

Seismic waves detected by 50Hz sampled GNSS observations

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Application of frequently sampled GNSS data is getting increasingly attractive research field, in particular, in the field of seismology (e.g., Larson et al.; 2003, Miyazaki et al., 2004; Yokota et al., 2009; Ohta et al., 2012). As most of GEONET (GNSS Observation NETwork) sites are now archiving 1Hz sampled data, such application research will be more active in the future. Analysis of ground shake may require higher frequency observation such as 5Hz, 10Hz or higher. However, it is known that amplitude and phase of observed ground displacements show fluctuations due to characteristics of data acquisition in the receiver electric circuits (e.g., Ebinuma and Kato, 2012). Thus, we need to be careful in applying such highly sampled GPS data for geoscientific researches.

We have used commercially available GNSS receivers to record 50Hz sampling to tackle above problems. We are introducing a record of ground shake due to an earthquake of 50Hz sampled data. We used three NetR8 (Trimble Co. Ltd.) GNSS receivers and they were established at Shizuoka University (Shizuoka Prefecture) since October 2011, Katono Elementary School (Fukushima Prefecture; KTNO) and Daido-higashi Elementary School (Ibaraki Prefecture; DDHG) since March 2012. We chose latter two locations as they are among the most active aftershock area due to 2011 Tohoku-Oki earthquake (Mw9.0).

About two weeks of 50Hz sampled data are stored in the internal memory of the receiver which are refreshed automatically in the receiver. Data at KTNO and DDHG are remotely archived through internet and data at Shizuoka University are downloaded manually, after a large earthquake occurred. Several data sets due to large earthquakes have been archived so far, all of which registered at least bigger than or equal to JMA Intensity 5- at nearby GPS sites. These data are analyzed using RTNet GPS software.

Among the archived data sets, a seismic wave was detected for the 2013 September 20 Fukushima-Hamadori earthquake, whose hypocentral parameters are as follows: latitude=N37.1deg, longitude=E140.7deg, depth=20km, M5.9, and the biggest JMA Intensity was 5+ at Iwaki, which is nearly immediately below the KTNO site. We used IGS final orbits and estimated the position of KTNO by putting the reference site at Daido-higashi (Baseline distance is about 106km to south) and Shizuoka University (Baseline length is about 308km to south east). Clear seismic wave was obtained for the baseline KTNO-DDHG for three components. Also, clear seismic wave was obtained for the baseline KTNO-Shizuoka Univ., though vertical component was not very clear, probably because the baseline distance was longer.

GNSS antennas at KTNO and DDHG sites are placed at the roof of the school buildings and at the roof of observation hut of Shizuoka University. Therefore, we may have to investigate the effects of swing of the building by comparing the record with nearby recorded strong motion. Moreover, the method of correction for amplitude and phase due to receiver characteristics should be investigated, which is left for future studies.

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