technical session considered issues related to Earth observation for land use, environmental monitoring and natural resources management. Presentations made during that session provided participants with an update on the status of the GEOMED project, which was initiated by a number of countries in the western Mediterranean region in 2011 with the objective of using geospatial data to develop a methodology for forecasting geodynamic status, estimate ground surface deformation and assess earthquake risk in the western Mediterranean. The project used satellite-based global positioning data, satellite images and seismic data to evaluate geodynamic status and tectonic risks. The project also promoted a long-term Mediterranean partnership and the exchange of students and researchers. Participants were also briefed on the proposal for a desert movement prediction centre for Africa, initiated by the International Space University. In the arid regions of Africa, water resources were scarce, and access to them was often unpredictable. That constraint led to uncertainty with respect to access to that resource, which in turn could increase human pressure on the environment, resulting in further water depletion. Space technology, primarily remote sensing, had demonstrated its effectiveness in monitoring factors that contributed to desertification, including natural climatic effects and the impact of human activities. When established, the desert movement prediction centre would provide prediction, modelling and recommendation services to countries affected by desertification.

26. Participants were also introduced to the project on the use of Earth observation data for the quantitative assessment of vegetation cover and the prediction of erosion-prone areas in the Shirvan National Park of Azerbaijan. Analysis of normalized difference vegetation index data derived from Landsat-5 (Thematic Mapper) multispectral images, with the use of the Universal Soil Loss Equation erosion prediction model, showed that the areas of bare land were decreasing in the corridor of oil and gas pipelines passing through Shirvan National Park, which constituted a positive environmental trend that was due to a number of strategic restoration measures. Participants recognized that there was still significant oil pollution in the Caspian Sea and that satellite-based monitoring and the quantitative analysis of space data could contribute to the cleaning activities. Other papers presented in the session demonstrated the effectiveness of the application of Earth observation data to assess conditions and trends with respect to ecosystem services in the Tha Dee watershed in Thailand, to estimate land degradation and desertification in Libya, to conduct soil erosion mapping and soil conservation in Nepal and to measure urban sprawl in Malaysia using geospatial indices. Participants were given examples of the use of Earth observation data for monitoring quarries of building materials, the activities of mining companies and other natural and anthropogenic objects in Belarus. They were also briefed on the role of space technologies in general geomonitoring systems in Belarus.

27. The fourth technical session, dedicated to GNSS and satellite communications, included the presentation of how the use of very small aperture terminal (VSAT) systems would benefit the Belarusian satellite communication network. Some of the benefits outlined in the presentation included the use of a satellite terminal that would allow users to receive satellite television, to send television broadcasts and to provide duplex Internet access. Participants were also informed of the use of

location-based social applications with socioeconomic benefits. Location-based social applications functioned as a social structure made up of individuals connected through relationships derived from shared interests and the physical locations of users, and provided a time and date of activities and a history of the locations of users.

28. Likewise, participants were briefed on the various stages in the development of a navigation and timing support system in Belarus over the past 20 years. A timeline was provided indicating the different activities, milestones and developments reached since the conception of the first navigation and information systems in the country, which were used in systems for transport monitoring and control, operative management and operation records. In the recent past, the structural elements of a unified navigation and timing system, which had been implemented in some industries, had been developed. More recently, projects for unified navigation and timing systems had been developed at the regional and international levels. Another paper presented a project on Global Positioning System-based autonomous navigation systems for agricultural off-road vehicles.

29. At the fifth technical session, participants considered issues related to the use of space applications for disaster management and emergency response. Participants were briefed on the role of social media in disaster management and their interaction with the space technologies. Evaluations of the efficiency of the use of social media in different types of disasters, including examples and statistical data, were also presented. Benefits of the use of social media during disasters included the ability to reach a vast part of the population in real time, to continuously provide updates of important information for the public when traditional media channels were unavailable, and to enable people in affected areas to inform others about their situation and get in touch with their friends and family and find information on the crisis and where to get help from the authorities and/or other citizens. However, it had to be taken into account that power and communication infrastructures were unreliable in disaster-stricken areas, especially during the response and recovery phases. The anonymity of social media platforms also gave rise to concerns about the reliability of the data that were shared, as in most cases that information could not be validated.

30. The participants were informed about activities carried out by the regional support offices of UN-SPIDER in Iran (Islamic Republic of) and Ukraine. A national portal for the archiving, searching and downloading of satellite imagery and value-added products had been developed by the regional support office in the Islamic Republic of Iran and those products were made available to end-users over the Internet. The portal also served as a platform for data-sharing, the assessment of user needs and requirements, and e-learning programmes. Currently, eight products prepared from Moderate Resolution Imaging Spectroradiometer (MODIS) satellite images and two products prepared from satellite images from the National Oceanic and Atmospheric Administration (NOAA) of the United States of America were produced and presented on the portal on a daily basis, including information such as the normalized difference vegetation index, the enhanced vegetation index, the snow coverage index, land surface temperature and sea level temperature. It was expected that in the near future the portal would include advanced remote sensing and digital image processing modules and online technical training courses on specific hazards such as earthquakes, droughts, landslides and flooding. Other papers presented at

the session presented case studies on satellite monitoring for the assessment of fire risk in the residual radiation hazard zone in Fukushima, Japan, and studies of risk assessment, resilience and early warning systems for weather- and climate-related hazards.

31. The sixth technical session discussed national and international initiatives and efforts made towards capacity-building in space science and technology. Participants were briefed on aerospace education programmes offered by the Belarusian State University and on the University's history, curricula, faculties and educational institutes. The Office for Outer Space Affairs informed participants about capacity-building activities carried out by the regional centres for space science and technology education, affiliated to the United Nations, which were established with the primary goal of developing, through in-depth education, an indigenous capability for research and applications in the core disciplines of remote sensing and geographic information systems (GIS), satellite communications, satellite-based meteorology and global climate monitoring, and space and atmospheric sciences. A thorough analysis of the concept, design and development of "village GIS" along with the optimization of resource use, was presented. Other technical papers presented in the session discussed socioeconomic benefits of the application of geospatial data and a case study of ionospheric precursors for predicting local earthquakes in Uzbekistan.

32. The seventh technical session discussed the development of space technologies, systems and equipment. Presentations made in the session provided participants with an update on the status of the satellite-based air traffic surveillance system under development by the German Aerospace Centre (DLR) and the European Space Agency (ESA). Currently, there was full radar coverage of aircraft routes only in selected high-density airspaces, and no air traffic management was possible in areas with insufficient ground infrastructure, such as open oceans and large areas of continents such as Africa, Asia and Australia. In such areas, flight crews used high frequency radio or the Future Air Navigation System (FANS) of satellite communication. Because of the high cost of communications, status messages were rare, and airplane separation in non-radar airspace was huge owing to safety considerations, resulting in a low airspace capacity. Satellite-based automatic dependent surveillance-broadcast (ADS-B) systems could facilitate the continuous surveillance of aircraft in any region and improve air traffic efficiency and safety. Another important consideration for developing ADS-B was the fact that no change was required to the existing airplane on-board equipment or air traffic management ground infrastructure that supported standard ADS-B messages.

33. The first in-orbit demonstration of the satellite-based air traffic surveillance system started in May 2013, when ADS-B over satellite equipment was launched as a guest technological payload on board the ESA small satellite mission PROBA-V. Performance assessment and analysis of data demonstrated the system's capacity for worldwide coverage of air traffic, including flight information regions not accessible by ground radar networks, thus confirming the concept of ADS-B over satellite. Other technical papers at the session focused on modern laser technologies used for the fabrication of solar cells, medium-resolution imaging payloads for microsatellites and research into parallel fusion of remote sensing images and its applications.

34. The eighth technical session continued the consideration of issues related to the Earth observation for land use, environmental monitoring and natural resources management, which had begun at the third session. A number of case studies on the successful application of space technology for food and water security and environmental monitoring were presented to participants in the workshop. Data from the joint Gravity Recovery and Climate Experiment (GRACE) satellite mission of the National Aeronautics and Space Administration (NASA) of the United States and DLR were used to evaluate groundwater storage trends in the north-western Sahara aquifer system shared by Algeria, Libya and Tunisia. Those data, supported by additional remote sensing information, ground truth and output from land surface models, showed an alarming rate of decrease in the total water storage in the region, primarily due to overexploitation of ground water resources. The results of the study also raised important issues related to water use in transboundary river basins and aquifers, such as the necessity of international water use treaties and of resolving discrepancies in international water law, and underlined the need for increased monitoring of core components of the water budget. Participants were also briefed on the FarmaBooth project concept developed by the International Space University to provide rural farmers in Africa with up-to-date satellite-derived information on their agricultural lands, as well as information on health and environment issues. The project will rely on the existing Pan-African e-Network, with its dedicated infrastructure and established financial framework and technical and academic support.

35. Spatial technologies (remote sensing, GIS and GNSS) were used in a project for precision farming and site-specific crop management in Egypt. Integrated use of those technologies could help to increase yield, reduce production costs and minimize negative impacts on the environment. The presented case study evaluated variable parameters that could affect agricultural production, including yield variability, physical parameters of the field, chemical and physical properties of soil, crop variability (e.g., density, height, nutrient stress, water stress and chlorophyll content), anomalous factors (e.g., insect and disease infestation and wind damage) and variations in management practices (e.g., crop seeding rate, use of fertilizers and pesticides and irrigation patterns and frequency). Other technical papers in the session demonstrated the capabilities of space technology to contribute to the development of national water management programmes, to the assessment of agricultural resources and to the monitoring of valuable natural ecosystems. Case studies in that regard from Belarus, Chile and Turkey were presented to participants. It was recognized by participants that many critical issues stressed in those case studies were common to all geographical regions and should be addressed at both the national and international levels.

III. Conclusions of the Workshop

36. Following the deliberations in the technical sessions, two working groups were established to consider thematic issues and concerns, discuss potential solutions using space technology, formulate observations and recommendations of the Workshop, develop project ideas for possible follow-up actions and examine possible partnerships that could be launched.

37. The first working group focused on issues related to capacity-building, data policy, and international and regional cooperation. The second working group discussed ways for the efficient transfer of space technologies from research and development and academic communities to end-users.

38. Discussions of the first working group centred on the importance of building capacity in the use of space technologies, primarily in developing countries. It was widely agreed that the application of geospatial technology was not widely used in many sectors even though there were applications with proven potential. In that context, the gap between the academic community and local users should be bridged using traditional and social media or through workshops and specific public awareness events. It was also recognized that the majority of developing countries had a lack of higher education, training and learning opportunities, thus contributing to the absence of qualified individuals to handle geospatial technology, as well as to the lack of adequate infrastructure.

39. The working group identified a need for better and more accurate up-to-date geospatial data. In that regard, great importance was attached to ensuring appropriate access to data and to developing data-sharing policies. Equally important was access to archived satellite imagery data, as well as to in situ observations and measurement data, especially for better preparedness, to develop resilience to natural disasters and to devise disaster reduction strategies.

40. The working group also emphasized the importance of commonly agreed standards for data exchange and reporting, as well as necessity of identifying country- and region-specific priorities and requirements for specific geospatial data. The participants also stressed the need to promote regional cooperation in the implementation of projects and programmes of common interest to various countries.

41. The second working group addressed concerns about gaps between research and development and academic communities and end-users in the use of appropriate space-related technologies, applications, information and services. The participants emphasized the need, in the development of regional policies, for the transfer and commercialization of space-related technologies coordinated and facilitated by specialized regional centres for the transfer of technology.

42. Participants noted that such regional centres could identify gaps in the use of existing space-related technologies and assess the potential obstacles for and benefits of their implementation in developing countries of the region. The centres could also select complete “ready-for-use” technologies developed under various funding sources by scientific and academic institutions and governmental organizations and develop a submission system for the evaluation of those technologies by independent experts for future transfer to other developing countries in the region.

43. Participants also observed that those regional centres should serve as regional focal points for communication with the respective governmental organizations and coordinate appropriate training activities and pilot projects, as well as publishing information on complete technology packages available for transfer and on needs with respect to particular technological solutions in developing countries of the region. They should also monitor progress in the transfer and use of technology in beneficiary countries. Participants noted that priority application areas for the

transfer of space-related technologies were cube satellite and microsatellite projects, integrated water management, degradation of land, oil spills and petroleum and natural gas pollution, and natural hazards, including earthquakes, landslides, flooding, dust storms, wild fires, drought, desertification and soil erosion.

44. The working groups discussions resulted in a number of conclusions and recommendations that included, among other suggestions, the following:

(a) The practice of conducting short- and long-term training courses and workshops on the application of space technologies in various areas in order to share best and innovative practices, should continue, in cooperation with the appropriate United Nations agencies;

(b) An Internet-based central portal for information on outreach activities, training opportunities and capacity-building initiatives for developing countries should be established. Such a portal should include a dedicated knowledge hub and virtual learning centre;

(c) The activities of the regional centres for space science and technology education, affiliated to the United Nations, should be supported, and expansion of that network should be considered;

(d) Research and development projects, including those in fundamental science, that can help to enhance countries' preparedness for the impact of natural disasters should be stimulated;

(e) All necessary steps should be taken for the prompt and smooth transfer of appropriate space-related technologies from research and development and academic domains to end-user communities, including the establishment of regional support offices for the transfer of space technology to achieve that objective.

45. At the closing session of the Workshop, participants discussed and approved the observations and recommendations of the working groups presented by chairs of those groups. Participants also expressed their appreciation to the Government of Belarus and the United Nations for organizing the Workshop and for the significant support provided.