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Systematic Site Characterization at Seismic Stations combined with Empirical Spectral Modeling: critical data for local hazard analysis

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The Swiss Seismological Service operates one of the densest national seismic networks in the world, still rapidly expanding (see http://www.seismo.ethz.ch/monitor/index_EN). Since 2009, every newly instrumented site is characterized following an established procedure to derive realistic 1D VS velocity profiles. In addition, empirical Fourier spectral modeling is performed on the whole network for each recorded event with sufficient signal-to-noise ratio. Besides the source characteristics of the earthquakes, statistical real time analyses of the residuals of the spectral modeling provide a seamlessly updated amplification function w.r. to Swiss rock conditions at every station.

Our site characterization procedure is mainly based on the analysis of surface waves from passive experiments and includes cross-checks of the derived amplification functions with those obtained through spectral modeling. The systematic use of three component surface-wave analysis, allowing the derivation of both Rayleigh and Love waves dispersion curves, also contributes to the improved quality of the retrieved profiles.

The results of site characterisation activities at recently installed strong-motion stations depict the large variety of possible effects of surface geology on ground motion in the Alpine context. Such effects range from de-amplification at hard-rock sites to amplification up to a factor of 15 in lacustrine sediments with respect to the Swiss reference rock velocity model. The derived velocity profiles are shown to reproduce observed amplification functions from empirical spectral modeling. Although many sites are found to exhibit 1D behavior, our procedure allows the detection and qualification of 2D and 3D effects.

All data collected during the site characterization procedures in the last 20 years are gathered in a database, implementing a data model proposed for community use at the European scale through NERA and EPOS (www.epos-eu.org). A web stationbook derived from it can be accessed through the interface www.stations.seismo.ethz.ch.