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Committee on the Peaceful Uses of Outer Space

Report on the United Nations/Morocco International Conference on the Use of Space Technology for Water Management

(Rabat, 1-4 April 2014)

I. Introduction

A. Background and objectives

1. The Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III), in particular through its resolution entitled "The Space Millennium: Vienna Declaration on Space and Human Development",[1] recommended that activities of the United Nations Programme on Space Applications should promote collaborative participation among Member States at the regional and international levels, emphasizing the development of knowledge and skills in developing countries,[2] especially for dealing with the challenges posed by the depletion of natural resources, loss of biodiversity and the effects of natural and anthropogenic disasters.

2. At its fifty-sixth session, in 2013, the Committee on the Peaceful Uses of Outer Space endorsed the programme of workshops, training courses, symposiums and conferences of the Programme on Space Applications for 2014. Subsequently, the General Assembly, in its resolution 68/75, endorsed the activities to be carried out by the Office for Outer Space Affairs of the Secretariat under the auspices of the United Nations Programme on Space Applications in 2014.

3. Pursuant to General Assembly resolution 68/75 and in accordance with the recommendations of UNISPACE III, the United Nations/Morocco International

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

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

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Conference on the Use of Space Technology for Water Management was held in Rabat from 1 to 4 April 2014.

4. The Conference was jointly organized by the Office for Outer Space Affairs, as part of the activities of the United Nations Programme on Space Applications for 2014, the Government of Morocco, the European Space Agency (ESA) and the General Secretariat of the Prince Sultan bin Abdulaziz International Prize for Water (PSIPW). It was co-sponsored by the Inter-Islamic Network on Space Sciences and Technology (ISNET) and the secretariat of the Group on Earth Observations (GEO). The event was hosted by the Royal Centre for Remote Sensing (CRTS) on behalf of the Government of Morocco.

5. The Conference was the third international event focusing on water-related issues in the series of meetings organized in cooperation with, and with the financial assistance of, ESA and PSIPW. The first United Nations/Saudi Arabia/United Nations Educational, Scientific and Cultural Organization International Conference on the Use of Space Technology for Water Management took place in Riyadh on 12-16 April 2008 (see A/AC/105/914) and the Second United Nations/Argentina International Conference on the Use of Space Technology for Water Management was held in Buenos Aires on 14-18 March 2011.

6. The 2014 Conference explored applications of space technology that provided cost-effective solutions or essential information for the planning and implementation of programmes or projects to enhance the management, protection and restoration of water resources and that contributed to mitigating water-related emergencies, providing safe drinking water and combating desertification. Participants in the Conference were given the opportunity to present case studies on successful applications of space technology in water resource management in their respective countries.

7. The primary objectives of the Conference were as follows: (a) to enhance the capabilities of countries in the use of space-related technology, applications, services and information for identifying and managing water resources; (b) to strengthen international and regional cooperation in that area; (c) to increase awareness among decision makers and the research and academic community of space technology applications for addressing water-related issues, primarily in developing countries; and (d) to promote educational and public-awareness initiatives in the area of water resource management and contribute to capacity-building processes in that area.

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

9. The present report describes the background, objectives and programme of the Conference. It has been prepared for submission to the Committee on the Peaceful Uses of Outer Space at its fifty-eighth session and to its Scientific and Technical Subcommittee at its fifty-second session, both in 2015.

B. Programme

10. The programme of the Conference was developed jointly by the Office for Outer Space Affairs and the programme committee of the meeting, which included representatives of ESA, CRTS, the GEO secretariat, ISNET and PSIPW.

11. The programme of the Conference included five technical sessions that focused on the following themes: (a) space applications for water productivity and economy; (b) international and regional initiatives to integrate space technologies in water resource management; (c) space applications for water security and risk management; (d) geospatial information for groundwater resource management; and (e) capacity-building and cooperation initiatives (including a comprehensive overview of the Earth Observation Land Data Assimilation System in the Middle East and North Africa and the ESA TIGER Capacity-building Facility and the Water Observation and Information System).

12. In addition, the Conference had a special "water prize" session, organized by PSIPW as an exclusive event within the framework of the Conference, with the participation of the prize-winner and representatives of the PSIPW General Secretariat. The programme of the Conference also included sessions of working group discussions.

13. At the opening of the Conference, introductory and welcoming statements were made by representatives of the Government of Morocco, the Committee on the Peaceful Uses of Outer Space, the Office for Outer Space Affairs, ESA, ISNET and PSIPW. A keynote address was made by a representative of the Global Water Partnership.

14. A total of 42 oral technical presentations were made during the three days of technical sessions, and 43 papers were presented at the poster session. All presentations focused on successful applications of space technology and space-related information resources that provided cost-effective solutions or essential information for planning and implementing programmes or projects in the areas of water resource management and water-related disasters, including case studies by participants. The Conference also featured presentations on the needs of end users engaged in managing water resources, as well as on international and regional cooperation and capacity-building initiatives required for the successful implementation of sustainable development programmes in developing countries.

15. Each technical session was followed by open discussion on specific topics of interest, with additional opportunities for participants to voice their opinions and raise queries. The discussions were continued in depth and summarized by two working groups established to prepare observations and recommendations, develop proposals for follow-up projects and examine possible partnerships to be formed. The first working group discussed capacity-building and international and regional cooperation. The second working group focused on issues related to future challenges for water resource management. The reports of the working groups were presented by their respective chairs at the closing session and were discussed and adopted by the participants in the Conference.

16. The Conference was conducted in English and French, with the use of simultaneous interpretation.

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

C. Attendance and financial support

18. Scientists, engineers and educators from developing and industrialized countries from all economic regions were invited by the United Nations, on behalf of the organizers, to participate in the Conference. Participants were selected on the basis of their scientific, engineering and educational background and their experience in implementing programmes and projects in which space-related technology, information and services were used for managing water resources. The participation of experts at the decision-making level from both national and international entities was particularly encouraged.

19. Funds allocated by the United Nations, the Government of Morocco, ESA, the GEO secretariat, ISNET and PSIPW were used to provide financial support for the participation of 39 participants, mostly from developing countries. Thirty-four participants received full financial support, which included international round-trip air travel, accommodation and a living allowance for the duration of the Conference. Five participants received partial funding to cover either their air travel or hotel accommodation and living expenses in the host country.

20. The hosting organization, CRTS, provided conference facilities, secretarial and technical support and transportation of participants from and to the airport and organized a number of social events for all participants of the Conference.

21. The Conference was attended by more than 100 participants from the following 43 States: Algeria, Argentina, Azerbaijan, Bahrain, Bangladesh, Botswana, Brazil, Cameroon, Croatia, Denmark, Djibouti, Egypt, Ethiopia, France, Germany, Ghana, India, Italy, Japan, Jordan, Kenya, Lebanon, Libya, Mexico, Morocco, Nepal, Netherlands, Nigeria, Pakistan, Peru, Poland, Romania, Russian Federation, Saudi Arabia, Sudan, Switzerland, Syrian Arab Republic, Thailand, Tunisia, Turkey, United States of America, Yemen and Zimbabwe. International intergovernmental and non-governmental organizations, such as ESA, EURISY, the Food and Agriculture Organization of the United Nations, GEO, ISNET, the University of Twente, PSIPW, the United Nations Institute for Training and Research (UNITAR) and the Office for Outer Space Affairs were also represented at the Conference.

II. Overview of technical sessions

22. The first technical session concentrated on the discussion of space applications for water productivity and economy. A number of case studies were presented to participants by speakers from Egypt, Italy, Morocco, Nigeria, Pakistan, Poland, Saudi Arabia and the United States. Participants in the Conference were briefed on the recent activities and projects carried out by the Italian Space Agency (ASI) in applying space technology for water management in such areas as monitoring water pollution, the management of water-related disasters and the related risk assessment. ASI had developed a constellation of four advanced synthetic aperture radar (SAR) satellites, COSMO-SkyMed, which were used for operational monitoring of the

coastal and maritime environment in the Mediterranean area. Through an extensive network of centres of excellence and in cooperation with universities and industrial partners, ASI worked on the development of national capabilities in the use of Earth observation data. A number of ongoing pilot projects were presented, including the Operational Eo-based Rainfall–run-off Forecast (OPERA) project to monitor dynamics and validate hydrodynamic models for post-disaster phases, and the project for monitoring hydrocarbon marine pollution (Project PRIMI) which was aimed at developing and implementing a modular system for the operational monitoring of marine pollution caused by hydrocarbon spills. The system used multiplatform synthetic aperture radar (SAR) and optical data (mainly Earth remote sensing, the Environmental Satellite (Envisat), COSMO-SkyMed, the Moderate Resolution Imaging Spectroradiometer (MODIS) and the Medium Resolution Imaging Spectrometer (MERIS)) for spill detection, and it provided information on wind, waves and currents.

23. The session also featured a presentation on the use of remote sensing data for water resources exploration in arid regions. In that project, carried out in the desert areas of North Africa and the Arabian peninsula, radar and thermal infrared images were used to reveal numerous hidden surface/subsurface features. Long wavelength radar had the unique ability to penetrate dry surface sand and detect the buried subsurface terrain. Thermal infrared monitoring had also proved to be capable of spotting moist cooler areas, particularly in hot dry surfaces. Integrating RADARSAT images and geographical information systems (GIS) had revealed several previously unknown paleorivers and lake basins in the region. One of those systems, the Kufrah basin, was the largest river basin identified to date in the eastern Sahara. The Gilf Kebir was another large paleoriver system located just east of the Kufrah basin, emanating from the Gilf plateau in Egypt. Both river systems ended in vast inland deltas at the southern margin of the Great Sand Sea. Those former lakes and rivers could potentially hold vast reservoirs of groundwater, oil and natural gas at depth. Similar to radar data, thermal infrared images had proved useful in detecting potential locations of subsurface water accumulation in desert regions. Analysis of both ASTER and daily MODIS thermal channels revealed several subsurface cool moist patches in the sandy desert of the Arabian peninsula. Analysis indicated that such evaporative cooling anomalies were the result of the subsurface transmission of the monsoonal rainfall from the mountains adjacent to the plain. The drilling of wells in several locations had demonstrated the presence of productive water aquifers, confirming the validity of the data used and the approaches adopted for water exploration in arid regions.

24. Presentations at the session also addressed the importance of the use of optical and microwave satellite data for revealing water resources in farming areas and for efficient agricultural land management and accurate yield forecasts in Egypt, Morocco, Poland and Saudi Arabia. A number of case studies on the use of geospatial techniques for water harvesting and on the advanced hydro-environmental monitoring system in the transboundary Niger river basin in Central Africa were presented at this session as well.

25. The second technical session considered international and regional initiatives to integrate space technologies in water resource management. The participants were briefed on the latest efforts of the Global Earth Observation System of Systems (GEOSS) in promoting effective multisectoral and interdisciplinary

collaboration based on coordinated and integrated efforts. The participants were shown how Earth observation data could help to reduce the loss of life and property from natural and human-induced disasters by improving our understanding of the complex environmental systems. It was critically important to recognize and manage the fundamental links connecting the fields of water-dependent domains; land use, including deforestation; ecosystem services; and food, energy and health security. Coordinated, comprehensive and sustained observations and information for management and decision-making in those domains constituted a first step. However, there was a need to develop an effective collaboration mechanism for working together across different disciplines, sectors and agencies to gain a holistic view of the continuity between environmentally sustainable development, climate change adaptation and enhanced resilience.

26. In that context, GEOSS was built through the coordination of efforts within GEO, a voluntary partnership established in February 2005, comprising 89 Member States, the European Commission and 77 participating organizations. The 10-year implementation plan defined a vision statement for GEOSS, its purpose and scope, expected benefits in the nine societal benefit areas (disasters, health, energy, climate, water, weather, ecosystems, agriculture and biodiversity), technical and capacity-building priorities, and the GEO governance structure. The full value of GEOSS lay in its ability to integrate Earth observation data and information across disciplines. As an example of that capacity, in the water sector, GEO had established the GEOSS Asian Water Cycle Initiative and the African Water Cycle Coordination Initiative. Through regional, interdisciplinary, multisectoral integration and interagency coordination in Asia and Africa, GEOSS was now carrying out effective actions and public-awareness activities in support of water security and sustainable development.

27. The participants in the conference were also given an update on the status of the TIGER initiative launched by ESA in 2002 as a Committee on Earth Observation Satellites (CEOS) response to the World Summit on Sustainable Development held in Johannesburg, with the objective of assisting African countries in overcoming problems faced in the collection, analysis and dissemination of water-related geo-information by exploiting the advantages of Earth observation technology. TIGER was based on a user-driven approach under African leadership, involving more than 150 African experts in 42 countries who actively participated in TIGER development projects and capacity-building actions. The initiative assisted African scientists, technical centres and water authorities to develop the tools, the knowledge and the capacity to exploit Earth observation technology for the monitoring and management of water resources and to enable African water authorities at the national level and authorities for transboundary basins to lead the transition from a demonstration stage to operational Earth observation information services. During 12 years of operation, more than 10,000 satellite scenes had been delivered to support national and regional research and demonstration projects, and more than 300 African experts had been trained.

28. The session also featured presentations on the World Bank/United States Agency for International Development (USAID)/National Aeronautics and Space Administration (NASA) of the United States initiative on regional coordination for improved water management and capacity-building; water-related initiatives by the Japan Aerospace Exploration Agency (JAXA) in various regions of the world;

Europe-Africa cooperation in water management; and the water scarcity initiative in the Near East and North Africa region conducted by the Food and Agriculture Organization of the United Nations, aimed at benchmarking and monitoring crop water productivity via satellite remote sensing.

29. The third technical session considered issues related to space applications for water security and risk management. The Conference recognized the critical necessity of establishing international standards in natural risk management, sustainable development and water management. A case study on remote sensing-based hydrological modelling for early warning of floods in the Awash river basin in Ethiopia was presented to participants, as a good example of the potential of space technology. The Awash river basin, which ran through the Rift valley, was a major river basin that had serious flooding problems. An early warning system was a prerequisite for mitigating the impact of floods. The study was carried out in three stages. In the first stage, a rainfall run-off model was developed. The second phase was validation of the Advanced Scatterometer (ASCAT) surface soil moisture product using in situ data, standard precipitation index computation and topographic wetness index processing. The third stage aimed at establishing the relation between the ASCAT surface soil moisture product and standard precipitation index and the water level in the river channel. Satellite data-derived products were used to enhance the GIS-based hydrological rainfall run-off routing model (LISFLOOD-FP), and the results were compared with observations of river discharge in the area. Furthermore, integrated index maps, which indicated source areas for flooding, were produced by combining the standard precipitation index and the topographic wetness index.

30. Participants were also briefed on the status of the joint Germany/Morocco project on environmental risk assessment and water management in the Safi region in Morocco. The three-year project carried out within the framework of the bilateral Moroccan-German Programme of Scientific Research (PMARS), in collaboration with the German Aerospace Center (DLR), addressed natural and man-made problems presenting serious risks in Morocco, especially endangered water resources and desertification. The project would result in establishing a risk management centre for natural hazards at the Cadi Ayyad University in Safi, which would address fundamental scientific, environmental and anthropological problems of national importance and social relevance. It would also develop a regional real-time geo-information system accessible worldwide via the Internet, with interdisciplinary dynamic content, enabling communication between scientists, technicians, policymakers and the public. The project used sophisticated free geospatial software tools and desktop solutions for data editing and analysis with a focus on remote sensing applications and data enhancement (e.g., the Geographic Resources Analysis Support System (GRASS)), spatial database management systems (e.g., PostgreSQL/PostGIS) and Internet map server applications (e.g., the University of Minnesota MapServer project). In order to achieve sustainability and a certain independence from further funding or licence problems, the land management system as well as all modelling investigations used the free/libre open source software (FLOSS), implementing the standards of the Open Geospatial Consortium.

31. Presentations at the session also featured case studies on the use of space-derived data for tsunami risk modelling, flood vulnerability assessment using

geospatial techniques, the use of space technology for estimating risks of natural hazards, and the creation of a Danube flood hazard and risk map atlas.

32. Discussions in the fourth technical session focused on the use of geospatial information for groundwater resource management. Participants in the Conference were introduced to water-related activities of the UNITAR Operational Satellite Applications Programme (UNOSAT), an operational satellite applications programme carried out by UNITAR. UNOSAT was created in 2001 as a technology-intensive programme with the mission of delivering imagery analysis and satellite-derived solutions to relief and development organizations within and outside the United Nations system in critical areas such as humanitarian relief, human security, strategic territorial planning, and development. The UNOSAT mission was to leverage satellite technology to generate geospatial information and create integrated solutions for human security, peace, and socioeconomic development in keeping with the mandate entrusted to UNITAR by the General Assembly since 1963. The work of UNOSAT involved combining the best commercial and open-source means available with innovative applied research to generate solutions that helped fill existing gaps and advance the work of the larger United Nations family in accordance with purposes and principles of the Charter of the United Nations. Since 2005, UNOSAT had also been developing new integrated training and technical assistance packages and conducted capacity development programmes in Central America, Asia and Africa. UNOSAT was a content-based programme, and its team was made of GIS and analysis specialists with field experience, supported by information technology engineers and policy experts.

33. Participants were briefed on activities carried out by UNOSAT in the area of the use of geospatial information for groundwater resource management, including a large-scale multi-year territorial management project in Chad to map water resources using satellite imagery in combination with field surveys. The project, which had the full-scale participation of the Chad Government, demonstrated how technology could facilitate access to clean water, help a country to reach its development goals and build national capacity in areas such as health care, food security, environmental protection and natural resource management. Other presentations in the session demonstrated the successful application of geospatial information in the following areas: the development of a national strategy for water resource management in Morocco, the monitoring of the Pilcomayo river along the border between Argentina and Paraguay, and using radar interferometric satellite data for groundwater management in the Arno river basin in Italy. The session also featured case studies on the management of underground water quality in a semi-arid environment in Botswana, the mapping of irrigated lands and groundwater resources in Morocco, and groundwater quality assessment using spatial modelling in the Peshawar district of Pakistan.

34. At the fifth technical session, participants discussed national and international efforts for cooperation and capacity-building in the use of space science and technology for water management. Participants were updated on the status of the EarthLab programme implemented by Telespazio of France. The aim of the programme was to establish a worldwide network of research and development centres for producing integrated geo-information to respond to local environmental issues and needs. EarthLab centres developed operational services in close collaboration with academic institutions and laboratories, small and medium-sized

enterprises and other industries in participating countries. The particular focus of the network was the use of Earth observation information, including both optical and radar satellite data, for environmental monitoring for sustainable agriculture, natural disaster and emergency management, water management and real-time coastal monitoring.

35. Participants were also introduced to the concept of the "green Master of Business Administration (MBA)" programme developed by the Indian Institute of Management in Kashipur in response to increasing demand for environment-oriented business education, which should include training in the use of Earth observation data and GIS for natural resource management, including water resource management. The programme highlighted issues such as technological developments, new emerging applications scenarios and the qualitative data received from a cross section of prospective participants, industry stakeholders, government agencies and management faculty. A model had been created for reviewing the current syllabus of the management course and making recommendations on changes needed, on the basis of advancement in the field. Participants in the Conference were also briefed on initiatives and actions for capacity-building conducted by CRTS of Morocco.

36. The session also featured a comprehensive overview of the status of the Land Data Assimilation System (LDAS) project implemented by countries of the Middle East and North Africa in close cooperation with the World Bank, USAID and NASA. It was highlighted in presentations that the scarcity of freshwater in most countries of the Middle East and North Africa was becoming an increasingly acute problem, particularly as populations grew, rapid urbanization continued and the pressure to shift water from agriculture (which consumed over 84 per cent of the region's water resources, on average) to domestic and industrial uses increased. Most countries of the Middle East and North Africa were classified as being in water deficit, defined as having less than 500 m^3 of renewable water supply per capita per year. Furthermore, more than 60 per cent of the region's water supply flowed across international borders, which further engendered political tensions between communities, stakeholders and countries, underlining the need for regional cooperation in water resource management in the Arab world. Remote sensing techniques and GIS, combined with land data assimilation and modelling techniques, now enabled the routine collection of accurate water data. Data collected in that manner could provide measurements over areas where no data had otherwise been available and at greatly reduced costs compared with traditional methods. Such data could also easily be turned into valuable information through maps and graphs that allowed stakeholders and water managers to make better informed decisions for water management and planning.

37. In that context, presentations at the session reviewed the role of the Arab Water Council in enhancing regional coordination, as well as capacity-building activities of Tunisian institutions for improving water resource management and adaptation to climate change, capacity-building efforts in Lebanon for assessing and monitoring environmental hazards and the sustainable management of natural resources and efforts in Morocco to strengthening end user capacities for improving water resource management and climate change adaptation. The session also reviewed the capacity-building activities of TIGER, including presentations on the latest status of the TIGER Capacity-building Facility and TIGER-NET project and its Water Observation and Information System for monitoring, assessing and taking

inventory of water resources in a cost-effective manner through satellite observation, with a focus on operational Sentinel data.

38. At the poster session of the Conference, case studies were presented on successful applications of space technology for water management in Algeria, Argentina, Azerbaijan, Bangladesh, Brazil, Cameroon, Croatia, Egypt, Germany, Ghana, India, Italy, Jordan, Kenya, Lebanon, Morocco, Nepal, Nigeria, Pakistan, Peru, the Russian Federation, Saudi Arabia, the Sudan, the Syrian Arab Republic, Thailand, Tunisia and Zimbabwe.

III. Conclusions of the Conference

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

40. Discussions of the first working group centred on the critical issues related to capacity-building and international and regional cooperation in the thematic area of the use of space technologies for water management. The participants recognized the need to establish long-term self-sustainable educational frameworks, which were required for the successful incorporation of space-related technology and services into integrated water resource management systems. It was also emphasized by participants that enhanced international coordination was required for the better integration of space-derived information into the policymaking and decision-making process.

41. Discussions of the working group resulted in a number of recommendations, which could be summarized as follows:

(a) Sustainable operation of international and regional centres of expertise, education and training, including the regional centres for space science and technology education, affiliated to the United Nations, should be supported and enhanced as those centres could play an important role in capacity-building and dissemination of knowledge in the area of the application of space technology to water management. Creation of new centres should also be supported;

(b) Strategic public-private partnerships between academic institutions, research and development organizations and private sector should be enhanced. Particular support should be provided to experts participating in cooperation mechanisms established between industrialized and developing countries and in South-South knowledge transfer;

(c) International capacity-building strategies for water resource management, such as those contained in the GEOSS Water Strategy Report, should be supported;

(d) Transboundary integrated water resource management projects involving both governmental bodies and institutions with technical expertise should be encouraged, as they can help States to identify common problems and work together to find solutions;

(e) Sustainable solutions for water resource management should be implemented by integrating the use of space technology in education curricula, continuing the practice of knowledge-sharing, introducing new online education opportunities, organizing international symposiums and workshops and establishing scholarship and student exchange programmes;

(f) Support should be provided for Internet-based portals focusing on the use of space technology for water management, which would provide a platform for sharing data and other information, including information on experts and scientists available for advisory services, best practices in water management, international projects and funding opportunities and education and training opportunities in water management. In that context, participants commended efforts of PSIPW and the Office for Outer Space Affairs in developing such a portal;

(g) Data-sharing principles of GEO and the data democracy principles developed by CEOS should be further promoted and supported by participants' agencies and institutions.

42. The second working group addressed the issues related to future challenges for water resource management. The participants emphasized that very often water is a source of conflicts as water resources are not distributed equally, in terms of quantity and quality, over the globe, and at the same time it could be a peace-enabling commodity. Thus, water availability and the efficiency of water use should be enhanced, at both the local and global levels, with space-based technology and information playing a significant role in that regard. It was noted that water was a key enabling good for the overall life ecosystem. The deterioration of water quality should be addressed in a cost-effective way in policies addressing pollution. In that regard, space-based technology could be an important tool for assessing and monitoring water quality and providing evidence.

43. Addressing the above issues, the participants put forward the following recommendations:

(a) Greater efforts should be made to adopt operational systems for integrated water resource management that make use of space-derived data;

(b) Both spatial and temporal availability of data should be improved in order to assess sources of water deterioration;

(c) Access to data should be open for all users and stakeholders;

(d) Space-based services for water management should be provided at a minimum cost for clients pursuing public-oriented projects;

(e) For proper risk assessment, evaluation of climate variability affecting the water cycle should be considered, at all levels, from the global to the local level, in order to monitor and manage water resources in case of extreme events.

44. Participants further noted that access to water was a fundamental human right of global concern, and space-based technologies could provide uniform data (Earth observation), signals (GNSS), communication infrastructures (telecommunications) and space-borne facilities (life support systems) to enable every social community to access appropriate information. There was also a need to develop a shared vision of global governance of water to ensure a sustainable balance between public interests (the society-oriented policy approach) and

value-added activities (the profit-oriented business approach). Space-based technologies again could support that balance by making available appropriate data, applications and infrastructures.

45. In that regard, participants recommended the following:

(a) Trust and reliable relationships between water stakeholders and space community should be strengthened in a stable and continuous way;

(b) Public awareness of data availability should play a critical role for efficient water management in the future;

(c) Support should be provided to information-sharing initiatives such as the international water portal, which was being developed by PSIPW to serve as a dedicated platform to share knowledge, information, research and data among professional users;

(d) Development of value-added services for water resource management, which were based on Earth observation data and driven by end-user needs, should be encouraged;

(e) Appropriate geospatial data infrastructures should be developed to facilitate access to and the sharing of data;

(f) A stable and continuous relationship between academic and research and development institutions and governmental bodies should be improved and enhanced in order to effectively utilize the potential of space technology and information for water management.

46. At the closing session of the Conference, participants discussed and approved the observations and recommendations of the working groups, which were presented by the chairs of the working groups. Participants also expressed their appreciation to the Government of Morocco, the United Nations and all other co-organizers of the event for organizing the Conference and for the significant support provided.

IV. Follow-up actions

47. Participants recognized that the Conference provided an excellent opportunity to facilitate support for the increased use of space technology for sustainable development in developing countries. It was noted that the United Nations Programme on Space Applications should continue to assist institutions and agencies in developing countries to build capacity in the use of space technology for water management through medium-term and long-term fellowships and programmes organized in cooperation with Member States. The Conference encouraged all participants to better utilize educational and training opportunities offered by the Programme.

48. It was also noted that the fourth international conference on the use of space technology for water management should be held in 2016 or 2017 and should be held at the Economic and Social Commission for Asia and the Pacific. That meeting should consider additional ways to improve national and regional coordination mechanisms for matters related to water resource management and to strengthen the

capacity of developing countries to respond to challenges related to water, enhancing international cooperation in that area.