Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

SGD23-01 Room:105 Time:May 25 13:45-14:00

A Robust and Wide Area GPS Monitoring System by PPP-AR

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Real Time Kinematic (RTK) solution is usually applied to monitor Earthquake, Volcano, Landslide, Buoy and any real time events. When strong earthquakes occur, RTK has possibilities of getting not accurate coordinate because the reference station may move together. Precise Point Positioning (PPP) is other method for real time solution and it works without reference station. But the accuracy is not enough to monitor such events.

To solve this problem, we have developed new GPS real time monitoring system by PPP with Ambiguity Resolution (PPP-AR). PPP-AR needs correction data from reference station network. We do not have to set up the network close to client station because it can apply to almost 1000km area. And the accuracy is almost equal to RTK.

We designed several local reference networks in Japan in our system. We run parallel solutions for one client station with each correction data from these networks in real time. When any movements happen in a network, our system selects other area's data automatically. Therefore, we can get accurate results robustly.

Keywords: PPP-AR, GPS Monitoring system

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SGD23-02 Room:105 Time:May 25 14:00-14:15

Estimation of precipitable water by way of analysis of all sites of nation-wide GEONET network

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In NIED for the study to improve the accuracy of heavy rainfall nowcasting in the Tokyo metropolitan area, we run the CReSS high-resolution atmospheric model assimilating the observation data of multi-parameter (MP) radar network. To accurate the model assimilating the accurate precipitable water observation data to the model, we run the automated system to calculate near-realtime hourly GPS precipitable water of about 150 GEONET network sites in the area every three-hour applying the RINEX file downloaded from GSI ftp server.

In addition, since 2011 fiscal year for the area of Osaka and Nagoya metropolitan areas and major local cities where flood disasters attacked before, we run the CReSS high-resolution atmospheric model when heavy rainfall attacks to clarify the atmospheric rainfall mechanism assimilating the observation data of the MLIT MP radar network. To accurate the atmospheric model assimilating the accurate precipitable water observation data it is required to calculate the accurate GPS precipitable water of the GEONET sites in and around the regions.

On the other hand, NIED established the automated system to estimate accurate site coordinates of all of nation-wide GEONET network sites applying the IGS ultra-rapid ephemeris and RINEX files automatically downloaded from GSI ftp server every day just after the observation for the development of the dynamic geodetic coordinates control system.

Thus in this study we have developed the system to calculate the accurate site coordinates of all of the GEONET network sites applying IGS rapid and final ephemerides and using the RINEX files obtained above, and to estimate the accurate vertical coordinate of all GEONET network sites automatically every day using the latest 30 days vertical coordinate solutions, and to calculate the GPS precipitable water of the sites in and around the region of the heavy rainfall anywhere domestic Japan immediately when flood disaster attacks, assimilating the GPS precipitable water to the CReSS model.

Keywords: GPS precipitable water, analysis of all GEONET sites, mechanism of heavy rainfall precipitation

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SGD23-03 Room:105 Time:May 25 14:15-14:30

Development of a new precise positioning technique using multi-GNSS signals

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GSI is developing and standardizing a new precise positioning technique which deal with multiple GNSS constellations, GPS, QZSS, GLONASS and Galileo, in order to mainly encourage effective surveys at places where are currently difficult to carry out them by only GPS satellites. This project is composed of 1)Development of suitable analysis methods with multi-GNSS, 2)Evaluation of the methods, and 3)Standardization of the precise positioning technique.

In fiscal year 2011, we examined existed analysis methods which cope with both classic GPS signals (L1 and L2) and modernized signal (L5) or multi-GNSS signals. Then we designed basic outline of the new software by integrating and expanding those ideas. In addition, we carried out preliminary experiments by using real multi-GNSS signals.

This presentation shows a blueprint of the project, results of FY 2011 and future plans from FY 2012.

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SGD23-04 Room:105 Time:May 25 14:30-14:45

GLONASS-R: A novel GNSS reflectometry solution based on software defined radio

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Other than GPS or Galileo, the Russian GLONASS system uses frequency-division multiple access (FDMA) to transmit the signals of the satellites to the user. This feature can be used to develop a GNSS-R system which works without the knowledge of replica codes and enables cross-correlation of direct and reflected signal in a simple and straightforward way. By applying this processing strategy any arbitrary coherent integration length can be achieved without knowledge of the navigation bits. We are going to summarize this novel method and present first results taken with our prototype system.

Keywords: GNSS, GLONASS, Software defined radio, Reflection

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SGD23-05 Room:105 Time:May 25 14:45-15:00

Extraction of the vertical seafloor movement recorded on ocean bottom pressure data by applying ICA

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In order to extract the vertical seafloor movement from ocean bottom pressure data obtained by the multi-point observation, we introduced Independent Component Analysis (ICA). The Ocean Bottom Pressure (OBP) change due to the predicted amount of seafloor vertical movement is comparable to or slightly less than that due to dynamic ocean processes. Therefore, it is needed some new methods that enable us to separate and/or extract the slow-slip component from the OBP data. ICA is one of the multivariable analysis techniques, which have been applied in the field of the speech processing and the electroencephalogram analysis [e.g., Common, 1994]. Since the spatio-temporal scale and the distribution of the slow-slip component is likely significantly different from those of oceanic components, ICA is expected to be a powerful method to separate them. In this study, we used FastICA algorithm developed by Apro Hyvarinen (see http://www.cs.helsinki.fi/u/ahyvarin/papers/fastica.shtml). To evaluate the practical performance of FastICA, we performed some experiments using the test data. The test data is a sum of the OBP data and the simulated slow slip event. The OBP data was obtained on 2009, which is a quite time in earthquakes, in Miyagi-Oki region [Hino et al., 2009]. The slow slip event was generated based on the result of numerical simulation shown in Hino et al. [2009]. Before ICA, tidal components were eliminated from OBP data by using BAYTAP-G. Also, sensor drifts were corrected by linear fitting function in advance. We applied FastICA to the test data on the assumption that the number of significant sources is 3. As a result, the artificial slow slip event was successfully extracted as the first independent component. The second and third independent component was likely corresponding to oceanic components. For comparison, we also applied Principal Component Analysis (PCA) to the test data described above. The result clearly showed the superior performance of FastICA for extracting the slow slip event from OBP data.

Keywords: slip event, ocean bottom pressure observation, seafloor movement, Independent Component Analysis, Principal Component Analysis

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SGD23-06 Room:105 Time:May 25 15:00-15:15

Warkworth geodetic station as a potential GGOS core site in New Zealand

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Auckland University of Technology (AUT) has constructed a 12-m radio telescope (WARK12M) in New Zealand near Warkworth, 60 km north of Auckland. It was launched October 2008 as New Zealand's first research capable radio telescope for the purpose of both astronomy and geodesy. Prior to that, GPS was the only space geodetic technique in New Zealand. WARK12M is collocated with GNSS station WARK belonging to the PositioNZ network operated by Land Information New Zealand. Warkworth is currently the only geodetic station in New Zealand that has the capability to become the national GGOS (the Global Geodetic Observing System) core site. Currently VLBI coverage of the Southern Hemisphere is low so Warkworth is an important new addition for the GGOS project.

The GGOS goal is an origin definition at 1mm accuracy or better and a temporal stability of the order of 0.1mm/yr, with similar numbers for the scale and orientation components. As a GGOS core site has to provide stable and high quality outputs, here we reconsider the geodetic analysis procedure at Warkworth, including ocean tide loading at the site. The displacements due to ocean tide loading calculated for Warkworth are up to +/-10mm for the horizontal components, and +/-40mm for the vertical component. A high-resolution land-sea data grid representation of the coastline is one of the important components for calculation of an accurate site-dependent ocean tidal coefficient. We compare the ocean tide loading displacements calculated using different grid data. One of the site-dependent coefficients was calculated by the Ocean Tide Loading Provider maintained by the Onsala Space Observatory. Another was calculated using GOTIC2 software with the Shuttle Radar Topography Mission data set, which provides 3 arc-second grid data all over the world. Differences between the ocean tide loading displacements in the two models were less than 1mm for the East-West component, +/-1mm for the North-South component, and +/-2mm for the vertical component. These differences are significant for the goal of 1mm target accuracy, demonstrating the importance of the right choice of coastline grid data.

Here we will discuss what is necessary to become a GGOS core site. In addition, we show the progress on the experiment we are conducting jointly with Japanese VLBI stations to provide ultra-rapid EOP result.

Keywords: VLBI, GNSS, GGOS, ocean tide loading