Surface Motion in the Western Coastal Plain of Taiwan after Removal of Groundwater Withdrawal Effects

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ABSTRACT:

The widespread groundwater pumping was proposed to obscure the tectonic signals expected from the blind thrust faults in the metropolitan Los Angeles. In Taiwan, the tip of westward propagated frontal blind thrust has been suggested to be located beneath the Western Coastal Plain by analyses of the horizontal GPS velocities and the geological uplift rates due to the convergence between the Philippine Sea and the Eurasian plates. However, the serious land subsidence has been consistently occurred in the Western Coastal Plain because of the artificial groundwater pumping for the development of agriculture in western Taiwan. The most significant subsidence rate is observed up to 109.4 mm/yr. The effect of groundwater pumping may disturb the pattern of the horizontal velocities caused by the movement of blind thrust. As a result, ignoring the groundwater withdrawal effects will make misunderstandings on the assessment of location and kinematic characteristics of the blind thrust in western Taiwan by analysis of horizontal velocities only. In this study, to obtain a reasonable horizontal velocity field for evaluating the fault behavior in western Taiwan, we therefore used more than 704 precise leveling measurements and 20 continuous GPS observations between 2000 and 2008 in the Western Coastal Plain of Taiwan to estimate and correct the effects of groundwater pumping. The contour of land subsidence rates in the Western Coastal Plain show a concentric-circle-like pattern with the peak subsidence rates of over 800 and 900 mm/yr at the northeastern and center area of the plain. Next, we will invert the vertical velocities for the land subsidence rate resulted from the groundwater withdrawal, using a dislocation model in an elastic half-space material. The accuracy of this dislocation model will also be assessed in this study. Then the corrections of horizontal velocities will be provided from this model to help us understand the reliable tectonic signals.