Vertical crustal deformation as derived by continuous GPS observations in Tohoku, NE Japan

Toshiya Sato[1], Satoshi Miura[2], Kenji Tachibana[1], Yoko Suwa[3], Akira Hasegawa[4]

[1] RCPEV, Tohoku Univ., [2] RCPEVE,Tohoku Univ., [3] Tohoku Univ., [4] RCPEV, Graduate School of Sci., Tohoku Univ.

A dense GPS network was established in 1997 around Ou Backbone Range (OBR), northeastern(NE) Japan (Sato et al., 2001), by deploying 9 new GPS stations so as to complement the sparse portion of GEONET operated by Geographical Survey Institute of Japan (GSI). This GPS network is aimed to investigate the present surface deformation and to understand the relationship between earthquake occurrence and deformation process of the island-arc crust. Three-year observations by the network show that the region between 38.8N and 39.8N in OBR demonstrates notable concentration of EW contraction. The region coincides with the area of active seismicity, including the focal areas of large earthquakes such as 1896 (M7.2), 1900 (M7.0), 1962 (M6.5), 1970 (M6.2), and 1998 (M6.1) events.

Murakami et al. (1999) suggested that the vertical displacement obtained by GPS agrees with the results of leveling survey operated by GSI in NE Japan and may represent the real vertical deformation. GPS data derived by the network for the period from 1997 to 2000 are analyzed using the precise point positioning technique (PPP) of GIPSY/OASIS-II. The PPP is adequate to discuss the vertical displacement, since it gives not the relative height changes like leveling surveys but the absolute coordinates of stations in the ITRF coordinate system. Our results show that the vertical displacements near the Japan Sea coast are around zero, while those near the Pacific Ocean coast show the subsidence. This overall pattern is in good agreement with the result by Murakami et al. (1999) and with that obtained from leveling survey operated by GSI. In addition, the subsiding rates in the region between 39.0N and 39.6N are slightly larger than the surrounding region. This may be related to the strain accumulation in OBR as revealed by our previous work (Sato et al., 2001).

Five observatories for crustal deformation were established by Tohoku University with quartz tube extensometers and water tube tiltmeters from 1967 to 1971 in Tohoku district. 8 new stations were added in 1981 and 1982 to form so-called the monitoring chain for crustal activity in the trans-arc direction from Kesen-numa at the Pacific Ocean coast to Gojome at the Japan Sea coast with a station separation of about 20 km. Horizontal strain velocity at each station is calculated by fitting a linear function in time for the same period as GPS data and compared with the horizontal strain rate obtained by Sato et al.(2001). The result shows the consistency in polarity at 8 stations out of 11 stations. However, the strain rates obtained by extensometers are larger in magnitude than those by GPS by a factor of about 2 to 10.