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Committee on the Peaceful Uses of Outer Space

Report on the United Nations/Germany Expert Meeting on the Use of Space-based Information in Early Warning Systems

(Bonn, Germany, 25-26 June 2013)

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 workplans, for the biennium 2010-2011[1] and 2012-2013,[2] 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 in Early Warning Systems was conducted on the premises of the United Nations in Bonn, Germany, on 25 and 26 June 2013. 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 Federal Ministry of Economics and Technology and the Federal Office of Civil Protection and Disaster Assistance of Germany and the Secure World Foundation (SWF). The Expert Meeting provided an opportunity to discuss the role that UN-SPIDER can play in promoting the use of space-based applications in early warning systems that have been set up around the world to minimize the impacts of hydrometeorologic, geological and biological hazards. The present report describes the background and

[1] See A/AC.105/937.
[2] See A/AC.105/C.1/2012/CRP.22.

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objectives of the Expert Meeting, provides a summary of the discussions and presents observations and recommendations made by the participants.

II. Organizational framework

4. The United Nations/Germany Expert Meeting on the Use of Space-based Information in Early Warning Systems was conducted as part of the outreach activities contemplated in the UN-SPIDER workplan for the biennium 2012-2013. It was one of the activities funded by the Government of Germany through its voluntary contribution to the programme.

A. Background and objectives

5. Early warning efforts began to be institutionalized within the United Nations through the International Decade for Natural Disaster Reduction. The International Strategy for Disaster Reduction conducted international early warning conferences in 2003 and 2006. 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, recognizes that early warning systems are "essential investments that protect and save lives, property and livelihoods, contribute to the sustainability of development, and are far more cost-effective in strengthening coping mechanisms than is primary reliance on post-disaster response and recovery".[3]

6. The Hyogo Framework for Action highlights explicitly, in paragraph 17, the need to focus on early warning systems as a way to improve disaster preparedness. It calls for United Nations agencies to work in close collaboration with existing networks and platforms and to support globally consistent data collection and forecasting on natural hazards as a way to improve early warning capacities worldwide.

7. 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."[4]

8. The Expert Meeting was aimed at facilitating the exchange of experiences and lessons learned regarding the use of space-based information in early warning systems; identifying needs; and discussing knowledge management strategies to improve existing early warning systems through the incorporation of recent advances in space-based applications.

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[3] A/CONF.206/6 and Corr.1, chap. I, resolution 2, para. 13 (i).

[4] See A/67/20, para. 21.

B. Attendance and financial support

9. The Expert Meeting was attended by 55 experts and professionals from 20 Member States: Austria, Belgium, Burundi, Canada, Chile, Germany, India, Italy, Iran (Islamic Republic of), Kenya, Mexico, Netherlands, Nigeria, Philippines, Poland, Russian Federation, Sri Lanka, Ukraine, United States of America and Zambia. Altogether, participants represented 42 national, regional and international organizations belonging to the space community, the disaster risk management community, the emergency response community, knowledge transfer and academic institutions, and internationally active private companies.

10. Funds allocated by the Federal Ministry of Economics and Technology of Germany through the UN-SPIDER programme and SWF were used to defray the costs of air travel, daily subsistence allowance and accommodation for eight participants from developing countries. The Federal Office of Civil Protection and Disaster Assistance of Germany provided technical guidance, while the UN-SPIDER programme, serving as host, provided conference facilities and secretariat and technical support.

C. Programme of activities

11. The programme of activities of the Expert Meeting was developed by UN-SPIDER, DLR, SWF and the Federal Office of Civil Protection and Disaster Assistance. The programme included an opening ceremony, four sessions, which included both plenary presentations and discussions in breakout groups, and a closing ceremony. Opening and closing remarks were made by representatives from DLR, SWF, the Federal Office of Civil Protection and Disaster Assistance and UN-SPIDER. Keynote presentations were made by UN-SPIDER, DLR and SWF.

12. The four sessions addressed the following topics:

(a) Improving early warning systems: novel space-based applications to monitor and forecast events;

(b) Enhancing the early warning message: from warning about events to their potential impacts;

(c) Enhancing links in the early warning chain;

(d) The way forward.

13. The first session, on the topic “Improving early warning systems: novel space-based applications to monitor and forecast events”, provided the setting for a discussion of the use of space-based information to monitor and forecast potentially catastrophic events that can trigger disasters. The session began with three keynote presentations. The first presentation, by UN-SPIDER, framed the theme by illustrating how space-based applications can support the four elements of effective early warning systems (risk knowledge, warning service, dissemination of warnings and response capability). For example, remote sensing techniques can be used to identify the location of critical infrastructure (schools, hospitals, government facilities, etc.); the combination of up-to-date and archived imagery can be used to estimate how severe an ongoing drought is in comparison to previous droughts; and

the transmission of tsunami warnings across continents is done using satellite telecommunications. The second presentation, by DLR, gave participants an overview of remote sensing applications for vulnerability and risk analysis, emergency response and early warning systems. The third presentation, by SWF, focused on early warning regarding near-Earth objects (NEOs), which is possible because NEOs can be detected using optical telescopes months or years before they may impact Earth, and could be deflected. In that presentation, reference was made to the international discussions on the same theme under the umbrella of the Committee on the Peaceful Uses of Outer Space.

14. The first session included a segment in which three breakout groups discussed issues such as: novel sources of space-based information at the global and regional levels can be used to improve the monitoring and forecasting capacities of existing national and local early warning systems; key challenges to be addressed when promoting the use of geospatial information in monitoring and forecasting activities and ways to approach such challenges; and strategies to facilitate the use of novel geospatial information technologies in early warning systems. Experts highlighted the usefulness of cost-free satellite imagery that is available on websites such as that of the Moderate Resolution Imaging Spectroradiometer and the archive of images from Landsat missions. They also highlighted novel initiatives regarding drought, such as the global Agricultural Stress Index System developed by the Food and Agriculture Organization of the United Nations (FAO) and the agriculture-climate observatory being launched in Chile. Experts further highlighted the benefits of using crowd-sourced and volunteered crisis data.

15. Experts noted existing challenges related to the use of satellite imagery, including the low spatial resolution of freely available satellite imagery, which means that their application is limited to very large-scale phenomena; the low bandwidth of Internet services in many developing countries, in particular in rural areas, which makes it difficult to access and download raw or processed satellite images or complex maps; and the reluctance of government agencies in developing countries to share their data. The experts highlighted the need for interoperability, and the standardization of data models, terminology and methods or tools to process data.

16. In the second session, entitled “Enhancing the early warning message: from warning about events to their potential impacts”, participants discussed the feasibility of using space-based information to improve warning procedures and to link early warning to emergency response efforts. The session included three plenary presentations. The expert from the Regional Centre for Mapping of Resources for Development made a presentation on the Regional Centre’s efforts in Africa on early warning, focusing on floods, landslides, epidemic diseases and droughts. The expert from the Canadian Forest Service briefed participants on the global efforts to monitor forest fires and made a presentation on the Global Observation of Forest Cover/Global Observation of Landcover Dynamics (GOFC-GOLD) Global Early Warning System for Wildland Fire. The Chair of the Working Group on Tsunami Risk Assessment and Reduction of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System made a presentation on the use of geospatial tools and space-based applications for tsunami risk assessment. Experts also addressed topics such as the use of space-based applications to contribute to the assessment of vulnerability of specific

communities, to improve the dissemination of warnings and the identification of evacuation routes, and to minimize losses to critical assets exposed to hazards.

17. Experts discussed ways in which archived and up-to-date satellite imagery and satellite-assisted positioning can be used to identify the location of vulnerable groups and assets, and how to benefit from the most up-to-date geoinformation technologies, including web-based geographic information systems (GIS) and geo-viewers. Experts pointed out that the combination of archived and up-to-date imagery could be used to track the changes in exposure of vulnerable assets and communities to hazards over time, but that it was difficult to use imagery to assess the vulnerability of communities owing to the socioeconomic aspects of vulnerability. In the context of biological hazards, the combined use of archived and up-to-date imagery to track historical occurrences of malaria or dengue episodes was suggested as a way to develop predictive models of the diffusion of such occurrences. In the context of geoinformation technologies, experts noted that GIS allow users to combine a wide variety of ground- and space-based data.

18. Experts identified several challenges that need to be addressed when promoting the use of space-based information and geospatial information technologies, including data on different scales and in incompatible formats; the difficulties in some countries of accessing data owing to their sensitivity or their commercial or military nature; the difficulties in developing countries of accessing data or information produced abroad; the lack of awareness regarding data available for applications in early warning systems; and low levels of capacity to process data. As a way to address these challenges, the experts suggested the development of methods to combine satellite data acquired at different resolutions and to harmonize satellite-based and ground-based data; the use of novel telecommunication technologies, including smart phones, to generate additional data; and capacity-building efforts.

19. The third session, entitled “Enhancing links in the early warning chain”, included plenary presentations by representatives from the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) Heidelberg University, FAO and the private company Environmental Systems Research Institute, Inc. (ESRI). The joint presentation by GIZ and Heidelberg University focused on the use of space-based information in community-based flood early warning systems in the Philippines. The presentation illustrated the use of satellite imagery to estimate rainfall, the use of digital elevation models derived from satellite missions and the use of radar imagery to track the extent of historical floods as ways to contribute to flood early warning systems. The presentation by FAO focused on its Agricultural Stress Index System (ASIS), which is based on 10-day satellite data of vegetation and land surface temperature from the meteorological operational satellite-advanced very high resolution radiometer (METOP-AVHRR) sensor. ASIS extends the classical approach of using anomalies of vegetation indices by incorporating agricultural information such as the European Commission Joint Research Center’s global crop mask and information on specific stages in the agricultural cycle. The presentation was complemented with a demonstration of the temporal evolution of the global agricultural stress index for each year from 1984 to 2011. The presentation by ESRI focused on the role of GIS as platforms with the potential to combine and synthesize information from many sources and to facilitate communication and collaboration

among experts and end users. Information on the ESRI disaster management programme was also provided.

20. The session included discussions in which experts focused on such topics as key challenges to be addressed when promoting the use of geospatial information generated at the global, regional and national levels in early warning systems operated at the local level, and ways to approach such challenges; strategies to combine the use of up-to-date and archived satellite imagery to improve early warning efforts; ways to integrate remote sensing and satellite-assisted navigation and positioning applications in early warning systems; and knowledge management efforts, including the way in which information should be contained in the UN-SPIDER knowledge portal so that it can be used in early warning systems set up and operated by agencies at the national or local level.

21. In the context of key challenges regarding the use of data and information generated and presented on global or regional websites in early warning systems operated at the local level, experts made reference to language barriers, limited access to the Internet, the lack of methods to transfer raw data into useful information, the incompatibility of various systems, lack of awareness concerning the quality of data, lack of funds, weak communication among different institutions, lack of awareness about what is possible and what is already in place, weaknesses in the identification of the needs of end users, and limited opportunities for training and education. In the context of the UN-SPIDER knowledge portal, the experts suggested the incorporation and dissemination of simple and interesting case studies, success stories, guidelines and baseline maps; the development and promotion of simple, usable tools that are adaptable to different formats and languages; and an open forum within the portal to facilitate dialogue among experts, operators of early warning systems and end users.

22. In the fourth session, experts discussed possible ways forward in four major areas: data and information management, capacity-building, networking and knowledge management efforts. The experts expressed the view that Earth observation techniques using the most up-to-date sensors can improve the determination of the temporal and spatial evolution of events capable of provoking disasters. They also reiterated that the combination of ground-based data, ground-based and satellite-based techniques and satellite-assisted positioning can be used to increase warning time, to define warning strategies more precisely and to suggest potential impacts of events on the basis of archived data, including satellite imagery.

23. Additional details concerning the discussion sessions, plenary presentations and other relevant aspects of the expert meeting can be found on the page of the UN-SPIDER knowledge portal devoted to the Expert Meeting (www.un-spider.org/earlywarning-expertmeeting).

III. Outcomes and recommendations

24. At the United Nations/Germany Expert Meeting on the Use of Space-based Information in Early Warning Systems, UN-SPIDER and its partners achieved a variety of outcomes and made recommendations, as presented below.

A. Outcomes

25. The Expert Meeting allowed participants:

(a) To become aware of recent advances regarding the use of space-based information in early warning systems and disaster preparedness;

(b) To become aware of the role of UN-SPIDER in early warning efforts and to identify ways and means of becoming engaged in such activities;

(c) To network with representatives of a variety of countries and regional and international institutions and to bridge the gap between the space and early warning communities;

(d) To share their experiences and their suggestions and recommendations regarding the use of space-based information in early warning systems and disaster preparedness.

26. The Expert Meeting allowed the UN-SPIDER programme:

(a) To help to bring the space, disaster risk management and emergency response communities closer together;

(b) To establish contact with experts from many institutions involved in early warning efforts;

(c) To collect a variety of suggestions and recommendations from experts regarding the use of space-based information in early warning systems;

(d) To improve its contact with space agencies;

(e) To coordinate efforts with the network of regional support offices;

(f) To compile experiences and lessons learned from existing early warning systems that already make use of space-based information;

(g) To identify knowledge management strategies that can facilitate access to and use of space-based information in early warning and disaster preparedness;

(h) To identify strategies or procedures to facilitate or improve the transition between early warning and disaster response efforts;

(i) To identify strategies to enhance synergies between the space community and members of the disaster risk management and emergency response communities involved in early warning and disaster preparedness;

(j) To promote the importance of the UN-SPIDER knowledge portal in the efforts on early warning.

B. Recommendations

27. The recommendations that emerged from the Expert Meeting stemmed from the various group sessions.

28. The experts expressed the view that Earth observation techniques using the most up-to-date sensors can improve the determination of the temporal and spatial evolution of events capable of provoking disasters. They also reiterated that the

combination of ground-based data and satellite-based techniques and satellite-assisted positioning can be used to increase warning time, to define warning strategies more precisely and to identify the potential impacts of events through the use of archived data, including satellite imagery. Furthermore, they reiterated the need to systematize the use of such techniques in early warning systems.

29. With specific regard to data and information, the experts suggested the promotion of the use of existing imagery, including freely accessible imagery available on a variety of online services, as a way to improve the routine operation of early warning systems; the establishment of geospatial databases containing reference data as a way to improve the assessment of risks and potential impacts, as well as to improve warning strategies; the combination of space- and ground-based data through novel applications, including through the incorporation of volunteer technical communities and the use of geo-viewer capabilities; and efforts to encourage data-sharing, including through platforms that invite people to upload their data and a clearing house to control data quality. The experts recognized the challenge faced in many countries regarding lack of access to data and suggested that UN-SPIDER should promote the establishment of spatial data infrastructures as a way for stakeholders, including government agencies, university researchers, operators of early warning systems and end users, to share their data. A parallel suggestion to deal with the lack of access to data at the local level was the promotion of GEONETCast, a near real-time global network of satellite-based data dissemination systems, as a way to receive satellite data directly, without Internet access. Another suggestion was to consider private-public partnerships as a way to deal with constraints due to lack of resources.

30. In the context of capacity-building, the experts suggested the identification of needs, the conduct of training programmes, the transfer of technical know-how as a way to facilitate access to and use of space-based information in early warning systems, and the conduct of simulations and exercises. Experts also suggested the development of a curriculum that should include modules on how to access, process and disseminate geospatial data, and modules on the different roles of stakeholders in early warning systems. Overall objectives should be improving capabilities to think in geospatial ways; the development of training material for three different target groups: technicians and professionals, decision makers and the general public, including students; and the development of a handbook containing all available resources and recommendations on the applicability of those resources.

31. In the context of networking, the experts suggested establishing a virtual communication platform, such as an online open forum, to facilitate communication among stakeholders; a community of practice focusing on the use of space-based applications in early warning that could concentrate its efforts on the development of web-based geospatial platforms, methods to downscale global datasets to make them useful at the national and local levels, and training material; and facilitating the dialogue among the scientific community, decision makers and the operators and beneficiaries of early warning systems.

32. In the context of the UN-SPIDER knowledge portal, the experts recommended the identification, systematization and promotion of case studies and success stories on the use of space-based information and geospatial technologies to improve the functionality of early warning systems; the incorporation and continuous updating of novel sources of data and methodologies developed in many regions of the world

that make use of space-based applications in early warning systems; the development and promotion of the use of guidelines on standardized data products; and the incorporation of a web-based GIS platform to make data from different sources available. Such a platform could also facilitate the sharing and exchange of data and provide baseline data to facilitate preparedness. The experts also suggested the incorporation in the portal of a specific section on early warning.

33. The experts also highlighted the need to address a variety of challenges, including language barriers, limited access to the Internet in some developing countries, weak data policy and institutional practices, the incompatibility of various information systems being used around the world, the difficulty of locating and accessing data and information, and the lack of financial resources and training opportunities.

C. The way forward

34. UN-SPIDER is taking into consideration the recommendations of the Expert Meeting in striving to incorporate the theme of early warning into its routine activities and its workplan for the biennium 2014-2015. The workplan will include 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.

35. 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

36. Since its establishment, the UN-SPIDER programme has incorporated awareness and outreach activities, technical advisory support, knowledge management, capacity-building and institutional strengthening into its comprehensive workplan.

37. The United Nations/Germany Expert Meeting on the Use of Space-based Information in Early Warning Systems allowed the programme:

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

(b) To identify directions and priorities for improving further its operation of the knowledge portal as a tool to enhance access to and use of space-based information to support early warning systems;

(c) To remain informed about geo-viewers, web-based mapping tools and other novel information technology applications and infrastructure, with particular emphasis on enhancing the use of space-based information in early warning systems;

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

38. 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 early warning 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.