Crustal structure of the Basque-Cantabrian Zone (N Spain) from seismic noise and receiver functions

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The Basque-Cantabrian Zone was one of the most subsident areas between the European plate and the Iberian sub-plate during the Mesozoic rifting process that gave birth to the Bay of Biscay. Since the latest Cretaceous and during the Cenozoic, a change to a contractional setting driven by the northward drift of the African Plate made this hyperextended rift basin to be inverted and incorporated into the Pyrenean-Cantabrian mountain belt. The resulting crustal structure shows a high complexity, as evidenced by the many existing geophysical observations pointing to the presence of intracrustal high-velocity bodies, deep transfer structures, and sharply-varying Moho depths across the area.

In this work, we use data provided by the dense SISCAN and MISTERIOS seismic networks, deployed in the region between 2014 and 2018, to obtain a detailed 3D shear-wave velocity model. We use the continuous recordings to compute seismic noise cross-correlation functions, from which we extract surface wave dispersion measurements. We use these measurements to obtain a set of phase velocity maps, and then perform a non-linear inversion at regularly spaced locations for the 1D shear-wave velocity structure. In the non-linear inversion, the forward modeling accounts for the presence of higher modes of surface waves, which have been shown to be more sensitive to velocity decreases with depth than the fundamental model. In order to better constrain the deeper layers of the model, we complement the seismic noise observations with an analysis of teleseismic receiver functions, which allows us to better constrain the depths of the major crustal discontinuities. Our results agree with previous geophysical studies, but significantly improve the availability of high-resolution information in the Basque-Cantabrian Zone.