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Co-seismic displacement of 2011 Off Tohoku Earthquake (M9.0) observed by GEONET and IGS networks applying GAMIT program

Seiichi Shimada^{1*}, Thomas A Herring²

¹NIED, ²MIT

Co-seismic displacement of 2011 Off Tohoku Earthquake (M9.0) observed by GEONET and IGS GPS network is obtained applying GAMIT/GLOBK 10.4 program (Herring et al., 2011). For the fiducial sites, we adopt 15 IGS network sites in eastern Asia, Pacific, and North America, whose ITRF2005 coordinates (Altamimi et al., 2007) are tightly constrained. We adopt IGS final orbit as precise ephemeris.

We divide nationwide GEONET sites and domestic IGS sites (TSKB and USUD) into regional 39 groups, obtain one-day GAMIT solutions of each group with IGS fiducial sites using RINEX data, and combine all the regional GAMIT solutions to one nationwide GEONET and IGS site coordinates solutions applying GLOBK program (Ito et al., 2009).

For the period before the earthquake, for four-day period during March 7 and 10UT, 2011, we combine every daily (24-hourly) solutions into one GEONET and IGS site coordinates solution applying GLOBK program. For the period after the earthquake, we analyze the RINEX data for the periods during 05:50 and 23:59UT on March 11 and 24 hour on March 12 (UT), 2011, applying GAMIT program and obtain daily GAMIT solution, then we combine two daily solutions into one GEONET and IGS site coordinates solution applying GLOBK program. Finally we obtain the co-seismic displacement subtracting post-seismic site coordinates from pre-seismic coordinates. Thus the displacements caused by the largest aftershock (M7.7) occurred off Ibaraki 29 minutes after main shock and other aftershocks occurred within two days after main shock may be contaminated in the co-seismic displacement.

In the resultant co-seismic displacement, for the horizontal movements, coastal area from Iwate to Ibaraki near the main shock generating fault, displacements directed eastward to eastern northeastward are significant. Moreover even by the sites in Kyushu Island in western Japan displacements directed eastward to eastern northeastward are detected. In the western part of Hokkaido, southern southeastward displacements are observed. For the vertical movements, in the coastal area from Iwate to Ibaraki near the main shock generating fault, significant subsidence is observed, and around the subsidential area seen the uplift area, consistent with the displacement calculated by the dislocation theory of the reverse type fault. In the western part of Hokkaido uplift area observed, and in the eastern part of Hokkaido subsidence area are widely seen. For the west of epicentral area, in the Izu Peninsula and the coastal area of central Shizuoka subsidence area are seen, and the other part of the western Japan are observed uplift area.

Keywords: 2011 Off Tohoku Earthquake, Co-seismic displacement, Global Positioning System, GEONET, IGS, GAMIT program