Development on a real-time monitoring system for coseismic deformation using GEONET data

Takuya Nishimura[1]; Mikio Tobita[1]; Tetsuro Imakiire[1]

[1] GSI

After the 2004 Sumatra-Andaman earthquake, researchers [e.g., Blewitt et al., 2006] proposed rapid detection of coseismic crustal deformation measured by GPS in order to develop a tsunami forecast and to estimate a seismic source area immediately after the earthquake. Some proposals in USA are operated on an experimental basis [e.g., Melbourne et al., 2008].

In the GEONET system operated by GSI, most of about 1230 continuous GPS stations are equipped with a real-time data transmission for 1 Hz sampling data. We developed a real-time monitoring system for crustal deformation, which can analyze the GPS data for 60 stations, simultaneously. And, we are operating this system on research basis. Repeatabilities of 1 Hz relative coordinates in a 100-km-long baseline analyzed by the real-time system are ˜10, ˜15, and ˜50 mm for east, north, and vertical components, respectively. They may increase up to twice in summer. In the fiscal year of 2008, the system was developed so that the coseismic displacements are automatically picked up in the 1Hz coordinates when the system received Earthquake Early Warning from Japan Meteorological Agency. We have a plan of further development to estimate a fault model in the fiscal year of 2009.

We analyzed the 1Hz GPS data for recent large earthquakes in a post-processing mode. The strategy of GPS analysis for the post-processing is similar to that for a real-time. We detected clear coseismic offsets and seismic waves for the Iwate-Miyagi Nairiku Earthquake in 2008 (M7.2), the Niigataken Chuetsu-oki Earthquake in 2007 (M6.8), and the Noto Hanto Earthquake in 2007 (M6.9). It will be possible to detect the coseismic displacement and estimate the fault model immediately after a M˜7 inland earthquake, if the GPS data near the epicenters are analyzed on real-time basis. On the other hand, it was difficult to detect significant coseismic displacements for the subduction earthquakes such as the M7.0 Ibarakiken-oki earthquake on May 8, 2008, the M6.9 Fukushimaken-oki earthquake on July 19, 2008, the M6.8 Iwateken-oki earthquake on July 19, 2008, and the M7.1 Tokachi-oki earthquake on September 11, 2008. The largest coseismic displacements for these earthquakes are about 1 cm, which is similar to the noise level. We, therefore, conclude that may be possible to estimate a fault model from real-time GPS data not for a M7 earthquake occurred in subduction zone but for an earthquake with magnitude 7.3 or larger.

Reference:

Blewitt, G., C. Kreemer, W. C. Hammond, H.-P. Plag, S. Stein, and E. Okal, Geophys. Res. Lett., Vol. 33, L11309, doi:10.1029/2006GL026145, 2006.

Melbourne, T. I., M. Santilan, A. Miner, and F. Webb, Eos Trans. AGU, 89(53), Fall Meet. Suppl.,