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Distribution of crustal deformation around the Echigo plain, the Niigata-Kobe Tectonic Zone

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We examined the GEONET GPS data to clarify the contemporary deformation in and around the Echigo plain, Niigata prefecture where located in the Niigata-Kobe tectonic zone and the deformation zone of the eastern margin of the Japan Sea. Compressional strain in a direction of ESE-WNW is concentrated in a narrow zone where strain rate is about 0.2 ppm/yr along the coast of the Japan Sea. This strain concentration zone which is about 25 km wide accommodates more than 5 mm/yr of compression and geographically corresponds to the Echigo plain. The zone significantly subsided whereas surrounding regions was uplifted. These characteristics of the deformation are concordant with that measured by conventional geodetic surveys spanned more than several decades. The strain rate observed by GPS does not change significantly during more than a decade in the strain concentration zone, which is contrast with a large temporal change of a strain rate in the eastern region affected by a subduction of the Pacific plate. We proposed a simple model to explain the characteristics of the deformation. The model consists of aseismic slip on reverse faults which are extended to the east and west rims of the Echigo plain. Modeling with gravitational viscoelastic medium is essential to reproduce the observed subsidence in the strain concentration zone.

We started campaign GPS measurements across the Echigo plain in 2010. The distribution of the observed crustal deformation suggests a broad extension caused by the 2011 Tohoku-oki earthquake in a direction of east-west. The extension in the Echigo plain is larger than that of the surrounding region. The area where the larger extension was observed approximately corresponds to the strain concentration zone before the earthquake.

Keywords: crustal deformation, GPS, geodetic survey, deep slip, strain concentration zone