Assessment of site amplification and the influence on M_L using the surface-downhole network in Taiwan

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This study analyzed site effects in terms of PGA and empirical transfer functions at 15 selected surface–downhole stations in Taiwan, as well as discussed its importance on local magnitude determination. The site amplification factors of the PGA were calculated using the ratio between the surface and downhole recordings. The mean PGA amplification factors ranged from 2 to an exaggerated value of 20 at different stations. Strong ground motions with and without site effects throughout Taiwan could be observed by comparing intensity distribution maps generated using the surface and downhole accelerations from four earthquakes($M_L > 6$). Empirical transfer functions derived using the single-station and two-station methods at the same sites showed comparable dominant frequencies and amplification factors; however, the empirical transfer function derived using the two-station method showed clearer resonance peaks, not only at fundamental frequencies but also at higher mode resonance frequencies. The HHSR and the HVSR were highly similar, particularly at medium frequencies. This finding supports that the HVSR can be used instead of the HHSR when only the surface recording is available. Moreover, the local magnitudes calculated using surface recordings were higher than those calculated using downhole recordings. The differences are attributed to the amplification caused by the sedimentary layers and resultant in 0.36, 0.46 and 0.49 on average for events with M_L >6, 5–6, and 4–5. Furthermore, HHSRs at 5–10 Hz and 1.1–1.7 Hz were strongly correlated with PGA amplifications and M_L differences, respectively.

Keywords: site amplification, surface-downhole, local magnitude