

14 June 2018

English only

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**Committee on the Peaceful  
Uses of Outer Space**  
**Sixty-first session**  
Vienna, 20–29 June 2018

## **Summary of the United Nations/Argentina workshop on the applications of global navigation satellite systems**

**(Falda Del Carmen, Argentina, 19–23 March 2018)**

### **I. Introduction**

1. Since the establishment of the first global navigation satellite system, the number of satellite systems offering position, velocity and time at global scales is increasing. New generation systems are being deployed and there is also a variety of systems that are available at regional scale.
2. The International Committee on Global Navigation Satellite Systems (ICG), established in 2005, convenes under the umbrella of the United Nations and serves to promote cooperation on matters related to global navigation satellite systems (GNSS). ICG works to enhance coordination among providers of GNSS, regional and augmentation systems in order to ensure compatibility, interoperability and transparency, and to promote the greater use of GNSS capabilities to support sustainable development, particularly in developing nations. ICG also serves to assist GNSS users with their development plans and applications, by encouraging coordination and serving as a focal point for information exchange.
3. The Office for Outer Space Affairs, in its capacity as the Executive Secretariat of ICG and its Providers' Forum, is promoting the use of GNSS throughout its programme on GNSS applications and related capacity building activities.
4. The availability of GNSS and other space-based systems is creating an unprecedented opportunity, bringing benefits in the areas of emergency management, marine and land monitoring or fleet control to name a few. Due to this availability, the development of integrated applications is an area in rapid expansion.
5. As part of the United Nations Programme on Space Applications, a United Nations/Argentina workshop on the applications of global navigation satellite systems was organized by the Office for Outer Space Affairs in cooperation with the National Commission for Space Activities (Comision Nacional de Actividades Espaciales, CONAE) of Argentina. The Workshop was held at the Centro Espacial Teofilo Tabanera, a facility of CONAE, in Falda del Carmen, Argentina, from 19 to 23 March 2018. It was co-sponsored by the European Union and the United States of America through ICG. The European Space Agency (ESA) is also co-sponsored the workshop.



6. Organized by the United Nations, previous regional workshops and international meetings on the applications of GNSS were held in China (A/AC.105/883) and Zambia (A/AC.105/876) in 2006, Colombia (A/AC.105/920) in 2008, Azerbaijan (A/AC.105/946) in 2009, the Republic of Moldova (A/AC.105/974) in 2010, the United Arab Emirates (A/AC.105/988), the Office for Outer Space Affairs in Vienna, Austria (A/AC.105/1019) in 2011, Latvia (A/AC.105/1022) in 2012, Croatia (A/AC.105/1055) in 2013, the Abdus Salam International Centre for Theoretical Physics in Trieste, Italy (A/AC.105/1087) in 2014, the Russian Federation (A/AC.105/1098) in 2015 and Nepal (A/AC.105/1149) in 2016. Those workshops addressed a wide array of GNSS applications for socioeconomic benefits and focused on initiating pilot projects and strengthening the networking of GNSS-related institutions in the regions.

7. The present summary describes the background, objectives and programme of the workshop and provides an overview of the observations and recommendations made by the participants.

## A. Background and objectives

8. The Office for Outer Space Affairs of the Secretariat, with the vision of bringing the benefits of space to humankind, promotes international cooperation in the peaceful uses of outer space, and strives to build capacity related to space-based technology, services and space law. The Office is also promoting the use of space technology as a tool to monitor and achieve the 17 Sustainable Development Goals (SDGs) of the 2030 Agenda for Sustainable Development (A/RES/70/1).

9. The contribution of the applications of GNSS to the aforementioned agenda is very broad. Transport and communications, aviation, surveying, mapping and Earth science, management of natural resources, the environment and disasters, precision agriculture, high-precision mobile application and provision of time information in critical national infrastructures are some of the direct applications of this technology.

10. In particular, this workshop contributed to spread the use of GNSS in support of:

*Sustainable Development Goal 3: Good Health and wellbeing* — GNSS positioning enables individual patients, staff or equipment to be monitored, and response teams directed more efficiently;

*Sustainable Development Goal 7: Affordable and clean energy* — GNSS reflectometry techniques can produce scatterometry models to assist in the optimum positioning of off-shore wind farms;

*Sustainable Development Goal 11: Sustainable Cities and Communities* — GNSS is widely used for urban planning in order to pinpoint structures and reference points for cadastral and urban planning purposes. It also allows the monitoring of displacements and detection of potential structural risks due to movement;

*Sustainable Development Goal 15: Biodiversity and Ecosystems* — GNSS reflectometry offers the potential for monitoring vegetation and biomass. It also has an important role in providing information for global monitors such as: carbon modelling, greenhouse gas emission inventories and deforestation control.

11. 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/systems are usually based on local origin or datum point, which restrict their use to a particular country. This makes cross-border mapping, development and planning projects difficult. This therefore calls for the establishment of a common and uniform continental reference frames/systems. In this respect, the Geocentric Reference

System for the Americas (SIRGAS) is responsible for the reference frame for South and Central America.

12. In line with the cross-cutting areas, as identified in a report of the Committee on the Peaceful Uses of Outer Space (A/72/20), the main objective of the workshop was to reinforce the exchange of information between countries and scale up the capacities in the region pursuing the application of GNSS solutions, widespreading information on the national, regional and global projects, which could benefit the region and to enhance cross-fertilization among them.

13. The specific objectives of the workshop were: (1) to introduce GNSS and its applications to transport and communications, aviation, surveying, mapping and Earth science, management of natural resources, the environment and disaster management, precision agriculture, high precision mobile application, and space weather effects on GNSS; (2) to promote greater exchange of actual experiences with specific applications; (3) to encourage greater cooperation in developing partnerships and GNSS networks, in the framework of the regional reference frames; and (4) to define recommendations and findings, in particular in forging partnerships to strengthen and deliver capacity-building in the utilization of space science and technology for sustainable economic and social development.

## **B. Programme**

14. At the opening of the workshop, introductory and welcoming statements were made by the Secretary General of CONAE and by the representatives of ICG and ESA as co-sponsors, and by the representative of the Office for Outer Space Affairs.

15. The Deputy Technical and Administrative Director of CONAE delivered the keynote presentation focusing on CONAE's actions and projects that were developed in accordance with the national space programme, materialized through Earth observation, exploration and peaceful uses of outer space, and technological developments for space use, which was periodically updated and extended to ensure that it suits the socioeconomic and productive requirements of the country.

16. The workshop technical sessions promoted productive discussions among participants, and covered a wide range of topics related to GNSS technology: (1) overview of GNSS in operation and development; (2) GNSS reference frames and reference station networks; (3) implementation of GNSS technology; (4) GNSS applications; (5) space weather; (6) capacity-building, education and training in the field of GNSS; (7) international and regional experiences of the use and implementation of GNSS technologies; and (8) national GNSS programmes.

17. During the workshop, a one day and half seminar on "GNSS spectrum protection and interference detection and mitigation" was organized. The purpose of the seminar was to highlight the importance of GNSS spectrum protection at the national level and explain how to reap the benefits of GNSS. Specific presentations that demonstrated GNSS jamming and spoofing were carried out.

18. Additionally two discussions sessions were held, where participants were split in three working groups to exchange views on: (1) capacity-building and institutional strengthening; (2) geodetic reference network; (3) specific GNSS applications. The discussion sessions were preceded by a presentation on the publication entitled "European Global Navigation Satellite System and Copernicus: Supporting the Sustainable Development Goals" (ST/SPACE/71) that was jointly prepared by the Office for Outer Space Affairs and the European GNSS Agency (GSA).

19. The programme was developed by the Office for Outer Space Affairs and CONAE in cooperation with ICG and ESA.

20. An informative technical tour of CONAE was organized for participants in the workshop. The tour gave the participants an inside look at satellite tracking and control facility.

21. The presentations made at the workshop, abstracts of the papers given and the workshop programme and background materials are available on the website of the Office for Outer Space Affairs at: [http://www.unoosa.org/oosa/en/ourwork/psa/schedule/2018/2018-workshop-on-global-navigation-satellite-systems\\_-\\_presentations.html](http://www.unoosa.org/oosa/en/ourwork/psa/schedule/2018/2018-workshop-on-global-navigation-satellite-systems_-_presentations.html).

### **C. Attendance**

22. Representatives of national space agencies, academia, research institutions, international organizations and industry from developing and developed countries concerned with the development and the use of GNSS for practical applications and scientific exploration were invited to participate in the workshop. Participants were selected on the basis of their scientific or engineering background, the quality of the abstracts of their proposed presentations and their experience in programmes and projects in GNSS technology and its applications.

23. Funds provided by the United Nations, the Government of Argentina and co-sponsors were used to defray the costs of air travel and accommodation for 27 participants. A total of 73 specialists in satellite navigation systems were invited to attend the workshop.

24. The following 22 Member States were represented at the workshop: Argentina, Brazil, China, Colombia, Croatia, Ecuador, Egypt, France, Italy, Japan, Latvia, Mexico, Morocco, Panama, Paraguay, Peru, Russian Federation, Spain, Thailand, Turkey, the United States of America and Venezuela. The European Union and the European Space Agency were also represented. Representatives of the Office for Outer Space Affairs also participated.

## **II. Observations and recommendations**

25. The workshop addressed the use of GNSS for various applications that 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.

26. Two discussion sessions were held as part of the workshop. During the first, three working groups met in parallel to discuss the following themes: (1) capacity building and institutional strengthening; (2) geodetic reference network; and (3) GNSS applications. During the second, the groups presented the results of their deliberations and formulated a common plan of action for the region. The participants put forward a number of observations and recommendations, which are summarized below:

### **A. Capacity-building and institutional strengthening**

27. The working group on capacity building and institutional strengthening held discussions in 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 related applications, including space weather and its effects on GNSS operations.

28. A further discussion on the existing capacity-building opportunities offered by national, regional and international institutions took place, where the participants informed about on-going opportunities and programmes.

29. The working group recognized the need to continue building national and regional expertise through the long and short-term training courses and education offered by the regional centre for space science and technology education for Latin America and the Caribbean, affiliated to the United Nations, and also through other academic and thematic centres of excellence worldwide.

30. The need for short training courses to be organized in cooperation with the Office for Outer Space Affairs in order to fully exploit the potential of applications based on multi-GNSS was recognized.

31. With a view to strengthen the existing GNSS network in the region, the working group recommended to facilitate the exchange and dissemination of information by electronic mail and to hold periodic virtual meetings.

## **B. Geodetic reference network**

32. The working group on geodetic reference network held discussions on geodetic reference frames, noting the United Nations resolution on a global geodetic reference frame (GGRF) for sustainable development adopted by the General Assembly on 26 February 2015 (A/RES/69/266). The working group recognized:

(a) The importance of GGRF for developing and improving the global spatial infrastructure (GSDI) in support of sustainable development goals of the 2030 Agenda for sustainable development;

(b) The effort committed by the Latin America and the Caribbean countries for deploying, maintaining and continuously improving their GNSS networks for the GGRF realization at national level;

(c) The success achieved by SIRGAS in coordinating the operation of the GNSS networks at regional level, and in processing the GNSS data to provide the community with a GNSS-based regional realization of the GGRF;

(d) The existence in Latin America and the Caribbean of other observing infrastructures that could enhance the current GNSS-based GGRF regional realization, namely:

i. Satellite Laser Ranging (SLR) stations in Arequipa, Peru (in partnership between Peru and the United States of America), in San Juan, Argentina (in partnership between Argentina and China) and Brasilia, Brazil (in partnership between Brazil and the Russian Federation); and a very-long-baseline interferometry (VLBI) station in Fortaleza, Brazil (in partnership between Brazil and the United States of America);

ii. the Argentina - German Geodetic Observatory that co-located SLR, VLBI and GNSS;

(e) The need of deepen the geodetic knowledge installed in the region to reach the highest international standards related to GGRF realization.

33. The working group recommended to develop a capacity building activity (with the assistance of international experts in the subject matter) to process and analyse SLR and VLBI data in combination with GNSS data and that this activity would be carried out at regional level in order to maximize the participation of representatives from the Latin America and the Caribbean countries.

34. Based on the above mentioned considerations and recognizing that in spite of the progress achieved in the region, either in the availability of GNSS observing stations as well as in the data analysis capabilities, the need for geodetic training at a more basic level than stated in the previous recommendation still persists in several countries of the region.

35. Considering the above stated, the working groups recommended:

(a) To implement capacity-building through training courses designated to space agencies especially geared towards the best use of georeferencing in the production of spatial information (for example, images, statistics, etc.), highlighting the infrastructure available in the region;

(b) To provide assistance for the acquisition, deployment and operation of GNSS networks in countries that still lack them or need to improve them;

(c) To provide assistance for the installation of the vertical component of the GGRF;

(d) To implement an outreach programme to promote the use of the SIRGAS observational infrastructure for applications complementary to the GGRF realization, for example, space weather, water vapour monitoring, augmented navigation assessment (space-based augmentation systems (SBAS) or ground-based augmentation systems), image processing;

(e) To encourage all geodesic data producing agencies to implement open access policies for their data.

36. In addition, participants noted that the region had a good GNSS observation infrastructure, operated mostly by cartographic agencies, for the support of georeferencing operations.

37. The working group also recommended to prepare a proposal for a pilot project aiming to augment the existing GNSS networks in order to transmit real time differential corrections for multi-purpose applications

### **C. GNSS applications**

38. The working group on GNSS applications structured the discussion at three different levels: scientific and technical, organizational, and specific applications. Synergies between the different levels were also considered.

39. At scientific and technical level, it was recommended:

(a) To consider the incorporation of multiple constellations into SBAS, which might have an impact across different services, in particular, civil aviation, and benefits to other sectors;

(b) To consider increasing the number of an international satellite-based search and rescue (COSPAS-SARSAT) stations for search and rescue applications;

(c) To organize a workshop on disaster management using the enhanced capabilities of GNSS, COSPAS-SARSAT, and earth observation.

40. At organizational level, it was recommended to create an inventory of equipment, applications and services, and capacity-building opportunities that were available in the region. This inventory could be used to enhance the communication between institutions in the region.

41. Participants noted that the Office for Outer Space Affairs was currently working in a solutions database, which would cover these aspects, by including institutional, country level and regional solutions. This tool would be available to all the countries.

42. At the level of specific applications, using GNSS and other technologies, participants recognized the need for additional workshops building upon the results of this workshop, including workshops focusing on training decision-makers (covering the integrated application of combined remote sensing, geographic information system and decision support systems).

### **III. Concluding remarks**

43. The recommendations and observations put forward by the participants in the workshop provided guidance on how institutions could work together through regional partnerships. The Office for Outer Space Affairs should provide support for consolidation of the partnerships that were formed at the workshop. Those partnerships will result in the sharing and transfer of knowledge and the development of joint activities and project proposals.

44. Additionally, it was recommended that 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 centres of excellence, and work further towards ensuring that end users will benefit from the GNSS multi-constellation.

45. The participants in the workshop expressed their appreciation to the United Nations, the Government of Argentina and co-sponsors for the substance and the excellent organization of the workshop.

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