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Utilizing vector wavenumber transform method to extract multi-mode dispersion curves of Rayleigh waves from ambient seismic noise and the application to structure inversion in Bohemian Massif

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Over the last years, extracting the empirical Green's functions (EGFs) from ambient seismic noise to obtain surface wave dispersion has become a well-established method in seismology. The EGFs derived from the vertical components of ambient seismic noise data include the fundamental-mode and higher-mode Rayleigh waves. Higher-mode Rayleigh waves can penetrate into deeper structure than the fundamental-mode ones. Considering the fundamental-mode and higher-mode Rayleigh waves simultaneously can greatly increase the constraint on shear velocity structure. The vector wavenumber transform method (VWTM) and the sensitivity analysis of dispersion curves of Rayleigh waves are two new approaches proposed by our group; the former can extract the dispersion imaging of the fundamental-mode and higher-modes of Rayleigh waves well from continuous ambient seismic noise data and the latter can be used to analyze the sensitivities of the fundamental-mode and higher-mode Rayleigh waves in depth and frequency.
In this study, we apply the VWTM to the ambient seismic noise data from some temporary and permanent stations in the northwest of Bohemian massif and adjacent areas to obtain the dispersion curves of fundamental-mode and higher-mode Rayleigh waves. Then, we perform an inversion based on the dispersion curves to obtain the one-dimensional shear velocity models and show the differences of inversion models between two different situations. One is to utilize only the fundamental-mode Rayleigh waves, the other is to use both of fundamental-mode and higher-mode Rayleigh waves. After that, with the aid of sensitivity analysis of dispersion curves, we analyze the sensitivities of fundamental-mode and higher-mode Rayleigh waves in different depths and frequencies. At the last, based on the above analysis and comparison, we derive 1-D shear wave velocity models in the northwest of Bohemian massif and adjacent areas.