Spatial Variation of the Crustal Stress Field in Taiwan Region

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Abstract

Taiwan is located along a strongly oblique convergent zone, where the Philippine Sea Plate (PSP) subducts northward beneath the Ryukyu Arc while the Eurasian Plate (EP) eastward beneath the Luzon Arc. In order to provide insight into the collision process and mountain-building for Taiwan, we applied a damped stress inversion technique (Hardebeck and Michael, 2006), which minimized the weighted sum of the data misfit and the model length, to the fault plane solutions which are shallower than 35 km from the Broadband Array in Taiwan for Seismology data center from 1995 July to 2006 December. Taiwan region was gridded with 0.1 degree space grid and each earthquake was assigned to the nearest grid node. We next simultaneously inverted for stress in all grid nodes included all events within a 0.3 degree x 0.3 degree rectangle centered at the grid node, but the grid node with less than 8 earthquakes was abandoned. For the damped inversion, we chose the value of the damping parameter near the corner of the trade-off curve, in the lower left, where both the model length and data variance are relatively small, and stress orientation uncertainty was estimated using 2000 bootstrap resamplings of the entire data set. The 95% confidence region of the stress model is defined by the 95% of bootstrap solutions closet to the preferred solution. The result of the damped stress inversion indicates that in general the direction of compression is consistent with the relative plate motion direction of the PSP and EP but varies with the tectonic units. The direction of compression shows a significant clockwise rotation around the Lukang Magnetization High in mid-west Taiwan, and the direction of extension is related to the rifting of the Okinawa Trough in northeastern Taiwan. On the other hand, the Huatung Fault seems to dominate the crustal stress field in southeastern Taiwan. Moreover, the spatial variation of the crustal filed shows a significant stress boundary which is corresponding to the location of a possible tear fault at the northwestern tip of the subducting PSP.