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A Comprehensive Relocation of Earthquakes in Taiwan from 1991 to 2005

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Abstract We have carried out a comprehensive relocation of a total of 267,210 earthquakes in Taiwan that occurred during the past 15 yr. We based our relocation process on the earthquake catalog of the Taiwan Central Weather Bureau Seismic Network (CWBSN) and made improvements in three aspects. First, we incorporated a large dataset of the *S-P* times from 680 Taiwan Strong-Motion Instrumentation Program (TSMIP) stations distributed throughout the island of Taiwan to improve the coverage of earthquakes on the island. Secondly, we added 18 Japan Meteorological Agency (JMA) stations in the southern Ryukyu Island chain to enhance the station coverage for eastern offshore events, especially around the subduction zone northeast of Taiwan. Thirdly, we adopted 3D V_P and V_P/V_S models in predicting the travel times of *P* and *S* waves. The effectiveness of these improvements in earthquake relocation can be seen in three aspects: (1) the reduction in the residuals of *P*-wave arrival times and *S-P* times, (2) a better understanding of the attenuation relationship between the peak-ground acceleration and epicentral distance, and (3) the geologically meaningful patterns of station corrections to *P*-wave arrival times and *S-P* times.

Online Material: Catalog of relocated earthquakes in Taiwan from January 1991 to December 2005.

Introduction

Taiwan is one of the most seismically active regions in the world. It is situated in the western portion of the Pacific Rim seismic belt. Along the Ryukyu trench east of the island of Taiwan, the Philippine Sea plate subducts northward under the Eurasian plate. Off the southern tip of the island, the South China Sea subplate, part of the Eurasian plate, subducts eastward under the Philippine Sea plate (Tsai *et al.*, 1977). Figure 1 is a schematic diagram showing the major geologic settings in the region. On the southeast side of Taiwan, the Longitudinal Valley, the suture zone of Eurasian and Philippine Sea plates, separates the region into two major tectonic provinces. The eastern side consists of the Coastal Range and several volcanic islands, and it is the leading edge of the Philippine Sea plate. The western province is associated with the Eurasian continental shelf (Ho, 1999), and can be classified into four north-northeast–south-southwest trending tectonic belts. They are, from west to east, the Coastal Plain, the Western Foothills, the Hsuehshan Range, and the Central Range (Fig. 1).

As a result of the regional tectonic movements, most of Taiwan is under a northwest–southeast compression with a convergence rate of about 8 cm/yr (Yu *et al.*, 1997). The Taiwan orogeny, started around 4 Ma (Suppe, 1984), is relatively young on the geological timescale. The island has a high rate of crustal deformation and a strong seismic activity. Since 1994, the Taiwan Central Weather Bureau Seismic Network (CWBSN, Shin, 1992; 1993a), the agency responsible for earthquake monitoring, records about 18,000 events each year in a roughly 400 × 550-km region. Many significant and damaging events that have occurred in the past decade have been well recorded and carefully studied, for example: the 1998 Reuy-Li M_w 5.7 earthquake (e.g., Chen *et al.*, 1999; Wu *et al.*, 2003), the 1999 Chi-Chi M_w 7.6 earthquake (e.g., Chang *et al.*, 2000; Shin and Teng, 2001; Teng *et al.*, 2001; Chen, 2003; Chen *et al.*, 2006; Wu and Chiao, 2006; Chang *et al.*, 2007; Wu and Chen, 2007), the 1999 Chia-Yi M_w 5.8 earthquake (e.g., Chang and Wang, 2006), the 2002 Hualien M_w 7.1 earthquake (e.g., Chen *et al.*, 2004), the 2003 Chengkung M_w 6.8 earthquake (e.g., Wu, Chen, Shin, *et al.*, 2006; Hu *et al.*, 2007), the 2006 Taitung M_w 6.1 earthquake (e.g., Wu, Chen, Chang, *et al.*, 2006), and the recent Pingtung M_w 7.1 earthquake in December 2006.

Among all of those events, the Chi-Chi earthquake was the largest inland earthquake to occur in Taiwan in the twen-

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