Inversion of the mechanical properties of the soil using the horizontal-to-vertical (H/V) spectral ratio of earthquake motions

Ariane Ducellier

Inversion of the mechanical properties of the soil usingthehorizontal-to-vertical (H/V) spectral ratio of earthquake motions

The earthquake motion generated by the multiple scattering due to the complexity of the underneath soil structure can be referred to as a diffusewave field. Under the assumption of the well-diffused wave field it is accepted that the average autocorrelation of a single receiver is proportional to the imaginary part of the Green's function when both source and receiver are located at the same point. In this study we focus on sites where the site effect can be described using a one dimensional model. Previous studies show that the imaginary part of the Green's function at the free surface is proportional to the square of the absolute value of the corresponding transfer function for a plane, vertically incident wave with unit amplitude. It is then possible to carry out an inversion of the 1D velocity structure using the relationship between the horizontal-to-vertical (H/V) spectral ratio and the ratio of horizontal and vertical transfer functions.

We verify that the average H/V spectral ratio computed with a sufficiently large number of earthquake data depends only on the underneath geological structure, and not on the set of data used to compute it. We then use a Genetic Algorithm to carry out inversions of the velocity structuresfor several sites of the K-NET and KiK-net networks in the Tohoku area, Japan, following the proposed theory for earthquake H/V spectral ratios. We compare the results of the inversions with a Genetic Algorithm to the results of linearized inversions. We use the model and data resolutions matrices from the linearized inversion to check if the parameters of the soil columns are well constrained by the inversion. Finally, we use the H/V spectral ratio to highlight the modification of the mechanical properties of upper soil layers after extreme ground motion.