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Committee on the Peaceful Uses of Outer Space

Report on the United Nations/Saudi Arabia/United Nations Educational, Scientific and Cultural Organization International Conference on the Use of Space Technology for Water Management

(Riyadh, 12-16 April 2008)

I. Introduction

A. Background and objectives

1. At the World Summit on Sustainable Development, held in Johannesburg, South Africa, from 26 August to 4 September 2002, Heads of State and Government strongly reaffirmed, in the Plan of Implementation of the World Summit on Sustainable Development,[1] their commitment to the full implementation of Agenda 21,[2] which had been adopted at the United Nations Conference on Environment and Development, held in Rio de Janeiro, Brazil, from 3 to 14 June 1992. They also committed themselves to achieving the internationally agreed development goals, including those contained in the United Nations Millennium Declaration (General Assembly resolution 55/2). The Johannesburg Declaration on Sustainable Development[3] and the Johannesburg Plan of Implementation were both adopted at the World Summit.

2. In its resolution 54/68 of 6 December 1999, the General Assembly endorsed the resolution entitled "The Space Millennium: Vienna Declaration on Space and

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[1] *Report of the World Summit on Sustainable Development, Johannesburg, South Africa, 26 August-4 September 2002* (United Nations publication, Sales No. E.03.II.A.1 and corrigendum), chap. I, resolution 2, annex, para. 1.

[2] *Report of the United Nations Conference on Environment and Development, Rio de Janeiro, 3-14 June 1992*, vol. I, *Resolutions Adopted by the Conference* (United Nations publication, Sales No. E.93.I.8 and corrigendum), resolution 1, annex II.

[3] *Report of the World Summit on Sustainable Development* …, chap. I, resolution 1, annex.

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Human Development",[4] which had been adopted by the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III), held in Vienna from 19 to 30 July 1999. UNISPACE III had formulated the Vienna Declaration as the nucleus of a strategy to address future global challenges using space applications. In particular, in the Vienna Declaration the States participating in UNISPACE III noted the benefits and applications of space technologies in addressing the challenges to sustainable development, as well as the effectiveness of space instruments for dealing with the challenges posed by the depletion of natural resources, loss of biodiversity and the effects of natural and anthropogenic disasters.

3. The implementation of the recommendations contained in the Vienna Declaration supports the actions called for in the Johannesburg Plan of Implementation to strengthen the capacities of Member States, in particular of developing countries, in order to improve the management of natural resources by increasing and facilitating the use of remote sensing data and increasing access to more affordable satellite imagery.

4. At its fiftieth session, in 2007, the Committee on the Peaceful Uses of Outer Space endorsed the programme of workshops, training courses, symposiums and conferences of the United Nations Programme on Space Applications for 2008.[5] Subsequently, the General Assembly, in its resolution 62/217 of 21 December 2007, endorsed the Programme on Space Applications in 2008.

5. Pursuant to General Assembly resolution 62/217 and in accordance with the recommendations of UNISPACE III, the United Nations/Saudi Arabia/United Nations Educational, Scientific and Cultural Organization International Conference on the Use of Space Technology for Water Management was held in Riyadh from 12 to 16 April 2008.

6. The Conference was organized by the Office for Outer Space Affairs of the Secretariat, as part of the activities of the United Nations Programme on Space Applications for 2008, and by the United Nations Educational, Scientific and Cultural Organization (UNESCO). On behalf of the Government of Saudi Arabia, the event was co-sponsored and hosted by King Abdulaziz City for Science and Technology (KACST) and the General Secretariat of the Prince Sultan bin Abdulaziz International Prize for Water (PSIPW).

7. The Conference built upon a series of meetings organized in the framework of the United Nations Programme on Space Applications in the period 2005-2007 on the integrated application of space technologies in the areas of natural resource management, environmental protection and natural disaster mitigation.

8. The Conference explored applications of space technologies 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. The

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[4] *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.

[5] *Official Records of the General Assembly, Sixty-second Session, Supplement No. 20* (A/62/20), para. 84.

Conference included a special session on space technology for water management: linking traditional and ancient methods to modern needs. Conference participants were given the opportunity to present case studies on successful applications of space technologies to water resource management in their respective countries.

9. The primary objectives of the Conference were as follows: (a) to increase awareness among decision makers and representatives of the research and academic community with regard to space technology applications available for improving water resource management in developing countries; (b) to examine low-cost space-related technologies and informational resources available for addressing water-related challenges; (c) to promote educational and public awareness initiatives in the area of water resource management; (d) to strengthen international and regional cooperation in the matters under consideration and to support the development of international networking; and (e) to stimulate the formulation of proposals for international, regional and national pilot projects using space-based technologies and information to support sustainable development programmes in developing countries.

B. Programme

10. The programme of the Conference was developed jointly by the Office for Outer Space Affairs, KACST and PSIPW. It included eight technical sessions that focused on the following themes: (a) international and regional cooperation in the use of space technology for water resource management and related capacity-building and public awareness initiatives; (b) use of space technologies in addressing water-related emergencies, natural disasters and climate change; (c) applications of space technologies that provide cost-effective solutions or essential information for planning and implementing programmes or projects to enhance the management, protection and restoration of water resources; (d) use of space technologies in mitigating water-related emergencies, providing safe drinking water and combating desertification; and (e) case studies presented by participants on applications of space technologies for enhancing water resource management in developing countries.

11. A special session on space technology for water management: linking traditional and ancient methods to modern needs was held on the second day of the Conference. The special session considered applications of remote sensing to detecting ancient water systems that could be adapted for modern-day use to satisfy needs for water, especially in developing countries. The session included discussion by working groups and a one-day technical field trip.

12. Introductory and welcoming statements were made by representatives of KACST, PSIPW, the Office for Outer Space Affairs and the local organizing committee. A keynote address was given by the Minister of Water and Electricity of Saudi Arabia.

13. A total of 46 oral technical presentations were made by invited speakers from both developing and industrialized countries during the four-day course of the technical sessions, and two papers were presented at the poster session. All the presentations focused on successful applications of space technologies 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. The Conference featured presentations on the needs of end-users engaged in managing water resources and on the international and regional cooperation and capacity-building initiatives required for successful implementation of sustainable development programmes in developing countries.

14. Each of the technical sessions was followed by open discussion, which focused on specific topics of interest and provided additional opportunities for participants to voice their opinions. The discussion was continued in greater detail, and was subsequently summarized, by three working groups established by the participants to develop ideas and proposals for possible follow-up action.

15. A detailed programme of the Conference, its proceedings and the list of participants are available on the website of the Office for Outer Space Affairs (www.unoosa.org).

C. Attendance and financial support

16. On behalf of the organizers, the United Nations invited developing countries to nominate candidates to participate in the Conference. To be eligible to attend, participants were required to hold a university degree or possess established professional experience in a field related to the overall theme of the Conference. Participants were selected on the basis of their working experience in programmes, projects or enterprises that were already using space technology applications or that could potentially benefit from using space technology. The participation of specialists at the decision-making level from both national and international entities was particularly encouraged.

17. Funds allocated by the co-organizers for the organization of the Conference were used to provide financial support needed by representatives from developing countries in order to attend the meeting. The United Nations contributed international round-trip air travel for 25 participants; UNESCO contributed daily subsistence allowances for 30 participants; and the Government of Saudi Arabia, through KACST and PSIPW, provided all participants with accommodation and meals for the duration of the Conference.

18. KACST and PSIPW also provided conference facilities, secretarial and technical support, daily transportation between the hotel and the Conference venue and airport transfers, and organized a number of social events for the Conference participants.

19. The Conference was attended by more than 100 participants from the following 31 States: Algeria, Argentina, Austria, Bahrain, Bangladesh, Burundi, Cameroon, Egypt, Ethiopia, France, Germany, India, Jordan, Lebanon, Libyan Arab Jamahiriya, Malawi, Morocco, Myanmar, Nigeria, Pakistan, Poland, Russian Federation, Saudi Arabia, Sudan, Switzerland, Syrian Arab Republic, Tunisia, Turkey, Ukraine, Viet Nam and Yemen.

20. The following international organizations, international and regional non-governmental organizations and other entities were also represented: the Office for Outer Space Affairs, UNESCO, European Space Agency (ESA), Youth Strategy for

Disaster Reduction, the Redemption Health Foundation for Sustainable Rural Development and Conservation, the International Commission of the Congo-Ubangi-Sangha Basin (CICOS), the Preparatory Committee for the Fifth World Water Forum and the Arab Center for the Studies of Arid Zones and Dry Lands (ACSAD).

II. Conclusions of the Conference

21. Pursuant to the deliberations of the Conference in the discussion sessions, three working groups were established in order to consider issues and concerns in the thematic area, to discuss potential solutions using space technologies, to formulate observations and recommendations of the Conference and to develop project ideas for possible follow-up action.

22. Each working group discussed its objectives with the goal of developing project ideas for follow-up action to be taken by participants after the Conference. The working groups outlined major tasks and ways and means of performing those tasks, including identifying potential funding sources, assigning responsibilities to each member in a group, defining final products to be produced as the end result and scheduling the work to be done.

23. Participants agreed upon the following ground rules for the groups' work:

(a) *Scope*. Consideration should be given to international and regional projects that could establish a true international partnership and appropriate networking among the parties involved;

(b) *Financial aspects*. Tasks and pilot projects should be performed on the assumption that no external funding would be available. That meant that each member would perform its part of the tasks on a voluntary basis and would not expect funding support. The approach adopted was that of members choosing tasks that overlapped with their regular duties at their home institutions;

(c) *Coordination*. At the national level, each member should form a country team upon returning home after the Conference and should define its own tasks and pilot projects in preferred thematic areas, with the scope, approach, product and schedule identified within the national team. At the regional level, members of each national team should share data and technical knowledge and facilitate the exchange of relevant information. The Office for Outer Space Affairs would monitor progress of the projects. National team leaders should inform each working group chairman and the Office for Outer Space Affairs of the status of project implementation at least twice a year.

24. The working group on integrated land and water resources management using space inputs discussed a proposal made by participants for a pilot project to study watershed management for optimal utilization of land and water resources, using space technology, in arid or semi-arid regions. The State of Karnataka in southern India was proposed as an initial study area.

25. During the discussion, participants recognized that integrated land and water resource management through appropriate exploitation of frontier technologies such as space technology, geographic information systems (GIS) and other enabling

technologies in conjunction with biotechnology and advanced irrigation and water harvesting technologies was expected to improve land and water resource management in a cost-effective and sustainable way.

26. Participants concluded that the watershed was a convenient and clearly defined topographical unit, and considered it a basic landscape element for effective management of land and water resources. Satellite remote sensing, because of its ability to provide synoptic views of large areas on a repetitive basis, had become an effective tool for watershed management. The potential of remote sensing technology for addressing various issues related to the development of watersheds was well established. It had been used for resource surveying and mapping, watershed characterization, water balance studies, run-off estimation, sediment yield assessment, watershed prioritization, action planning for improved water and agriculture development, monitoring and evaluation. Information derived from satellites could be integrated with data from other sources in GIS databases to support plans for land and water resource development.

27. Taking into account the above-mentioned capabilities of remote sensing and GIS, the participants believed that the proposed study would effectively address such issues as drought, soil erosion, environmental degradation, wasteland, deforestation, impact of irregular rainfall, groundwater depletion, and poor agricultural and water-use practices and drainage patterns in developing countries.

28. It was proposed that satellite data covering three seasons should be used in the project for resource mapping, which would include current land use or land cover, geology, structure, geomorphology, groundwater prospects and the mapping of drainage lines and surface water, soil and other related resources. For detailed mapping on the scale 1:4,000 or better, it was proposed to use high-resolution satellite data (1-2.5 m resolution) for the summer season and moderate-resolution data (5-10 m) for other seasons in the same coverage areas. Other sources of information, such as survey maps, field data, ancillary data, socio-economic data and laboratory analysis data, would complement satellite-derived information.

29. The working group agreed on a common methodology for carrying out the project, adopted a plan of action, discussed monitoring and evaluation procedures and examined funding opportunities. It was emphasized that the proposed project would be beneficial for decision makers in the participating countries as they would gain access to more reliable data, it would improve land and water resource management and enhance regional cooperation, and it would contribute to capacity-building in developing countries.

30. The working group on applications of space technology and data discussed project ideas in the following thematic areas:

(a) Application of remote sensing to address hydrological problems in arid and semi-arid areas with the objective of filling the gap that exists between optical and microwave data. Data from microwave satellite systems, such as Radarsat-1, Radarsat-2, the Environmental Satellite (ENVISAT) and the Advanced Land Observing Satellite (ALOS), could be used in the project along with optical data received from the Terra moderate resolution imaging spectrometer (MODIS), the Terra advanced spaceborne thermal emission and reflection radiometer (ASTER) and the National Oceanic and Atmospheric Administration advanced very high resolution radiometer (NOAA/AVHRR) platforms;

(b) Oil spill monitoring, especially in the Persian Gulf area. The best results could be achieved by using data from microwave instruments operating on such platforms as Radarsat, Terra SAR-X and ENVISAT;

(c) Snow cover monitoring in the Hindu Kush-Himalayan area with the objective of observing glacial snow coverage, glacial movement, melting, and glacial outburst lakes in order to monitor the global impact of climate change. Data from the Landsat Thematic Mapper (TM), NOAA/AVHRR and ENVISAT would be suitable for this kind of study;

(d) Extent of salinity and water logging, given their significance in arid and semi-arid regions where water evaporated quickly. Those phenomena occur in poorly drained soils where water cannot penetrate deeply; and excessive irrigation in poorly drained soil causes water logging. Often it is not possible to observe those effects until it is too late and plants have already been damaged due to lack of oxygen. Remote sensing data from such satellites as Terra ASTER, Terra MODIS and microwave data would provide reliable and timely information for addressing those problems;

(e) Setting up early warning systems for flood, drought, food security, desertification, land use change, groundwater pollution and illegal drilling of wells. Any early warning system for arid and semi-arid areas should be based on remote sensing data and should include such components as vegetation growth conditions, moisture conditions, estimation of evapotranspiration and crop production assessment. The system should also deliver information on irrigation and should monitor irrigated areas in order to prevent water logging. An attempt should be made to use satellite data to detect drought and to monitor its expansion in order to estimate its impact on crop production. The use of high-resolution satellite data, both optical and microwave, from the synthetic aperture radar (SAR) of the European remote sensing satellite, ENVISAT, Landsat TM and Terra MODIS, would be extremely beneficial for such a system.

31. The working group also discussed potential project ideas for the application of space technologies in such areas as groundwater exploitation, sea-level water monitoring, detection and exploration of ancient water systems, and inventory and modelling of the shape and bottoms of lakes and rivers for determining the capacity of reservoirs.

32. The working group on capacity-building, data policy and international, regional and national cooperation discussed the following issues:

(a) *Training, capacity-building and regional centres*. The working group discussed the need to establish a regional centre for space science and technology education in the Arabic language. Participants were of the opinion that nine-month postgraduate courses offered by such a centre would be extremely beneficial for the region. The working group also discussed the need for educational institutes and universities to offer both short-term and long-term programmes on remote sensing and GIS technologies for specialists from developing countries;

(b) *Establishing regional or global teams to cooperate in pilot projects*. The working group discussed ways of establishing cooperation with data providers, with international, regional and local organizations and with private companies to provide data, financing and advisory services required for implementing the pilot

projects proposed by the other two working groups. The participants were of the view that, in providing such support, priority should be given to projects likely to have a major global or regional impact. The working group decided to establish a focal point for each international, regional and local project;

(c) *Data availability*. The working group noted that long-term planning required steady availability of data from providers and a mechanism for sharing data; in that regard, data requirements and stable sources of data should be clearly identified for proposed pilot projects. To support projects, the National Commission on Space Activities (CONAE) of Argentina could offer, free of charge, multispectral images from the multispectral medium resolution scanner (MMRS) of the Scientific Applications Satellite (SAC-C), and KACST could provide images of the Saudi Arabian region from the Ikonos Earth observation satellite;

(d) *Data sharing and capacity sharing*. The participants recommended that the United Nations Programme on Space Applications should assist institutions and organizations of developing countries in finding the technical experts needed for implementing the pilot projects. The working group encouraged all participants at the Conference to better utilize the educational and training opportunities offered by the Programme. It was also recommended that participants and their respective institutions should develop appropriate local databases and resource inventories to be shared at the international, regional and national levels;

(e) *Data policy*. The participants recognized that the analysis of available data (data catalogue) and an evaluation of the data needed were the first steps in establishing a national data policy. A national data policy should address, among other issues, such matters as how to use the data, who can use the data and the data licensing procedure. Standardization of data was viewed as a necessary but time-consuming task;

(f) *Pilot projects*. Participants agreed that appropriate pilot projects were a necessary step and also the best way to achieve development goals. The working group felt that regionally focused projects might receive better support from donor agencies, and it recommended the following criteria for the final selection of projects: (a) pilot projects should be regionally specific but should reflect common objectives of regions; (b) desertification, climate change and better water resource management were important to many regions; and (c) issues should be tackled on a one-by-one basis;

(g) *Networking*. The participants agreed that networking was crucial for the effective application of space technologies in the area of water resource management. They recommended that an Internet website should be established to support such networking and to provide a platform for sharing data and information, including information on experts and scientists available for advisory services, on education and training opportunities in the area of water management and on funding opportunities. PSIPW offered to assist in the development and hosting of such a portal.

33. The working group recommended that participants should conduct a survey on training needs in remote sensing and GIS applied to water resource management. The participants noted the necessity of holding workshops, conferences and training courses on water management on a regular basis, and they expressed support for

such international and regional initiatives as the Fifth World Water Forum and the activities of the Arab Water Council.

34. The reports of the working groups were presented at the closing session of the Conference and were adopted by the participants. At that session participants expressed their appreciation to the Government of Saudi Arabia, the United Nations and UNESCO for organizing the Conference and for the significant support provided.

III. Follow-up action

35. The Conference provided an excellent opportunity to facilitate support for the increased use of space technologies in pursuit of sustainable development in developing countries. The pilot projects and actions identified by the working groups would provide guidance on how participants' home institutions could work together through regional partnerships.

36. The Office for Outer Space Affairs should monitor the progress of implementation of the above-mentioned projects and should coordinate action by national teams. The Office should also facilitate an exchange of information between national teams and consolidate the partnership established in Riyadh.

37. Implementation of those projects would ultimately improve regional and national coordination mechanisms for matters related to water resource management, strengthen the capacities of developing countries to respond to water-related challenges and enhance international cooperation in that area.