Geophysical Research Abstracts
Vol. 15, EGU2013-3218, 2013
EGU General Assembly 2013

Combined estimation of kappa and shear-wave velocity profile of the Japanese rock reference

Valerio Poggi, Benjamin Edwards, and Donat Fäh
Swiss Seismological Service, ETH Zurich, Switzerland (poggi@sed.ethz.ch)

The definition of a common soil or rock reference is a key issue in probabilistic seismic hazard analysis (PSHA), microzonation studies, local site-response analysis and, more generally, when predicted or observed ground motion is compared for sites of different characteristics. A scaling procedure, which accounts for a common reference, is then necessary to avoid bias induced by the differences in the local geology. Nowadays methods requiring the definition of a reference condition generally prescribe the characteristic of a rock reference, calibrated using indirect estimation methods based on geology or on surface proxies. In most cases, a unique average shear-wave velocity value is prescribed (e.g. Vs30 = 800m/s as for class A of the EUROCODE8). Some attempts at defining the whole shape of a reference rock velocity profile have been described, often without a clear physical justification of how such a selection was performed. Moreover, in spite of its relevance in affecting the high-frequency part of the spectrum, the definition of the associated reference attenuation is in most cases missing or, when present, still remains quite uncertain.

In this study we propose an approach that is based on the comparison between empirical anelastic amplification functions from spectral modeling of earthquakes and average S-wave velocities computed using the quarter-wavelength approach. The method is an extension of the approach originally proposed by Poggi et al. (2011) for Switzerland, and is here applied to Japan. For the analysis we make use of a selection of 36 stiff-soil and rock sites from the Japanese KiK-net network, for which a measured velocity profile is available. With respect to the previous study, however, we now analyze separately the elastic and anelastic contributions of the estimated empirical amplification. In a first step - which is consistent with the original work - only the elastic part of the amplification spectrum is considered. This procedure allows the retrieval of the shape of the velocity profile that is characterized by no relative amplification within the network. Subsequently, the contribution of intrinsic attenuation is analyzed, disaggregated from the anelastic function by using the frequency independent (and site-dependent) attenuation operator kappa (κ). By comparing the dependency of κ with the quarter-wavelength velocity at selected sites, a frequency-dependent predictive equation is established to model the attenuation characteristics of an arbitrary rock or stiff-soil velocity model, such as the reference model obtained in the first step.

The result of this application can be used to model the site-dependent attenuation for any rock and stiff-soil site for which an estimation of the velocity profile or its corresponding quarter-wavelength velocity representation is available. As an additional output of the present study, we also propose a simplified method to estimate kappa from the average velocity estimates over the first 30m (Vs30). We provide an example of such predictions for a range of Vs30 velocities up to 2000m/s.