United Nations A/AC.105/1136

General Assembly

Distr.: General
20 December 2016

Original: English

Committee on the Peaceful Uses of Outer Space

Activities carried out in 2016 in the framework of the workplan of the International Committee on Global Navigation Satellite Systems

Report of the Secretariat

I. Introduction

1. The International Committee on Global Navigation Satellite Systems (ICG), established in 2005, has encouraged tangible international cooperation. Leading global satellite operators have coordinated their global navigation satellite systems (GNSS) services to provide global coverage in satellite-based positioning, navigation and timing in order to benefit civil, commercial and scientific users worldwide. ICG acts as a platform for open discussion and the exchange of information under the umbrella of the United Nations, and as such promotes the use of GNSS technology for environmental management and protection, disaster risk reduction, agriculture and food security, emergency response, more efficient surveying and mapping, and safer and more effective transportation by land, sea and air.

2. ICG meets annually to discuss developments in GNSS and to review the status of implementation of its workplan and hence to build a GNSS system of systems to be used by civilian users. The ICG document "Extracts from reports of the International Committee on Global Navigation Satellite Systems and its Providers' Forum", which consolidates decisions and conclusions contained in the reports of meetings of ICG and its Providers' Forum, is available on the ICG information portal (www.unoosa.org/oosa/en/ourwork/icg/documents.html).

3. The eleventh meeting of ICG and the seventeenth meeting of the Providers' Forum were held in Sochi, Russian Federation, from 6 to 11 November 2016 (see A/AC.105/1134). The Roscosmos State Corporation for Space Activities hosted the meeting on behalf of the Government of the Russian Federation.

4. The ICG workplan is carried out by the following four working groups: systems, signals and services (Working Group S, formerly Working Group A), enhancement of GNSS performance, new services and capabilities (Working Group B), information dissemination and capacity-building (Working Group C), and reference frames, timing and applications (Working Group D). Detailed information about the working groups is available on the ICG information portal (www.unoosa.org/oosa/en/ourwork/icg/working-groups.html).

V.16-10672 (E) 060117 090117

5. Pursuant to the ICG workplan, the coordination of future programmes among current and future GNSS operators, including those operating augmentation systems, will enhance the utility of GNSS services and should result in a number of new international and national programmes that support a broad range of interdisciplinary and international activities, particularly in developing nations.

6. To support the work of ICG, its working groups and its Providers' Forum, the Office for Outer Space Affairs of the Secretariat was designated as the executive secretariat of ICG. In that capacity and as the body leading Working Group C, the Office, through its programme on GNSS applications, each year co-organizes and co-sponsors a wide range of seminars, training courses and workshops. Those activities usually bring together a large number of experts, including specialists from developing countries, to discuss the GNSS applications in various fields of the world economy.

7. The present report describes the activities undertaken or supported by the Office for Outer Space Affairs during 2016 and the major results achieved. Detailed information on the activities and educational resources is available on the ICG information portal (www.unoosa.org/oosa/en/SAP/gnss/icg.html).

II. Activities of the International Committee on Global Navigation Satellite Systems carried out in 2016

8. Pursuant to the ICG workplan for 2016 and its recommendations, the Office for Outer Space Affairs, in partnership with members, associate members and observers of ICG and international entities focused on: (a) disseminating information through a network of the information centres hosted by the regional centres for space science and technology education, affiliated to the United Nations; (b) promoting the use of GNSS as tools for scientific applications; and (c) building the capacity of developing countries in using GNSS technology for sustainable development.

A. Information dissemination through a network of the information centres hosted by the regional centres for space science and technology education, affiliated to the United Nations

9. The ICG information centres are hosted by the regional centres for space science and technology education, affiliated to the United Nations. The regional centres are located in India and China for Asia and the Pacific, in Morocco and Nigeria for Africa, in Brazil and Mexico for Latin America and the Caribbean and in Jordan for West Asia. The main objective of the ICG information centres is to enhance the capabilities of member States to use GNSS and related applications at the regional and international levels so as to advance their scientific, economic and social development. The centres coordinate their activities closely with ICG and its Providers' Forum through the ICG executive secretariat.

10. A course on the Global Navigation Satellite System (GLONASS) and future perspectives of GNSS was held at the African Regional Centre for Space Science and Technology Education — in French language (CRASTE-LF) in Rabat from 23 to 27 May 2016. The course was held simultaneously with a nine-month postgraduate course on GNSS and introduced the following topics: navigation signals and navigation data messages, error sources, and technologies for the modelling and mitigation of ionospheric scintillation effects on GNSS receivers; international cooperation, and compatibility and interoperability of GNSS systems. The GLONASS programme of the Russian Federation, its architecture and future development were

also introduced. The Office for Outer Space Affairs, Roscosmos and Reshetnev Information Satellite Systems organized the course as a follow-up to the recommendations of the United Nations/Russian Federation workshop on the applications of GNSS held in Krasnoyarsk, Russian Federation, in 2015 (see A/AC.105/1098).

11. A total of 25 researchers from six African countries (Algeria, Central African Republic, Guinea, Mauritania, Morocco and Tunisia) attended the course. Participants recommended that other system operators offer similar courses to the regional centres for space science and technology education, affiliated to the United Nations, so that the regional centres could develop top-level skills among their staff in support of their mission as information centres for ICG and its Providers' Forum. Doing so would help to work towards the establishment of a network of associated centres in the regions and increase awareness among the main actors concerning GNSS, such as decision makers, research institutions, industry, service and data providers, and end users.

B. Promoting the use of global navigation satellite system technologies as tools for scientific applications

1. Space weather effects on global navigation satellite systems

12. Dual-frequency signals transmitted by GNSS satellites offer an excellent means to monitor and study ionospheric total electron content (TEC) and ionospheric irregularities. Those ionospheric characteristics are of great importance not only for satellite navigation, but also for ionospheric and space weather monitoring and research. Currently hundreds of GNSS receivers around the globe are able to obtain information about ionospheric conditions at any time. That information complements and integrates substantially the amount of ionospheric data available from other sources. However, to obtain maximum benefit from GNSS-derived TEC data, it is necessary to calibrate them. Different techniques have been developed for that purpose.

13. A workshop on the use of ionospheric GNSS-derived TEC data for navigation, ionospheric and space weather research was held in Trieste, Italy, from 20 to 24 June 2016, in cooperation with the Abdus Salam International Centre for Theoretical Physics (ICTP), Boston College and ICG. The workshop was co-sponsored by the United States of America through ICG. The workshop's purpose was to introduce the use of GNSS-derived TEC data in satellite navigation, ionospheric and space weather research. The first part of the workshop was devoted to theoretical information about TEC calibration techniques. The second part consisted of hands-on practice in the computer laboratory to ensure the appropriate utilization of the techniques.

14. A total of 55 experts from 21 countries participated in the workshop. Funds provided by the United States and the European Commission through ICG were used to defray the costs of air travel for nine experts from Argentina, India, Kenya, Nigeria and Rwanda. Detailed information about the workshop is available on the ICTP website (indico.ictp.it/event/7600/).

2. Reference frames and timing

15. In recognition of a number of ongoing projects and initiatives to establish regional reference frame networks that meet the growing needs of industries, science programmes and the general public using positioning applications, cooperation was established between GNSS providers and the regional reference frames. This cooperation will enhance applications in fields such as geodesy, mapping, surveying, geoinformation, natural hazard mitigation and Earth sciences.

16. A workshop and several short courses on AfricaArray were held at the University of the Witwatersrand, Johannesburg, South Africa, from 17 to 23 January 2016. AfricaArray is an innovative programme to promote, strengthen and maintain a workforce of geoscientists and researchers for Africa. This was the eleventh annual scientific workshop on AfricaArray. Scientific presentations were made over a two-day period by students, postdoctoral researchers and faculty engaged in the AfricaArray project.

17. The topics of the presentations broadly fell into four categories: the structure, tectonics and resources of Africa; geodesy and space science; seismic monitoring and hazard assessment; and mining-related seismicity. The purpose of the workshop was to bring together the participants in the AfricaArray project who use seismic and Global Positioning System (GPS) data for conducting research, to share their research results and to provide training.

18. The workshop consisted of a session with AfricaArray station operators on the installation and configuration of cellular modems and routers to enable real-time data access from GPS and seismic recorders.

19. The workshop was attended by 75 scientists from 17 African countries. Funds provided by the United States through ICG were used to defray the costs of air travel of 14 experts from Africa. Detailed information about the workshop and the AfricaArray project is available on the AfricaArray website (www.africaarray.psu.edu).

20. In accordance with the ICG recommendation on reference frames, the Office for Outer Space Affairs, in cooperation with the commission on positioning and measurement (Commission 5) of the International Federation of Surveyors (FIG), the International Association of Geodesy (IAG), the regional committee of the United Nations Initiative on Global Geospatial Information Management for Asia and the Pacific (UN-GGIM-AP) and the New Zealand Institute of Surveyors co-organized and co-sponsored a technical seminar entitled “Reference frames, datum unification and kinematics”. The seminar was held in Christchurch, New Zealand, on 1 and 2 May 2016, in conjunction with the seventy-eighth FIG working week.

21. At the seminar, particular focus was put on deformation modelling and datum unification, which reflected geodetic priorities for the Asia-Pacific region. Many of the participants represented countries situated on the Pacific Ring of Fire, an arc of volcanoes and fault lines with frequent earthquakes where there was a strong need to model deformation in order to maintain accurate spatial references. The theme of datum unification reflected the desire of Pacific island nations to work more closely together in sharing knowledge and resources for their mutual benefit.

22. A total of 53 experts, representing a mix of academic and government institutions and industry from 15 countries, participated in the seminar. Funds provided by the United States through ICG were used to defray the costs of air travel for five experts from Fiji, Nepal, the Philippines and Poland. Detailed information about the seminar is available on the FIG Commission 5 website (www.fig.net/fig2016/commission5.htm).

C. Building the capacity of developing countries in using global navigation satellite system technology for sustainable development

1. Regional workshop on global navigation satellite system applications

23. The United Nations/Nepal workshop on the applications of GNSS was organized jointly by the Office for Outer Space Affairs and, on behalf of the Government of Nepal, the survey department of the Ministry of Land Reform and Management. The

workshop was co-organized and co-sponsored by ICG and the Galileo Control Centre of the German Space Agency (DLR). The workshop was hosted by the survey department of the Ministry and held in Kathmandu from 12 to 16 December 2016.

24. The workshop addressed the use of GNSS for various applications that are able to provide sustainable social and economic benefits, in particular for developing countries. Current and planned projects that use GNSS technology for both practical applications and scientific explorations were presented. Cooperative efforts and international partnerships for capacity-building, training and research were discussed.

25. Participants recognized the importance of the use of GNSS technology to improve the emergency response to natural disasters and reduce the associated risk and impact to human life. Participants acknowledged that this required robust information technology and multi-agency cooperation and interoperability that include both governmental and non-governmental organizations. Presentations were given that, overall, featured efforts to leverage existing mobile telephone and Internet technologies coupled with GNSS in order to provide improved services for disaster management, primarily by reducing location uncertainties and information transfer times.

26. During the workshop a seminar was held on space weather and its effects on GNSS. It focused on cross-cutting areas, in particular resiliency, the ability to depend on space systems and the ability to respond to the impact of events such as adverse space weather. The seminar was organized in cooperation with ICG Working Group C and Boston College. The purpose was to inform participants about space weather phenomena and to illustrate the effects of those phenomena on GNSS. The seminar described the challenging aspects of space weather phenomena, their impact on GNSS users, the variability of those impacts and the actions that might mitigate their effects.

27. Participants recognized that the space weather seminar was very useful and more programmes on the topic should be planned. The importance of space weather to civil aviation and to the future of space flight was highlighted. Participants recommended to develop space weather discussion forums to educate the public and policy makers alike about space weather phenomena, and to set up additional workshops to provide opportunities for students and professionals to be involved in space weather data analysis and space weather prediction.

28. Another seminar was held during the workshop, the topic of which was GNSS spectrum protection and interference detection and mitigation. It was organized by ICG Working Group S. The purpose of the seminar was to educate participants on the importance of GNSS spectrum protection at the national level and explain how to reap the benefits of GNSS. It was noted that the seminar successfully challenged the participants to engage with their respective national spectrum management agencies to ensure continued access to the benefits GNSS provides.

29. GNSS reference frames, reference station networks and the determination of vertical datums, being areas in which knowledge-sharing was essential, were major discussion topics. It was highlighted that continuously operating reference station (CORS) networks played an important role in addressing critical national priorities such as identifying seismic hazards, disaster recovery and mitigation, and infrastructure development. In order to take full advantage of emerging GNSS technology, it was essential to develop modernized national horizontal reference systems, including deformation models and vertical datums based on accurate local geoid models. It was therefore emphasized that it was important to have international cooperation relating to knowledge, resources and the sharing of information about the development of CORS networks and geodetic reference systems.

30. During the workshop, a low-cost GNSS receiver system for real-time kinematic (RTK) was demonstrated. The system was built around a very low-cost GNSS receiver and a Raspberry Pi computer running an open-source software package for GNSS positioning named RTKLIB. The participants found the system very useful for education and training purposes and even for survey and mapping, where the accuracy required is at the sub-metre level. The participants also requested improvements to make it compatible with different types of base-station receivers. It was noted that the system will be developed for the Android platform in the future.

31. In order to enable knowledge-sharing and exchange programmes, participants recommended that the Office for Outer Space Affairs provide support for the consolidation of the partnerships that had been formed at the workshop. Those partnerships will result in the sharing and transfer of knowledge and the development of joint activities and carrying out projects. Participants also recommended that national, regional and international institutions make every effort to provide support to institutions in Nepal through exchange programmes and technical support.

32. The presentations made at the workshop, abstracts of the papers given, the workshop programme and background materials are available on the website of the Office for Outer Space Affairs (www.unoosa.org).

2. Side event on multifunction GNSS signals and ways to protect them, hosted by the International Committee on Global Navigation Satellite Systems

33. An ICG side event entitled “ICG, multifunction GNSS signals and how to protect them” was held on 1 June 2016. It had been organized by the ICG executive secretariat, the European Commission and the European GNSS Agency. The side event was hosted in conjunction with the fourth European Space Solutions conference (The Hague, Netherlands, 30 May-3 June 2016), a major event bringing together actors from government, industry, academia and society to exchange information and views on the solutions that space technology can provide to better address developmental challenges. The conference provided an opportunity to discuss highly relevant issues that guide and affect space policies and activities in fields as diverse as agriculture, climate change, environment, mobility and water.

34. The ICG side event was aimed at a wide audience including scientists, developers, entrepreneurs, policymakers, end users and beneficiaries of positioning, navigation and timing technologies. Pursuant to the ICG workplan and its programme on GNSS applications, the event focused on interference detection and mitigation and on promoting the use of GNSS technologies as tools for scientific applications, in particular the effects of space weather on GNSS. Participants also had the chance to learn about multi-GNSS cooperation. The main objectives of the event were to share technical expertise and experiences in specific GNSS-related projects and initiatives through formal presentations and panel discussions.

35. Funds provided by the European Commission through ICG were used to defray the costs of air travel and accommodation for seven participants from Brazil, France, India, Latvia, Malaysia, Morocco and Nigeria. The presentations made at the event and the event’s agenda are available on the website of the ICG information portal (www.unoosa.org/oosa/en/ourwork/icg/activities.html).

III. Technical advisory services

36. To present its work as the ICG executive secretariat, its programme on GNSS applications and the future role of ICG in a multi-GNSS constellation, and to receive feedback from the GNSS community in all its diversity, the Office for Outer Space Affairs participated in and contributed to the following international conferences and symposiums:

(a) Munich Satellite Navigation Summit 2016, held in Munich, Germany, from 1 to 3 March 2016;

(b) Tenth International Satellite Navigation Forum, held in Moscow on 11 and 12 May 2016;

(c) European Space Solutions, held in The Hague, Netherlands, 30 May-3 June 2016;

(d) Twenty-ninth International Technical Meeting of the Satellite Division of the Institute of Navigation, held in Portland, Oregon, United States, from 12 to 16 September 2016.

37. The Office for Outer Space Affairs, as the executive secretariat of ICG, participated in and contributed to the second International Civil Aviation Organization/Office for Outer Space Affairs Aerospace Symposium, held in Abu Dhabi from 15 to 17 March 2016. Presentations made during the panels on risks posed to civil and suborbital operations and on governmental cooperation with aerospace stakeholders highlighted several aspects of the ICG working groups' activities that promote work related to space weather and its effects on GNSS. They also highlighted how integration of a global and local ionospheric model could improve the accuracy of the ionospheric modelling. Of particular note was the work ICG was doing to build a multi-GNSS environment for sustainable development.

38. The executive secretariat of ICG also participated in and contributed to the United Nations/United Arab Emirates High-level Forum: Space as a Driver for Socioeconomic Sustainable Development, held in Dubai, United Arab Emirates, from 20 to 24 November 2016 (see A/AC.105/1129). The High-level Forum was the first of its kind. During a breakout session a presentation was made on space diplomacy, in which the current status of ICG was described together with the significant progress towards compatibility and interoperability among global and regional systems it had brought about. ICG had not only promoted GNSS capabilities, but also fostered new partnerships among the various stakeholders. An overview was given of the activities and opportunities ICG offered. Those activities promoted the sustainable use of GNSS technology for national development.

39. The Office for Outer Space Affairs organized two preparatory meetings for the eleventh meeting of ICG. Chaired by the Russian Federation, they were held in Vienna on 22 February and 7 June 2016, respectively, on the margins of the fifty-third session of the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space (15-26 February) and the fifty-ninth session of the Committee (8-17 June). At the meetings it was emphasized that the ICG working groups were playing a key role in the implementation of the workplan of ICG and its Providers' Forum.

40. The Office also organized the sixteenth meeting of the Providers' Forum, held in Vienna on 6 June 2016 and co-chaired by the Russian Federation and the United States. The meeting focused on issues related to open service information dissemination, service performance monitoring, spectrum protection, interference detection and mitigation, and space weather. The report of the meeting covered activities undertaken

by the ICG information centres and was provided by the ICG executive secretariat. The secretariat of Multi-GNSS Asia provided a report on a multi-GNSS demonstration project carried out in the Asia/Oceania region. The agenda of the meeting and detailed information about the presentations are available on the ICG information portal (www.unoosa.org/oosa/en/ourwork/icg/providers-forum/meetings.html).

41. The Office for Outer Space Affairs further organized the interim meetings of the ICG working groups. Those formed the basis for the views and recommendations on spectrum protection, open service performance, the monitoring of open services, the review of existing user position integrity concepts and further action. The following intersessional meetings and workshops were held in 2016:

(a) Fifth workshop on GNSS spectrum protection and interference detection and mitigation, held in Changsha, China, on 17 May in conjunction with the 2016 China Satellite Navigation Conference, held from 18 to 20 May. The workshop focused on the following topics: GNSS interference effects on infrastructure and applications, and the typical interference cases; and interference detection and geo-location capabilities and technologies;

(b) Meeting of Working Group S held in Vienna from 8 to 10 June. Working Group S summarized the status of its current work and discussed the following topics: spectrum protection; interference detection and mitigation; interoperability; open service performance standard; project to demonstrate global monitoring and assessment;

(c) Meeting of Working Group B held in Vienna on 8 June. The meeting focused on the status of current work and discussed the following topics: (i) space service volume; (ii) the workplan of the applications subgroup of Working Group B; (iii) space weather;

(d) Working Group C held a seminar on building capacity for the use of GNSS-related technologies in various fields of science and industry at the Istituto Superiore Mario Boella in Turin, Italy, on 21 and 22 March. Participants in the United Nations/Italy long-term fellowship programme on GNSS and related applications also attended the seminar.

IV. Voluntary contributions

42. In 2016, ICG activities were successfully implemented thanks to the support and voluntary contributions, financial and in kind, of member States:

(a) The Government of the United States provided $150,000 to support capacity-building and technical advisory services, and arranged for experts to make technical presentations and participate in discussions during activities described in the present report;

(b) The Government of the Russian Federation provided sponsorship for two staff members of the Office for Outer Space Affairs to participate in and contribute to the eleventh meeting of ICG and its planning meetings;

(c) The European Commission provided 100,000 euros to support capacity-building and technical advisory services, and arranged for experts to make technical presentations and participate in discussions as part of activities described in the present report;

(d) The Government of Japan and the Government of China provided sponsorships for experts to make technical presentations and participate in discussions as part of activities described in the present report.