



## **High resolution imaging of lithospheric structures beneath the Pyrenees by full waveform inversion of shortperiod teleseismic P waves**

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Thanks to the deployment of permanent and temporary broadband arrays, coverage and data quality have dramatically improved in the last decade, especially for regional-scale studies. In addition, owing to the progress of high-performance resources and numerical simulation techniques, waveform inversion approaches nowadays become a viable alternative to classical asymptotic ray based tomographic approaches.

Exploiting full waveforms in seismic tomography requires an efficient and precise method to solve the elastic wave equation in 3D inhomogeneous media. Since resolution of waveform inversion is limited by the seismic wavelength as well as the wavefield sampling density, it is crucial to exploit short-period teleseismic waves recorded by dense regional arrays. However, modeling the propagation of short-period body waves in heterogeneous media is still very challenging, even on the largest modern supercomputers. For this reason, we have developed a hybrid method that couples a global wave propagation method in a 1D Earth to a 3D spectral-element method in a regional domain. This hybrid method restricts the costly 3D computations to inside the regional domain, which dramatically decreases the computational cost, allows us to compute teleseismic wavefields down to 1s period, thus accounting for the complexities that affect the propagation of seismic waves in the regional domain.

We present the first application of this new waveform inversion approach to broadband data coming from two dense transects deployed during the PYROPE experiment across the Pyrenees mountains.

We obtain the first high-resolution lithospheric section of compressional and shear velocities across an orogenic belt. The tomographic model provides clear evidence for the under-thrusting of the thinned Iberian crust beneath the European plate and for the important role of rift-inherited mantle structures during the formation of the Pyrenees.