United Nations A/AC.105/1130

General Assembly

Distr.: General
7 November 2016

Original: English

Committee on the Peaceful Uses of Outer Space

Report on the United Nations International Conference on Space-based Technologies for Disaster Management: Understanding Disaster Risk

(Beijing, 19-21 September 2016)

I. Introduction

1. In its resolution 61/110 the General Assembly decided to establish the United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER) as a programme within the United Nations to provide universal access for all countries and all relevant international and regional organizations to all types of space-based information and services relevant to disaster management to support the full disaster management cycle.

2. The United Nations International Conference on Space-based Technologies for Disaster Management is the annual event of the UN-SPIDER programme. It has been held in Beijing since the establishment of the UN-SPIDER Beijing office in 2011. The 2016 Conference was held from 19 to 21 September.

3. The conferences have covered various themes based on the current issues and needs identified in the course of UN-SPIDER technical advisory activities. Those activities are aimed at enabling national Governments to make effective use of space-based information in disaster risk reduction and emergency responses and form the UN-SPIDER contribution to the activities of the Office for Outer Space Affairs of the Secretariat. They are one concrete element in the development of stronger space governance and supporting structures in the run-up to the 2018 thematic cycle of the Committee on the Peaceful Uses of Outer Space dedicated to the fiftieth anniversary of the United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE+50), which must lead to an improved delivery of its programme in the context of the 2030 Agenda for Sustainable Development.

4. Previous conferences covered best practices for risk reduction and rapid response mapping (2011), risk assessment in the context of global climate change (2012), disaster risk identification, assessment and monitoring (2013), multi-hazard disaster risk assessment (2014), and a consolidating role in the implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030 (2015). The theme of the 2016 Conference was understanding disaster risk, in line with priority 1 of the Sendai Framework.

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5. The Conference marked another step in the long-term effort of the Office for Outer Space Affairs and UN-SPIDER to build on the commitments of the Sendai Framework and the 2030 Agenda for Sustainable Development through UNISPACE+50.

6. The Conference brought together national organizations involved in disaster management and generating geospatial information in the countries where UN-SPIDER technical advisory support had been provided or was offered. The Conference was also attended by representatives of the UN-SPIDER regional support offices, various regional and international organizations, and experts from centres of excellence from different parts of the world.

II. Background and objectives

7. The Conference built upon the outcomes of the 2015 Conference, whose theme was a consolidating role in the implementation of the Sendai Framework.

8. The main aim of the Conference was to provide a platform for discussing how Member States could use space-based technology and other means to understand disaster risk and build disaster resilience. Its further aims were to contribute to the long-term effort of the Office for Outer Space Affairs and UN-SPIDER to actively support the implementation of the Sendai Framework and the Sustainable Development Goals.

9. The Conference was co-organized with the Ministry of Civil Affairs of China in collaboration with the Ministry of Foreign Affairs, the China National Space Administration and the Asia-Pacific Space Cooperation Organization.

10. The Conference brought together 98 participants. The attendees represented organizations such as civil protection agencies, national disaster management agencies, national space agencies, research institutions, science and technology agencies, non-governmental agencies and private entities.

11. A total of 73 organizations from the following 32 countries were represented at the Conference: Armenia, Bangladesh, Canada, China, Georgia, Germany, Ghana, India, Indonesia, Iran (Islamic Republic of), Iraq, Italy, Japan, Kenya, Lao People's Democratic Republic, Mexico, Mongolia, Mozambique, Myanmar, Nepal, Pakistan, Peru, Russian Federation, Sri Lanka, Sudan, Thailand, Trinidad and Tobago, Turkey, United Kingdom of Great Britain and Northern Ireland, United States of America, Viet Nam and Zimbabwe.

III. Programme

12. Five plenary sessions, three breakout sessions and two institutional visits were held. A total of 54 presentations were given during the plenary and breakout sessions. The Conference was followed by a one-week training programme for 30 participants.

13. At the plenary sessions participants addressed the following topics: building on 10 years of UN-SPIDER achievement; risk assessment and mapping using Earth observation data; access to data and information for risk assessment; national spatial data infrastructure and data frameworks to support disaster management; and networking and engagement with the UN-SPIDER network.

14. The parallel breakout sessions had as their topics indicators for monitoring the global targets of the Sendai Framework, procedural guidelines for sharing space-based information during emergency response operations (in line with priority 4 of the

Sendai Framework), and crowdsource mapping for risk assessment and emergency response operations.

15. On the last day of the Conference institutional visits were paid to the Yungang satellite Earth station and the National Disaster Reduction Centre of China.

16. From 22 to 27 September 2016 a short training course was held on space-based technologies for flood and drought monitoring and risk assessment at the Regional Centre for Space Science and Technology Education for Asia and the Pacific, located at Beihang University in Beijing. It was attended by 30 Conference participants.

IV. Programme of activities

17. The year 2016 marked the tenth anniversary of UN-SPIDER. To commemorate that milestone an anniversary conference was held in Vienna on 7 and 8 June 2016 at which participants reflected on the work done by UN-SPIDER and the outlook for the future.

A. Building on 10 years of UN-SPIDER achievement

18. The 1st meeting was dedicated to building on 10 years of UN-SPIDER achievement. Participants reflected on the efforts and outcomes of the UN-SPIDER programme over the previous 10 years, reviewed ongoing collaborations and discussed possible activities for the coming years. In preparation for UNISPACE+50 they also addressed issues related to building disaster-resilient societies.

19. Participants summarized experiences and good practices developed by various countries, UN-SPIDER regional support offices and other organizations in the UN-SPIDER network. The discussions focused on building geospatial infrastructure for the management of disaster risks and monitoring the implementation of the Sendai Framework.

20. The meeting included five presentations on the following topics: the first decade of UN-SPIDER — charting the path to an improved understanding of disaster risk through space-based information; building capacity for space-based disaster risk reduction in Asia and the Pacific; using space technology in disaster risk management in China; work of the International Centre for Integrated Mountain Development on behalf of UN-SPIDER in Bhutan, Myanmar and the South Asia region.

21. Participants were informed about services and opportunities offered by UN-SPIDER to promote the use of space-based information in disaster risk reduction. Those included services to strengthen networks and partnerships, training opportunities, joint workshops, advisory services, access to space-based information during emergencies, knowledge management and dissemination (e.g. by maintaining the UN-SPIDER knowledge portal and publishing recommended best practices) and putting space-based information on the agenda as part of global dialogues (e.g. by including Earth observation in the Sendai Framework).

22. Participants acknowledged the benefits of UN-SPIDER and its prominent efforts to promote the use of space-based information at all stages of disaster management.

23. The 1st meeting resulted in the following observations: (a) there was a concrete need to translate space-based tools into operational early warning systems; (b) there was an increasing need to engage the private sector in the building of disaster management and early warning systems; (c) there was a need for consistent efforts to enhance collaboration between providers and users of Earth observation data; (d) there

was a need for standard operating procedures to facilitate the use of Earth observation at different levels of national disaster management structures.

B. Risk assessment and mapping using Earth observation data

24. The 2nd meeting was dedicated to risk assessment and mapping using Earth observation data. Its objectives were to discuss the enhancement of applied research and development related to the approaches, models, methodologies, tools, standards, service platforms and operational projects for risk assessment and mapping; to outline the issues related to risk assessment and mapping, especially based on experiences with improving the effectiveness of maps and the efficiency of mapping services; to consider the role of space-based information, advances in remote sensing data, information products, and software tools used for risk assessment, data visualization and data dissemination; and to examine how applications can reduce the vulnerability of populations and infrastructure in line with the spirit of one of the thematic priorities of UNISPACE+50, namely international cooperation towards low-emission and resilient societies.

25. The 2nd meeting included 10 presentations on the use of Earth observation in the response to different types of disasters such as earthquakes, floods, cyclones, droughts, landslides and forest fires. Speakers discussed space-borne technology and Lidar technology operated from vehicles and drones, as well as other Earth observation tools. The major topics discussed in the 2nd meeting included the use of satellite radar observation for earthquake response and risk assessment, the use of high spatial resolution remote sensing images to detect damage, and the use of accurate three-dimensional city modelling using Lidar technology for urban disaster risk assessment and mapping.

26. Participants in the 2nd meeting highlighted the use of radar satellites in conducting interferometric analysis as a way to map co-seismic ground deformations caused by earthquakes. The incorporation in those types of interferometric applications of data from the Sentinel-1A and Sentinel-1B satellites of the European Space Agency as well as of other radar satellites in recent years was highlighted as a game-changer, given their high revisit frequency.

27. Participants discussed the use of Earth observation techniques in risk assessment, early warning and preparedness efforts. The case of the Islamic Republic of Iran demonstrated how Earth observation could be used in developing drought severity indices and using those to assess drought hazards, and how drought risk maps could be generated by combining land-use data obtained from Earth observation with in situ data on population, drought hazards and drought vulnerability data.

28. Participants discussed the use of Earth observation applications in estimating the potential impact of disasters. The resulting information could be used in determining the number of people in a population that would need humanitarian assistance when disaster struck. Participants mentioned tools and technologies available for creating databases on city infrastructure vulnerable to collapse, such as OpenStreetMap, which could be used for crowdsourcing information from local communities, and Lidar platforms mounted on vehicles and drones.

29. The experiences from China, Indonesia, Bangladesh, the Islamic Republic of Iran and Nepal highlighted the following challenges: (a) lack of communication between the producers of Earth observation products and the end users; (b) end users were not sufficiently exposed to best practices on the use of Earth observation technology and products; (c) issues arising when Earth observation data were integrated with in situ data; and (d) the lack of appreciation of indigenous knowledge,

and hence its insufficient utilization in the generation of products using Earth observation applications.

30. In conclusion, the participants in the 2nd meeting acknowledged that much was being done to enhance the use of Earth observation data in disaster response efforts, in particular in disaster impact assessment. However, little had been done to use Earth observation in disaster risk management. Thus, participants noted that experts needed to dedicate efforts to truly understanding disaster risks in line with the Sendai Framework.

C. Access to data and information for risk assessment

31. The 3rd meeting was dedicated to access to data and information for risk assessment. Its objective was to discuss various types of space-based and geospatial information needed for risk assessment; access to such information; information available in the public domain; and ways to share information, provide exposure to the range of satellite data available, and the utility of such data in generating products needed in risk assessment. The meeting contributed to the activities under one of the objectives of UNISPACE+50, namely capacity-building for the twenty-first century, which includes, among other goals, universal access to information.

32. The Sendai Framework recognizes the value that space-based technology and Earth observation have for disaster management and emergency response operations. It also specifically highlights the importance of using information gathered by space-based platforms for the purpose of pre-disaster risk assessment, which can help to prevent and mitigate disasters and prepare an effective response.

33. The participants addressed three main topics: various types of space-based and geospatial information needed for risk assessment; access to information and ways to share it; and the range of satellite data available in the public domain. These topics were highly relevant to priority 1 of the Sendai Framework: understanding disaster risk.

34. Under the topic of space-based and geospatial information needed for risk assessment, speakers demonstrated the availability and utility of remote sensing data and imagery to model, monitor, forecast and assess disaster events such as droughts, floods, cyclones and fires. They pointed out that publicly accessible national, regional and global data could also be used for that purpose. For example, in the presentation about the Global Flood Monitoring System the speaker referred to data sets such as population distribution that were needed to calculate the criticality of exposure (i.e. the intensity of exposure multiplied by the probability of exposure). Given the spatial and temporal patterns of population distribution, such information needed to be better modelled in the risk assessment phase.

35. Under the topic of access to information and ways to share it, participants highlighted that online geographic information systems were efficient means to access and share disaster-related geographic information with end users. The web-based application GeoNode was presented as an example of an open-source content management system that could be used to share spatial data. GeoNode was increasingly being adapted to make sharing and offering access to geospatial data sets easier, as was evident from several applications that were based on it.

36. On the topic of satellite data available in the public domain, one speaker discussed the role of free and open-source satellite data. The use of Landsat data was cited as a best practice that showed that open-source data had a much greater market value than the public investment required to gather them. The Copernicus Sentinel

satellites and the Landsat constellation were mentioned as sources of free and open imagery that could be used for risk-related analyses at the desired spatial resolution.

37. Lastly, the role of meteorological and geostationary satellites was discussed, with particular reference to the characteristics that gave them very high revisit frequencies. Several participants stressed a need to reduce the time required for data transmission and delivery to the users.

D. National spatial data infrastructure and data frameworks to support disaster management

38. The 4th meeting was dedicated to national spatial data infrastructure and data frameworks to support disaster management. Participants discussed the latest trends and developments in the establishment of national spatial data infrastructure. They also discussed data frameworks and ways to integrate incompatible data held by multiple stakeholders. Speakers highlighted the importance for national disaster management agencies of having data standards and data frameworks and discussed ways to get such standards in place.

39. The following topics were presented during the meeting: the integration of enhanced data sources into a standardized geospatial system for multiple stakeholders; the construction and development of a high-resolution Earth observation system by China; emergency response and preparedness for the Asia-Pacific region; and the framework for, methodology for and practice of building national data infrastructure for dynamic risk mapping and monitoring.

40. The meeting provided an overview of the integration of geographic information systems with “big data” to create smart geographic information systems in support of disaster risk assessment and response efforts. Participants noted that the Internet of things might be used to provide real-time information during disasters.

41. One speaker highlighted the construction and development of Gaofen, the high-resolution Earth observation satellite system of China, and its capabilities for monitoring typhoons, landslides and ecological disasters. Together with other global Earth observation systems, Gaofen would offer greater monitoring capability required for specific applications such as ranking the risk of infectious diseases caused by environmental catastrophes.

42. Participants discussed the challenges associated with managing disasters in Asia and the Pacific region, which included the absence of a framework for decision-making that could be used to evaluate initial needs based on disaster scenarios; the lack of awareness of the variety of satellite-derived products available for use during a disaster; the inadequate capacity for processing raw satellite images to derive meaningful information; and the limited capacity for utilizing satellite-derived products.

43. International humanitarian partners offered assistance where the resources of national Governments were inadequate to respond to emergencies. The argument was made that international humanitarian organizations should make effective use of space-based information when analysing situations and measuring the impact of disasters.

44. The use of dynamic risk assessment systems in assisting risk-based decision-making was discussed. Although data were available for the purpose of risk assessment, they were not systemically organized, which made them difficult to access. Risk-informed decision-making was presented as a model that supported the

quick and systematic inventorying and evaluation of data. It had already been tried in Nepal.

E. Networking and engagement with the UN-SPIDER network

45. The 5th meeting was dedicated to networking and engagement with the UN-SPIDER network. The objectives for the meeting were to provide an insight into the activities supported by UN-SPIDER in partnership with national disaster management agencies; to discuss the ways and means of making those activities more effective and relevant to the needs of the Member States; and to enhance the engagement of Member States and partner organizations with UN-SPIDER.

46. The UN-SPIDER regional support offices, partner countries and other stakeholders provided an update of their work. With the support of Member States, regional support offices and other partners, UN-SPIDER had been able to build a wide network of governmental agencies, international and regional organizations, non-governmental organizations, scientific organizations, private companies and other stakeholders. UN-SPIDER had carried out several technical advisory missions, capacity-building programmes and outreach activities in Asia, the Pacific, Africa, and Latin America and the Caribbean.

47. The following regional support offices provided updates: the International Centre for Integrated Mountain Development, the International Water Management Institute, the Asian Disaster Preparedness Centre, the Asian Disaster Reduction Centre, the Indonesian National Institute of Aeronautics and Space and the Iranian Space Agency.

48. The representatives of Ghana, Kenya, the Lao People's Democratic Republic, Mozambique, Myanmar, Sri Lanka and Viet Nam described the impact of their joint efforts with UN-SPIDER. In addition the country office in China of the United Nations Development Programme, the Ministry of Civil Defence of the Russian Federation and the Regional Centre for Space Science and Technology Education for Asia and the Pacific provided updates on their activities.

49. The meeting clearly brought to the fore the enormous contributions made by UN-SPIDER in the last 10 years, and by the UN-SPIDER Beijing Office in the last 6 years, in making disaster management stakeholders at the highest levels in several national Governments aware of the need to use space-based information, in training officials on a wide range of technology applications, in generating technical material, guides and handbooks, and in addressing the policy and coordination gap related to the use of Earth observation in disaster management.

50. The Member States and the regional support offices proposed activities that UN-SPIDER could carry out in the coming years.

F. Indicators for monitoring the global targets of the Sendai Framework for Disaster Risk Reduction 2015-2030

51. The first parallel breakout session was dedicated to indicators for monitoring the global targets of the Sendai Framework. Participants identified important issues and formulated recommendations.

52. The focus of the breakout session was on discussing the role of Earth observation in supplying indicators for monitoring the global targets of the Sendai Framework. Reference was made to the two other relevant international frameworks, namely the Sustainable Development Goals and the Paris Agreement, which had been signed at the twenty-first session of the Conference of the Parties to the United Nations

Framework Convention on Climate Change. The topic had been chosen in view of the ongoing engagement of the United Nations Office for Disaster Reduction and Member States in developing indicators to monitor global targets of the Sendai Framework.

53. Participants discussed the contribution space technology could make to the monitoring of the implementation of the Sendai Framework. Space technology, especially Earth observation technology, provided baseline and evidence-based data that could be used as reference points to monitor progress towards the Framework's global targets. The discussions were based on the outcomes of the open-ended intergovernmental expert working group on indicators and terminology relating to disaster risk reduction.

54. Participants also discussed targets and indicators, the flow of data and information and the feasibility of using Earth observation technology. The core issue was to understand how global targets were defined and how the indicators could be used to measure them. The group also discussed the challenges associated with defining targets and indicators, possible ways of creating a link between the targets of the Sustainable Development Goals and those of the Sendai Framework, issues in defining targets at the national and local levels and the way in which they fed into global targets.

55. In connection with the topic of targets and indicators, the main concerns that surfaced were: the lack of resources within countries to define targets at the subnational or local level; the lack of coordination within various organizations in countries in defining indicators and collecting relevant information and data related to those indicators; and the lack of procedural guidelines to standardize the collection of relevant data.

56. On the topic concerning the flow of data and information, participants raised the following concerns: gaps in the data flow mechanism between various levels of organizations; lack of awareness of the availability of open-source data, information and tools; knowledge gap between local communities and scientific communities; interoperability and consistency of data, especially where it comes to integrating geospatial data with other data, insular data management (also known as "data silos"); and data accessibility.

57. In connection with the feasibility of using Earth observation technology in monitoring the global targets of the Sendai Framework the participants in the breakout session drew attention to the following points: (a) the need to use technology to gather contributions from local communities and improve the implementation of global targets; (b) the necessity of data standardization, standard operating procedures and guidelines; (c) the need to address coordination gaps related to data acquisition and sharing; and (d) the urgent need to strengthen capacity to bridge the gaps between the generation, management, and dissemination of information on one hand and decision-making on the other.

G. Procedural guidelines for sharing space-based information during emergency response operations

58. A second parallel breakout session was held to discuss procedural guidelines for sharing space-based information during emergency response operations. The discussions were based on a series of workshops conducted by UN-SPIDER and the Economic and Social Commission for Asia and the Pacific (ESCAP) for the benefit of States members of the Association of Southeast Asian Nations (ASEAN) to develop procedural guidelines for sharing space-based information during emergency response operations. The outcome of those workshops was reflected in the booklet entitled

"Procedural guidelines for national disaster management agencies and space agencies in ASEAN countries for sharing space-based information during emergency response". In order to provide additional guidance to the discussion, reference was also made to the output of the International Working Group on Satellite-based Emergency Mapping, currently chaired by the Office for Outer Space Affairs.

59. The participants conferred on ways to replicate those procedural guidelines for other regions and specific disasters. They focused on issues such as data needed for emergency response operations, data access, skills and capacity, emergency mapping products and product dissemination, and shared recommended practices and experiences.

60. Participants appreciated a presentation on good practices. The presentation was based on the procedural guidelines booklet and the working paper entitled "Emergency mapping guidelines" of the International Working Group.[1] Participants recommended further studies and exploration of potential complementarities between the two documents, especially as both provided generic and more hazard-specific guidance, and suggested that each refer to the other if and when relevant.

61. Speakers highlighted the duplication of efforts that existed in the work being done to activate satellite emergency mapping services. Participants agreed that better coordination with end users was needed to check whether services had been activated for similar areas of interest before honouring new service requests. Such coordination would help to ensure a more efficient use of space-based resources.

62. The participants formulated of the following recommendations: (a) both end users and data providers should promote a culture of data and information-sharing based on free and open data policies, especially in emergency situations; (b) anything that may prevent information-sharing (such as data sensitivity) should be clearly defined as part of preparedness activities; (c) utilization of volunteer and crowdsourcing activities to acquire and produce data during emergencies should be factored into the procedural guidelines booklet; (d) the needs of first responders on the ground for further revision of the guidelines should be taken into account; and (e) the common minimum infrastructure required to implement the guidelines must be identified and reflected in the guidelines themselves.

H. Crowdsource mapping for risk assessment and emergency response operations

63. A third parallel breakout session was held to discuss crowdsource mapping for use in risk assessment and emergency response operations. Its objectives were to identify methods for complementing crowdsource mapping with space technology, to identify how crowdsourced maps could be tailored to specific situations; and the utilization of multiple crowdsource mapping platforms in specific countries such as China. Representatives of the Office for the Coordination of Humanitarian Affairs, the National Disaster Management Organization of Ghana, the Prime Ministry Disaster and Emergency Management Authority of Turkey, the Humanitarian OpenStreetMap Team and Tsinghua University shared their experiences with the outsourcing of mapping to crowd-based platforms during major disasters.

64. Three methods of crowdsource mapping were highlighted: detailed cartographic mapping (e.g. OpenStreetMap), microtasking for feature tagging (e.g. MapSwipe), and ground reporting and the use of social media (e.g. Ushahidi).

[1] Available at www.un-spider.org/sites/default/files/IWG_SEM_EmergencyMappingGuidelines_v1_Final.pdf.

65. Participants shared experiences with various methods of crowdsource mapping. Tsinghua University spoke about citizen engagement in reporting visual assessments of water quality using a mobile application. The National Disaster Management Organization of Ghana discussed the reporting of water levels and flooding risks by district officers. The Prime Ministry Disaster and Emergency Management Authority of Turkey gave a presentation about the identification and mapping of landslides through the visual interpretation of high-resolution imagery. Finally, the Office for the Coordination of Humanitarian Affairs spoke about the use of maps that show who is doing what and where (known as 3W mapping), social media mining, and OpenStreetMap for collecting data during typhoon Haiyan, which struck the Philippines in 2013.

66. Speakers identified various ways in which space technology and remote sensing could complement crowdsource mapping. Those included: increasing the accessibility of Earth observation data for crowdsource mapping through open licences, formats and services; feeding data from satellites providing lower spatial resolution and a high revisit frequency into crowdsourced maps to enable efficient damage assessment over large areas; the use of advanced machine learning algorithms for automated feature extraction; and increasing the availability and affordability of devices used for crowdsource mapping and imagery.

67. Participants highlighted some of the challenges facing crowdsource mapping and ways to address them. The most common concern was the lack of reliability and the questionable quality of the crowdsourced data. Several solutions were available to reduce errors, including validation based on ground truth data and random proofing by experienced mappers. It was important to integrate crowdsourced mapping information with data coming in from traditional field response mechanisms. There was a need for increased dialogue between disaster response organizations and those coordinating crowdsource mapping projects. Several recommendations were made to improve coordination, including the creation of a well-defined protocol to engage crowds and online groups (e.g. the Digital Humanitarian Network).

68. Participants expressed the concern that some of the products coming out of crowdsource mapping projects might not be useful to disaster response operations. One solution was to use automated online mechanisms through which first responders could make their needs known to volunteers, who could then deliver results based on those needs.

69. The third breakout session resulted in the following recommendations: (a) to provide Conference participants and stakeholders with examples where the power of community was successfully leveraged through crowdsourced mapping; (b) to address major issues that stood in the way of making community-based tools more effective; (c) to formulate guidelines on involving communities in identifying risks under normal circumstances, providing early warnings and building resilience.

I. Observations and recommendations

70. The recommendations formulated at the Conference on the role of Earth observation in disaster management were in line with the UNISPACE+50 thematic priorities, in particular international cooperation towards low-emission and resilient societies (thematic priority 6) and capacity-building for the twenty-first century (thematic priority 7). The impact of the work carried out by UN-SPIDER in the last 10 years was clear from the presentations given by several national disaster management agencies. The countries engaged with UN-SPIDER were enhancing their institutional capacity, generating guides, handbooks and technical materials, setting up

training institutions and addressing the gap between policy and coordination related to the use of Earth observation in disaster management.

71. UN-SPIDER was fulfilling its mandate with the support of its network of regional support offices, regional centres for space science and technology education, affiliated to the United Nations, Member States and other partners. The Conference recommended that UN-SPIDER should continue strengthening that network by engaging with the private sector in building disaster management and early warning systems; by enhancing collaboration between providers and users of Earth observation data; and by helping national Governments in preparing standard operating procedures to facilitate use of Earth observation at different levels of their national disaster management structures.

72. While several initiatives were focused on using Earth observation in disaster response efforts, not enough mechanisms were available to systematically promote the use of Earth observation in disaster risk management. There was a need for experts to gain a true understanding of disaster risks, as stated in the Sendai Framework.

73. Various types of space-based and geospatial data, information, tools and systems needed for risk assessment were available in the public domain. Many of them were open-source or could be accessed at a low cost. There was a need to raise awareness among users that they could access such resources and use them for the practical purpose of identifying disaster risks. UN-SPIDER could play a critical role by disseminating information on those resources through its knowledge portal and its outreach activities.

74. The Conference noted that data standards and frameworks were a critical requirement for national disaster management agencies. The use of specific models, tools and portals for risk assessment and mapping would streamline the development of data standards and the implementation of spatial data infrastructure, since such tools and portals required input in specific data formats. The Conference noted that national spatial data infrastructure and data frameworks could provide quick and systematic inventories and evaluations of the data needed for risk-informed decision-making.

75. The Conference noted that it was critical for the space community to understand the process of developing indicators to monitor the global targets of the Sendai Framework and document the role of space-based information in measuring those indicators. Further efforts were needed to document the contributions of space technology, in particular Earth observation, to the monitoring of specific global targets. The Conference recommended that this be made the topic of further UN-SPIDER workshops.

76. The Conference recommended that the guidelines being developed for States members of ASEAN on the utilization of Earth observation during emergency response operations should incorporate the outcomes of the International Working Group on Satellite-based Emergency Mapping and the experience of its members.

77. The Conference found that issues limiting the direct or indirect use of space-based information in crowdsource mapping needed to be addressed so that community contributions could be incorporated into risk assessment and emergency response efforts.

J. Conclusion

78. According to the feedback given by participants, the Conference was successful in generating thoughts and ideas on the role of Earth observation and related

technologies in understanding disaster risk, and provided substantial guidance on the implementation of the Sendai Framework.

79. The Conference resulted in a commitment by the Office for Outer Space Affairs to provide sustained support to the implementation of the Sendai Framework through UN-SPIDER and formulated thoughts on emerging issues, such as the contribution of Earth observation to monitoring the implementation of the global targets of the Sendai Framework.

80. The Conference provided useful materials for UNISPACE+50, as well as valuable input for the Seventh Asian Ministerial Conference on Disaster Risk Reduction, held in New Delhi from 2 to 5 November 2016.

81. The Conference resulted in guidelines, technical information and recommendations for the benefit of Member States for implementing the Sendai Framework. The participants were able to discuss a strategic workplan and its implementation, building on 10 years of UN-SPIDER achievement.

82. In conclusion, the observations and recommendations formulated at the Conference were valuable to efforts to understand disaster risk and develop the knowledge base of UN-SPIDER. They fed into the wider efforts of the Office for Outer Space Affairs, in preparation for UNISPACE+50, to enhance the benefits of space technology for Member States and assist Member States in reaching their goals in disaster risk reduction and sustainable development.