Analysis of Crustal Deformation in Central and Northern Taiwan Using Block Modeling with GPS Observations

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Abstract

Taiwan locates in a high seismic activity belt of the southeastern Asia. In central Taiwan, many large earthquakes occurred in historic time, such as the 1906 Meishan (M_L= 7.1), the 1935 Hsinchu-Taichung (M_L=7.1), and the 1999 Chi-Chi (M_w= 7.6) earthquakes. GPS horizontal velocities, in addition, also show a shortening rate of about 30 mm/yr across the Central Range to the Deformation Front in the central Taiwan. In this study, we employed a method of block modeling to study the interseismic behavior, evaluate slip deficits and earthquake potential of all activity faults which published by CGS in this area. We use the 2006-2013 GPS observations from 262 continuous and 498 campaign stations and set our model with 23 blocks and 17 boundary faults for the study area. In this study, we set two models. One of model only considered block rotation and fault coupling effect, and another added internal strain in our model. We first calculated the geodetic long-term slip rates, which reflect relative motion between blocks, and the back-slip rates, which reflect interseismic fault coupling, of the boundary faults. Our elastic model results revealed large rates of slip deficit (>10 mm/yr) occur on the N-S trended Sanyi—Chelungpu—Tachienshan—Chukou faults of the Western Foothill rather than the Tachia—Changhua fault of the Deformation Front. In addition, we also used Monte Carlo method to set a 2-D model fault model cross Tachia—Changhua, Chelungpu and Tamaopu—Shuangtung fault. The result shows that higher slip rate of 24 mm/yr on Tamaopu—Shuangtung fault, and smaller on Tachia—Changhua fault. As a result, we think this kind N-S trended faults have relatively high earthquake potential due to the fast absorption of contracted strain energy across the Western Foothill of Taiwan. For 100 years recurrent interval, the magnitude of larger than Mw 6 earthquake might occur on the most of fault in the study area, and the top five of magnitude are consistent of N-S trended faults on western Foothills belt.

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