Development of a Routine Analysis System of GEONET by PPP-AR

Hiroyuki Nakagawa
Geospatial Information Authority of Japan

The Geospatial Information Authority of Japan (GSI) operationally analyzes GNSS data of the Japanese nationwide GNSS array of about 1300 stations, called GEONET. The result is used as a part of fundamental data for evaluating earthquake activity or monitoring volcanic activity of Japan. However, even up-to-date GEONET operational analysis does not always have enough rapidness or temporal resolution.

Therefore, we focused on PPP-AR (Precise Point Positioning with Ambiguity Resolution). PPP-AR can produce time series of station coordinate with high temporal resolution more rapidly than the current system. Also, the accuracy is comparable to the GNSS baseline analysis.

In this study, we developed a prototype system of GEONET routine analysis by PPP-AR. This system consists of two units. The first unit estimates the correction information for PPP-AR (precise orbit and clock information, and Fractional Code Bias) by GNSS data from about 100 global stations. Using them and GEONET data of GPS and GLONASS, the second unit calculates coordinate solution of 24 hours length in 1 sec. interval by PPP-AR. Typically, it takes about 2.5 – 3.5 hours after GNSS data acquisition to get solutions for all the GEONET stations.

We then evaluate quality of the coordinate solutions. Removing about 140 stations that influenced by bad observation environment such as shielding by vegetation, the standard deviations (SD) of the horizontal components of the daily solution were calculated for one year. The result shows that the average of all the SD is about 1cm, comparable to the operational “ultra-rapid solution” of GEONET, although the average SD is larger than 1cm in summer showing seasonal variation.

Finally, to evaluate effectiveness for detecting crustal displacement, we processed the data during the 2016 Kumamoto Earthquake, which is a series of earthquakes from April 14, 2016 (local time) in Kumamoto prefecture of Japan. For the main shock (M 7.3, 01:25 on April 16), the crustal displacement by this system is consistent to those by the GEONET operational analysis. For about 2.5 hours apart foreshocks of 21:26 on April 14 (M6.5) and 00:03 on April 15 (M6.4), the GEONET operational analysis could not separate crustal displacements of those earthquakes because of low temporal resolution, but this system can separate them.