

Identification of the coseismic displacement from successive earthquakes that occurred within 1 day using the kinematic GPS

Kazutoshi Sato[1]; Manabu Hashimoto[2]

[1] RCEP, DPRI, Kyoto Univ.; [2] DPRI., Kyoto Univ

It became possible that a crustal deformation can be caught by using the kinematic GPS with the accuracy of +/- 1 cm in the horizontal component on the basis of our experiments and analyses. We believe our new method will detect the pre-slip prior to the large earthquake.

Here, we try to identify crustal deformations corresponding to consecutive seismic activities within 1 day. Recent examples of multiple earthquakes that occurred within 1 day is listed as follows.

The Northern Miyagi earthquake sequence on July 26, 2003, the Tokachi-oki earthquake on September 26, 2003, the off Kii peninsula earthquakes on September 5, 2004, and the Niigata Chuetsu earthquake on October 23, 2004 occurred in and around Japan.

Among them we take two large earthquakes that occurred in Japan, which were accompanied by multiple aftershocks larger than M6. One is the 2003 Tokachi-oki earthquake (Mw 8.1), the other is the 2004 Niigata Chuetsu earthquake (Mw 6.5).

We used 30-second sampling data with 10 degrees elevation mask provided by GEONET. We use TRACK software, the kinematic mode contained in GAMIT ver.10.07. We divided time window carefully not to stride over coseismic displacements, and applied the smoothing using the moving averages. First we calculate the averaged displacement for 2 hours before the earthquake, and this solution was made 0. As for the displacement right after the earthquake occurrence, dispersion grows large with an influence of the Kalman filter. Therefore the value for several minutes after the earthquake occurrence was made true position.

The 2003 Tokachi-oki earthquake (Mw 8.1) occurred at 4:50 JST on September 26, 2003.

This is the first earthquake of a magnitude 8 class after the GEONET was established. Large displacements are observed at the time of the mainshock, such as 88 cm at 940015, Hiroo, 81 cm at 960532, Erimo2. Since the epicenter of the largest aftershock is deviated to the southwest, displacements are large at the end of the Erimo cape, such as 12 cm at 940019, Erimo and 950144, Samani.

The 2004 Niigata Chuetsu earthquake (Mw 6.5) occurred at 17:56 on October 23, 2004, JST, which is an shallow inland earthquake. Here we try to extract coseismic displacements from the mainshock and aftershocks which occurred after the mainshock within the 1 day. The 950241, Niigata-Oogata, was chosen for the reference point taking the geometry of source fault and observation points into consideration. The largest displacements are observed at the mainshock are the largest (such as 17 cm at 960658, Sumon, and 8 cm at 950240 and 950242, Niigata-Yamato).

We applied this technique to the actual earthquake and we tried the coseismic change due to the aftershocks buried in the static analysis. A clear change due to aftershocks could be caught as that result. The integral value of the displacement which kinematic analysis could get more showed good agreement with the direction and amount of the vector with the static analysis as well. These show that it is effective as a new technique which explains a stepping change in the detailed crustal movement, such as successive earthquakes.