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A Comparison of Ground Motion Prediction Equations with Different Magnitude Scales

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Probabilistic Seismic Hazard Analysis (PSHA) is very important in an earthquake disaster mitigation program and ground motion prediction equation (GMPE) is one of the most fundamental elements in PSHA. In the past, most of the GMPEs were used Richter scale (ML) as an earthquake magnitude parameter. Current practice, Moment magnitudes (MW) is frequently used instead. However, we all know ML and MW are different in presenting earthquake size of different frequency bands. There is no discussion about the advantage and disadvantage of using the two different magnitude scales in the GMPEs.

The purpose of this study is to compare the GMPEs scaled with ML and MW. The advantage and disadvantage of those GMPEs will be reported. We used the data collected by the Taiwan Strong Motion Instrumentation Program during 1993–2014. First of all, two groups of GMPEs, respectively scaled by ML and MW were developed using Genetic Algorithm (GA). Since our purpose is to discuss the effects of magnitude scales in the GMPEs, the magnitude and shortest distance between site and rupture plane are the only two parameters in our regression analyses. The so called Campbell's form of attenuation equation is used.

The results show that the GMPEs scaled by ML give the better prediction accuracy for estimating the peak ground acceleration (PGA) and acceleration response spectra in the period range of 0.01∼0.5sec. It is in consistence with the definition of ML. On the contrary, displacement response spectra in the period range of 2.0∼8.0sec can be predicted more accurately by GMPEs scaled as a function of MW which is defined based on the average rupture of fault plane. In turns, this may suggest that it is better to use GMPEs with appropriate magnitude scale to estimate ground motions of different period ranges.