Coulomb stress change on the fault in Japan assumed from focal mechanism estimated from GNSS surface displacements of GEONET

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Introduction

Many studies used Coulomb stress change (ΔCFS) to discuss effects of large tectonic events like large earthquakes on surrounding faults. Calculation of ΔCFS is usually applied dislocation model assuming in an elastic half-space. It requires a source fault model for each tectonic event. On the other hand, previous studies (Ueda & Takahashi 2005; Ohzono & Takahashi 2016) suggest a method to calculate ΔCFS directly from the observed GNSS displacement. If the method reasonably works, it gives ΔCFS imparted by not only large tectonic events but also constant deformation. Nishimura (2017) examined efficacy of the method, and demonstrated ΔCFS increase on some fault segment ruptured by large earthquake before their rupture.

The purpose of this study is to demonstrate that actual earthquakes are consistent with ΔCFS calculated by the constant deformation from the observed GNSS displacement.

Method and Result

We calculate ΔCFS in same way to Nishimura (2017) on all source faults before the 2011 Tohoku-oki Earthquake imparted by the constant deformation observed by a GNSS. When the depth of hypocenter is less than 20km, approximately 70 % of calculated ΔCFS is positive, and annually increases several kPa (fig. 1, 2). The result is as our expectation that the method to calculate ΔCFS directly from the observed GNSS displacement reasonably works at a shallow depth in the upper crust.

Keywords: Coulomb stress change (ΔCFS), GNSS

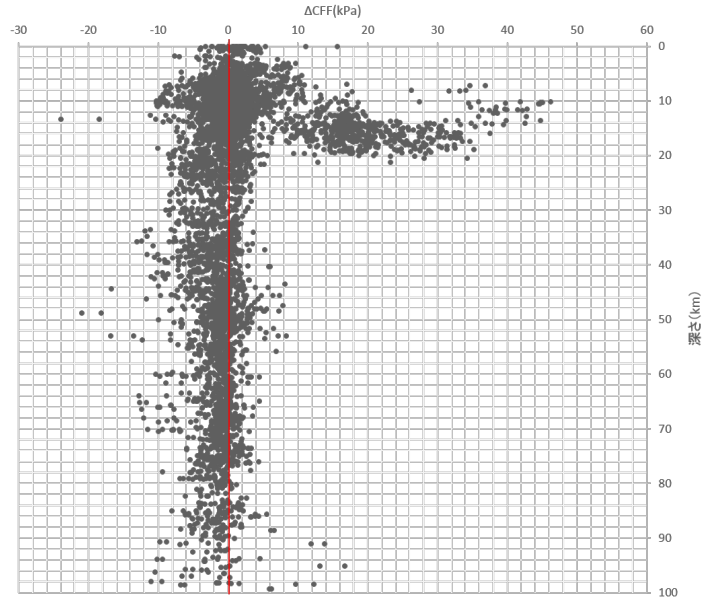

図-1 GNSS観測から推定した地震断層の定常地殻変動によるΔCFSと震源の深さの関係
Fig.1 Correlation between ΔCFS imparted by the constant annual deformation on the fault assumed from focal mechanism estimated from GNSS surface displacements and depth of hypocenter.

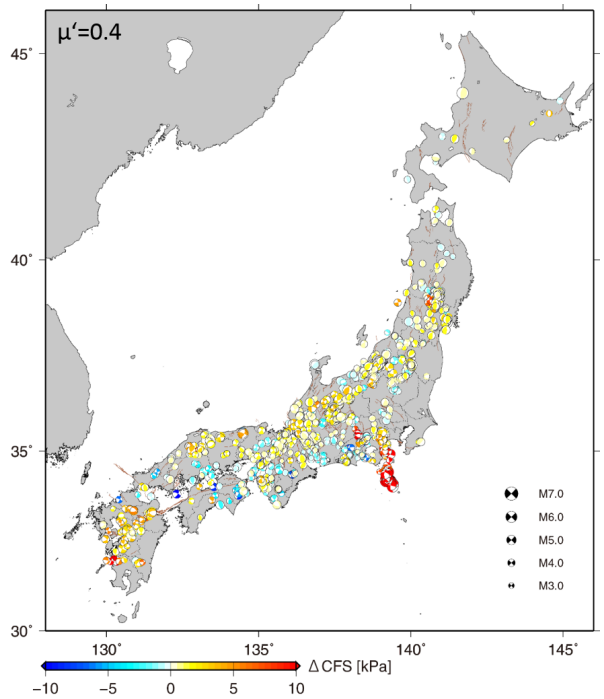

図-2 GNSS観測から推定した地震断層(深さ20km以浅)の定常的地殻変動によるΔCFS
Fig.2 ΔCFS imparted by the constant annual deformation on the fault assumed from focal mechanism estimated from GNSS surface displacements.