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Committee on the Peaceful Uses of Outer Space

Activities carried out in 2013 in the framework of the workplan of the International Committee on Global Navigation Satellite Systems

Report of the Secretariat

I. Introduction

1. The Global Positioning System (GPS) of the United States of America and the Global Navigation Satellite System (GLONASS) of the Russian Federation are currently fully operational global navigation satellite systems (GNSS). Next generation GNSS that are currently being developed include the modernized GPS and continued revitalization of GLONASS, as well as the European satellite navigation system (Galileo), China's Compass/BeiDou, the Indian Regional Navigation Satellite System (IRNSS) and Japan's Quasi-Zenith Satellite System (QZSS). Each of these navigation satellite systems will bring extra satellites and signals to deliver better accuracy, reliability and availability. As new systems emerge, signal compatibility and interoperability among GNSS, as well as transparency in the provision of open civil services, are key factors in ensuring that civil users receive maximum benefit from GNSS applications.

2. Satellite navigation and positioning data are now used in a wide range of areas, which include mapping and surveying, monitoring of the environment, precision agriculture and natural resources management, disaster warning and emergency response, aviation, maritime and land transportation and research areas such as climate change and ionospheric studies. Applications of GNSS offer a cost-effective way of pursuing sustainable economic growth while protecting the environment.

3. The Office for Outer Space Affairs, in its capacity as the executive secretariat of the International Committee on Global Navigation Satellite Systems (ICG) and its Providers' Forum, is promoting the use of GNSS throughout its programme on GNSS applications. The Committee was established in 2005 under the umbrella of the United Nations. It promotes international cooperation on issues of mutual



interest related to civil satellite-based positioning, navigation, timing and value-added services.

4. The present report reflects the wide range of activities carried out in 2013 by the Office for Outer Space Affairs as outlined in the ICG workplan. Detailed information on the activities can be found 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 2013

5. With education and capacity-building forming the core of the ICG programme on GNSS applications and pursuant to the ICG workplan, the Office for Outer Space Affairs focused on capacity-building and information dissemination through (a) regional centres for space science and technology education, affiliated to the United Nations; and (b) regional workshops, training courses and technical seminars, and their follow-up projects.

A. Regional centres for space science and technology education, affiliated to the United Nations

6. Regional centres for space science and technology education have been established in India 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 Western Asia under the auspices of the United Nations Programme on Space Applications implemented by the Office for Outer Space Affairs. The main objective of the centres is to enhance the capabilities of Member States, at the regional and international levels, in various disciplines of space science and technology that can advance their scientific, economic and social development. Each of the centres provides postgraduate education, research and application programmes with an emphasis on remote sensing, satellite communications, satellite meteorology and space science.

7. In 2013, the publication of an education curriculum on GNSS (ST/SPACE/59), together with the GNSS glossary of terms, produced as a direct response to the needs of the GNSS user community in the framework of the ICG Providers' Forum workplan, was made available to the regional centres for space science and technology education. This curriculum supplemented the proven standard model education curricula of the regional centres developed through the United Nations Programme on Space Applications.

8. The regional centre for space science and technology education in French (see www.crastelf.org.ma), located in Rabat, began the first session of the postgraduate course on GNSS in late 2013, and the regional centre for space science and technology education in English (see www.arcsstee.org), located in Ile-Ife, Nigeria, will begin the course in early 2014 with the purpose of training university educators, and research and applications scientists, through rigorous theory, research, applications, field exercises and pilot projects in GNSS and its applications that could contribute to sustainable development in each country. The course

prerequisite is a degree in electronics and communications engineering, geomatics, or software and computer engineering.

9. This GNSS course consists of nine modules covering specific areas of GNSS, including position determination techniques, sensors and embedded system design, receivers and GNSS applications. The duration of the course is 36 weeks, followed by one year of pilot project work in the course participant's home country. An electronic version of the curriculum in Arabic, English, French and Spanish can be downloaded from the website of the Office for Outer Space Affairs (www.unoosa.org/oosa/en/SAP/centres/education-curriculum.html).

10. Efforts to build capacity in space science and technology are considered a major focus of the Office for Outer Space Affairs and are of specific interest to ICG with particular reference to GNSS and its applications. Such efforts aim to provide support to the regional centres for space science and technology education affiliated to the United Nations, which would also act as information centres for ICG.

11. Funds provided by the regional centre for space science and technology education in French and the Government of the United States (through ICG) were used to defray the costs of air travel and accommodation for 10 participants. A total of 15 specialists were invited to attend the first session of the nine-month postgraduate course on GNSS from 20 November 2013 through 10 September 2014 in Rabat.

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. In the past few years, different institutions have begun to deploy several instruments of a different kind (for example, GNSS receivers, ionosondes, magnetometers) in many low-latitude countries in Africa, South America and South-East Asia, over which the ionosphere had remained less known because of the scarce distribution of ionospheric sensors. As a consequence, the new sets of data now available are expected to make possible improvements in ionospheric modeling efforts, particularly considering data assimilation techniques. Additionally, some specific phenomena that take place in this region can be utilized. Since the ionosphere is the major error source in GNSS receivers, an improved knowledge of the low-latitude ionosphere would mitigate the ionospheric effects on GNSS positioning applications (e.g. for precision agriculture, environmental monitoring, civil aviation) in the same geographic region.

13. Within the framework of the workplan of ICG, the Office for Outer Space Affairs, together with Boston College (United States) and the European Space Agency (ESA) co-organized the workshop on GNSS data application to low-latitude ionospheric research, held in Trieste, Italy, from 6 to 17 May 2013. The Abdus Salam International Centre for Theoretical Physics hosted the workshop. The workshop integrated formal lectures with hands-on practice to learn about analysing atmospheric and ionospheric data obtained from GNSS measurements.

14. In addition, a presentation on the "Ionospheric ground-based monitoring network in low-latitude regions", part of the Alcantara initiative of ESA, was

presented. The main objective of the initiative is to develop a Galileo-based ionospheric scintillation monitor (GISMO) in order to analyse impacts on GNSS, periods of high solar activity and extreme events.

15. A total of 83 scientists, engineers and educators in the field of GNSS and space weather from 25 developing countries and countries with economies in transition from all economic regions participated in the workshop. Funds provided by the United States through ICG were used to defray the costs of air travel for nine participants.

16. The Office for Outer Space Affairs, together with the Scientific Committee on Solar Terrestrial Physics (SCOSTEP), also organized the 2013 space science school in Nairobi. This school was hosted by the Technical University of Kenya.

17. Lectures covered topics ranging from the solar interior to the impact of solar variability on the terrestrial space environment. Information on space weather and Earth's climate was also included in the lecture notes. In addition to lectures, the participants had the opportunity to gain hands-on experience in data analysis, observation and instruments, including the GPS network and ionospheric monitors.

18. Funds provided by the United States through ICG were used to defray the costs of air travel for three lecturers from the following three United States institutions: University of Illinois, the Smithsonian Astrophysical Observatory and Stanford University.

2. Reference frames and timing

19. Development projects, applications, services or products requiring georeferencing require a uniform coordinate reference system. Most countries have some form of national reference frame or system. These reference frames and systems are usually based on local origin or datum points, which restrict their use to a particular country. This makes cross-border mapping, development and planning projects difficult and therefore calls for the establishment of common and uniform continental coordinate reference frames and systems.

20. To strengthen cooperation among the regional reference frames, the eighth AfricaArray workshop was supported by ICG, in accordance with its workplan for 2013. The workshop was held at the University of the Witwatersrand in Johannesburg, South Africa, from 15 to 18 January 2013. It was attended by 73 participants representing 22 African countries.

21. Over the course of two training programmes and one workshop, the participants were taught by international experts in GNSS on topics such as the operation of AfricaArray stations and assessment of seismic hazard. The Global Earthquake Model regional programme for sub-Saharan Africa was also presented.

22. Funds provided by the United States, through ICG, were used to defray the cost of air travel for 15 participants from Africa.

23. The International Association of Geodesy (IAG) and the International Federation of Surveyors (FIG), both founding members of ICG, work together in international forums such as Group of Earth Observation and the United Nations Initiative on Global Geospatial Information Management. The two organizations also co-lead the ICG Working Group on Reference Frames, Timing and

Applications. The Federation typically represents the interest of high-accuracy users and service providers, while IAG provides a link to the geodetic community.

24. Within the scope of its activities as the executive secretariat of ICG and its Providers' Forum, the Office for Outer Space Affairs supported the seminar on "Reference frames in practice". The seminar was organized in cooperation with IAG and FIG, and held on 21 and 22 June 2013, immediately following the South-East Asian Survey Congress, held from 18 to 20 June 2013 in Manila. This was the second time such a joint activity was organized by IAG, FIG and ICG. The first took place in 2012 at the FIG Working Week in Rome. Presentations made at the second technical seminar are available from www.fig.net/commission5/index.htm.

25. A technical manual on "Reference frames in practice" will be published by FIG as a follow-up to the discussions on reference frames and recommendations made during the joint activities in 2012 and 2013.

26. The seminar was attended by 50 participants from 20 countries. Funds provided by the United States through ICG were used to defray the costs of air travel for four participants from Fiji, Indonesia and Papua New Guinea.

C. Regional workshops on global navigation satellite system applications

27. Pursuant to General Assembly resolution 67/113 and as part of the United Nations Programme on Space Applications, the United Nations/Croatia Workshop on the Applications of Global Navigation Satellite Systems (see A/AC.105/1055) was organized by the Office for Outer Space Affairs of the Secretariat and the Faculty of Maritime Studies of the University of Rijeka on behalf of the Government of Croatia. The Workshop was co-sponsored by the United States (through ICG) and hosted by the Faculty of Maritime Studies of the University of Rijeka in Baška, Krk Island, Croatia, from 21 to 25 April 2013.

28. The main objective of the five-day Workshop was to provide a forum in which participants could share their technical expertise and experiences in specific GNSS-related projects through formal presentations and panel discussions. Furthermore, the Workshop was to develop a regional plan of action that would contribute to the wider use of GNSS technology and its applications, including the possible establishment of specific pilot projects in which interested institutions could work together at the national and/or regional level. A detailed programme of the Workshop and its proceedings is available on the website of the Office for Outer Space Affairs (www.unoosa.org).

29. In that context, Workshop participants recommended (a) providing a forum in which users and system providers could exchange experience and practice in research and innovation in GNSS, and contribute to the global debate on the interoperability of GNSS and interference detection and mitigation; (b) providing education and outreach on the use of GNSS information for scientific applications, such as weather forecasting, geodynamics and ionospheric studies; (c) developing a GNSS applications database, to be accessed through the ICG information portal and the websites of the ICG information centres, that would describe each specific GNSS application and how it worked.

III. Technical advisory services

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

(a) Institute of Navigation International Technical Meeting, held from 28 to 30 January 2013 in San Diego, California (United States);

(b) Global Geodetic Observing System Inter-Agency Committee Meeting, held on 5 April 2013 in Vienna;

(c) Seventh GNSS Vulnerabilities and Solutions Conference, held from 18 to 20 April 2013 in Baška, Krk Island, Croatia;

(d) International GNSS Conference, held from 16 to 18 July 2013 in Gold Coast, Queensland, Australia;

(e) Institute of Navigation GNSS+ 2013 Conference, held from 16 to 20 September 2013, Nashville, Tennessee (United States).

31. The Office for Outer Space Affairs organized the preparatory meetings for the eighth meeting of ICG, co-chaired by the United Arab Emirates, and the eleventh meeting of the Providers' Forum, co-chaired by China and the United States, held in Vienna on 18 February 2013 and on 10 and 11 June 2013, respectively. Those preparatory meetings were held on the margins of the fiftieth session of the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space and the fifty-sixth session of the Committee. At the meetings, it was emphasized that ICG should play an important role in future GNSS developments and their implications for civil use and performance. Member States of ICG focused on issues related to the effective functioning of ICG and its current structure as a body established to promote cooperation on matters of mutual interest related to civil satellite-based positioning, navigation timing and value-added services, as well as the compatibility and interoperability of GNSS.

32. The Office for Outer Space Affairs, in its capacity as the ICG executive secretariat, organized the interim meetings of the ICG working groups that formed the basis for views and recommendations on spectrum protection, open service performance and the monitoring of open services, as well as on monitoring the progress of the interoperable GNSS Space Service Volume and reviewing existing user position integrity concepts for further actions. The following ICG intersessional meetings and workshops were organized in 2013:

(a) Workshop on GNSS spectrum protection and interference detection and mitigation, held from 19 to 22 April 2013 in Honolulu, Hawaii (United States);

(b) Meeting of ICG Working Group A on compatibility and interoperability of global and regional navigation satellite systems and satellite-based augmentations, held from 11 to 13 June 2013 in Vienna;

(c) Meeting of ICG Working Group B on enhancement of the performance of GNSS services, held on 12 June 2013 in Vienna.

33. Through ICG, the Office for Outer Space Affairs organized a special session on GNSS to be held on 4 December 2013 to discuss education and training programmes on GNSS and the benefits of such programmes for African countries, including the projects related to real-time dual-frequency GPS stations for ionospheric studies in Africa and international cooperation. The session was organized as an associated event of the African Leadership Conference, to be held in Accra from 3 to 5 December 2013.

IV. Voluntary contributions

34. The activities of ICG in 2013 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 \$100,000 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 Governments of China, India and the Russian Federation, as well as the European Union and ESA, provided sponsorships for experts to make technical presentations and participate in the activities carried out in the framework of the ICG workplan;

(c) The government of Dubai provided a sponsorship for a staff member of the Office for Outer Space Affairs to participate in and contribute to the eighth meeting of ICG and its planning meetings.

35. The Office for Outer Space Affairs was also given a Galileo navigation satellite model by the European Commission, which was added to the Office's permanent exhibit at the Vienna International Centre. This model contributes to the exhibit's GNSS section, which already has on display three models of navigation satellite systems: GPS of the United States, GLONASS of the Russian Federation and Compass/BeiDou of China.