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Active deformation of Tainan tableland of southwestern Taiwan based on geodetic measurements and SAR interferometry

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Abstract

The D-InSAR technique is applied to detect the active fault-related folding structure of the Tainan tableland near the deformation front in SW Taiwan by using ERS SAR images during 1996–2000. The Tainan tableland is located in-between a blind fault in the west and the Houchiali fault in the east, thus the Tainan tableland is interpreted as a pop-up structure in a fold-thrust belt at active tectonic margin. Interferometric processing of six SAR images reveals the average slant range deformation (SRD) as ~12.5 mm/yr. The uplift rate is higher in eastern Tainan tableland than that in western Tainan tableland, and it increases from west edge of Tainan tableland and decreases across the Houchiali fault. The campaign-mode GPS data set from 1999 to 2003 indicate an average horizontal movement of 12±4 mm/yr in the direction of N44°W for the Tainan tableland with respect to western coastline. Furthermore 5 precise leveling surveys across Tainan tableland over a period of 2 years show an uplift rate of ~14 mm/yr for the benchmarks on the tableland. Based on the 2-D analytical solution with the constraint of he inferred fault geometry, the slip rate along the inferred Tainan fault is ~16 mm/yr, ~10 mm/yr along the Houchiali fault, and ~25 mm/yr along the inferred Chungchou fault. Consequently we propose that active deformation of the Tainan tableland is likely resulted from the freely slipping of the Tainan fault and the Houchiali fault. The locking depth should be located on the deeper part of décollement, eastern of the Chungchou fault. In addition, the combination of D-InSAR, GPS data and the precise leveling data reveals that the short-term deformation rate is larger than long-term deformation rate, which implies that a destructive seismic event could occur in the eastern Tainan area.

Keywords: InSAR; Taiwan; Tainan Tableland; Crustal deformation; Deformation front; Houchiali Fault

1. Introduction

Space geodetic techniques, especially the Interferometric Synthetic Aperture Radar (InSAR), have become a powerful tool for high accuracy geodetic monitoring of a wide range of deformation associated with earthquakes and volcanoes, fault activity and crustal deformation at plate boundaries (Massonnet and Feigl, 1998; Bürgmann et al., 2000). The still ongoing collision between the Luzon volcanic arc and the China continental margin of Eurasian plate began ca. 5 Ma (e.g., Suppe 1984; Angelier, 1986; Ho, 1986; Teng, 1990, 1996). The collision belt connects the Ryukyu subduction zone, where Philippine Sea plate is subducting beneath the Eurasian plate, and the Manila subduction zone, where the Philippine Sea plate is overriding the crust of South China Sea (Fig. 1). The GPS measurements and the NUVEL-1 and -1A models of global plate motion predict motion of the Philippine Sea plate toward the northwest (~305°–310°), at a rate of 70–82 mm/yr relative to the Eurasia plate, in good directional agreement with the previous estimates (Seno et al., 1993; Yu et al., 1997, 1999; Zang et al., 2002). The orogenic belt of central-southern Taiwan

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