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**Committee on the Peaceful
Uses of Outer Space****Report on the United Nations/Colombia/United States of
America Workshop on Applications of Global Navigation
Satellite Systems****(Medellin, Colombia 23-27 June 2008)****Contents**

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I. Introduction

A. Background and objectives

1. In its resolution 54/68 of 6 December 1999, the General Assembly endorsed the resolution entitled “The Space Millennium: Vienna Declaration on Space and Human Development”,¹ 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. The strategy contained in the Vienna Declaration included key actions to use space applications for human security, development and welfare. One such action was to improve the efficiency and security of transport, search and rescue and other activities by promoting universal access to and the enhancement and compatibility of space-based navigation and positioning systems.

2. The Plan of Action to further develop space capabilities to meet the development goals emphasized by UNISPACE III, contained in document A/59/174 entitled “Review of the implementation of the recommendations of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space” and endorsed by the General Assembly in its resolution 59/2 of 20 October 2004, presented findings and proposed actions in areas vital for the well-being and future of all nations. These actions include maximizing the benefits of the use and applications of global navigation satellite systems (GNSS) to support sustainable development.

3. There is a remarkable and growing number of civil users of GNSS such as the United States of America Global Positioning System (GPS), the Russian Federation Global Navigation Satellite System (GLONASS), the European Galileo system and the Chinese Compass/BeiDou and a growing number of satellites augmenting existing GNSS constellations. For developing countries in particular, GNSS applications offer a cost-effective way of pursuing economic growth without compromising the need to preserve the environment, thus promoting sustainable development. Satellite navigation is now used in a wide range of sectors, including but not limited to, mapping and surveying, monitoring of the environment, precision agriculture and natural resources management, disaster warning and emergency response, aviation and maritime and land transportation.

4. At its fifty-first session, in 2008, the Committee on the Peaceful Uses of Outer Space noted that, pursuant to General Assembly resolution 62/217 of 21 December 2007, the Scientific and Technical Subcommittee had considered the agenda item on recent developments in global navigation satellite systems as a new regular item and had reviewed issues related to the International Committee on Global Navigation Satellite Systems (ICG), the latest developments in the field of GNSS and new GNSS applications.²

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

² *Official Records of the General Assembly, Sixty-third Session, Supplement No.20 (A/63/20)*, paras. 132-141.

5. The Committee noted with appreciation that ICG had been established, on a voluntary basis, as an informal body to promote cooperation, as appropriate, on matters of mutual interest related to civil satellite-based positioning, navigation, timing and value-added services and on the compatibility and interoperability of GNSS, and to promote the use of GNSS to support sustainable development, particularly in developing countries. The Committee also noted that the establishment of ICG had been a concrete result of the implementation of the recommendations of UNISPACE III.³

6. In that context, the Office for Outer Space Affairs of the Secretariat, in cooperation with the Vice-President of Colombia and the satellite navigation group of the Colombian Commission on Space, organized the United Nations/Colombia/United States of America Workshop on Applications of Global Navigation Satellite Systems. The Workshop was held in Medellin, Colombia from 23 to 27 June 2008 and hosted by the Colombian Commission on Space on behalf of the Government of Colombia. The Workshop was co-sponsored by the United States.

7. The Workshop built upon the work carried out by the Office for Outer Space Affairs within the framework of the United Nations Programme on Space Applications. Taking into account the objectives of the forthcoming Sixth Space Conference of the Americas, to be held in 2009, and the plan of action that had been agreed upon at the International Workshop on the use and Applications of Global Navigation Satellite Systems, held in Bogotá in 2005, the Workshop examined the progress of the projects launched in 2005 and provided fresh impetus to projects that had not yet moved forward. In addition, new projects related to the implementation and use of satellite navigation technology were proposed.

8. The Workshop addressed the GNSS applications that could be used for precision farming, which improves agricultural productivity and food security; climate change, which affects land use, forest and agriculture; tele-health and tele-epidemiology, which provide early warning of infectious diseases such as dengue fever, Chagas disease, malaria, and so forth; and e-learning, which stimulates the growth of indigenous nuclei capacity in Latin American and Caribbean countries. It also focused on the Geocentric Reference System for the Americas (SIRGAS) and the compatibility and interoperability of GNSS systems from the perspective of the user.

9. The objectives of the Workshop were (a) to share experiences of GNSS application projects that had already been implemented in countries of the region in order to gain insight into the lessons learned; (b) to increase the regional technical and human capacities in GNSS applications with a view to establishing regional cooperation programmes to synergize resources; (c) to initiate pilot projects for collaboration at the regional level; (d) to explore the possibility of setting up national and regional coordination mechanisms among authorities in related fields with a view to exchanging experiences, identifying common needs, implementing coordinated actions and disseminating information on the various applications of GNSS technologies; and (e) to review the status of currently existing plans and

³ Information on the International Committee on Global Navigation Satellite Systems can be found at www.icgsecretariat.org.

projects on GNSS at the regional and international levels for near-, medium- and long-term applications.

10. The present report describes the background to and objectives of the Workshop and provides a summary of the presentations and observations made by the participants. It was prepared for submission to the Committee on the Peaceful Uses of Outer Space at its fifty-second session and to its Scientific and Technical Subcommittee at its forty-sixth session, both to be held in 2009.

B. Programme

11. Introductory and welcoming statements were made by the Executive Secretary of the Colombian Commission on Space, the Chairman of the Committee on the Peaceful Uses of Outer Space and representatives of the United States National Coordination Office for Space-based Positioning, Navigation and Timing and the Office for Outer Space Affairs.

12. The programme of the Workshop included technical sessions and comprehensive discussion sessions, during which the priority areas where pilot projects should be launched were identified and the possible partnerships that could be established in the region were examined. Presentations by invited speakers described current and future global space-based navigation and positioning systems, augmentation systems for navigation and SIRGAS. The Workshop addressed the use of GNSS in agriculture and environmental management, tele-health and landscape epidemiology, civil aviation and inland waterway or marine transportation. Participants were also provided with an overview of currently available education and training in GNSS and its applications.

13. During the five days of the Workshop, invited speakers from both developing and industrialized countries delivered a total of 36 presentations, which focused on national, regional and international projects and initiatives involving the use of GNSS technologies. The Office for Outer Space Affairs contributed a presentation entitled "United Nations Programme on Space Applications and status of the follow-up projects and initiatives since the United Nations/United States of America International Meeting on the Use and Applications of Global Navigation Satellite Systems" (see A/AC.105/846), in which the work carried out by the Office in supporting activities for GNSS-based applications was highlighted. A presentation entitled "The United Nations and GNSS: International Committee on Global Navigation Satellite Systems (ICG)" defined a regional coordination mechanism that could serve as an interface to ICG. In a presentation entitled "United Nations-affiliated regional centres for space science and technology education and ICG information centres" the regional centres for space science and technology education, affiliated to the United Nations, were discussed and it was suggested that they also act as ICG information centres in order to foster a more structured approach to information exchange to respond to the desire of ICG and the regional centres to create a collaborative network.

C. Attendance

14. A total of 100 participants from Argentina, Brazil, Colombia, Cuba, Ecuador, Grenada, Guatemala, Honduras, Mexico, Paraguay, Peru, the Russian Federation, Spain, Switzerland, Trinidad and Tobago, the United States and Venezuela (Bolivarian Republic of) attended the Workshop. The Office for Outer Space Affairs was also represented.

15. Funds provided by the United Nations, the Government of Colombia and the United States were used to defray the costs of air travel, daily subsistence allowance and accommodation for 17 participants from developing countries.

II. Summary of presentations

16. The presentation sessions provided participants with detailed information about the value of GNSS for a variety of applications. The discussion sessions focused on interoperability and compatibility from the perspective of the user and on the prospects for the use of GNSS technology in various areas of applications in Latin America and the Caribbean countries, highlighting current trends and initiatives, and institutional aspects that should be further considered. Based on what had been presented during the thematic sessions and a thorough summary of the issues discussed during the working group sessions, participants defined a common strategy for the region.

17. Details of the programme of the Workshop, the background materials and the presentations may be obtained from the website of the Office for Outer Space Affairs.⁴

18. The first presentation session provided an update on satellite-based navigation systems in operation or under development. A representative for each system, the Global Positioning System (GPS) of the United States, the Global Navigation Satellite System (GLONASS) of the Russian Federation and Galileo of the European Community, provided an overview of the systems and infrastructure-based augmentations and a summary of current or planned characteristics and performance, as well as of the ongoing interactions among service providers. Speakers also highlighted the role of ICG as a forum for all the providers and users to build the basis for compatible and interoperable operations for the benefit of end users. Participants were also informed about the density of the continuously operating reference stations (CORS), which should be increased for the areas of SIRGAS of Latin America and the Caribbean in order to promote the use of GNSS and extend the coverage of CORS to all of the Americas.

19. The second presentation session covered international initiatives on GNSS implementation and use. Participants learned about the various tools used for precision agriculture: GPS, geographic information systems (GIS), yield mapping, remote sensing and variable rate application (VRA) equipment. VRA equipment is the computer controller, receiving information from several sensors, which is input to a database on the position of equipment as it operates in the agricultural field, and providing information in a computer-compatible format. In agricultural fields,

⁴ The website of the Office for Outer Space Affairs may be found at www.unoosa.org.

having precise location information available at any time allows crop, soil and water measurements to be mapped. Improving the agricultural process could reduce production costs and increase the stewardship of land, water and related natural resources. Participants also learned about a light detection and ranging (lidar) system, consisting of GNSS, an inertial navigation system and a laser scanner, as a cost-effective tool for the generation of surface models over extended areas. Examples were presented of lidar systems used in mapping and GIS applications.

20. The third presentation session focused on regional initiatives on GNSS implementation and use. The participants were shown examples of the use of data from GPS stations in and near South America in order to perform a quantitative assessment of Wide-area Augmentation System-type ionospheric correction algorithms in the Caribbean, Central and South American region. Participants were also given an overview of the modernization phases of the Brazilian Network for Continuous Monitoring of GPS, the aim of which is to provide real-time data from 15 stations and to compute wide-area differential GPS (WADGPS)-type corrections, to be transmitted to users in Brazil and the surrounding areas. It was also emphasized that the WADGPS service would enable users to connect to the new SIRGAS 2000 system for positioning and navigation applications.

21. The presentations on case studies provided an additional opportunity to understand how advances in satellite remote sensing, global positioning and GIS made it easier to integrate ecological, environmental and other data for the purpose of developing models that could be used in landscape epidemiology, in mapping of rural and urban areas, and for urban cadastration. These presentations provided discussion points for the working group sessions.

22. The final presentation session on education and training highlighted the available capacity-building opportunities supported by national and international institutions. In particular, the Regional Centre for Space Science and Technology Education in Latin America and the Caribbean, affiliated to the United Nations, offered in-depth training in satellite telecommunications and navigation systems at its Brazil and Mexico campuses. Participants noted that various workshops and training courses on the use of GNSS, organized as part of the United Nations Programme on Space Applications, had provided information on global applications of GNSS and their benefits for humanity. Participants noted the positive experience of the Colombian Institute for the Development of Science and Technology in developing a GNSS knowledge map that linked to various scientific fields, such as astronomy, aeronomy, ionosphere and geodesy. The activities carried out for capacity-building through the pro tempore secretariat of the Fifth Space Conference of the Americas were also presented.

III. Observations and recommendations

23. Four discussion sessions were organized as part of the Workshop. During the first, participants had an opportunity to discuss GNSS compatibility and interoperability at the user level. During the second, issues and concerns relating to the use and applications of GNSS were discussed and a framework for a mechanism of regional cooperation was defined. During the third, participants were divided into six working groups on the basis of their areas of expertise and interest to discuss the

following themes: aviation; surveying, mapping and Earth sciences; management of natural resources, environmental monitoring and disaster management; precision agriculture; tele-health and landscape epidemiology; and education and capacity-building. During the fourth, the working groups presented the results of their deliberations and formulated a common plan of action for the region. Participants also discussed the format for a regional network that would enable the creation of partnerships and a regional database that would contribute to the sharing of knowledge on the use of GNSS and related applications.

24. During the first discussion session, the panellists who were GNSS system providers talked about commonalities among systems, signal structure and services and posed some questions for GNSS users. Participants noted that there was a need for continuous discussion on the opportunities offered by the various new satellite navigation systems to achieve maximum end-user benefit, especially in developing countries. It was suggested that a session on compatibility and interoperability from the perspective of the user should be included as a regular session in all similar GNSS activities of the Office. Participants were encouraged to provide feedback in defining GNSS compatibility and interoperability from the perspective of the user for consideration by the ICG working group on compatibility and interoperability during the third meeting of ICG, to be held in Pasadena, United States, from 8 to 12 December 2008.⁵

25. During the second discussion session, in recognition of the various ongoing projects and programmes of relevance to the region, the Workshop agreed on actions to further strengthen a reference system for Latin America and the Caribbean through SIRGAS, with the commitment of nations in the region and the support of international partners.

26. During the third discussion session, the six working groups met in parallel to share experiences of GNSS application projects that had been implemented in the countries of the region since the holding of the International Workshop on the Use and Applications of Global Navigation Satellite Systems in September 2005. Each working group also focused on the prospects for the use of GNSS technology in the region, in particular ongoing and planned initiatives, steps that should be taken together and strategies for increasing networking among national and regional institutions. The following elements were also considered by the members of the working groups: the need for a regional coordination mechanism that could serve as an interface for ICG, the need to bridge the knowledge gap between institutions and the need to build sustainable national and regional infrastructure for GNSS applications through more research and development programmes.

27. The working group on aviation held discussions on a regional project on a satellite-based augmentation solution for the Caribbean, Central America and South America (SACCSA), recognizing that the ionospheric studies proposed for phase three of the SACCSA project were of considerable importance for obtaining information on and characterizing ionosphere behaviour in the region and, consequently, for the implementation of the GNSS solution. The working group agreed to prepare a proposal regarding its support for phase three of the SACCSA project and its willingness to participate in it. The working group also agreed that

⁵ The website for the third meeting of the International Committee on Global Navigation Satellite Systems can be accessed at www.geolinks.org/icg3/index.html.

countries should exchange experiences of and cooperate in the design and implementation of GNSS-based air traffic control procedures in the region.

28. The working group on surveying, mapping and Earth sciences identified three follow-up initiatives for (a) further strengthening the implementation of the SIRGAS reference frame in the region; (b) jointly conducting research focusing on environmental concerns, using GNSS, remote sensing and geospatial data, with a view to understanding and predicting changes in the environment, including deforestation, soil moisture and sea-level variations, water vapour in the atmosphere (using GPS-meteorology), the greenhouse effect and changes in land cover (using Landsat satellite imagery); (c) setting up an Internet-based discussion forum to facilitate the exchange and dissemination of information. The working group also recommended that the workshop web page should include links to existing initiatives such as the Global Mapping Project, Global Spatial Data Infrastructure and the United Nations Geographic Information Working Group.⁶

29. The working group on management of natural resources, the environment and disasters held discussions on the establishment of a regional network of institutions with responsibility for disseminating information, including information on their activities. The main objective of the network would be (a) to promote and develop cooperation in the use of GNSS technology with a view to sharing experiences among institutions engaged in protection of the environment and management of natural resources; (b) to develop a methodology and an approach for integrating GNSS position information into environmental reporting in order to bridge information gaps among decision makers; and (c) to increase awareness of the use of GNSS technology among decision makers and the general public.

30. The working group on precision agriculture reviewed ongoing or completed regional projects and discussed elements to be considered for developing and implementing new projects on precision agriculture. The working group agreed on the following actions: (a) the definition of policies and strategies for the implementation of precision agriculture at the local and regional levels; (b) the distribution of equipment and hosting of training activities on the use of GNSS in precision agriculture for different levels of user; (c) the promotion of spectral sampling of crop management systems with a view to creating an open-access library of spectral response properties of crops; and (d) the strengthening of research on the use of GNSS technology in precision agriculture and the prioritization of such research under national agricultural policies.

31. The working group on telemedicine reported that advances in satellite remote sensing, global positioning and GIS made it possible to integrate ecological, environmental and other data for the purpose of developing predictive models that could be used in disease surveillance. The working group agreed to use, in endemic areas in Argentina, Colombia and Paraguay, remote sensing and GNSS technology as indispensable tools in pilot projects for dealing with disease outbreaks and epidemics, and monitoring diseases transmitted by vector insects. The Mario Gulich Institute of Advanced Space Studies of Argentina, the National Institute of Health of

⁶ The website of the Global Mapping Project can be found at www.iscgm.org, that of the Global Spatial Data Infrastructure at www.gsdi.org and that of the United Nations Geographic Information Working Group at www.ungiwig.org.

Colombia and the National Service for the Eradication of Malaria of Paraguay offered to lead the projects.

32. The working group on education and capacity-building on GNSS held discussions on GNSS education and training, as well as on the appropriate format for a regional network that would enable the creation of partnerships in the use of GNSS and its applications. The development of an education curriculum on GNSS for the regional centres for space science and technology education, affiliated to the United Nations, was discussed. It was recommended that a number of disciplines, such as surveying, precision agriculture, electrical engineering, civil aviation and land transport, should be included in the GNSS curriculum.

33. The fourth discussion session focused on the functional partnership that could be established in order to promote the use of GNSS in the region, including ongoing and planned initiatives, the steps that should be taken together and strategies for increasing networking among national and regional institutions. Participants recognized the need to further strengthen SIRGAS in order to promote the use of GNSS and extend the coverage of CORS to all of the Americas. With reference to the three SIRGAS working groups (Reference System, Geocentric Datum and Vertical Datum), participants recommended that each country should establish contact with the SIRGAS working groups and assign a national task force, to include specialists in different application areas and a focal point to facilitate cooperation at the local and regional levels.

34. 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 to the United Nations, and other academic centres of excellence. The working groups also recognized the need for additional workshops and training courses that would build upon the results of the current Workshop. The working groups welcomed the offer made by the Regional Centre for Space Science and Technology Education in Latin America and the Caribbean, affiliated to the United Nations, to organize a one-month training course on satellite navigation- and location-based services at the Mexico campus.

IV. Conclusions

35. The workshop provided a unique opportunity to garner support for the increased use of GNSS technology for sustainable development in Latin America and the Caribbean. The initiatives identified would guide institutions working together through regional partnerships. It was recommended that the Office provide support with a view to consolidating the partnerships formed during the Workshop, which, it was hoped, would result in the sharing and transfer of knowledge and the development of joint activities, in particular through pilot projects.

36. Participants recognized that knowledge-sharing and the establishment of partnerships would be greatly facilitated by the creation of a GNSS task group of focal points of the current Workshop working groups, which would be responsible for maintaining continuity and promoting the implementation of the recommendations of the Workshop and projects proposed during the discussions of the working groups. It was also recommended that a summary of the activities to be

developed by the proposed task group be posted in the GNSS section of the website of the Office for Outer Space Affairs.⁷

37. It was recommended that the Office continue its work on capacity-building through the regional centres for space science and technology education, affiliated to the United Nations, which would also act as ICG information centres, and that the Office work towards fostering a more structured approach to information exchange in order to establish a network between ICG and the regional centres, thereby forging a connection between the institutions involved or interested in work related to GNSS applications and GNSS system providers.

38. Participants recognized the importance of the Space Conference of Americas as an opportunity to facilitate dialogue and promote collaboration in the Americas on space-related issues.

39. Participants expressed their appreciation to the Government of Colombia, the Vice-President of Colombia, the satellite navigation group of the Colombian Commission on Space, the United Nations and the Government of the United States for organizing the Workshop and for providing significant support.

⁷ The section of the website of the Office for Outer Space Affairs devoted to Global Navigation Satellite Systems may be found at www.unoosa.org/oosa/SAP/gnss/index.html.