Research on the development of rapid and accurate GNSS routine analysis system (2)

*Hiroyuki Nakagawa[1]

1. The Geospatial Information Authority of Japan

The Geospatial Information Authority of Japan (GSI) routinely analyzes GNSS data obtained by GEONET and monitoring crustal deformation all over Japan. The results are used as fundamental data in the field of such as evaluating earthquake activity or monitoring volcanic activity.

However, depending on the timing of earthquake occurrence or speed of deformation of mountain body, even up-to-date GEONET routine analysis do not always have enough rapidness or time resolution. New analysis method that is more rapid and with higher time resolution are required.

Therefore, we focused on Precise Point Positioning with Ambiguity Resolution, or PPP-AR. With corrective information called Fractional Cycle Bias (FCB) as well as precise orbit and clock information of GNSS satellites, PPP-AR can calculate position for each site as accurate as those derived by interferometric analysis. A key feature is that the position of the stations in every epoch can be calculated rapidly with small calculation load. In addition, PPP-AR does not need fixed reference station. That has advantage when crustal deformation occurs over wide area by large earthquake and it is difficult to find the point that is not subjected to the deformation.

Thus, GSI has started a three-year research project since the April of 2017. In this project, we will develop more rapid and accurate GNSS analysis method based on PPP-AR and make prototype system implementing this method envisioning future GEONET routine analysis. The goal of this research is developing analysis method that can routinely and stably obtain the solution of one-second interval with typical repeatability of about 1cm in horizontal component within about two hours after data acquisition.

In 2018, we perform test analysis of 31 days from Jul. 12 to Aug. 12, 2018 using prototype system under development. Twenty-four hour time series of 1 sec. interval from 0 hour to 0 hour of next day was calculated for al GEONET station once a day, and evaluated estimated satellite orbit and clock, and resulted GEONET time series solutions. First, as an evaluation of quality of estimated satellite orbits and clocks, RMS of estimated orbits with respect to IGS final orbit and RMS of estimated clocks with respect to CODE clock were calculated. As a tentative result, RMS of orbit is about 2.7cm for GPS and about 8.8cm for GLONASS, and RMS of clock is about 4.15ns for GPS and about 6.02ns for GLONASS. Next, as a evaluation of repeatability of GEONET time-series solutions, we calculate a frequency distribution of standard deviation of horizontal coordinate time series. Then, frequency distribution peak is located at a bin from 1.0 to 1.2cm of standard deviation and almost 25% of all time series are fall into this bin. On the other hand, only 21% of time series has standard deviation less than 1cm, which is target of this research project. Time series with standard deviation less than 1.4cm accounts for about 68%.

In this presentation, we will consider the reason and a way to improve the quality of estimated orbit/clock and time series solution.

Keywords: GNSS, PPP-AR, GEONET routine analysis, GEONET

