

Estimation of fault parameter with maximum Δ CFS based on GNSS data

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In order to estimate fault parameter (strike, dip and rake), which has the maximum Δ CFS (coulomb failure stress) at each area, we analyze horizontal GNSS data and compared the results with existing active faults. The Δ CFS is useful information to assess whether the fault tends to slip or not, based on stress redistribution induced by stress disturbances such kind of large earthquakes. Although the Δ CFS is calculated assuming source fault and its dislocation theory in general, Ueda and Takahashi (2005) and Nishimura (2018) propose an effectiveness of Δ CFS calculation from surface strain distribution observed by GNSS data. In this study, we apply this approach and search fault parameters that has the maximum Δ CFS at each area. For the test case, we calculated Δ CFS for an active fault, Yamagata-basin fault zone, using GEONET data before and after the 2011 Tohoku-oki earthquake. As a result, calculated stress field and estimated fault parameters before the earthquake well corresponds to the geometry of the actual active fault. From this test, we also found that this method calculates the Δ CFS with dip-dependency. This is due to the absence of vertical information in our method. Under the constraint of dip angle, we apply this method for Tohoku region using horizontal displacement data from September 2004 to September 2007, then we compared the result and active faults database. As a result, the region that shows high value of Δ CFSs and its fault parameters correspond to the region that evaluated S rank (category of high risk) and X rank (evaluation is difficult because of few data) faults announced by the Earthquake research committee. We also found high value of Δ CFS area even in areas without active faults. The source region of the 2008 Iwate-Miyagi inland earthquake is one of them. The estimated fault parameters with high Δ CFS also correspond to the fault mechanism of it. If the strain and stress estimated from horizontal GNSS data is caused by elastic accumulation on the fault, our method probably useful for future fault slip assessment on the current high Δ CFS fault at each area.

Keywords: Δ CFS, GNSS, active fault