Application of Site Amplification Factors to Determine the Local Magnitude from Borehole Seismic Stations in Taiwan

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Since the inception of 62 borehole seismic arrays deployed by Central Weather Bureau (CWB) in Taiwan until the end of 2018, a large quantity of strong-motion records have been accumulated from frequently occurring earthquakes around Taiwan, which provide an opportunity to detect micro-seismicity. Each borehole array includes two force balance accelerometers, one at the surface and other at a depth of a few ten-to-hundred (30-492) meters, as well as one broadband seismometer is below the borehole accelerometer. In general, the background seismic noise level are lower at the downhole stations than surface stations. However, the seismograms recorded by the downhole stations are smaller than surface stations due to the near-surface site effect. In Taiwan, the local magnitude (M_L) determinations use the attenuation function derived from surface stations. Therefore, the M_L will be underestimated by using current attenuation function for downhole stations. In this study, we used 19079 earthquakes to investigate the site amplification at subsurface materials between downhole and surface stations. Results demonstrate the amplification factors ranging from 1.11 to 5.74, provide the site effect parameter at shallow layers and have a strong relationship with Vs30. Further, we apply the amplification factors to revise the station local magnitude for downhole station. The revised M_L at downhole stations correlate well with the M_L at surface stations. Implement of the downhole station in the M_L determination, it enhances the ability to detect the micro-earthquake and makes the earthquake catalog more comprehensive in Taiwan.