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Committee on the Peaceful Uses of Outer Space

Report on the United Nations/Pakistan/Prince Sultan bin Abdulaziz International Prize for Water Fourth International Conference on the Use of Space Technology for Water Management

(Islamabad, 26 February–3 March 2018)

I. Introduction

1. The United Nations Programme on Space Applications, implemented by the Office for Outer Space Affairs of the Secretariat, was established in 1971 to assist Member States with capacity-building in the use of space science, space technology and space applications in support of sustainable development, as well as to promote international space cooperation. Since its inception, the Programme has organized several hundred training courses, conferences, seminars and meetings for the benefit of Member States, promoting collaborative participation among Member States at the regional and international levels in a variety of space science and technology activities. The Programme's emphasis has been on the development and transfer of knowledge and skills to developing countries and countries with economies in transition.

2. The Office for Outer Space Affairs, the Government of Pakistan and the Prince Sultan bin Abdulaziz International Prize for Water (PSIPW) jointly organized a conference in collaboration with Inter-Islamic Network on Space Sciences and Technology (ISNET) to promote the use of space technology in water management for the benefit of developing countries.

3. The Conference was held in Islamabad from 26 February to 2 March 2018. It was hosted by the Pakistan Space and Upper Atmosphere Research Commission (SUPARCO) on behalf of the Government of Pakistan.

4. This was the fourth in the series of international conferences on water-related aspects of space technology applications. The previous conferences took place in Saudi Arabia, Argentina and Morocco in 2008, 2011 and 2014, respectively.

5. The present report describes the background, objectives and programme of the Conference, and provides a summary of the observations and recommendations made by the participants.

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A. Background and objectives

6. As rapid population growth and development pressures continue to impose additional stress on scarce resources, space technology, in particular technology for remote sensing by satellite, has proven its capability to meet the challenges facing water resource management. Continuous observation of the Earth from space has become a crucial part of managing water resources for the benefit of humankind and the environment. It has also made forecasting services possible that help to prevent water-related disasters such as floods and droughts.

7. Remote sensing satellites provide data on water-related key variables such as rainfall, precipitation, soil moisture, water storage, evaporation floods and droughts. They do so on the spatial and temporal scales needed to make reliable assessments. The ability to use satellite data for assessing and managing water resources is especially important in countries and regions of the world that have no adequate hydrological networks.

8. At its forty-seventh session, in 2004, the Committee on the Peaceful Uses of Outer Space first considered matters related to the use of space technology in water resource management. The Committee noted that in response to the deepening water crisis, space technology could contribute to improving water resource management by providing data and information on the availability of water resources and water use. The Committee also noted that the scientific data on water resources provided by satellites, once converted into practical information, could be used to formulate policy and implement programmes at the national, regional and international level, including those of the World Bank, the United Nations Development Programme and other entities of the United Nations system.

9. Furthermore, with the fiftieth anniversary of the United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE+50) and the establishment of a “Space2030” agenda, it becomes even more important to consider how space technologies and related applications can support the pursuit of the Sustainable Development Goals and other global agendas. Thus, the discussions and recommendations of this Conference were considered a relevant resource that helped to highlight issues and identify actions under UNISPACE+50 thematic priority 5 (Strengthened space cooperation for global health) and thematic priority 6 (International cooperation towards low-emission and resilient societies) on the way to “Space2030”.

10. The organizers of the Conference intended to address the above-mentioned issues, identify gaps and discuss ways in which space technology could help to improve the management of water resources in general. They also intended to address specific issues such as water management challenges in mountain regions, desertification, water storage, flood and drought monitoring, access to safe drinking water and the management of water-related emergencies in developing countries.

11. The primary objectives of the Conference were to:

(a) Enhance the capabilities of countries in the use of space-related technologies, applications, services and information for the identification, management and monitoring of water resources;

(b) Strengthen international and regional cooperation in that area;

(c) Raise awareness among decision makers, researchers and academia of the capabilities of space technology applications in addressing water-related issues, primarily in developing countries;

(d) Promote educational and public-awareness initiatives and contribute to capacity-building efforts in the field of water resource management;

(e) Consider and review new or emerging technologies and approaches in that domain;

(f) Contribute to the understanding of issues related to health and resilient societies, which are thematic priorities of UNISPACE+50.

B. Attendance

12. The Conference brought together experts and stakeholders belonging to both space-related and water-related sectors. Among the participants were local, national, regional, and international organizations, academic institutions, governmental and non-governmental organizations, multilateral and bilateral development agencies.

13. Funds provided by the United Nations, the Government of Pakistan, PSIPW and ISNET covered travel, accommodations and other costs for 34 participants from 21 countries.

14. The Conference was attended by over 200 participants, including a significant number of representatives of water-related national, international, governmental and non-governmental organizations. Forty-five international participants from the following 28 countries were present: Afghanistan, Australia, Austria, Bangladesh, Botswana, Canada, China, France, Germany, Indonesia, Iran (Islamic Republic of), Iraq, Jordan, Kenya, Morocco, Nepal, Nigeria, Russian Federation, Saudi Arabia, Serbia, Sudan, Switzerland, Syrian Arab Republic, Tunisia, Turkey, United Kingdom of Great Britain and Northern Ireland, United Republic of Tanzania and Uzbekistan.

C. Development and content of the programme

15. The Conference agenda was developed by the Office for Outer Space Affairs together with SUPARCO. It included plenary presentations grouped into thematic sessions, a poster session and discussion groups. The purpose of the discussion groups was to agree on the actions and recommendations put forward by the participants. The focus areas were:

(a) Space-related technology applications that provide cost-effective solutions and information essential to the planning and implementation of programmes and projects to enhance the management, protection and restoration of water resources;

(b) Use of space-related technologies in mitigating water-related emergencies, addressing challenges specific to mountain regions, storing and providing safe drinking water, combating desertification and monitoring floods and droughts;

(c) Capacity-building in the use of space-related solutions for water management, including the development of human resources, the establishment of technical infrastructure and legal frameworks and access to financial resources;

(d) Education and training requirements for various target groups relating to the use of space-related technologies to address water-related challenges, and public awareness initiatives in that area;

(e) International, regional and national initiatives and international and interregional cooperation;

(f) Case studies relating to the successful use of space technology applications to enhance the management of water resources in developing countries.

16. The Conference also included a poster session at which seven posters were exhibited. Participants were given ample time to review each poster and exchange observations with the presenters.

II. Summary of the Conference programme

A. Opening session

17. The Conference was formally opened by the Federal Minister of Interior and of Planning, Development and Reforms of Pakistan. Participants watched a video address by the Director of the Office for Outer Space Affairs and further welcome addresses by the chairman of SUPARCO and a representative of PSIPW.

18. Speakers regarded the Conference as the "need of the hour" in the national and global contexts, and in the context of the 2030 Agenda for Sustainable Development. The representatives of the host country, the United Nations and PSIPW noted that the outcomes of the Conference should be carefully followed up so as to devise better water management systems and effectively address water-related issues. They also stressed that the Conference's recommendations should support the thematic priorities of UNISPACE+50.

B. Special plenary session

19. The Conference started with a special plenary session. Representatives of the Office for Outer Space Affairs, the European Commission Joint Research Centre (JRC), the secretariat of the Group on Earth Observations, and the African Association for Remote Sensing of the Environment gave keynote presentations on the following topics:

(a) UNISPACE+50 and the importance of space technologies for water and development-related Sustainable Development Goals;

(b) Global surface water: The where and when of inland and coastal waters;

(c) Earth observations in support of the monitoring frameworks for the Sustainable Development Goals;

(d) Promoting effective utilization of Earth observation systems for Africa's development through the use of multispectral and synthetic aperture radar imaging data to optimize the water management practices.

20. Participants discussed the need to develop better data diplomacy policies. They addressed the lack of willingness to share data, the lack of an agreement or common framework for the sharing of data (in particular transboundary data) and the necessity to increase collaboration concerning in situ data, which could be met through regional collaboration. Other topics of discussion were unconventional ways of finding new water sources, the need for flood management plans and the offer of assistance in that regard, and the synergetic use of optical and radar imagery to identify irrigation strategies and achieve adequate water productivity levels across the African continent.

C. Thematic session 1. Space applications for water security and related risk management

21. Thematic session 1 consisted of the following five presentations:

(a) A keynote address by the United Nations Educational, Scientific and Cultural Organization (UNESCO) about that organization's water-related activities involving satellite solutions;

(b) A presentation by SUPARCO about identifying river bank erosion hot spots and mapping river discharge data using geospatial technologies;

(c) A presentation by the Environmental Protection and Sustainable Development Society about the use of space technology in water resource management in the Syrian Arab Republic;

(d) A presentation by the Office for Space Sciences, Research and Development (Serbia) entitled “Space applications for water and disaster management: Serbia Space Strategy 2018”;

(e) A presentation by SUPARCO on geospatial technologies for flood hazard assessment in Pakistan.

22. Speakers and participants in the discussions called for scaled-up capacity-building and the rapid adoption of integrated approaches to water management in developing countries.

D. Introduction and interactive ideas session: towards a United Nations/Prince Sultan bin Abdulaziz International Prize for Water space and water portal

23. The interactive ideas session was moderated by the Office for Outer Space Affairs. Its purpose was to discuss statistics as well as expectations of participants concerning the series of international conferences on the use of space technology for water management. The main focus was to collect user requirements and preferences regarding a new online space and water portal, under development at the Office for Outer Space Affairs, for the benefit of the space and water communities. The portal was being developed with the kind support of PSIPW.

E. Thematic session 2. Geospatial information in water resource management

24. Thematic session 2 consisted of the following 19 presentations:

(a) Keynote address by the Commonwealth Scientific and Industrial Research Organisation (Australia) on monitoring, detecting surface water using remote sensing;

(b) A presentation by the Central European University on assessing water ecosystem services and their dependency on land use changes with Google Earth Engine and the ArcSWAT soil and water assessment tool based on a case study of the Sea of Azov basin;

(c) A presentation by UNESCO entitled “UNESCO World Water Quality Portal: Monitoring water quality using satellite data”;

(d) A presentation by SUPARCO on improving land surface model simulations using advancements in the parameterization and assimilation of satellite-retrieved data;

(e) A presentation by the British Columbia Institute of Technology (Canada) on the Murgh-o-Mahi cube satellite for water resource management;

(f) A presentation by the Jinja Engineering Company (Uganda) on the sustainable use of irrigation water in arid areas of East Africa;

(g) A presentation by the King Abdulaziz City for Science and Technology (Saudi Arabia) on the discovery of groundwater reserves;

(h) A presentation by SUPARCO and the Agency for Barani Areas Development on improving water management in Punjab (Pakistan) Barani areas through the use of geospatial technologies;

(i) A presentation by the Institute of Space Technology (Pakistan) on flash floods due to urbanization;

(j) A presentation by SUPARCO on the Application of synthetic aperture radar imagery for disaster management;

(k) A presentation by the Hong Kong Polytechnic University (China) on the spatio-temporal analysis of changes in rainfall regime using long-term satellite-based rainfall data in the Sudano-Sahelian zone of Nigeria;

(l) A presentation by the Water Research Institute (Islamic Republic of Iran) on Iranian experiences relating to the use of satellite images and energy balance-based algorithms in estimating the actual evapotranspiration;

(m) A presentation by SUPARCO on the annual run-off estimation of the Kunhar river using satellite remote sensing and geographic information systems (GIS) techniques;

(n) A presentation by the Royal Jordanian Geographic Centre on improved water resource management using geospatial data and remote sensing techniques, based on a case study of the Al-Azraq area;

(o) A presentation by SUPARCO on the validation of satellite data from the Tropical Rainfall Measuring Mission with rain gauge data in Sindh province in Pakistan;

(p) A presentation by the Disaster Management Division of the Ministry of Home Affairs of Nepal on the use of space technology for water management;

(q) A presentation by the University of Melbourne (Australia) on spatio-temporal water quality assessment of the river Ravi and surrounding area in the Lahore district in Pakistan;

(r) A presentation by SUPARCO on designing a rapid response mapping system for flood monitoring and damage assessment using geospatial technologies;

(s) A presentation by the National University of Computer and Emerging Sciences (Pakistan) on the optimization of water resources using a conjunctive management approach for surface and groundwater.

25. This session was focused on the use of geospatial information for water resource management. It covered all aspects that are vital to water management, such as surface water hydrology, ground water hydrology, evapotranspiration, precipitation, snow melting, water quality and water conservation techniques. In their presentations, the speakers explained expedient applications of geospatial information in water resource management.

26. In the ensuing discussion, the following issues were addressed:

(a) The availability of sensors for monitoring surface water and the recommendation to combine data from various sensors to compensate for their respective limitations;

(b) Time frames taken into consideration in calculations at the JRC Global Surface Water Explorer;

(c) The necessity to consider nuclear pollution and heavy metals and the possible use of degradable plastics, which, once successfully applied in cube satellites, could be used for bigger satellites;

(d) The combination of in situ measurements and remote sensing as the way ahead.

F. Thematic session 3. Using space technologies to address water challenges in mountain regions

27. Thematic session 3 consisted of the following five presentations:

(a) Keynote address by the Institute of Tibetan Plateau Research of the Chinese Academy of Sciences on glacier volume in the Upper Indus river basin: solid storage of Pakistan water, and on transboundary hydro-ecological and spatio-temporal characterization of large water;

(b) Presentation by SUPARCO and the Agency for Barani Areas Development on satellite topographic mapping: a key space technology for sustainable water resources monitoring and management;

(c) Presentation by SUPARCO on the space-based assessment of glacier fluctuation in the Hunza basin, Western Karakoram, Pakistan;

(d) Presentation by SUPARCO on the monitoring of glaciers and the modelling of future meltwater availability in the snow- and glacier-fed basin of North Pakistan;

(e) Presentation by the Institute of Space Technology (Pakistan) on the assessment of watershed modelling using ArcSWAT and the SPHY spatial processes in hydrology model, a case study from a high-altitude glacierized catchment (Hunza).

28. Among the issues discussed at this session were the following:

(a) The necessity of high-accuracy data and easier access to satellite and other geospatial data in general;

(b) Potential areas for collaboration;

(c) Channels underneath sand, the penetration of soil (other than desert sand) by radar and best practices. The suggestion was made that geologists collaborate with remote sensing specialists to evaluate the locations of river channels;

(d) Some participants requested remote sensing organizations to make their data publicly available with cloud cover pre-extracted;

(e) Technical difficulties in terms of distinguishing debris from glaciers, and the need for field data for evaluation;

(f) The classification of data, both visually and based on features.

G. Thematic session 4. Capacity-building and cooperative initiatives

29. Thematic session 4 consisted of the following presentations:

(a) Keynote address by the Institute of Tibetan Plateau Research of the Chinese Academy of Sciences on the possible impact of black carbon on recent changes in the water cycle pattern over the third pole;

(b) Presentation by the African Regional Centre for Space Science and Technology Education — in English Language, affiliated to the United Nations, on the way forward for its post-graduate programmes and the Global Monitoring for Environment and Security (GMES) project;

(c) Presentation by the Central European University on the role of universities in capacity-building relating to application of satellite technologies;

(d) Presentation by the Green University of Bangladesh on the perspective of Bangladesh on the role of academic institutions in the application of remote sensing data for water management;

(e) Presentation by Xavier International College (Nepal) entitled “Equal space right”;

(f) Presentation by the University of Khartoum Space Research Centre entitled “Review of current status of space application for water management in developing countries and the potential development in the Sudan”.

30. The focus of thematic session 4 was on capacity-building initiatives related to the use of space technology for water and the environment. The speakers highlighted the ongoing initiatives and emphasized that stakeholders needed to collaborate to promote the utilization of space technology in water management and related fields of socioeconomic development.

31. Among the issues discussed in this session were the following:

(a) The westerly and monsoon system dynamics and regional specifics;

(b) Limitations on accepting participants in capacity-building initiatives due to a lack of funds;

(c) Transboundary river management issues affecting Bangladesh, such as the lack of water and sudden flash floods, and the need for topographical mapping to improve decision-making;

(d) Possible ways to encourage astrophysics students and researchers in Nepal to work on topics relating to space science as an intermediary solution pending the development of a space science study programme in the country.

H. Thematic session 5. Case studies

32. Thematic session 5 was focused on case studies in space technologies undertaken at several institutions. Participants shared the experiences garnered by various experts in different working environments. The following presentations were given:

(a) Keynote address by the University of Salzburg (Austria) on tools and services made available to the humanitarian community for groundwater exploration and water management;

(b) Presentation by the National Space Research and Development Agency (Nigeria) on microplastics as an environmental stressor and threat to human and sea life;

(c) Presentation by Groundwater Relief (United Kingdom) on satellite data and GIS to help water development and management;

(d) Presentation by the College of Forestry, Wildlife and Tourism of Sokoine University (United Republic of Tanzania) on the influence of hydrological fluctuations on vegetation and avifauna species composition, abundance and diversity in the Bahi swamp wetlands in the central part of the United Republic of Tanzania;

(e) Presentation by the University of Kufa on spectral and meteorological indices for drought monitoring in a case study in Sulaimaniyah in the Kurdistan region of Iraq;

(f) Presentation by SUPARCO on a soil and water conservation needs assessment using geospatial techniques in a case study of the Potohar region of Pakistan;

(g) Presentation by the Provincial Disaster Management Authority of the Punjab on GIS-based identification of waterborne diseases;

(h) Presentation by the University of the Punjab entitled “Surveillance and analysis for causes of water pollution in groundwater”;

(i) Presentation by SUPARCO on the delineation of potential sites for groundwater recharge in Lahore (Pakistan) using remote sensing and GIS techniques;

(j) Presentation by Moscow State University on remote sensing applications in agricultural water management in the central part of the Russian Federation;

(k) Presentation by SUPARCO on Economizing Water resources using geospatial technology solutions in Pakistan;

(l) Presentation by SUPARCO entitled “Impact of change in depth to groundwater on vegetation cover: a case study for portion of upper Thal Doab, Punjab (Pakistan)”;

(m) Presentation by SUPARCO on the application of geospatial technologies to assist in groundwater exploration in the Thar desert;

(n) Presentation by the African Association of Remote Sensing of the Environment entitled “Crop water productivity under climate forcing and irrigation strategy in the irrigated zone of Doukkala (Morocco)”.

33. Discussions during thematic session 5 addressed the following issues:

(a) Ways to strengthen international and regional cooperation to raise awareness in addressing water-related issues among decision makers and the research and academic communities;

(b) The need to identify sources of contamination and evaluate environmental conditions on the ground that themselves are possible sources of contamination; the consideration and monitoring of sources of water, groundwater and possibly untreated drinking water;

(c) The future challenges relating to groundwater if no action is taken, considering changing groundwater conditions and levels identified;

(d) The danger of land subsidence;

(e) The urgent need to increase validation and quality control in the field.

I. Poster session

34. At the poster session, participants from Afghanistan, France, the Islamic Republic of Iran, the Russian Federation, Tunisia and Uzbekistan briefly presented their posters to the plenary and discussed the technical aspects of their work with other Conference attendees.

35. The seven poster presentations covered the general topics, including:

(a) Water-related problems in Afghanistan;

(b) Inventory using space-based data of existing sinkholes and detection of areas resembling sinkholes in the Siberian permafrost region;

(c) Use of Moderate Resolution Imaging Spectroradiometer-based vegetation condition index for drought monitoring in drylands in Tunisia;

(d) Remote sensing and GIS for urban flood risk assessment: lower Don river case study;

(e) Deriving and evaluating of Urmia lake bathymetry and stage curve for shallow lake using remote sensing data.

36. More information posters were displayed at the exhibition booths of the Office for Outer Space Affairs, PSIPW and SUPARCO.

J. Discussion groups

37. Participants were divided up over several breakout sessions, during which they discussed ways to expand the use of space technologies, space-based data and derived information to improve decision-making and to prioritize areas where pilot projects could be launched and concrete partnerships could be established.

38. The breakout groups held in-depth discussions about the following focus areas: space technology in water-related disaster risk management, geospatial information in water resource management and space technology for water-related challenges in mountain regions. They proposed recommendations for the Conference to agree upon, which they presented at the final plenary session.

III. Observations and recommendations

39. The Conference enabled participants from national, regional and international organizations and from the private sector to learn about space-based applications and techniques developed in recent years to contribute to efficient water management. Participants held lively discussions and exchanged views and lessons learned. They explored the opportunities offered by the space community and looked at ways to make effective use of them to address water scarcity and other challenges faced globally in water management.

40. The organizers compiled the recommendations and suggestions experts presented regarding the use of space-based applications and solutions to efficiently address various water-related issues. They will be evaluated and may guide the Office for Outer Space Affairs in its future activities in the field of space solutions for water management.

A. Observations

41. Participants expressed concern regarding the lack of regional exchanges for academia. They also expressed concern about the lack of awareness of the data sources that were available and the possibilities that existed to access space-based data such as meteorological data provided by the Tropical Rainfall Measuring Mission or by the Global Precipitation Measurement constellation. Furthermore, a request was made for more capacity-building initiatives and funding specifically for the support of developing countries.

42. Several participants noted that there was a lack of communication between research and development institutions, policymakers and affected communities.

43. Some participants expressed concern that the volume of geospatial and remote sensing data could become too large to be analysed with existing computer hardware. Other participants highlighted the limited amount of freely available high-resolution data, specifically digital elevation models and bathymetry data.

44. Space technology and satellite-based Earth observation can play a significant role in the improvement and support of water quality management. Specifically, the use of Earth observation data can contribute significantly to improving global water quality data and the implementation and monitoring of the Sustainable Development Goals.

45. The chairs reminded participants of the complexity of climate change, as several participants had mentioned challenges that related to it. They highlighted that water resource management should remain a top priority in the fields of activity that dealt with climate change.

46. Participants shared observations of natural phenomena such as glacial lake outburst floods, decreasing snowfall and dust storm interactions with snow. They reminded their audience that the quality of flood forecasting remained poor and that it was necessary to improve flood mapping in many frequently affected regions.

B. Recommendations

47. Participants repeatedly suggested that the support for research in subject areas such as human-induced water hazards, and monitoring and exploration techniques for underground water at the regional level, should be increased. Support was expressed for water conservation efforts and the use of space solutions in those efforts. It was noted that there was a need to investigate the use of machine learning techniques to develop prediction modelling in water resource management.

48. The recommendations of the Conference strongly pointed in the direction of a need to improve data sharing, with special attention given to the needs of developing

countries. One of the recommendations was to improve access to freely available high-resolution satellite and geospatial data, specifically digital elevation models and bathymetry data.

49. The need was noted for in situ ground data to be used for the verification of scientific models used in space-supported water research and monitoring. Participants also noted that data sharing policies should be developed and encouraged more at the local level. Success stories should serve as models in other countries.

50. The Office for Outer Space Affairs was urged to encourage countries with which it works to establish national spatial data infrastructure councils to streamline and standardize the data sharing at the national level.

51. The recommendation was made that efforts be streamlined and integrated across countries within a given region, with regional-level planning and management. The Office for Outer Space Affairs was asked to further activate and enlist the support of regional remote sensing centres and the regional support offices of the United Nations Platform for Space-based Information for Disaster Management and Emergency Response.

52. In addition, participants highlighted the formation of cross-disciplinary teams to research and monitor water-related challenges, the development of more public-public and public-private partnerships and the establishment of a pool of experts for networking. Participants also recommended the organization of dedicated events and conferences on water quality, including in cooperation with the Office for Outer Space Affairs, to give this important issue its own platform.

53. Participants highlighted that the need for capacity-building had grown and recommended the encouragement and expansion of national and international in-country training activities and the establishment of train-the-trainer programmes intended to maximize the transfer and sharing of knowledge. They also recommended giving support to and coordinating the exchange of knowledge between the activities of neighbouring countries, inter alia, in the form of student exchange programmes and joint research, and promoting e-learning courses and distance learning programmes free of charge or at a very small cost.

54. Participants suggested that the gap between research and application should be bridged more often and that academia and research laboratories should, for that purpose, be encouraged to step up their representation in multi-stakeholder workshops and conferences. Participants further highlighted the need to review existing research, strategies and recommendations and to implement them as much as feasible.

55. Some participants recommended and warned at the same time that, although geospatial technologies and remote sensing could play a crucial role in water resource management and had tremendous potential, the space community should be careful not to oversell its capabilities as being the answer to everything.

56. Concerning water-related challenges in mountain regions, recommendations were put forward to create monitoring systems that mapped and observed glaciers in order to mitigate glacial outburst floods and ecosystem degradation in general, and to use space technology to identify fresh water reservoirs in mountainous regions. Efforts should be closely coordinated with similar projects and initiatives focusing on problems in and the resilience of mountain regions.

57. Recommendations were put forward with a geographical focus on particular mountain regions, such as the recommendations to apply space technology in the Himalayan region in order to monitor and reduce the risk to infrastructure, to upgrade Afghanistan’s flood monitoring and management system and, finally, to improve the identification and classification of mountain regions in Pakistan.

58. Participants gave recommendations concerning web portals dedicated to collecting and disseminating information, including recommendations to establish a global portal for sharing information on the research conducted and on success stories in the field of water management aided by space solutions and another

recommendation to create a network database for important thematic research areas. It is noteworthy that the Office for Outer Space Affairs is in the course of developing a “space for water” portal with the support of PSIPW.

59. Furthermore, participants highlighted public awareness of water-related issues, the promotion of water conservation techniques and the monitoring of human-induced water hazards as areas to be prioritized. For example, a request was made to develop mobile apps for the public on the use and utilization of water at the country level.

60. Participants encouraged the utilization of existing web portals such as the UNESCO World Water Quality Portal, the JRC Global Surface Water Explorer and resources of the Committee on Earth Observation Satellites and the Group on Earth Observations for research, data validation and further development by stakeholders such as decision makers and water practitioners.

61. Participants made further recommendations about modelling and cautioned that global models could be applied directly to all regions, but that site-specific models should be developed and used instead. Participants further suggested that verified models should be used for forecasting exercises and not only for ex post facto studies.

62. Participants highlighted that it was important to develop integrated geospatial data layers with accurate information on water consumption per soil type, crop and region. The suggestion was made that other airborne exploration tools, e.g., drones, could aid in monitoring the uneven distribution from water rich to water scarce areas.

63. A request was expressed to develop remote sensing technology solutions that could be used to find the nearest available water resource. One area in which such solutions could be very helpful was the installation of water supply in refugee camps.

64. Participants further agreed on miscellaneous and specific requests, such as for a multi-hazard risk and vulnerability assessment, a reduction in the cost of specialized geospatial and remote sensing software and limits on the use of illegal copies, and the improvement of procedures to monitor water-related disasters.

65. Finally, participants stressed that representatives to the Committee on the Peaceful Uses of Outer Space should be given better briefings so as to increase their sensitivity to water-related issues and raise their awareness of the matters addressed at the Conference with a view to increasing their commitment to concretely addressing all the above-mentioned recommendations.

IV. Conclusion

66. The United Nations/Pakistan/Prince Sultan bin Abdulaziz International Prize for Water Fourth International Conference on the Use of Space Technology for Water Management brought together stakeholders working on the research, development, and application of space-based technologies to address water-related challenges, thereby providing an excellent example of focused inter-agency cooperation. As a result, a range of follow-up activities can be identified and water monitoring and management strategies can be implemented in the future, based on the recommendations made at the Conference.

67. There was general agreement that the capacities of the water management and water monitoring sectors would be greatly enhanced by better integrating and using space-based technologies and that this fact should be better communicated to decision makers and the wider public.