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Shallow Vs Structure of the Mauleon Basin (Western Pyrenees) by Joint Inversion of Horizontal-to-Vertical Spectral Ratios and Rayleigh Wave Group Velocities from the large-N Maupasacq Experiment

Maik Neukirch, Antonio García-Jerez, Antonio Villaseñor, Laurent Stehly, Pierre Boué, Sébastien Chevrot , Matthieu Sylvander, Jordi Díaz , Mario Ruiz , Francisco Luzón, Magali Collin, Sylvain Calassou, Katerina Polychronopoulou, Nikos Martakis, and Adnand Bitri

Institut de Ciències de la Terra Jaume Almera, Barcelona, Spain (mneukirch@ictja.csic.es)

Horizontal-to-Vertical Spectral Ratios (H/V) and Rayleigh group velocity dispersion curves can be used to estimate the shallow S-wave velocity (Vs) structure. Knowing the Vs structure is important for geophysical data interpretation either in order to better constrain data inversions for P-wave velocity (Vp) structures such as travel time tomography or full waveform inversions, or to directly study the Vs structure for geo-engineering purposes (e.g. ground motion prediction). The main purpose of this study is to investigate the potential and performance of the combination of H/V and surface wave dispersion data for a dense passive seismic array. The joint inversion of H/V and dispersion data for 1D Vs structure allows to characterize the uppermost crust and near surface, where the H/V data (0.03 to 10 s) is most sensitive while the dispersion data (1 to 30 s) constrains the deeper model which would, otherwise, add complexity to the H/V data inversion and impede its convergence.

During this large-scale experiment, 197 three-component short-period stations were continuously operated for 6 months (April to October 2017) covering an area of approximately 1500 km2 with a site spacing of approximately 3 km. The recovered 1D models reach to a depth of 500 to 1000 m. Due to the wide site spacing compared to the model depth, combining these 1D models to a 3D model by interpolation is computationally more economic than attempting a real 3D inversion with this data. The illustrated 3D model can be used to constrain the fine structure of the upper crust for subsequent inversions that attempt to recover deeper models with inherently less resolution such as travel time tomography, or full waveform inversion that requires a very good starting model. Due to the sensitivity of H/V data to density, we also show a preliminary 3D density model of the area that could (and, in the future, will) be used in combination with available gravity measurements.