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Report on the United Nations/Germany Expert Meeting on the Use of Space-based Information for Flood and Drought Risk Reduction

(Bonn, Germany, 5-6 June 2014)

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 risk management to support the full disaster management cycle.

2. In its workplan for the biennium 2014-2015 (A/AC.105/C.1/2013/CRP.6), the programme committed itself to organizing international workshops to enhance horizontal cooperation and knowledge transfer and to focus on specific thematic issues.

3. The United Nations/Germany Expert Meeting on the Use of Space-based Information for Flood and Drought Risk Reduction was conducted on the premises of the United Nations in Bonn, Germany, on 5 and 6 June 2014. The expert meeting was organized by the UN-SPIDER programme in cooperation with the German Aerospace Center (DLR) and benefited from the support provided by the German Federal Ministry of Economics and Technology and the Secure World Foundation (SWF) of the United States of America. The expert meeting provided an opportunity to discuss the role that UN-SPIDER can play in promoting the use of space-based applications to contribute to assessing and reducing risks related to floods and droughts worldwide. The present report describes the background and objectives of the expert meeting, provides a summary of the discussions and contains observations and recommendations made by the participants.

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II. Organizational framework

4. The United Nations/Germany Expert Meeting on the Use of Space-based Information for Flood and Drought Risk Reduction was conducted as part of the outreach activities contemplated in the UN-SPIDER workplan for the biennium 2014-2015. It was one of the activities funded by the Government of Germany and SWF through their voluntary contributions to the programme.

A. Background and objectives

5. The report of the Secretary-General on the implementation of the International Strategy for Disaster Reduction noted as follows:

> The cumulative impact of disasters represents significant lost opportunities for human development. Since 1992, when the international community first met to discuss sustainable development at the Earth Summit in Rio de Janeiro, Brazil, more than 4.4 billion people have been affected in internationally reported disasters, a total of $2 trillion in damages, or an estimated 25 years of total overseas development aid, has been incurred, and over 1.3 million lives have been lost (A/68/320, para. 1).

6. In its publication entitled *Disaster through a Different Lens: Behind Every Effect, There is a Cause*, the United Nations Office for Disaster Risk Reduction indicates that floods and storms are hazards that affect most people. Such weather-related events represented 81 per cent of all disaster events in the period 2000-2010 and accounted for 72 per cent of all economic losses and 23 per cent of fatalities in that period. The publication also highlights the fact that droughts remain the disaster type causing the most fatalities in Africa and that since 1980, droughts and associated famines have claimed nearly 558,000 lives and affected more than 1.6 billion people.

7. The publication entitled “Measuring the human and economic impact of disasters”,[1] a commissioned review for the Government Office for Science of the United Kingdom of Great Britain and Northern Ireland, states that almost 90 per cent of all small- and medium-scale disasters are triggered by hydrometeorological events such as floods, storms and droughts. According to the publication, floods are by far the most common disasters worldwide, accounting for nearly half of all catastrophic events in developing countries in the period 1961-2010. Combined, floods and storms accounted for nearly 70 per cent of all natural disasters worldwide in that period.

8. To reduce the extent of such disasters through preventive efforts, the United Nations began a worldwide effort through the International Decade for Natural Disaster Reduction 1990-1999. The Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters, which was the outcome of the 2005 World Conference on Disaster Reduction, stated that “disaster risk arises when hazards interact with physical, social, economic and environmental vulnerabilities”. The Framework proposes as an outcome for the 2005-2015 decade: “the substantial reduction of disaster losses, in

[1] Available from www.gov.uk.

lives and in the social, economic and environmental assets of communities and countries". That outcome is to be achieved through the systematic integration of disaster risk reduction efforts into policies, plans and programmes for sustainable development and poverty reduction and be supported through bilateral, regional and international cooperation, including partnerships.

9. The Hyogo Framework for Action highlights that the starting point for reducing disaster risk includes the generation of knowledge of the hazards that communities face, the physical, social, economic and environmental vulnerabilities of societies, and the ways in which such hazards and vulnerabilities are changing in the short and long terms, followed by action taken on the basis of that knowledge. In addition, the Framework recognizes the value of concerted international cooperation and an enabling international environment, which are essential to stimulating and contributing to developing the knowledge, capacities and motivation needed to achieve disaster risk reduction at all levels.

10. Space-based technologies, especially Earth observation, provide valuable information on both sudden-onset and slow-onset hazards, including information on land cover and exposure of assets for risk assessment and information that can be used to improve warning service and response capability. Recognizing the usefulness of space-based information, the Committee on the Peaceful Uses of Outer Space has stressed that "loss of life ... could be diminished if better information were available through improved risk assessment, early warning and monitoring of disasters" (A/67/20, para. 21).

11. Taking into consideration the value of Earth observations and space-based information, both the Hyogo Framework for Action and the outcome document of the United Nations Conference on Sustainable Development (Rio+20), entitled "The future we want", make explicit reference to the need to promote the application of in situ and space-based Earth observations, as well as space technologies, to assess disaster risks and thus contribute to disaster risk reduction efforts worldwide.

12. To provide continuity to the ongoing efforts targeting disaster risk reduction worldwide, the General Assembly, in its resolution 66/199, requested the secretariat of the International Strategy for Disaster Reduction to facilitate the development of a post-2015 framework for disaster risk reduction. In paragraph 3 of that resolution, the Assembly stressed the importance of the continued substantive consideration of the issue of disaster risk reduction and encouraged Member States and the relevant United Nations bodies to take into consideration the important role of disaster risk reduction activities for, inter alia, the achievement of sustainable development.

13. Considering the role that space-based information can play in contributing to disaster risk reduction efforts in the case of floods and droughts, the UN-SPIDER programme conducted the United Nations/Germany Expert Meeting on the Use of Space-based Information for Flood and Drought Risk Reduction at the United Nations campus in Bonn, Germany, in June 2014.

14. The expert meeting was conducted with the aim of facilitating the exchange of experiences and lessons learned regarding the use of space-based information in flood and drought risk reduction, and identifying needs and discussing knowledge management strategies to contribute to disaster risk reduction efforts, with a particular focus on floods and droughts, and in order to discuss ways to make use of space-based information in the upcoming decade, within the context of the new

framework for disaster risk reduction that Member States will launch at the Third World Conference on Disaster Risk Reduction to be held in Sendai, Japan, in March 2015.

B. Attendance and financial support

15. The expert meeting was attended by 57 experts and professionals from 18 Member States: Austria, Bangladesh, Egypt, Germany, Ghana, Honduras, Italy, Iran (Islamic Republic of), Kenya, Luxemburg, Mexico, Netherlands, Nigeria, Pakistan, Sudan, Ukraine, United Kingdom of Great Britain and Northern Ireland, and United States of America. Altogether, participants represented 44 national, regional and international organizations belonging to the United Nations system, the space community, the disaster risk management and the emergency response communities, knowledge transfer and academic institutions and internationally active private companies.

16. Funds allocated by the German Federal Ministry of Economics and Technology through the UN-SPIDER programme and by SWF were used to defray the costs of air travel, daily subsistence allowance and accommodation for nine participants from developing countries.

C. Programme of activities

17. The programme of activities of the expert meeting was developed by UN-SPIDER, DLR and SWF. The programme included an opening ceremony, four sessions, which included both presentations in plenary meeting and discussions in break-out groups, and a closing ceremony. Opening and closing remarks were made by representatives of the German Federal Ministry of Economics and Technology, DLR, SWF and UN-SPIDER. Keynote presentations were made by UN-SPIDER, DLR and SWF.

18. The four sessions addressed the following topics: (a) space technologies for disaster risk reduction; (b) flood risk reduction; (c) drought risk reduction; and (d) the way forward.

19. The first session, entitled “Space technologies for disaster risk reduction”, opened the discussion regarding the use of space-based information to assess hazards, exposure, vulnerability and risks and to identify potential measures to reduce existing risks. The first presentation, by the Ministry of Public Administration of Bangladesh, shed light on the specificities of recent floods in that country, including causes and impacts. To improve disaster preparedness efforts, the Government of Bangladesh was now placing more emphasis on ground- and space-based data for more effective flood warnings and mitigation. Bangladesh’s Flood Forecasting and Warning Centre used satellite data combined with data from 52 monitoring points for effective, real-time flood forecasting. The second presentation, by the Regional Centre for Mapping of Resources for Development (RCMRD), gave participants an overview of how space-based information is used in African countries to contribute to land-use planning, sound policy formulation and allocation of resources. In its presentation RCMRD made reference to SERVIR-Africa, a service that provided satellite information in case of

disasters, which can also be used in other fields, such as agriculture, biodiversity or climate change adaptation.

20. The first session included a segment for discussion in which three break-out groups discussed the following issues: which novel sources of space-based information can be used to contribute to the assessment of hazards, vulnerabilities, risks and their changes over time; key challenges to be addressed in promoting the use of space-based information in the assessment of those risks and ways to approach such challenges; and lessons learned regarding how to encourage decision makers and disaster risk managers to make use of space-based information.

21. Participants highlighted the usefulness of modern satellites such as the TanDem-X and the Sentinel satellites in applications related to flood and drought risk reduction. They noted that satellites covered all regions of the world, providing imagery which could be used to generate land-use/land-cover data which was useful in generating hazard maps. They also reiterated the fact that hazard assessments could not be conducted exclusively with satellite data, as additional ground-based information was necessary for that purpose. In addition, they noted that data generated through currently operational radar satellites did not have the required vertical resolution (in the order of decimetres, at least) to be used to generate the cross sections of river channels and adjacent areas, which were needed to elaborate flood hazard maps. However, the combination of optical and radar data were suited for the detection of river channels and their banks.

22. In the context of vulnerability assessment, participants agreed that low spatial resolution was sufficient to monitor several parameters, including soil moisture, which was relevant in the case of droughts. Similarly, they noted that high spatial resolution data were necessary to assess the number of elements, e.g., the building structure in urban areas, exposed to hazards such as floods on a local scale. They also stressed that high spatial resolution data were more expensive and required better processing capacities due to their size. Participants also noted that there were advanced remote sensing approaches that could be used to identify different urban structures such as residential or industrialized areas. However, such approaches might not be easily transferable to cities in developing countries due to the high costs of using such approaches.

23. When addressing the use of satellite technologies to assess changes in risk over time, the participants agreed that the appropriate resolution of imagery to be used for such a purpose depends on the type of object that would be monitored over time (crops, buildings, land use, etc.). With respect to tracking changes in the exposure of vulnerable elements over time, the following observations were made:

(a) Low resolution imagery might be sufficient to identify new settlements in urban and rural areas and their changes over time on a coarse basis;

(b) Low resolution imagery would be sufficient to track changes in the distribution of vegetation in areas exposed to hazards;

(c) High resolution imagery, or low resolution imagery in combination with ground-based data, was needed to determine whether a building was a hospital, a school, a hotel or a government building;

(d) High resolution imagery, or low resolution imagery in combination with ground-based data, was needed to identify the construction or demolition of specific buildings, including houses, hospitals, schools and other critical infrastructure.

24. Participants agreed that in order to effectively assess changes in risks over time, it was important to be aware that such changes might differ from region to region, and thus approaches to track such changes needed to be adapted to each particular region. Such approaches also needed to be differentiated in terms of which data were to be collected and at which intervals of time.

25. Participants also mentioned existing challenges related to the use of satellite imagery, including the freely available satellite imagery of low spatial resolution, which limited their application to very large-scale phenomena; the low bandwidth of Internet services in many developing countries, in particular in rural areas, which made it difficult to access and download raw or processed satellite images or complex maps; and the challenges that developing countries faced in allocating budgets for the acquisition of high resolution satellite imagery sold on a commercial basis.

26. At the second session, on flood risk reduction, participants exchanged and discussed lessons on the use of Earth observation techniques learned from past floods, identified ways to enhance the use of the UN-SPIDER knowledge portal to support flood risk assessment, and identified recommendations regarding how flood risk management could be improved through the use of space-based information. The session included three plenary presentations. The expert from the German Committee for Disaster Reduction made a presentation on the assessment of coping capacities related to the 2013 floods in Germany. The expert commented that the 2002 and 2013 floods impacted similar geographic areas but that the financial losses in 2013 were much smaller than those in 2002. He noted that such results could be the direct outcome of the implementation of flood risk management directives enacted by the government as a result of the 1993 and the 2002 floods. The second presentation, by experts of DLR, focused on two automated satellite-based techniques, one for exposure mapping and the other for flood mapping. It was noted that through the use of TerraSAR-X data, which had a spatial resolution of up to 3 meters, urban areas could be mapped globally (the global urban footprint). They also noted that the combination of three-dimensional models of urban areas derived from synthetic aperture radar data and ancillary data on buildings and populations could be used to estimate both exposure and vulnerability to floods. In the context of flood mapping, the experts presented the fully automated flood-monitoring service of DLR and the Centre for Satellite-based Crisis Information, which used the data of the Moderate Resolution Imaging Spectroradiometer (MODIS), TerraSAR-X and Sentinel-1. The expert from Pakistan’s Space and Upper Atmosphere Research Commission (SUPARCO) presented a rapid damage assessment and rapid response mapping tool that used the MODIS instrument aboard the Terra and Aqua satellites and Spot 4 and Spot 5 data, as well as ground surveys, to estimate the extent and the impact of floods. He noted that SUPARCO had collaborated with the Food and Agriculture Organization of the United Nations (FAO) in the assessment of damage to crops. In the near future, SUPARCO planned to conduct an inventory of landslides and to map landslide- and earthquake-prone areas using Earth observation techniques.

27. At the second session, participants in three break-out groups discussed issues such as lessons learned from past floods on the use of geospatial information, enhancing the use of the UN-SPIDER knowledge portal to support flood risk reduction, and improvements in flood risk management through the use of space-based information.

28. In the case of floods, participants noted that satellite imagery could be used to elaborate maps of areas that were inundated and that contribute to assessing the impact. Regional and global mechanisms such as the Copernicus Emergency Management Service, Sentinel Asia and the Charter on Cooperation to Achieve the Coordinated Use of Space Facilities in the Event of Natural or Technological Disasters (also called the International Charter on Space and Major Disasters) contributed to emergency response efforts through the provision of maps depicting the extent of areas that have been flooded. Participants also noted that the Tropical Rainfall Measuring Mission sensor provided data on rainfall that could be used in early warning systems to forecast potential floods. However, rainfall was only the trigger, and rainfall measurements could not provide a precise picture of how floods would evolve.

29. In the context of agriculture, participants indicated that geospatial data could be used to assess the effects of floods on crops and reiterated the need for in situ knowledge concerning the types of crops currently exposed to floods as a way to enhance the applicability of space-based products.

30. Regarding ways to enhance the use of the UN-SPIDER knowledge portal, participants reiterated the need for a portal that compiled and provided quick and easy access to a variety of information related to flood risk reduction. They noted that in order for the portal to support disaster risk managers dealing with floods, it was very important to understand that target group exactly, including their needs, prerequisites and working realities (i.e., obstacles they faced, conditions under which they worked, etc.). Participants suggested that the portal could benefit from the greater involvement of experts as a way to create content, which users could then rate. They also noted that UN-SPIDER should consider allowing institutions to register as users of the portal, to complement the existing registration of individual users. That could lead to improved links between the portal and the websites operated by those institutions. In addition, participants indicated that the portal could benefit from the incorporation of a geo-viewer that would facilitate the discovery of archived flood maps stored in websites and the visualization of changes in the behaviour of floods over time.

31. To improve flood risk management efforts through the use of space-based information, participants noted that UN-SPIDER should promote the use of new data stemming from recently launched satellites such as the Sentinel satellites. In addition, they suggested promoting the combined use of high and low spatial resolution data, as they complemented each other. For example, MODIS provided data sets that covered large areas at once with low spatial resolution images that could be used to get a good overview of large areas, while TerraSAR-X provided complementary data sets with a higher spatial resolution but a smaller swath, which could be used to zoom in and look at smaller areas such as cities in greater detail.

32. Participants also recommended that UN-SPIDER promote ways to combine satellite information with in situ measurements and incorporate those sources of

data into hydrological and hydraulic models. The parameters that could be monitored using Earth observation techniques included land-use/land-cover, deforestation, soil moisture, the extent of past floods, biomass and snow cover. Through an assessment of how land use changes had affected the behaviour of floods, decisions could be made regarding where to build new dams and retention areas, urban planning and flood preparedness. Participants noted that, to implement that recommendation, UN-SPIDER should contribute to the development of flood management guidelines incorporating the use of space-based information and promote their use in countries around the world.

33. The third session, on the topic of drought risk reduction, included presentations in plenary meeting by representatives of the Iranian Space Agency (ISA), Hoefsloot Spatial Solutions and the Science, Technology and Experimentation Division of the United States Southern Command. The presentation by ISA focused on the role of e-learning in strengthening capacities worldwide on the use of space-based applications in disaster risk reduction. Specific information was given regarding the development, the content and the assessment of an e-learning course on the use of geographic information systems and remote sensing applications for drought monitoring that had recently been implemented by ISA. The second presentation, by Hoefsloot Spatial Solutions, focused on the licensed but free software Africa RiskView, which used satellite-based rainfall information to estimate the effects of droughts in various regions and to estimate the costs of assisting affected communities. The third presentation, by the Science, Technology and Experimentation Division of the United States Southern Command, focused on a novel technological approach developed by the Division to enable stakeholders to generate and share relevant geospatial content using the Rapid Open Geospatial User-driven Enterprise (ROGUE) application. The application facilitated the integration of geographical information provided voluntarily with authoritative data and the sharing of data and information among organizations involved in humanitarian efforts.

34. During the discussion session, participants addressed several topics, including lessons learned from the use of Earth observation in past droughts, strategies to combine the use of up-to-date and archived satellite imagery to improve early warning efforts, ways to enhance the use of the UN-SPIDER knowledge portal to support drought risk assessment, and recommendations regarding how drought risk management can be improved through the use of space-based information.

35. In the context of lessons learned regarding the use of Earth observation in past droughts, participants made reference to several observation platforms used in the case of droughts such as the Tropical Rainfall Measuring Mission, an operational satellite-based data source for monitoring precipitation. As the Tropical Rainfall Measuring Mission would finalize its operations in the following months, it was expected that the Global Precipitation Monitoring Core Observatory would ensure data continuity for precipitation monitoring. Participants also made reference to the Soil Moisture and Ocean Salinity (SMOS) radiometer, a scientific and experimental sensor to be used for monitoring soil moisture that could complement efforts to predict crop productivity. In addition, participants recalled that the thermal bands 10 and 11 of Landsat 8 could be suitable for estimating soil moisture; with 100-meter resolution, they provided a much higher spatial resolution than the SMOS data (35 kilometres), which could be useful for applications in agriculture.

36. Participants also made reference to the Famine Early Warning System Network developed by the United States and implemented worldwide with support from the United States Agency for International Development. The Network was an operational service that made use of satellite-derived vegetation indices such as the Normalized Difference Vegetation Index and the Enhanced Vegetation Index, rainfall estimations, evapotranspiration, the crop soil water index and other ground-based data to monitor droughts and their effects on food security.

37. Participants noted that there was a need to ensure that information was shared among all relevant stakeholders at all levels. They also recommended that UN-SPIDER should implement strategies to enhance collaboration among stakeholders at the national and international levels in order to improve drought risk management, especially with a focus on crops. They also suggested the compilation and dissemination of best practices identified by different organizations with the aim of learning from past experiences and replicating successful approaches.

38. Regarding the UN-SPIDER knowledge portal and how the portal could enhance the use of space-based information in drought risk reduction, participants noted that several indicators could be used to monitor droughts, and they suggested that the portal should be structured so that it facilitated the search and discovery of the descriptions and uses of such indicators, as well as relevant data, products and software tools that had been developed to track the temporal and spatial manifestation of droughts and to assess their impacts. In addition, they suggested that the knowledge portal should highlight those emergency mechanisms that provided support in case of drought and the products they offered. Finally, they suggested the incorporation of a discussion forum in which users could exchange their experiences and a database or list of experts that could be used to establish contact with such experts on an individual basis, as needed.

39. Participants indicated that many products were already available or under development for monitoring drought, including the FAO Agriculture Stress Index System, the drought information system being developed by the Joint Research Centre of the European Commission and the Famine Early Warning System Network of the United States Agency for International Development. They also noted emerging satellite-based applications that could be used in drought risk reduction, including hyperspectral satellite imagery that could be used to detect plant water stress at an early stage of a drought; the DLR Environmental Mapping and Analysis Program (EnMAP), which would carry a hyperspectral sensor, to be launched in 2017; and a planned Lidar sensor to be launched by the United States, which would have the potential to identify crops and underground water.

40. Participants also noted that drought early warning systems could benefit from the monitoring capacities of Earth observation satellites. They recommended the use of low resolution satellite imagery for near-real-time drought monitoring in the case of very large areas. They also reiterated the need to validate satellite-based products in a timely manner through the use of ground-based calibrations as a way to minimize errors and uncertainties.

41. The fourth session was used to discuss the way forward, especially in view of the ongoing efforts to develop the post-2015 framework for disaster risk reduction, which will be officially launched at the upcoming Third World Conference on Disaster Risk Reduction. During the session, participants addressed several issues,

including ways in which space-based applications could contribute to the achievement of the goals and targets to be defined at the upcoming Conference; strategies to promote synergies among international and regional organizations and national disaster risk reduction institutions in order to promote the use of space-based information at the national and local levels; and strategies to promote synergies among government agencies and other relevant stakeholders at the national and local levels in order to institutionalize the use of space-based applications in disaster risk reduction as a way to contribute to the achievement of the goals and targets to be defined in the post-2015 framework for disaster risk reduction.

42. To provide additional guidance to participants during the break-out discussions, an overview presentation was made by the secretariat of the International Strategy for Disaster Reduction on the preparatory process for the Third World Conference on Disaster Risk Reduction,[2] including possibilities to interact and participate in the Conference. As in previous sessions, participants were asked to split into three discussion groups, which addressed strategies to promote the use of space-based technologies in the coming decade under the umbrella of the new framework to provide continuity to the Hyogo Framework for Action.

43. Taking into consideration the draft version of the monitoring system which the secretariat of the International Strategy for Disaster Reduction has proposed to track progress in the reduction of risks and underlying risk drivers to be included in the post-2015 framework for disaster risk reduction, participants identified potential applications of space-based information that could be used to generate data to be used in several of the indicators proposed in the draft version of the monitoring system, including those related to exposure of vulnerable assets, those related to the environment and those linked to natural hazards.

44. Participants also prepared a two-page document for stakeholders participating in the Third World Conference on Disaster Risk Reduction that contained key messages on the use of space-based applications. The key messages suggested by participants were:

(a) Satellite-derived information is essential for disaster risk reduction and disaster management. The high temporal resolution and the increasing spatial resolution make it an indispensable source of information to replace or complement local measurements or assessments;

(b) The use of geospatial and space-based information should be emphasized in the post-2015 framework for disaster risk reduction.

45. Participants also suggested several strategies to increase cooperation, coordination and communication among key initiatives and key players at the international level. Among them were the need for a partnership or platform to ensure mutual communication among international organizations on the one hand and local users on the other hand; the need for institutions at the international level to agree on a common agenda and a working plan as a way to promote the use of such applications worldwide; and a strategy to formalize such a partnership and a proposed common agenda or working plan.

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[2] Further information is available at www.unisdr.org.

46. Recognizing the need for government agencies at the country level to cooperate to enhance the use of space-based applications in disaster risk reduction, participants suggested that regional and international organizations could contribute to the institutionalization of the use of space-based applications at the national level in several ways, including:

(a) Facilitating communication and synergies among national government agencies;

(b) Facilitating the sharing of experiences and lessons learned among agencies at the national level on the use of space-based applications;

(c) Providing incentives to agencies that collaborate and share data and information;

(d) Developing and promoting the use of tools such as mobile applications that make data-sharing at the national and at international levels as simple as possible.

47. Additional details concerning the discussion sessions, plenary meeting presentations, the evaluation and other relevant aspects of the expert meeting can be found on the specific page of the UN-SPIDER knowledge portal dedicated to the expert meeting (www.un-spider.org/BonnExpertMeeting2014).

III. Outcomes and recommendations

48. At the United Nations/Germany Expert Meeting on the Use of Space-based Information for Flood and Drought Risk Reduction, UN-SPIDER and its partners achieved a variety of outcomes and made recommendations, as presented below.

A. Outcomes

49. The expert meeting allowed participants:

(a) To become aware of recent advances in the use of space-based information in flood and drought risk reduction;

(b) To become aware of UN-SPIDER efforts in disaster risk management and to identify ways and means to become engaged in such efforts;

(c) To become aware of UN-SPIDER efforts related to the upcoming Third World Conference on Disaster Risk Reduction and to identify ways and means to become engaged in such efforts;

(d) To network with representatives of a variety of countries and regional and international institutions;

(e) To share their experiences and provide their suggestions and recommendations regarding the use of space-based information in flood and drought risk reduction.

50. In a complementary fashion, the expert meeting allowed the UN-SPIDER programme:

(a) To contribute to connecting the space, disaster risk management and emergency response communities;

(b) To establish contact with experts from many institutions involved in disaster risk reduction efforts;

(c) To collect a variety of suggestions and recommendations from experts regarding the use of space-based information in flood and drought risk reduction;

(d) To improve its contact with space agencies;

(e) To continue conducting efforts with the network or regional support offices;

(f) To compile experiences and lessons learned regarding the current and potential use of space-based information in flood and drought risk reduction;

(g) To identify knowledge management strategies that could facilitate access to and use of space-based information in flood and drought risk reduction;

(h) To identify strategies or procedures to enhance the use of the UN-SPIDER knowledge portal in applications related to flood and drought risk reduction;

(i) To identify strategies to enhance synergies between the space community and those members of the disaster risk management and emergency response communities involved in flood and drought risk reduction.

B. Main recommendations

51. Several recommendations were proposed in the group sessions held during the expert meeting.

52. The assessment of hazards, exposure, and vulnerability related to floods and droughts benefits from the combined use of space-based and ground-based data.

53. Satellites generate low, moderate and high resolution imagery, all of which can be used in risk assessment and to track changes in the level of risk over time. While high resolution data can be used to assess the exposure of buildings, including critical infrastructure, moderate resolution data can be used to track the effects of droughts on crops at the national level.

54. In recent years, several space agencies have changed their policies regarding access to data, providing access to satellite imagery free of charge (for example, Landsat and Sentinel satellite data). UN-SPIDER should bring stakeholders together to develop procedures for use of such data in the context of disaster risk reduction.

55. The combination of archived and up-to-date satellite imagery offers disaster risk managers the opportunity to visualize how exposure of vulnerable elements has changed in recent decades in urban and rural areas and offers the possibility of identifying measures that can be implemented as a way to reduce the extent of floods. In addition, such imagery can be used to track environmental degradation.

56. UN-SPIDER should continue its efforts to institutionalize the use of space-based information in disaster risk reduction applications worldwide. The programme should facilitate synergies among government agencies at the national level through the provision of the right incentives.

57. The UN-SPIDER knowledge portal could benefit from the more active involvement of experts and users. It should facilitate the dissemination of case studies and best practices on the use of space-based applications in disaster risk assessment and reduction, and it should facilitate the discovery of relevant data, products and methodologies for drought and flood risk reduction.

58. In the context of the Third World Conference on Disaster Risk Reduction and the post-2015 framework for disaster risk reduction, the following recommendations were highlighted:

(a) UN-SPIDER and other international organizations could benefit from approaching UNISDR to make that organization aware of the usefulness of space-based data in several indicators that are being proposed to track progress in disaster risk reduction efforts worldwide;

(b) There is a need to lobby Governments to highlight the use of geospatial and space-based information in the post-2015 framework for disaster risk reduction. UN-SPIDER should refine, if necessary, and distribute to national delegates well in advance the key messages elaborated by the participants during the expert meeting;

(c) There is a need to lobby data providers as a way to facilitate access to data for disaster risk management;

(d) The space community could benefit from coordinating its efforts at the international level as a way to provide technical advisory support to Member States under the umbrella of the new framework for disaster risk reduction to be launched during the Third World Conference on Disaster Risk Reduction.

C. The way forward

59. Having completed the expert meeting, UN-SPIDER is elaborating a plan of work taking into consideration these recommendations as a way for the programme to incorporate the theme of flood and drought risk reduction into its routine activities and its workplan for the period 2014-2015. The workplan will include making additions to the knowledge portal and other complementary knowledge management efforts to be carried out by the programme through its offices in Beijing, Vienna and Bonn, with the support of its network of regional support offices.

60. In addition, UN-SPIDER will make use, within its resource limitations, of the recommendations and suggestions made by experts in the areas of capacity-building and institutional strengthening.

IV. Conclusions

61. Since its establishment, the UN-SPIDER programme has designed and implemented a comprehensive plan of work that incorporates awareness and outreach activities, technical advisory support, knowledge management, capacity-building and institutional strengthening.

62. This expert meeting has allowed the programme to do the following:

(a) To gather elements to consolidate its plan of work to strengthen its knowledge management efforts targeting the use of geospatial and space-based information to enhance the resilience of nations;

(b) To gather recommendations to improve the knowledge portal as a tool to enhance access to and use of space-based information to support disaster risk reduction efforts worldwide;

(c) To become aware of the most recent advances regarding space-based applications that should be promoted in the context of flood and drought risk reduction;

(d) To expand its community of experts who can support the development of new applications in the UN-SPIDER knowledge portal.

63. Recognizing that disasters affect both developed and developing countries but that it is those who are most vulnerable who suffer most from them, the outcomes of the expert meeting will help UN-SPIDER to improve its efforts in implementing its mandate so that it may assist national agencies and regional and international organizations that devote their efforts to flood and drought risk reduction as a way to achieve the goal of enhancing the resilience of nations, as proposed in the Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters.