



# General Assembly

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**Committee on the Peaceful  
Uses of Outer Space**

**United Nations/European Space Agency/Sudan Regional  
Workshop on the Use of Space Technology for Natural  
Resource Management, Environmental Monitoring and  
Disaster Management**

**(Khartoum, 4-8 April 2004)**

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## **I. Introduction**

### **A. Background**

1. In its resolution entitled “The Space Millennium: Vienna Declaration on Space and Human Development”,<sup>1</sup> the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III) recommended that activities of the United Nations Programme on Space Applications promote collaborative participation among Member States at both the regional and the international level by emphasizing the development of knowledge and skills in developing countries and countries with economies in transition.
2. At its forty-sixth session, in 2003, the Committee on the Peaceful Uses of Outer Space endorsed the programme of workshops, training courses, symposiums and conferences planned for 2004. Subsequently, the General Assembly endorsed the United Nations Programme of Space Applications for 2004 in its resolution 58/89 of 9 December 2003.
3. As part of the Programme, the Office conducted the United Nations/European Space Agency/Sudan Regional Workshop on the Use of Space Technology for Natural Resource Management, Environmental Monitoring and Disaster Management. Organized by the Office for Outer Space Affairs of the Secretariat and the Remote Sensing Authority of the Sudan, the Workshop was co-sponsored by the European Space Agency (ESA), hosted by the National Centre for Research of the Sudan and held in Khartoum from 4 to 8 April 2004.
4. As space technologies play a vital role in the areas of natural resource management, environmental monitoring and disaster management, the Office for Outer Space Affairs has identified those topics as priority thematic areas in which greater use of space-based solutions in developing countries can be promoted. Through regional workshops, expert meetings, pilot projects and training opportunities, the United Nations Programme on Space Applications has been implementing a space technology and disaster management programme and a natural resource management and environmental monitoring programme to assist developing countries in adopting space-based solutions for solving environmental and disaster-related issues.
5. The Workshop provided a unique opportunity to bring together experts, decision makers and practitioners to share experience and knowledge with the aim of defining the actions and follow-up activities required to improve the use of space technology for natural resource management, environmental monitoring and disaster management in the region. It is anticipated that the results of the Workshop will contribute to several ongoing initiatives, including the goals set forth in the United Nations Millennium Declaration (General Assembly resolution 55/2); the Plan of Implementation adopted by the World Summit on Sustainable Development, held in Johannesburg, South Africa, from 26 August to 4 September 2002;<sup>2</sup> the work being carried out by the various action teams working within the framework of the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space; the Charter on Cooperation to Achieve the Coordinated Use of Space Facilities in the Event of Natural or Technological Disasters (International Charter “Space and Major Disasters”); the Land Cover Map and Geodatabase for Africa

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(AFRICOVER) project of the Food and Agriculture Organization of the United Nations; and the ESA TIGER project.

## **B. Objectives**

6. The overall goal of the Workshop was to contribute to the ongoing efforts to integrate space technologies into operational programmes in Africa and Western Asia, with a particular focus on natural resources management, environmental monitoring and disaster management. The specific objectives were to increase the awareness of managers and decision makers of the potential benefits of using space-based technologies in those areas; to consolidate further the understanding of the types of information and communication required and the extent to which those requirements could be met by space technologies; to identify the specific needs of individual programmes and projects, taking into consideration local institutional settings, including specific training and capacity-building needs; and develop a regional plan of action that would contribute to the wider incorporation of space-based solutions, including the possibility of one or more pilot projects, in which interested national institutions could incorporate and test the use of space technologies.

## **C. Programme**

7. At the opening of the Workshop, statements were made by the Vice-President of the Republic of the Sudan and the Minister for Science and Technology and by representatives of ESA and the Office for Outer Space Affairs. Representatives of the Remote Sensing Authority of the Sudan, ESA, the Economic Commission for Africa (ECA) and the Office for Outer Space Affairs made the keynote presentations. Seven presentations were made at the open session and a total of 25 further presentations were made during the thematic sessions. The four discussion sessions allowed for deliberation on the structured discussion topics, which lead to the development of a strategy for forming partnerships and for increasing the use of space-based technologies in the region.

## **D. Attendance**

8. A total of 160 participants from the following 16 countries attended the workshop: Belgium, Burundi, Canada, Egypt, Ethiopia, Germany, Kenya, Lebanon, Morocco, Saudi Arabia, South Africa, Sudan, Syrian Arab Republic, Uganda, United Republic of Tanzania and Zambia. A high proportion of the participants were female. In addition, the Office for Outer Space Affairs, ECA, the United Nations Development Programme, the Office of the United Nations High Commissioner for Refugees, the World Food Programme, the United Nations Educational, Scientific and Cultural Organization, the World Health Organization (WHO), ESA and the Regional Centre for Mapping of Resources for Development were also represented.

9. Funds allocated by the United Nations and the co-sponsor, ESA, were used to defray the cost of air travel and daily subsistence allowance of 14 participants and 2 representatives of the Office for Outer Space Affairs.

## II. Summary of presentations

10. Presentations made by participants focused on the major topics of the Workshop, namely, the use of space technology for agriculture and natural resource management; land use and land degradation; hydrology and water resource management; environmental monitoring and assessment; and food security and human security. A presentation session focusing specifically on the experience of the Sudan provided an opportunity for additional presentations on the Sudan related to the themes of the Workshop. Three discussion sessions provided an opportunity to share success stories and to identify and understand existing constraints, which were then used as input for the development of a national (Sudanese) and regional strategy for the application of space technology. The national and regional strategies were merged during a fourth discussion session, leading to the development of the Khartoum Vision (see paras. 30-32 below and the annex to the present report).

11. The keynote addresses established a framework for the discussions that were to follow and highlighted the potential of space applications in the development of solutions to problems existing in the region, as well as the existing constraints in applying space technology. The importance of space technology for natural resource management, environmental monitoring and disaster management was emphasized. It was stated that existing national and regional capacities must be improved through the transfer of knowledge and technology in order to use space technology effectively. At present the application of space technology was hindered by poor Internet access; poor data accessibility; lack of national capacity, coupled with poor capacity-building; lack of awareness of the benefits of space technology; and limited resources. The keynote addresses introduced the following discussion points: the need to further support capacity-building and the need for an increase in space technology education; the need for free and open access to information; the need to focus on increasing the awareness of decision makers of the benefits of space technology; and the need to increase involvement of the private sector, academia and society in the design and implementation stages, to conduct activities and use regional networks to contribute to improved capacity-building, to establish innovative funding mechanisms to implement projects, to formulate policies and develop information infrastructures, including spatial data infrastructures, to facilitate distribution of hardware and software, to support research and development, to develop sector applications (such as electronic health (e-health)) and to develop institutional strategies for information and technology.

12. The presentations on the theme agriculture and natural resource management provided an opportunity for an extended discussion on the need to improve access to data and demonstrated the successful application of remote sensing in studying desertification, mapping natural resources, detecting fire, agriculture, irrigation and water use and in optimizing crop production. Of particular interest was the presentation of a pilot project that had demonstrated the potential of precision farming in the Sudan and had resulted in an increase in yield, thereby proving the cost-effectiveness of such a space-based solution for the Sudan.

13. The presentations on land use and land degradation highlighted the need for environmental sensitivity index maps; continuous environmental monitoring; forest species delineation studies; cooperation between countries that share resources; and development of policy and legal frameworks to ensure appropriate application of the

information obtained. The presentations demonstrated the successful use of remotely sensed data in assessing environmental degradation through the development of land use/land cover change maps; developing forest fire vulnerability indicators; generating information for forest fire management and rehabilitation; estimating wood volume; detecting illegal logging activities; and mapping disasters. It was shown that space technology had been used effectively in the region, although only on a small scale, and that the data used were often outdated. The presentations highlighted the potential contribution that geo-information and space-based technologies could make to humanitarian assistance and to forest management.

14. The presentations on hydrology and water resource management demonstrated that space technology provided a viable alternative data source for water resource management and recommended that space technology be adopted as a tool in integrated water resource management and related activities. The ESA TIGER initiative, which was a step towards implementing the recommendations of the World Summit on Sustainable Development, focused on space, water and Africa and aimed at developing sustainable Earth observation information services for integrated water resource management in developing countries, with a focus on Africa. It was shown that remote sensing was an important tool in the exploration and assessment of groundwater resources in the Sudan and the region as a whole, contributing to reducing the investigation costs and increasing the possibility of detecting structures with a high water potential. Geo-spatial data were being used in decision support systems for ground- and surface-water modelling and could be used as an early warning system for floods and soil erosion, as well as for sediment transport in upper catchment areas. In addition, the potential use of meteorological, geological and hydrological remote sensing data as an input to rice irrigation systems was highlighted.

15. The presentations on environmental monitoring demonstrated that remote sensing techniques and geographical information systems were essential tools for monitoring the environment, for disaster management and for geological mapping. The Climate Prediction and Application Centre of the Intergovernmental Authority on Development was monitoring extreme weather events and providing advance warning by using decadal rainfall distributions. WHO had used geo-spatial technologies for such purposes as creating disaster vulnerability maps, reporting on malaria and identifying the location of health facilities. In that case, population density was overlaid with other health-related information to provide a valuable tool for support decision-making.

16. The presentations on food security and human security highlighted the status of various food security programmes that used geo-spatial technologies. The Global Monitoring for Food Security (GMFS) incorporated field data, socio-economic data and remotely sensed data into an early warning system that was used at the regional, national and local levels, as well as also by development agencies, food aid agencies, policy-making institutions and research institutions. The programme included a crop monitoring system, which identified areas under cultivation and analysed historical trends to forecast yield and production in selected sites in sub-Saharan Africa. The World Food Programme (WFP) explained its use of satellite imagery for chronic vulnerability mapping and crop performance analysis during the growing season, which was then used to plan the distribution of food aid. The WFP

chronic vulnerability index was based on staple crop production per capita, livestock asset per capita, pasture quality and quantity, road accessibility, average price of maize and sorghum, historical needs, drought risk, variability in staple crop production and probability of rainfall “shocks” (extreme dry or wet). School infrastructure data were combined with the chronic vulnerability indicators in a geographical information system to plan school feeding activities. The use of remotely sensed data and associated products had enabled the Sudan Meteorological Authority to warn decision makers and other groups of potential hazards well in advance. It was recalled that developing countries such as the Sudan were seriously hit by environmental emergencies or disasters because there were no established warning systems and that in the Sudan, specifically, there was a lack of infrastructure for monitoring meteorological factors (such as rainfall) that played a major role in food security. An early warning system must be established as part of a strategic framework for emergency prevention, preparedness, assessment, mitigation and response. In addition, it was stated that a satellite-based agro-meteorological monitoring system would greatly enhance food security in the region.

17. The presentations that were made at the Workshop are available on the web site of the Office for Outer Space Affairs ([www.oosa.unvienna.org/SAP/act2004/sudan/presentations/index.html](http://www.oosa.unvienna.org/SAP/act2004/sudan/presentations/index.html)).

### **III. Observations and recommendations**

#### **A. Approach to establishing a regional strategy**

18. Four discussion sessions were conducted with the purpose of developing a common strategy for the use of space technology in the region. In the first three discussion sessions, the participants were divided into three groups, with two groups focusing on the issues from the perspective of the Sudan and the third group on a regional perspective. The sessions were designed to share and understand success stories, define constraints and then develop a common strategy. The fourth and final discussion session merged the strategies of the three groups of participants to produce a vision for the region.

#### **B. Building upon success stories and identifying constraints to the further use of space-based technology solutions**

19. The first discussion session, entitled “Building upon success stories”, focused on building an understanding of how space-based technologies had been successfully incorporated into natural resource management, environmental monitoring and disaster management. The discussion groups provided a number of examples that demonstrated the successful use of space technologies in the region.

20. Participants agreed that the term “success story” referred to solutions that incorporated space-based technologies that were implemented successfully, operated in a sustainable manner and produced outcomes that influenced planning and decision-making processes.

21. Examples of success stories included the use of space technology for watershed management (erosion, pollution and agriculture); remote sensing of the Great Rift Valley of Africa; rice crop production monitoring, which had been successful in Asia and was beginning to be used in Africa; disaster management, more specifically in the reduction of the impact of floods caused by tropical cyclones in Madagascar; desert locust monitoring; integrated management of water resources (the Congo, Niger, Nile, Senegal rivers); groundwater exploration in the basement rocks in southern Darfur (the Sudan); and desert margin mapping.
22. The participants also identified several successful data access initiatives—leading, for example, to the current availability of free low- to medium-resolution imagery—such as the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) and the Land Remote Sensing Satellite (Landsat) thematic mapper (TM). The Wide Area Monitoring Information System (WAMIS) initiative of the Satellite Applications Centre of the Council for Scientific and Industrial Research of South Africa was an example of the successful implementation of necessary infrastructure, development of relevant software and creation of a mechanism for sharing remote sensing data and products.
23. Participants pointed out that factors that contributed to success stories included the incorporation of local knowledge, the inclusion of a grass-roots perspective and the involvement of the community. Additionally, the solution had to be driven by demand rather than supply to ensure successful implementation.
24. During the first discussion session the transboundary nature of space technology was highlighted. The study of ancient elephant migration paths was cited as an example of the need to find solutions that bridged national borders. The need for regional cooperation was further emphasized during a discussion on the need for ground receiving stations in Africa because such stations always covered several countries at once.
25. The second discussion session was structured to identify constraints that prevented the increased use of space-based technology applications for natural resource management, environmental monitoring and disaster management. Participants focused on existing constraints in the areas of government policy, capacity development and existing infrastructure, as well as on low awareness of the potential benefits of space technology.
26. In the area of government policies, participants argued that government policies and legislation relating to the geo-spatial industry, in particular remote sensing, were not based on a clear understanding of end-user needs. With regard to policy formulation, in particular, there was a need for a bottom-up approach beginning with the requirements of the user, as well as a need to develop national policies to support the resolution of legislative issues related to copyright, accessibility and availability.
27. With regard to human capacity, the lack of on-the-job training based on local needs was seen as a particular constraint. Exchange programmes and the initiative on centres of excellence of the New Partnership for Africa's Development were seen as potential solutions to that problem. Furthermore, participants argued that sustainable training required committed, local advocates.

28. Participants agreed that there was a lack of awareness among state institutions, civil organizations and decision makers in general of the benefits of space-based technologies in the areas of natural resource management, environmental monitoring and disaster management. They stressed that, in order to overcome the problem of decision makers not understanding the technology, continuous advocacy concerning the contribution that space technology could make to sustainable development was required.

29. Lack of sufficient infrastructure in the region was highlighted by participants, who pointed to the need for additional hardware and software, improved Internet connectivity and availability of data (in particular high-resolution imagery at affordable prices and image maps). Insufficient data availability was a result of the absence of national databases and limited exchange and sharing of information.

### **C. The Khartoum Vision**

30. Building upon the points raised during the discussion sessions, participants discussed a strategy for action that would be a framework for the effective utilization of space-based technologies in Africa and Western Asia. That framework was agreed upon by all participants as the Khartoum Vision (see annex), which provides common guidance by focusing on capacity-building, data access, networking, spatial data infrastructures, coordination of national and regional space policies, raising awareness and building upon existing initiatives.

31. The participants recognized that knowledge-sharing and the establishment of partnerships would be greatly facilitated by the creation of a regional task force of focal points, which would form a network of institutions with responsibility for disseminating information on activities and information that could benefit all the institutions involved. The Remote Sensing Authority of the Sudan offered to coordinate such a task force.

32. The Khartoum Vision was read during the closing ceremony by the former President of the National Council for Research of the Sudan.

### **D. Role of the Office for Outer Space Affairs**

33. The Workshop provided a unique opportunity to channel support for the further use of space technologies in the Sudan and in the region. The Khartoum Vision provides guidance on how institutions can work together through regional partnerships. The Office for Outer Space Affairs should provide support in the consolidation of the partnerships that were formed in Khartoum, which will result in the sharing and transfer of knowledge and the development of joint activities, in particular through the creation and strengthening of the regional task force of focal points. Additionally, the Office should continue its work on capacity-building through the regional centres for space science and technology education, affiliated with the United Nations and work further towards ensuring that available data sets reach the end-user.



34. The Sudan has offered to host a follow-up workshop in Khartoum in two years' time. It is recommended that the United Nations utilize that opportunity to build upon the success of the 2004 Workshop.

*Notes*

<sup>1</sup> *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.

<sup>2</sup> *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.

## **Annex**

### **The Khartoum Vision**

#### **United Nations/European Space Agency/Sudan Regional Workshop on the Use of Space Technology for Natural Resource Management, Environmental Monitoring and Disaster Management**

Khartoum, 4-8 April 2004

##### **The Khartoum Vision: a Vision for Building Partnerships in the Use of Space Technologies**

1. The United Nations/European Space Agency/Sudan Regional Workshop on the Use of Space Technology for Natural Resource Management, Environmental Monitoring and Disaster Management was held in Khartoum from 4 to 8 April 2004. Some 160 participants from 16 countries, including representatives of seven United Nations entities and several international and regional organizations, met to discuss and learn about the ongoing efforts to integrate space technologies into operational programmes in Africa and Western Asia, with a focus on natural resource management, environmental monitoring and disaster management. The meeting was organized jointly by the Office for Outer Space Affairs of the Secretariat, the Remote Sensing Authority of the National Centre for Research of the Sudan and the European Space Agency.
2. The presence of the Vice-President of the Republic of the Sudan, the Minister for Science and Technology and the State Minister for Agriculture at the opening of the Workshop greatly motivated the participants and demonstrated the strong support that was being provided in the area of space science and technology in the Sudan.
3. Recognizing that space technologies played an important role in the above-mentioned areas, participants made a number of observations and recommendations, which are presented below.

#### **1. Capacity-building**

4. Participants recognized the need for continuous building of national and regional expertise, through the provision of long- and short-term training and education at the regional centres for space science and technology education affiliated with the United Nations and other centres of excellence, including academic institutions.
5. In order to gain an updated view of the training and educational opportunities that were currently available, the participants recommended that a list of existing training and educational opportunities in the area of space science and technology for both Africa and Western Asia be compiled and disseminated.

6. Participants recognized the need for a curriculum to support the development of graduate and postgraduate courses in the various areas of space science and technology. This could be similar to the existing curricula developed for the regional centres for space science and technology education affiliated with the United Nations for courses in the areas of remote sensing and geographical information systems; space and atmospheric science; satellite communications; and satellite meteorology and global climate.

7. In order to facilitate knowledge-sharing, participants recommended that institutions implement institutional exchange programmes that would provide opportunities for experts to visit partner institutions. Workshop participants also stressed the importance of developing joint research projects, which would also contribute to capacity-building within each institution.

8. Participants recognized the importance of regional technical gatherings such as AfricaGIS and the biannual conferences of the African Association for the Remote Sensing of the Environment, as well as meetings of other professional societies, as opportunities to share knowledge and gain further expertise. In particular, professionals in Africa should contribute to the newly established official journal of the African Association for the Remote Sensing of the Environment, the *African Journal of Geoinformation*.

## **2. Networking**

9. Participants recognized that knowledge-sharing and the establishment of partnerships would be greatly facilitated through the creation of a regional task force of focal points, which would be responsible for disseminating information on activities and other information that could benefit all institutions involved. The Remote Sensing Authority of the Sudan offered to coordinate the regional task force.

10. Furthermore, participants recommended that the regional task force of focal points establish a web page where useful information could be posted by contributing institutions and an electronic mail (e-mail) discussion list to facilitate the exchange and dissemination of information and also hold periodic meetings. In particular, the participants welcomed the offer of the Government of the Sudan to host a follow-up meeting in two years' time.

## **3. Data access**

11. Participants recognized that, although a significant quantity of spatial data were freely available, information about which spatial data were freely available was not common knowledge. In order to contribute to making such information available, participants recommended that each institution, in particular the regional centres, maintain a web page with links to web sites that had information on freely available data, including links to the web pages of partner institutions. Those institutions should also consider establishing and maintaining clearing-house services so that the availability of data could be easily determined.

## **4. Spatial data infrastructures**

12. Participants recognized the importance of spatial data as a backbone for planning, decision-making and ensuring sustainable development, as well as the

need for spatial data for food security, poverty alleviation, environmental monitoring and control and natural resource management. Consolidation of national spatial databases should be done in a coordinated manner through the implementation of a national spatial data infrastructure. Participants recommended that Member States give priority to establishing such infrastructure with all the necessary components (national standards, metadata, a clearing house, a national database and training). The content of the core data sets should be defined by a collective effort of all spatial data stakeholders in the country. Participants recognized the leadership of the Economic Commission for Africa in the establishment of such infrastructure and encouraged Member States to participate.

#### **5. National and regional space policies**

13. Participants noted the need for a coordinated approach to the incorporation and use of space-based technologies in the region and recommended that Member States implement national plans for the incorporation of space-based technologies and participate in existing mechanisms that contribute to the establishment of regional and global policies. Such mechanisms included the Committee on the Peaceful Uses of Outer Space of the Secretariat and its two Subcommittees, the Committee on Earth Observation Satellites and its World Summit on Sustainable Development follow-up working groups, including the African Advisory Group, and the ad hoc intergovernmental Group on Earth Observations initiative. Furthermore, participants recognized the need to include research as an integral part of all national space policies.

#### **6. Raising awareness**

14. Participants recognized the need for continuously raising awareness of the usefulness of space-based technologies and recommended that such awareness-raising begin with children, through the education system, as well as with the media. In addition, participants recommended that Member States promote the annual observation from 4 to 10 October of World Space Week in their countries.

#### **7. Building upon existing initiatives**

15. Participants recognized that there were a number of ongoing initiatives that should be taken advantage of and recommended that institutions build upon the opportunities provided by such initiatives when proposing new projects and activities. A list of initiatives should be included on the web page of the regional task force of focal points.

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