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Seismic Displacement Analysis of GPS Permanent Stations due to the Tohoku-Oki Mega-thrust Earthquake in Korea and Asian Regions

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In this study, we analyzed the effects of seismic displacements due to the mega thrust earthquake occurred near Tohoku-Oki area on Mar. 11, 2011 with Mw 9.0 magnitude in the context of evaluation of position change by the earthquake on the Korean and Asian GPS permanent stations. For this, two weeks GPS data observed around the event of Tohoku-Oki earthquake (Mar. 4 $\sim$ Mar. 18, 2011) were obtained from 22 GPS permanent stations in the vicinity of epicenter (Korea, Japan, Russia, China and Taiwan) and 284 IGS global stations. All available GPS data were processed and adjusted by GAMIT/GLOBK software to estimate the co-seismic horizontal displacements at each station. As the results of GPS analysis, the co-seismic displacements due to Tohoku-Oki earthquake were clearly revealed in the GPS stations of Asian region, Japan and its neighboring countries, and even to affect the horizontal position of GPS station (WUHN in China) which is located about 2,700 km away from the epicenter.

Also, we performed the elastic deformation analysis using the horizontal displacements of baselines between Korean GPS stations in order to analyze the effects of Tohoku-Oki earthquake more precisely to the Korean region. The size of maximum shear strain rate calculated during the event of Tohoku-Oki earthquake is 7.5 times greater than the size of annual rate in Korean region. In conclusion, it was found that the effects of Tohoku-Oki earthquake had resulted in the horizontal displacements, ranging from 14.9 mm to 58.3 mm in the geodetic positions of Korean GPS stations. So, these irregular displacements can cause the position error in the relative GPS survey such as DGPS up to 20 mm without updating the coordinates of GPS stations in Korea.