Accuracy and precision assessment of the real-time kinematic GNSS time series for moored buoy using three-axis programable moving table

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Rapid understanding of the magnitude of large earthquakes and their associated fault dimensions are extremely important. Especially, capture of the coseismic deformation in the offshore region will be key information to understand the fault dimensions for the large interplate earthquake. Based on this background, Tohoku University and JAMSTEC are jointly developing the on-demand crustal deformation monitoring system using moored buoy system. The buoy can measure the sea-floor horizontal crustal deformation by GNSS/Acoustic technique and vertical deformation using ocean bottom pressure sensor. One of the key technology in our developed system is the real-time kinematic GNSS which can measure three-dimensional position of the buoy in real-time. In contrast, it is difficult to understand quantitatively the precision and accuracy of estimated buoy position because no reference for the position. Thus, we assess the precision and accuracy of real-time kinematic GNSS time series using programable three-axis movable table.

We have developed the single-axis precise programable movable table (Ohta et al., 2016). We expanded this developed system to three-axis. For the real-time kinematic analysis, we adopted Trimble CenterPoint RTX (hereafter, RTX) with 10Hz sampling interval. The correction message for the analysis was received via a stationary satellite. We also estimated the GNSS antenna position using very short-baseline kinematic analysis as reference solution. The developed movable table can operate single axis horizontal displacement, rotational movement, and tilt deformation. To simulate the actual buoy movement, we gave the motion to the movable table based on the actual buoy movement. We conducted the experiment in 24 hours duration.

We calculated the residual time series between obtain time series by RTX and short-baseline kinematic solution. The difference between averaged absolute position was quite good in the horizontal components which was less than 10mm. In contrast, the vertical component shows the clear discrepancy between them. RTX time series shows systemically higher than the baseline analysis which reached approximately 230mm. In contrast, the precision of the calculated residual time series was good in both of the components. Calculated standard deviations were 10-11mm and 28mm in horizontal components and vertical component, respectively. We will show the more detailed results from our experiment and discuss the ability of the real-time kinematic analysis in our developed buoy.

