Application covering Letter for
the IGS M-GEX

From

Shanghai Astronomical Observatory (SHAO)
As

Multi-GNSS Experiment Analysis Center

Shanghai Astronomical Observatory(SHAO) of the Chinese Academy of Sciences (CAS), was established in 1962. SHAO has more than 200 staffs, in which ~75% are scientific employ. Among them, we have one academician of Chinese Academy of Sciences (CAS) and one academician of Chinese Academy of Technology (CAT). Besides the post-graduate and PhD programs, SHAO initiated the postdoctoral program since 1995. In 2006, SHAO established a joint postdoctoral program with Max Plank Institution for Astrophysics (MPA, Germany), aims at attracting the top level PhD candidates from all over the world for their post-doctor research.

SHAO has four research departments: Shanghai Center for Astro-geodynamics Research (SCAR), Center for Galaxy and Cosmology (CGC), Division of Very Long Baseline Interferometry (VLBI), and Division of High Technology Laboratories. The SCAR engages in measurement and analysis of the motion of the Earth and its dynamical mechanisms using the modern space techniques, including space Geodesy and astronomy. We operate a core site (Shanghai) with co-location of VLBI,SLR and GNSS equipments in the supporting the GGOS geodetic core network. We maintained the analysis centers for all these three techniques. Since early 2011, we start the GNSS data analysis using the global GNSS network in an IGS-mode. After a period of experimental operation, the system is in routine operation with good stability and precision. As a further development of the analyzing system, we consider the Multi-GNSS analysis as a promising topic and direction. We fully support our group of the GNSS analysis to participate in the IGS M-GEX project and wish the success of the project.

Deputy Director, Shanghai Astronomical Observatory Director, SCAR

Prof. Jinliang Hou Prof. Bin Wu

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Response to the Call for Participation

International Global Navigation Satellite Systems Service

IGS

Multi-GNSS Experiment

IGS M-GEX

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Form 4: IGS M-GEX Analysis Efforts

Organization

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Describe your anticipated efforts for analysis interests	1. Improving our GNSS data processing platform 2. Analysis of received signals and equipment performance 3. Data processing of provided global data set 4. Dedicated evaluation of Multi-GNSS products

Strategy and Plan for the data analyzing efforts at SHAO

1. Objectives

Today, GNSS provides irreplaceable data resource for user positioning. GNSS positioning has been applied to Geodetic studies, including global tectonics, reference frame maintenance, earth rotation, LEO projects, disaster early warning etc. Using data of globally distributed GPS network, IGS provides the highest products to global users.

With the upgrading of GPS and Glonass systems and upcoming Galileo and Compass/BD, QZSS systems, better accuracy, reliability and availability of positioning is foreseen, especially for users in mountain areas and Urban Canyon Environments. To achieve these objects, the precise and consistent GNSS products are of vital importance.

On the other hand, most analysis platform developed from the GPS only analysis lacks in the Multi-GNSS analysis options. Multi-GNSS analysis requires a consistent structure of the analyzing software, which should be able to handle data set from different systems and solve the related parameterization issues. IGS M-GEX provides a great platform to upgrade the analyzing systems by sharing experimental data and organizing workshops.

By taking part in the IGS M-GEX, we aim to improve our GNSS analysis abilities and thus strengthen our understanding of the involved issues.

2. State of Science and Technology, Previous Work

Shanghai Astronomical Observatory (SHAO) has long history in research of Astronomy and Geodesy. The Center for Astro-geodynamics Research (SCAR) engages in measurement and analysis of the motion of the Earth and underlying dynamical mechanisms using the modern space techniques, including space Geodesy and astronomy. We operate a core site (Shanghai) with co-location of VLBI,SLR and GNSS equipments in the supporting the GGOS geodetic core network. We maintained the analysis centers for VLBI, SLR and GNSS.

SHAO hosts the Central Bureau of the Asia-Pacific Space Geodynamics (APSG) program, which unites all relevant activities in the Asia-Pacific

region into a cooperative research project in plate tectonic, crustal motion and deformation, and sea level changes.

SHAO is the current one of collaborative coordinators in the establishment of the Crustal Movement Observation Network of China (CMONOC), which includes ~260 fiducial sites and ~2000 campaign sites and serves for GPS meteorology, network RTK, disaster early warning and monitoring, space weather research etc.

Since early 2011, we start the IGR-like GNSS data analysis using the global GNSS network. After a period of experimental operation, the system is in routine operation with good stability and precision. Our products have been utilized and acknowledged in many key space programs of China.

3. Description of the Work Plan

Based on the outline we define the following four work packages (WPs).

WP1:Software development

WP2:Data issue

WP3:Data Analysis

WP4:Products Validation & Comparison

WP1 focuses on the modification and improvement of the analyzing software. Tasks including inputs and outputs modifications, GNSS models refinement, definition of new parameters in Multi-GNSS analysis, parameter estimation strategy improvement etc.

WP2 handles the data exchange format issues and analyzing data qualities.

WP3 carries out data processing based on the observations from IGS M-GEX. Depending on the outputs of this WP, software debugging and improvement will be done in an iterative way.

WP4 checks and compares products internally and with other analysis participants. Comparisons including direct products comparisons and user positioning performance evaluation.

4. Necessity for Funding

All costs including manpower salary and travels will be afforded by SHAO.

5. Project Team/Publication

Leading Scientists

Bin Wu is professor and director of the Center for Astro-geodynamics Research, Shanghai Astronomical Observatory. and head of the GNSS analysis center. His main research field includes SLR data analysis and applications, precise orbit determination, satellite altimetry, gravity and tides, earth rotation and reference frames determination.

Junping Chen studied Geodesy at the Tongji University in Shanghai. He got a PhD in Satellite Geodesy in 2007. Between 2006 and 2011 he was a research scientist in department 1 "Geodesy & Remote Sensing" at the GFZ and involved in IGS activities. Since May 2011, he is professor at Shanghai Astronomical Observatory and head of the GNSS analysis center.

Haojun Li received his PhD in Geodesy from Tongji University in Shanghai in 2010. His main research interests focused on Precise Point Positioning (PPP) and PPP based estimation of atmospheric delays. Now he is a research assistant at Shanghai Astronomical Observatory, Chinese Academy of Sciences.

6. Selected publications

Li, H.-J. etc. (2010): The realization and analysis of GNSS network based real-time precise point positioning. Chinese Journal of Geophysics-Chinese Edition, 53, 6, 1302-1307.

Li, H., Chen, J., etc. (2010): Network based real-time precise point positioning. Advances in Space Research, 46, 9, 1218-1224.

Chen J, Ge M, Dousa J, Gendt G (2009): Evaluation of EPOS-RT for Real-time Deformation Monitoring. Journal of Global Positioning Systems 8(1):1-5.

Chen J. and Wang J. (2008): Reduced-dynamic Precise Orbit Determination for Low Earth Orbiters Based on Helmert Transformation, in artificial satellite,42,3,2007, pp 155-165 DOI: 10.2478/v10018-0008-008-x

Chen J. and Wang J. (2008): Reduced-Dynamic Precise Orbit Determination Based on Helmert Transformation. In book: VI Hotine-Marussi Symposium on Theoretical and Computational Geodesy, DOI: 10.1007/978-3-540-74584-6_21, pp 138-142, February, 2008, Springer Berlin Heidelberg.