United Nations A/AC.105/1132

General Assembly

Distr.: General
16 March 2017

Original: English

Committee on the Peaceful Uses of Outer Space

Report on the United Nations/Islamic Republic of Iran Workshop on the Use of Space Technology for Dust Storm and Drought Monitoring in the Middle East Region

(Tehran, 5-9 November 2016)

I. Introduction

1. The United Nations Programme on Space Applications, implemented by the Office for Outer Space Affairs, was established in 1971 to assist Member States with capacity-building in the use of space science, space technology and space applications in support of sustainable development, and to promote international space cooperation. Since its inception, several hundred training courses, conferences, seminars and meetings have been organized under the Programme for the benefit of Member States.

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

3. The Workshop was organized by the United Nations in cooperation with the Government of the Islamic Republic of Iran represented by the Ministry of Information and Communications Technology and the Iranian Space Agency. It was hosted by the Government in Tehran.

4. The Workshop was closely linked to the 2030 Agenda for Sustainable Development, in particular the relevant Sustainable Development Goals and targets, namely Goals 3, 13 and 15 and targets 3.9, 3.d, 13.1, 13.3, 15.2, 15.3 and 15.b. The outcomes of the Workshop, summarized in concise observations and recommendations (see section III of the present report), will inform the thematic priorities for the thematic cycle dedicated to the fiftieth anniversary of the United Nations Conference on the Exploration and Peaceful Uses of Outer Space

[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, sect. I, para. 1 (e)(ii), and chap. II, para. 409 (d)(i).

V.17-01632 (E) 050417 060417

(UNISPACE+50), to be held in 2018. The Workshop specifically addressed UNISPACE+50 thematic priority 5 on strengthened space cooperation for global health, thematic priority 6 on international cooperation towards low-emission and resilient societies and thematic priority 7 on capacity-building for the twenty-first century (see A/71/20, para. 296).

A. Background and objectives

5. Climate change and its numerous consequences, such as frequent drought conditions, have led to a steady increase in the frequency and intensity of sand and dust storms in many parts of the world. It is anticipated that the severity of such storms will continue to increase over the coming years. Sand and dust storms present environmental risks, such as desertification, and health risks, such as respiratory disease, and can affect regional climates. They have worsened over the last decade, both in the Middle East and elsewhere. It has therefore become more important to monitor such storms and the drought conditions they cause from space, using remote sensing technologies and geospatial data. It is also important to design development policies for the affected areas that are environmentally, socially and economically sustainable. Space technologies can play an important role in that regard.

6. Space technology is one of several technologies essential for successfully implementing the 2030 Agenda for Sustainable Development. It helps to provide data, information and services that can directly or indirectly contribute to achieving particular Sustainable Development Goals or to assessing and monitoring the status of the implementation progress.

7. The Workshop was thus primarily aimed at raising awareness of space technologies and promoting their use in the monitoring of droughts and of sand and dust storms for the benefit of the host country, the Middle East and developing countries in general. Participants explored how current space technologies were helping to identify and monitor the effects of climate change, including droughts and sand and dust storms, on vulnerable areas at the international and regional levels.

8. Remote-sensing satellites help to provide data on several key variables, such as rainfall, precipitation, water storage, soil moisture and its evaporation, land use and, more recently, even wind force and direction, over areas and timespans (known as spatial and temporal scales) appropriate for reliable assessments. A satellite-based approach to the assessment and management of, in particular, droughts is therefore very important in countries and regions where adequate water resources are acutely lacking, because it helps decision makers to anticipate food shortages and famine and to take preventive action.

9. While the potential benefits of space science and technology and their applications for developing countries are generally well-recognized, their successful implementation and operational use is subject to the continuous development of human resources at all levels, the training of end users, the development of appropriate infrastructure and policy regulations, and the allocation of the necessary budgetary resources. Events such as the Workshop are a key element in making progress in those areas.

10. The objectives of the Workshop were to:

(a) Discuss the contributions made by space technology to sustainable environmental, economic and social development by supporting the efficient monitoring of drought conditions and related hazardous phenomena;

(b) Enhance the capabilities of countries in the use of space-related technologies, applications, services and information for the monitoring of droughts and of sand and dust storms;

(c) Examine low-cost space-related technologies and information resources available for addressing needs relating to such monitoring in developing countries;

(d) Strengthen international and regional cooperation by improving synergies among space agencies and specialized monitoring agencies;

(e) Increase awareness among decision makers and the research and academic community of space technology applications for the monitoring of droughts and of sand and dust storms, primarily in developing countries;

(f) Promote educational and public-awareness initiatives in those domains, highlighting recent advances, and contribute to capacity-building efforts.

B. Attendance

11. The Workshop brought together stakeholders working in frameworks for the monitoring of droughts and of sand and dust storms, including specialists with hydrological and meteorological expertise, as well as representatives of the space industry and of space agencies, representatives of other governmental and non-governmental organizations and international experts. They discussed and shared user requirements and experiences and presented existing or planned space technologies and applications relevant to the topic at hand.

12. The Workshop was attended by up to 200 participants, with a larger number of national institutions being represented at the plenary sessions on the opening day. There were 18 international participants coming from the following 15 countries: Afghanistan, Austria, Azerbaijan, China, France, Germany, Iraq, Lebanon, Pakistan, Romania, Russian Federation, Sudan, Switzerland, Tunisia and Venezuela (Bolivarian Republic of).

C. Programme

13. The Workshop programme was developed together with the Iranian Space Agency. It included plenary presentations grouped into thematic sessions, a poster session and discussion groups. The purpose of the discussion groups was to agree on the actions and recommendations put forward by the participants. The following focus areas were identified:

(a) Applications of space technologies that provide cost-effective solutions and essential information for the planning and implementation of programmes and projects to improve the monitoring of droughts and of sand and dust storms;

(b) Use of space technologies in mitigating emergencies related to droughts or storms emergencies and in combating desertification;

(c) Use of space technologies for early warning purposes;

(d) Capacity-building in the monitoring of droughts and of sand and dust storms, including the development of human resources, the establishment of technical infrastructure and the consideration of possible legal or cooperative frameworks, including access to financial resources if needed;

(e) International, regional and national initiatives and international and interregional cooperation in the monitoring of droughts and of sand and dust storms;

(f) The review of the specific conditions and information needs of the Middle East in that context, within the broader scope of environmental monitoring;

(g) The review of case studies on successful applications of space technologies for the monitoring of droughts and of sand and dust storms in developing countries in general.

14. Participants held breakout sessions, during which they discussed ways of expanding the use of space technologies and derived data and information to

improve decision-making, as well as priority areas where pilot projects could be launched. They examined whether concrete partnerships could be established.

15. The Workshop included a poster session at which four posters were presented. Participants were given ample time to review each poster and ask the presenters questions.

16. The Workshop clearly demonstrated that space technology and its applications were already making essential contributions to efforts undertaken to address various needs relating to the monitoring of droughts and of sand and dust storms, and that space technology had advanced considerably and had become more accessible and affordable over recent years. At the same time it remains difficult to gain access to data collected by satellites, especially very-high-resolution data, because of prohibitive costs and other limitations. This and other questions are addressed in detail in the observations and recommendations presented below (see section III).

17. For the second day of the Workshop, the Iranian Space Agency had organized a technical visit to the Islamic Republic of Iran Meteorological Organization for the benefit of international expert participants. It offered the experts an opportunity for closer interaction with local practitioners with a mandate to monitor droughts and sand and dust storms. A number of national initiatives were presented and challenges were discussed. Data reception and processing facilities were also visited. The visit was a great opportunity to interact with a larger number of local experts, and to ask questions in an informal setting.

18. Following the technical visit, international participants were offered a cultural tour of Tehran, including visits to a number of national museums, which presented a unique occasion for participants to learn about the impressive history and heritage of the host country.

19. The programme of the Workshop, together with the presentations and material from the poster session, will be made available on a dedicated page on the website of the Office for Outer Space Affairs.

II. Summary of the Workshop

A. Opening session

20. The Workshop was formally opened by Mohsen Bahrami, Deputy Minister of Information and Communications Technology and President of the Iranian Space Agency. Welcome addresses were given by the Deputy Minister of Roads and Urban Development and the President of the Islamic Republic of Iran Meteorological Organization, by the Vice-President of the Iranian Space Agency, by the Head of the National Centre for Combating Dust Storms of the National Department of Environment and by the representative of the Office for Outer Space Affairs.

21. Speakers highlighted the importance of the Workshop in the national and regional contexts as well as in the context of the 2030 Agenda for Sustainable Development, the Sendai Framework for Disaster Risk Reduction 2015-2030 and the Paris Agreement on climate change. Both the representatives of the host country and the United Nations representative noted that the outcomes of the Workshop should be carefully followed up and should contribute to defining the road map for UNISPACE+50.

B. Session 1
Using space technology for sand and dust storm monitoring and related risk assessment

22. Workshop session 1 included presentations on the following topics: early warning for sand and dust storms and droughts, given by a representative of the

secretariat of the United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa; support provided by the Group on Earth Observations (GEO) towards the attainment of the Sustainable Development Goals, given by a representative of the GEO secretariat; vertical interaction of synoptic systems in producing sand and dust storms in the Middle East, given by a representative of the Islamic Republic of Iran Meteorological Organization; and comprehensive guidelines for using remotely sensed data for the study and investigation of sand and dust storms, given by a representative of the University of Tehran.

23. It was shown that sand and dust storms were one of the challenges on the way to achieving the Sustainable Development Goals. Their frequency had increased in recent decades, with soil and meteorological factors contributing to their development, and they were having an environmental, socioeconomic and health impact on the ground.

24. Speakers stated that to address that challenge it was crucial to mobilize resources through building effective partnerships among stakeholders at all levels. New strategies were being developed under the Convention to Combat Desertification that focused on land degradation, global coordination and consolidated policies regarding sand and dust storms, preparedness measures and risk reduction strategies, and financing opportunities for actions relating to sand and dust storms. Easy and flexible access to space-based data for monitoring the areas where the sand and dust feeding into storms originates was of high importance. The GEO secretariat was working on improving the coordination of observation systems and the promotion of open space data policies.

25. The representative of the GEO secretariat introduced the Global Earth Observation System of Systems and presented its services. The speaker highlighted the value of having a common infrastructure that made it possible to discover and access data sets and services.

26. The three main mechanisms responsible for feeding dust into the Middle East were discussed, among them migrating cyclones and the associated strong vertical and frontal activities, development of the nocturnal low-level jet and the associated turbulence, and the convective activities that brought strong gusty winds together with local downbursts of dry cold air.

27. Speakers pointed to the main types of information and data sets needed for an effective study of sand and dust storms and drought phenomena. Those included meteorological data (such as wind speed, wind direction and precipitation), soil properties, available water capacity, land degradation trends, land use and land cover, geology and geomorphology, morphogenetic processes, agricultural activities and socioeconomic factors.

C. Session 2
Using space technology for drought monitoring and risk assessment

28. Workshop session 2 included presentations on the following topics: comparing actual satellite-based emergency mapping activities with stakeholder evaluations of geoinformation benefits for space-based information supporting drought monitoring and mitigation, given by a participant from Germany; lessons learned from climate change and drought monitoring efforts for sand and dust storm management, given by a representative of the University of Tehran; drought risk assessment activities using remote sensing data at the Iranian Space Agency; and monitoring droughts, land degradation and desertification in arid Tunisia, given by a representative of that country's Institut des Régions Arides.

29. The first speaker reviewed past materials and discussed a recent article on global trends in satellite-based emergency mapping published in *Science* by a group

of experts in satellite-based emergency mapping.[2] He concluded that space-based drought mapping and monitoring activities were still not widespread in all affected regions, which indicated that space technologies were still underutilized for better monitoring of such phenomena, and that space-based data were currently mainly used for vulnerability mapping.

30. Speakers agreed that the availability of disaggregated and suitable socioeconomic data continued to be a bottleneck in regional drought vulnerability and risk assessment, and that drought hazards may be better mitigated with measures to downscale the water cycle through, for example, afforestation, reforestation or agroforestry. Speakers agreed that satellite remote sensing was the method of choice for monitoring such mitigation measures.

31. Some presenters noted that droughts could occur in any climate, and that over 70 per cent of droughts that had an economic impact had natural, meteorological causes. Speakers expected an increase during the twenty-first century in the number and size of drought-affected areas, leading to adaptation challenges. Dry farming and overgrazing in many areas of the world contributed to desertification. Given those factors, and the increase in water demand globally, droughts as well as sand and dust storms would remain long-term global challenges.

32. Speakers pointed out that it was important to conduct observation and monitoring over larger time periods, for example five years. Adequate intervals, for example 10 years, would be needed between assessment steps to allow for recordable changes to be observed systematically, as active degradation often took place prior to observed or analysed time periods. Practitioners needed to clearly state such requirements to satellite operators and data providers in general.

D. Session 3
Using space technology for disaster management

33. Workshop session 3 included presentations on the following topic: United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER), regional support office in the Islamic Republic of Iran, given by a representative of the Iranian Space Agency; data collection relating to environmental parameters between 2005 and 2014, given by a representative of the Khavaran Institute of Higher Education (Islamic Republic of Iran); the impacts of climate change on land productivity in West Asia, given by a participant from China; land capability and regional Landsat-based drought monitoring from 1982 to 2014, given by a participant from Lebanon; and the assessment of meteorological parameters for drought identification using satellite data, given by a representative of the Institute of Space Technology (Pakistan).

34. The speakers highlighted the role and activities of the UN-SPIDER regional support office in providing case studies and awareness-raising materials on drought monitoring using satellite imagery. They mentioned the various projects and data-collection activities that could be or were relevant to the management of disasters relating to droughts or sand and dust storms. They gave examples of the use of freely available satellite imagery, Landsat in this case, for long-term drought monitoring over large areas.

35. In their presentations during session 3, the speakers mainly considered the use of space technologies and space-based data in disaster management and mitigation activities, with a focus on disasters related to droughts or to sand and dust storms and their impact on the Middle East. They highlighted the value and importance of various local data collection and processing facilities and laboratories that could more efficiently support such efforts at the country levels when needed.

[2] Available at http://science.sciencemag.org/content/353/6296/247.

E. Session 4
Using space technology for drought monitoring and risk assessment

36. Session 4 was organized as a follow-up session because of the large number of presentations submitted for its topic: using space technology for drought monitoring and risk assessment. Six presentations covered the following topics: perspectives of Afghanistan on droughts and the use of space technologies to reduce its effects, given by a representative of the Independent Directorate of Local Governance (Afghanistan); evaluating a remotely sensed drought index for mapping drought patterns in the Urmia Lake basin, given by a representative of Shahid Beheshti University (Islamic Republic of Iran); addressing spatio-temporal drought monitoring using remote sensing and geospatial techniques, given by a representative of Salahaddin University (Iraq); Interferometric Synthetic Aperture Radar (InSAR) technique applied to land subsidence assessment in residential areas of the Islamic Republic of Iran resulting from a high drought frequency, given by a representative of Tarbiat Modares University (Islamic Republic of Iran); addressing challenges and drought risk management in the Islamic Republic of Iran, given by a representative of the Forests, Range and Watershed Management Organization (Islamic Republic of Iran); and air temperature extraction from Moderate Resolution Imaging Spectroradiometer (MODIS) imagery, given by a representative of Khavaran Institute of Higher Education.

37. Speakers introduced innovative procedures such as air temperature extraction from moderate-resolution satellite imagery. They highlighted the complex, interdisciplinary and cross-sectoral nature of droughts, discussed a range of research methods and standpoints, and pointed out the challenges that remained in the areas of data access, availability or capacity to work with space-based technologies and data in countries such as Afghanistan. It was nevertheless emphasized that resources for addressing climate change and droughts were underutilized in some countries.

38. It was noted that changes in water availability and the increase in the frequency of droughts resulted from both anthropogenic and natural causes, and that, in particular, the decreases in river flows were linked to droughts and sand and dust storms. As in previous sessions, some of the presenters proposed various drought mitigation measures such as the creation of green belts or targeted agricultural measures, and emphasized the importance of having in place programmes and strategies to cope with droughts and of prioritizing integrated water resource and watershed management. All speakers agreed that there was a strong need for education and public awareness-raising in this domain.

F. Session 5
Using space technology for sand and dust storm monitoring and risk assessment

39. Session 5 was a follow-up session. Three presentations covered the following topics: vulnerability mapping of sand and dust storms using remotely sensed data and geospatial modelling, given by a representative of the University of Tehran; visibility estimation using the combined visible and thermal infrared bands of MODIS in the west and south-west of the Islamic Republic of Iran, given by a representative of the Atmospheric Science and Meteorological Research Centre (Islamic Republic of Iran); and the analysis of dust hazards in the west of the Islamic Republic of Iran, given by a representative of Kharazmi University (Islamic Republic of Iran).

40. Presenters gave an overview of the costs countries faced because of damage from sand and dust storms. They highlighted the importance of regional collaboration to prevent and mitigate the effects of sand and dust storms. A proposal was made to convert indicators used in the region to remote sensing indices and

develop an accurate vulnerability map of West Asia, given that that region had the highest risk of being affected by sand and dust storms. Simulation studies had shown that before arriving in the west of the Islamic Republic of Iran, dust particles could have followed a path through the south of Turkey, the Syrian Arab Republic and Iraq, indicating the extent and complexity of the phenomenon.

41. Speakers highlighted the need to install more instruments for ground measurements and the collection of in situ data. They discussed the importance of combining many indicators to create early warning systems for sand and dust storms.

42. Synoptic analysis conducted in the Islamic Republic of Iran showed that the existence of thermal low pressure cells could lead to air convergence and air intake at near-ground level, and strong vorticity could result in cyclonic movements acting as dust catchers. In such situations the usual measures, such as planting a protective green belt of trees, would often not help, as the dust particles were too high up in the air. The areas where such phenomena most often occurred were in Turkey, the Syrian Arab Republic and Iraq, and for that reason the conclusion was that international cooperation was needed to tackle the problem.

G. Session 6
Education and capacity-building

43. The topic of session 6, the final session of the Workshop, was education, capacity-building and awareness-raising. Two presentations were given, covering the following topics: the project entitled “In-service information and communications technology training for environmental professionals” (ISEPEI) of the Central European University (Hungary) and the Eye on Earth initiative; and the Office for Outer Space Affairs and its capacity-building efforts in the framework of the United Nations Programme on Space Applications and of UN-SPIDER.

44. It was emphasized that addressing droughts was a complex task that required a multidisciplinary approach. Many environmental, social, economic and technical disciplines needed to be involved to explain it. Universities and networks, or communities such as those developed under the Eye on Earth initiative, could provide support by acting as knowledge hubs promoting practical applications of information and communications technology and space technologies, filling gaps where needed.

45. The presentation by the Office for Outer Space Affairs highlighted the various benefits of space activities and presented the Office’s mandates, which included the promotion of collaboration and capacity-building aspects. The speaker mentioned the numerous conferences, workshops and fellowship programmes that were aimed at building capacity and discussing the many problems related to natural disasters and the space technology available to address them.

46. At the end of the session, a discussion focusing on the capacity-building needs in the region developed, with ideas and suggestions being exchanged among participants. It was stressed that image processing software was often prohibitively expensive and solutions should be promoted based on either open-source software or acceptable software licensing terms to ensure that relevant projects that required satellite imagery processing could be completed under adequate conditions. Ways of addressing sanctions-related difficulties in accessing adequate software and data tools in a number of countries (including Iran (Islamic Republic of), the Sudan and the Syrian Arab Republic) was considered an important topic by some participants. The need for a more comprehensive dust forecasting system with enhanced capabilities was highlighted.

H. Discussion groups

47. Time was set aside for breakout discussion groups in which participants could address issues and requirements specific to droughts and sand and dust storms in smaller, informal settings with a view to developing recommendations for the plenary session. On the final day of the Workshop, the breakout groups reported their findings to the plenary session together with suggested recommendations. Those were then discussed, further refined and agreed upon by all Workshop participants. They are included in the present document.

48. The main concerns raised in relation to drought monitoring were difficulties with and limitations of data in general; country-specific challenges that were more difficult to address; gaps in Landsat data over North Africa and other regions, with data access mechanisms often being difficult to use; the lack of expertise in remote sensing among many specialists working on climate change and other environmental disasters; the low resolution of satellite sensors measuring soil moisture, or the fact that value-added products relating to soil moisture were available for certain regions only and to a limited extent for the Middle East; the need for more options when accessing imagery and image processing online, to reduce the need for downloading large sets of imagery data.

49. The discussions about sand and dust storm monitoring highlighted that such storms should be considered disasters rather than natural occurrences. Remote sensing techniques should be used more to identify mineralogy and help to model sand and dust storms (at the more accurate local level, rather than globally) with a view to forecasting them more accurately. Participants mentioned the importance of a soil erodibility index possibly being developed using satellite imagery. They also mentioned the need for more cross-country cooperation and knowledge exchange in the more affected regions, including joint research and master and doctoral programmes addressing these topics.

50. The Iranian Space Agency offered to establish a regional data centre for the monitoring of droughts and of sand and dust storms, and for sharing data with its neighbouring countries, using its two data-collection facilities and the national laboratory for remote sensing and spectrometric studies.

51. Some participants noted that while technological advances were highlighted in many presentations, user needs or demands were not as clearly articulated and donor projects often had a fragmented approach to addressing user needs on the ground. Others emphasized the importance of taking into consideration traditional techniques and local knowledge.

52. Participants called for the United Nations to consolidate methodologies in its work with droughts and sand and dust storms, including by standardizing data requirements. They agreed that the secretariat of the Convention to Combat Desertification might be the most suitable entity to head such a task in cooperation with other regional mandated United Nations entities with responsibilities in the field of disaster management. Other entities, such as the Office for Outer Space Affairs, could provide support by giving data access and bridging technology gaps where possible.

I. Poster session

53. A special session enabled participants to view and discuss the four posters submitted and to give an opportunity to the presenters to briefly introduce their work to the plenary.

54. The poster presentations had the following topics: spaceborne detection and monitoring of sand and dust storms, given by a participant from France; design of the on-board imaging sensor and required signal processing in monitoring of droughts and of sand and dust storms using small satellites, given by a

representative of the Institute of Space Research and Aerospace of the Ministry of Higher Education and Scientific Research of the Sudan; benefits and applications of the Miranda satellite platform, given by a representative of the Bolivarian Agency for Space Activities (Bolivarian Republic of Venezuela); and the assessment of drought severity using the vegetation temperature condition index from Terra/MODIS data, given by a representative of the Institute of Technical and Vocational Higher Education (Islamic Republic of Iran).

III. Observations and recommendations

55. The conference enabled the participants and organizers to:

(a) Learn about space-based applications and techniques developed in recent years to contribute to the monitoring of droughts and of sand and dust storms in the Middle East;

(b) Communicate and exchange views and lessons learned with representatives of a variety of countries, regional and international institutions and the private sector;

(c) Explore how best to take advantage of the opportunities offered by the space community to contribute to its activities;

(d) Collect a variety of suggestions and recommendations made by experts with regard to the use of space-based applications and solutions aimed at the monitoring of droughts and of sand and dust storms;

(e) Facilitate the coordination of global efforts undertaken by the space community to contribute to the implementation of the drought policy framework and technical guidelines being drafted by the secretariat of the United Nations Convention to Combat Desertification;

(f) Promote the use of Earth observation to track and identify areas affected by or vulnerable to droughts or to sand and dust storms.

A. The role of space technology

56. The general consensus was that space technology, in particular Earth observation satellites and global navigation satellite systems, could play a greater role in the monitoring of drought development and of sand and dust storms in general, and in supporting policy- and decision-making.

57. Participants agreed that, currently, remote sensing by satellite was not always capable of covering and supporting the analysis of the entire range of phenomena addressed in the Workshop. More specific sensors and very-high-resolution satellite imagery together with broader scientific approaches that included hydrology and ecology were needed to quickly identify chemical compositions and other features on the ground as required. End users and decision makers should be aware of the limitations of space technologies, and should be adequately informed about the possibilities.

58. It was suggested that an accurate, large-scale map should be developed showing the vulnerability of West Asia to droughts and to sand and dust storms, using available satellite imagery and following best practices in satellite-based vulnerability mapping. Such an endeavour would require a coordinated effort to identify and collect relevant satellite imagery data identification.

B. Governance considerations

59. The sharing of information and data between various national ministries was seen as being a general problem present in many countries. It was agreed that for

geospatial and space-based data, the approach of the national spatial data infrastructure should be encouraged and implemented without delay. The full and open sharing of information and data nationally and across relevant institutions must be encouraged and even enforced.

60. An important recommendation agreed upon was that regional or subregional forms of collaboration were needed in West Asia, given the high risk of droughts and related problems. This point was also stressed by some experts from institutions that had been unable to participate in the Workshop but had made contributions electronically.

61. The United Nations Economic and Social Commission for Asia and the Pacific, although unable to participate, contributed to the recommendations by submitting input about the regional action programme for Asia under the Convention to Combat Desertification to strengthen the existing capacity of the member countries and to form specific networks for effective measures to combat desertification.

C. Capacity-building

62. Participants highlighted the need to obtain space-based data more easily, as there was a gap in data availability, coverage and access for many years or areas of interest. Such needs could be brought to the attention of data access and distribution entities such as the United States Geological Survey (for Landsat data), the European Space Agency or Google (specifically the Google Earth engine platform), to mention a few. Ready imagery-derived products or image layers of interest could be made more accessible via online services.

63. National participants suggested that there was a need to hold similar workshops in the near future and requested the Office for Outer Space Affairs to consider supporting their organization. Such workshops should mainly focus on more specific processes and technology applications. The organizers should take into account concrete local needs and aim at inviting more representatives from the energy and finance sectors, as those could provide valuable input.

64. Participants welcomed the efforts highlighted by the Office for Outer Space Affairs to put in place data access and data sharing agreements with several national space agencies and commercial entities to enable easier and simplified access to very-high-resolution satellite data collections for broader disaster-related support.

65. It was agreed that any algorithm for drought monitoring needed validation to ensure accurate results. Calibration sites could be used for that purpose, such as the reference supersites whose maintenance was led by the Committee on Earth Observation Satellites. Those supersites already held a large number of data sets for purposes of sensor calibration and results validation. A dedicated supersite for drought monitoring could be proposed to the Committee.

66. Several participants called for better communication and information-sharing. In that context it was seen as important to consider the possibility of creating more online resources, including a dedicated social media presence or collaborative web presence for drought monitoring, where all experiences and knowledge could be shared easily. Such an approach could include customized online courses and webinars.

D. Other matters

67. The participants expressed their hope that the Office for Outer Space Affairs would continue to work with relevant stakeholders to promote the use of space science and technology and its applications for the monitoring of droughts and of sand and dust storms, as the Office focused on the thematic priorities of UNISPACE+50.

68. Finally, the Workshop participants thanked the Government of the Islamic Republic of Iran for hosting the Workshop, and the Iranian Space Agency, in particular its staff, for making all the arrangements and co-sponsoring the Workshop.

IV. Conclusions

69. The United Nations/Islamic Republic of Iran Workshop on the Use of Space Technology for Dust Storm and Drought Monitoring in the Middle East Region played an important role in bringing together stakeholders working on the development, use and application of space-based and geospatial technology for addressing droughts and sand and dust storms in the Middle East and beyond. A range of possible follow-up activities have been identified, as presented in the present document.

70. The present Workshop report will be brought to the attention of relevant policy- and decision-making bodies in a targeted way, and will inform the Committee on the Peaceful Uses of Outer Space and the United Nations General Assembly. It will also serve as a basis for identifying specific follow-up activities in the planning for UNISPACE+50, as detailed above.

71. Making full use of the framework and opportunities provided by UNISPACE+50, the Office for Outer Space Affairs stands ready to assist any Member States in developing and implementing the capacity-building actions necessary for the monitoring of progress relating to the Sustainable Development Goals and the global challenges of our rapidly changing world in the twenty-first century.