Shallow shear wave velocity structures of strong motion stations (TSMIP) in Taiwan from Receiver Function analysis

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The active collisions between the Philippine Sea plate and the Eurasian plate cause the high seismicity and result in major tectonic features in and around Taiwan. There is a wide range of alluvium plains and basins, including the Western Coastal Plain, the Pingtung Plain, the Taipei Basin, and the Ilan Plain, that are filled with unconsolidated Quaternary sediment covering the bedrock. The obvious seismic site effect amplifies and extends incident seismic waves and can result in earthquake disasters. Therefore, a detailed shallow velocity model, reflecting the real and complex seismic site effects in these areas, is necessary for ground motion simulation and prediction in Taiwan.

The advantage of the even strong motion stations and numerous records in Taiwan has been taken to apply the Receiver Function (RF) technique to high-frequency acceleration seismograms recorded by Taiwan Strong Motion Instrumentation Program (TSMIP) stations, which are operated by the Central Weather Bureau (CWB), to estimate the shallow shear wave velocity (Vs) structures. In the RF analyses of this study, all horizontal waveforms were converted to radial components and divided by the vertical component in the frequency domain of the Fourier spectra to derive the RFs. An average RF of each station would be calculated to enhance the converted phases and reduces the inharmonic arrivals. Based on the geological, geophysical, and Engineering Geology Database for TSMIP (EGDT) drilling data, an initial layer model with variable Vs and thickness is assumed to model RF and estimate Vs profile of a station by Genetic Algorithm (GA) search. Finally, the one-dimensional shallow Vs profiles of the TSMIP stations were estimated by RF analysis and forward modeling with GA search. All the results proved that this method is an effective and convenient way to construct a shallow Vs structure of alluvium plain (or basin) overlaying a hard bedrock. Based on all the Vs structures estimated in this study, a preliminary shallow velocity model can be constructed for Taiwan. In addition, the results also can be compared with the Vs30 of EGDT to confirm the site conditions of TSMIP stations and provide another important site parameter, the $Z_{1.0}$, for applying to seismology and earthquake engineering.