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Abstract

We demonstrate, in this study, not only inaccurate seismic hazard assessment in Taiwan due to the earthquake intensity scale problem but also some general characteristics of damaging events in the past decade. Earthquake intensity is a method of expressing the size or energy of an earthquake in terms of effects on people and destruction on infrastructure. The Central Weather Bureau (CWB) intensity scale is classified into eight intensity degrees, from 0 (micro) to 7 (great), which are equivalent to the following ground acceleration (in cm/sec2 or gal): Below 0.8, 0.8-2.5, 2.5-8.0, 8.0-25, 25-80, 80-250, 250-400 and above 400 (http://www.cwb.gov.tw/eng/index.htm). It had originated from Japan Meteorological Agency (JMA) intensity scale, which further divided intensities 5 and 6 into two subdivisions of lower and upper after the 1995 Kobe earthquake. Similarly, the CWB intensity scale was also revised after the 1999 Chi-Chi earthquake. Before the earthquake, there were only seven intensity degrees, from 0 to 6. However, the maximum ground acceleration of Chi-Chi earthquake was about 1000 gal and the existing intensity scale could not accommodate this high PGA value. The need for revision was imperative. The new scale with an addition of new intensity degree, 7, was effective on 1st August, 2000.
An earthquake intensity, from 1 to 7, is assigned (0 is not being assigned) at each station according to the maximum recorded value of ground acceleration. The maximum value can come from one of three components, Vertical, North-South and East-West, of the ground acceleration. During the period from January 2000 to December 2009, there are totally fifteen free-field strong-motion seismic events which intensities are recorded as 7 in Central Weather Bureau Geophysical Database Management System (http://gdms.cwb.gov.tw/). However, only four events among them have caused casualties according to statistics from the website of National Fire Agency, Ministry of the Interior (http://www.nfa.gov.tw). Eleven are harmless. The scale, intensity 7, does not truly reflect the accurate seismic hazard assessment. According to the CWB earthquake intensity scale, intensity 7 should have severe damage to or collapse of some buildings. Take intensity 6 (PGA values are between 250-400 gal) as another example, four out of fourteen seismic events of the same period, 2000-2009, caused damages. None of sixty-four seismic events with intensity 5 (PGA values are between 80-250 gal) have caused casualties and/or damage during the same period; and, only one record of damage with intensity 3 (PGA values are between 8.0-25 gal) has been recorded. Hence, no casualties or damage were recorded in seismic events with intensities smaller than 6, except the only one record from intensity 3 (discarded for further analysis since discrepancies have later been found). In terms of percentage, damage rates of intensities 6 and 7 are respectively 28.6% and 26.7%. From the above examples, the classification of an earthquake intensity scale clearly cannot depend only on the maximum recorded PGA value.
Using the same set of data, we show some characteristics of damaging events in Taiwan: shallow earthquakes (0-50 km) do matter! No intermediate or deep earthquakes in Taiwan cause damage in the past decade. Local

magnitudes, nevertheless, vary in a wider range (ML=5.25-6.99). Seismic hazard originates both from onshore and offshore earthquakes and site effects contributed from, for instance, Taipei Basin, are obvious.