

Accuracy estimation of Long Base Line Real Time Kinematic GPS for observations of seafloor crustal deformation

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Our research group of Nagoya University has performed the observations of seafloor crustal deformation by using the system combined Kinematic GPS analysis and Acoustic Ranging for the purpose of the research of plate subduction in the areas around Japan. In this system, we determinate the locations of observation vessel using Kinematic GPS positioning and measure the distance between the observation vessel and the seafloor transponders by using the acoustic wave. These observations have been repeatedly performed at the Kumano basin and Suruga Bay from 2004 and 2005, respectively. The accuracy of observation is 2-3 cm in the horizontal components.

We have two problems in this system. One is limited observation time, the other is long delay of 2-3 weeks to be produced the precise ephemerides. We are planning to develop a real-time observation system with buoys. We have carried out Real Time Kinematic GPS tests on land for evaluating the accuracy of RTK GPS positioning.

We carried out the experiments with Real Time Kinematic GPS on October, 2007. A GPS rover station was installed at Nagoya University and three reference GPS stations were installed in Inuyama, Mizunami and Nakatsugawa city with the baseline lengths about 20 km, 35 km and 65 km, respectively. We used the iCGRS and Aquarius GPS receivers. Each receiver recorded the GPS signals at one second interval. We applied choke ring antennae for preventing multipath effect such as reflected wave from buildings. Each GPS receiver was equipped with a rubidium atomic clock. In the GPS rover station, we set up the horizontal slider of about 7 m in length to move a choke ring antenna. The choke ring antenna behaved back-and-forth motion at a velocity of 15 cm/s. We choose the test period in order that the number of GPS satellites would be enough large and the distribution of GPS satellite would be good. The test periods were 2-8 hours a day.

An RTK positioning software, RTKNav, was used to analyze RTK GPS positioning. A software, GrafNav, which has been used to analyze the observations of seafloor crustal deformation was used to compare between the results of RTK GPS positioning and that of Kinematic GPS positioning. The correct values of GPS rover position are determined from the post-positioning Kinematic GPS analyses with relation to the new GPS station which was installed at Nagoya University with baseline lengths of about 7 m. We calculated the coordinates of four reference GPS stations with Bernese software Ver 5.0.

The test results are as follows. The accuracy of RTK GPS positioning itself (iCGRS receiver) shows that the error value is about 4 cm for the baseline length of about 35 km, and the value is about 11 cm for the baseline length of about 65 km. The position difference between the RTK and Kinematic analysis becomes long with the longer base line length. The accuracy of RTK GPS positioning itself (Aquarius receiver) shows that the error values vary from day to day, ranging from 4 cm to 40 cm. In addition, we do not get the quantitative result from comparing with the correct values.

Finally, we are planning to carry out additional tests on April, 2008 with four reference stations in order that we examine when the baseline length is about 50 km and the test period is long.