

United Nations/Nepal Workshop on the Applications of Global Navigation Satellite Systems Kathmandu, 12 – 16 December 2016

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Introduction:

The United Nations/Nepal Workshop on the applications of global navigation satellite systems (GNSS) was organized jointly by the United Nations Office for Outer Space Affairs and the Survey Department of the Ministry of Land Reform and Management on behalf of the Government of Nepal. The Workshop was co-organized and co-sponsored by the International Committee on Global Navigation Satellite Systems and GfRmbH Galileo Control Centre, German Space Agency(DLR).

A total of 113 participants from the following 32 countries attended the workshop: Australia, Bahrain, Bangladesh, Brazil, China, Croatia, Egypt, Estonia, Fiji, France, Germany, India, Indonesia, Japan, Lao PDR, Latvia, Malaysia, Mongolia, Morocco, Myanmar, Nepal, New Zealand, Pakistan, Philippines, Russian Federation, Saudi Arabia, Thailand, Turkey, Ukraine, United States of America and Uzbekistan. Representative of the European Commission was also present. Representative of the Office for Outer Space Affairs also participated. The Workshop was hosted by the Survey Department of the Ministry of Land Reform and Management and held in Kathmandu, Nepal, from 12 to 16 December 2016. The Workshop addressed the use of GNSS for various applications that can 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. Building upon cross-cutting areas, in particular resiliency, including matters related to the ability to depend on space systems and to respond to the impact of events such as adverse space weather, a seminar on space weather and its effects on GNSS was held during the Workshop. The purpose of the seminar was to provide a background on the phenomena

of space weather and illustrate its effects on GNSS. This seminar described the challenging aspects of space weather phenomena, their impact on GNSS users, the variability of these impacts and the actions that may mitigate their effects. Seminar on GNSS spectrum protection and interference detection and mitigation was also organized during the Workshop. 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. It was highlighted that the seminar was successful in fulfilling its intended purpose of educating participants

on the importance of GNSS spectrum protection, and challenging them to engage with their respective national spectrum management agencies to ensure continued access to the benefits GNSS provides.

GNSS reference frames, reference station networks and determination of vertical datum were the topics of major discussion, where the knowledge sharing was very essential. It was noted that continuously operating GNSS stations (CORS) play an important role in critical national priorities such as identifying seismic hazards, disaster recovery and mitigation and infrastructure development in developing countries. In order to take full advantage of emerging GNSS technology the development of modernized national horizontal reference systems including deformation models and vertical datum based on accurate local geoid models are essential. Therefore international cooperation in terms of knowledge, resource and sharing of the information in development of CORS networks and geodetic reference systems was emphasized.

RTKLIB (free open source software) demonstrations related with low-cost GNSS receiver system for real time kinematic (RTK) using RTKLIB were made. The system was based on a very low cost GNSS receiver, Raspberry-Pi computer using RTKLIB. The participants found such system very useful for education, training and even for survey and mapping where required accuracy is within a sub-meter level. The participants also requested to improve the system to make it compatible for different types of base station receiver makers. The system will be developed in android platform in future.

Participants learned about the improvement in the existing infrastructure either by launching new satellites (in case of Galileo,

Beidou Navigation Satellite System (BDS), Quasi-Zenith Satellite System (QZSS), Indian Regional Navigation Satellite Systems (IRNSS)) or by modernization of the existing signals (as with Global Positioning Systems (GPS) of the United States and Global Navigation Satellite System (GLONASS) of the Russian Federation). Participants took note of the release of new interference control documents (ICD) for all GNSS along with activities for international collaboration on compatibility and interoperability among the GNSS operators.

Participants were also informed about the role of the international committee on global navigation satellite systems (ICG) as a forum for the providers and users to build the basis for compatible and interoperable operations for the benefits of end users. Recognizing that GNSS technology has enormous potential to contribute to the management and protection of the environment, disaster risk reduction, agriculture and food security, emergency response, improving the efficiency in surveying and mapping, and to enhance the safety and effectiveness of transportation by land, sea and air, low cost GNSS receivers, the participants put forward a number of recognitions and recommendations, which are presented below:

GNSS Applications and Technology Development:

Participants recognized that GNSS has very important applications in surveying and mapping and in the precise positioning. It plays a prominent role in every infrastructure development of the country. Participants also recognized the importance of the use of GNSS technology to improve emergency response to natural disasters and reduce the associated risk/impact to human life. This was an extremely important application

for GNSS requiring robust information technology and multi-agency cooperation and interoperability that include both governmental and non-governmental organizations

(NGO). Overall the presentations featured works that leverage existing mobile phone and internet technologies coupled with GNSS to provide improved services for disaster management primarily through reducing location uncertainties and information timelines.

Key recommendations included the following: (i) continue the development and integration of information technology, global information system (GIS), mobile phone ,GNSS and remote sensing technologies to achieve improved disaster management tools accessible to the public; (ii) engage public and private agencies and organizations to favourably affect public policy to ensure maximum benefit to the population being served. These activities may include, but are not limited to the following: (a) obtain endorsement for these efforts; (b) enable access to data bases and data sources in support of these efforts; and (c) develop a framework to formally manage requisite cross-agency

cooperative and collaborative efforts needed to adopt and exploit the new capabilities.

Space Weather:

Participants recognized that the space weather seminar was very useful and more programs on the topic should be planned. The importance of space weather to civil aviation and future of space flight was highlighted. In that context, participants in the workshop recommended that: (a) space weather discussion forums should be developed to educate the public as well as policy makers

about space weather phenomena; (b) other workshops should provide opportunities for students and professionals to be involved in space weather data analysis and prediction.

Continuously Operating Reference Station (CORS) Network and Reference Frames:

Participants recognized that CORS operators should be encouraged to facilitate earth deformation studies. Participants emphasized the importance of modernizing national geodetic reference system. It was noted that the new geodetic datum of Nepal has made some progress but its completion will require international co-operations.

Capacity Building:

The participants recognized the need for the continuous building of national and regional expertise, through the provision of scholarships, long-term and short-term training and education at the United Nations-affiliated Regional Centres and other academic centres of excellence. In addition, participants stressed the need to make the existing educational opportunities available to a wider university community. 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, GIS and decision support systems).In order to enable knowledge sharing, participants recommended that institution exchange programmes, providing opportunities for experts to visit and work with partner institutions. In particular, participants recommended that national, regional and international institutions make every effort to provide support to Nepalese institutions through exchange programme and technical support.

Participants expressed their appreciation to the Survey Department of the Ministry of Land Reform and Management of Nepal for the hospitality, substance and organization of the Workshop. Participants also expressed their appreciation for the significant support provided by the Government of Nepal, the United Nations, ICG and GfRmbH Galileo Control Centre, DLR.

SUMMARY OF THE WORKSHOP: WORKSHOP STATISTICS

1. There were two organizers and one co-organizer of the Workshop
2. Three committees were formed to conduct the Workshop. The name of the committees and their chairpersons are as follows:

| <i>Committees</i> | <i>Chairpersons</i> |
|--------------------------|---------------------|
| 1. Steering Committee | Mr. Krishna Raj BC |
| 2. Organizing Committee | Mr. Niraj Manandhar |
| 3. Preparatory Committee | Mr. Niraj Manandhar |
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3. The workshop was run for 5 days which had nearly 26 hours of technical presentations and seminar, that is 5.2 hours each day excluding breaks.
4. There was one key note presentation, Ten sessions with total 48 presentations and 7 speeches and remarks made in this Workshop which was to be followed by next 5 remarks in the closing session.

5. In seminar session 23 presentations were made.
6. The number of Technical Papers presented and their respective areas were as follows:

| <i>Session</i> | <i>Number of papers</i> |
|--|-------------------------|
| 1. Overview of GNSS | four |
| 2. GNSS Applications and Technology Development | Six |
| 3. Environment Monitoring and Management Using GNSS | Seven |
| 4. Seminar on Space Weather and its effects on GNSS | Five |
| 5. Seminar on GNSS Spectrum Protection and Interference Detection and Mitigation | |
| I. Overview | Two |
| II. Introduction to GNSS | Five |
| III. Spectrum Management | Six |
| IV. Spectrum Protection | Four |
| V. Interference Detection and Mitigation | Three |
| 6. RTKLIB DEMO | Two |
| 7. Space Weather | Five |
| 8. GNSS Reference Frame and Reference Station Network | Thirteen |
| 9. RTK: Technology and Applications | Eight |
| 10. GNSS Implementation and Uses: Case Studies | Six |

There were 113 participants from 32 countries in the workshop. Among them, 87 participants were from 17 Asian countries which is a great achievement.

7. The number of national participants from Nepal was 56.
8. The papers were from 28 countries: six continents except from ANTARCTICA.
9. The Workshop started with inaugural session chaired by Mr Krishna Raj BC, Director General of Survey Department and was inaugurated by Honorable Minister of Ministry of Land Reform and Management Mr. Bikram Pandey.
10. The Workshop ended with a closing ceremony chaired by Mr Krishna Raj BC.



Author's Information

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