Investigation on the reliability of TEM PSHA2015

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The Taiwan Earthquake Model (TEM) has had a new probabilistic seismic hazard model (TEM PSHA2015) for determining the probability of exceedance (PoE) of the ground motion over a specified period in Taiwan. We conducted several tests to investigate the adequacy of the seismic source parameters adopted by the TEM PSHA2015. The observed maximal peak ground acceleration (PGA) of the $M_L > 4.0$ mainshocks from 1993 to 2015 were used to test the predicted PGA from areal and subduction zone sources based on a time-independent Poisson distribution. In Figure 1, we compared the observations with the predicted PGA, this comparison excluded the observations from the 1999 Chi-Chi earthquake, as this was the only earthquake associated with the identified seismogenic structures in the testing period. This study showed that the predicted PGA for a 63% PoE in a 23-year period corresponded to observations confirming the applicability of the parameters to areal and subduction zone sources. Additionally, we compared the observation of the 2016 Meinong earthquake with the predicted ground motion from disaggregated hazard maps. The result indicated that contribution to the seismic hazard in southern Taiwan is mainly from fault sources. The observed hazard of the 2016 Meinong earthquake (M_w 6.4) corresponds to the contribution of areal sources. In addition, we adopted disaggregation analysis to determine the contribution of each seismic source to the hazard and used tornado diagrams to analyze the sensitivities of the source parameters to the ground motion levels of the PSHA for six metropolitan cities in Taiwan. Sensitivity tests on the seismogenic structure parameters indicated that the slip rate and maximum magnitude are the dominant factors in the TEM PSHA2015.

Key words: PSHA, Poisson process, seismic hazard, disaggregation, sensitivity test
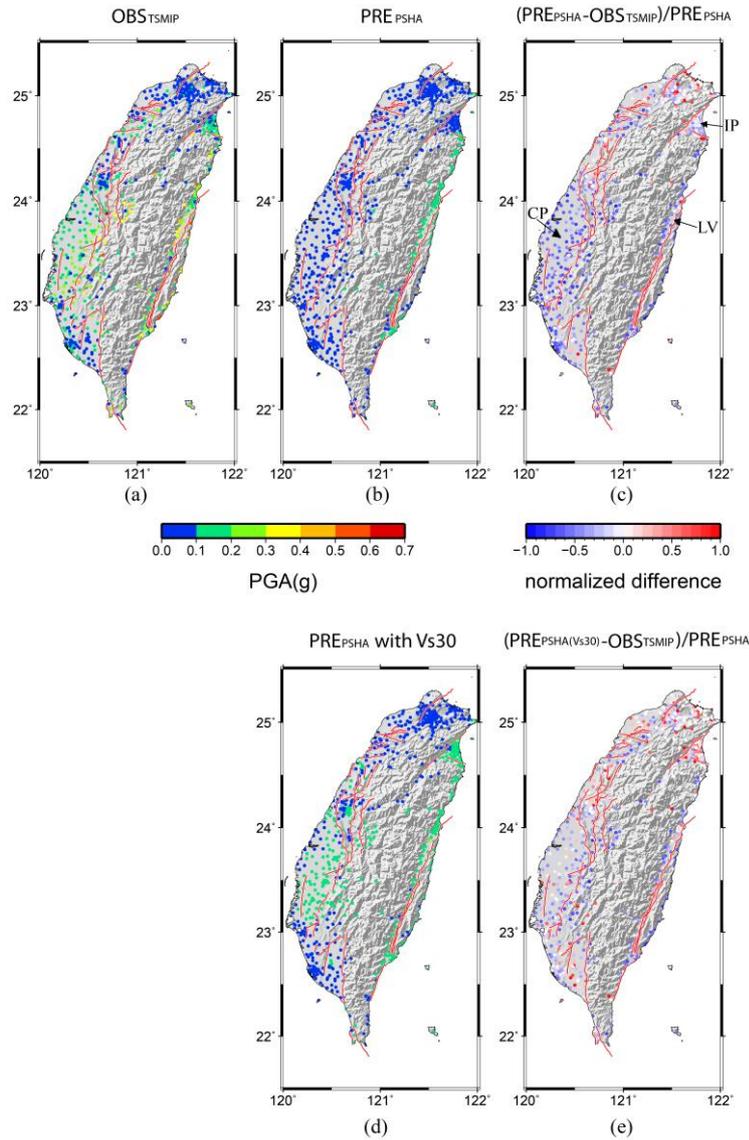
Figure 1 Comparison of the observed maximal PGA for 1993–2015 and predicted PGA of PSHA with a 63% PoE over 23 years. (a) Observed maximal PGA recorded by the Taiwan Strong Ground Motion Network during 1993–2015. (b) Predicted PGA of the PSHA according to shallow areal sources and subduction zone sources for bedrock sites (V_{s30} = 760 m/s). (c) Normalized PGA difference between the observed maximal PGA and the predicted PGA. The normalized PGA difference is defined as the difference between the predicted and observed maximal PGAs divided by the observed maximal PGA for bedrock sites (V_{s30} = 760 m/s). (d) Predicted PGA considering the V_{s30} of the sites. (e) Normalized PGA difference between the observed maximal PGA and the predicted PGA considering V_{s30}. The Coastal Plain, Ilan Plain, and Longitudinal Valley are denoted as CP, IP, and LV, respectively.