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PRISM3D: a preliminary 3D reference seismic model of the crust and upper mantle beneath Iberia

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Earthquake location and moment tensor inversion are usually performed assuming one-dimensional (1D), radially symmetric models of the Earth's seismic velocity field. In a region such as Iberia, that hypothesis may no longer be valid: its location combining a plate boundary context with a passive margin environment indeed results in the presence of mountain ranges and abyssal plains, and juxtaposes sedimentary basins, thickened, normal and thinned continental crust, oceanic material, and even, locally, exhumed mantle. Furthermore, earthquakes in the Gulf of Cadiz and in the Alboran Sea, respectively west and east of Gibraltar Strait, are known to occur in the upper mantle, which also presents lateral velocity variations. A three-dimensional (3D) seismic velocity model of the crust and upper mantle beneath Iberia therefore appears necessary for accurate travel time and waveform modeling, in order to account for lateral variations of topography, Moho depth and lithology, and improve earthquake location and source inversion. Here, we present a new 3D P- and S-wave velocity model for Iberia. The model spans a region ranging from 17W to 6E in longitude and 28N to 47N in latitude, and from 7km above to 250 km below sea level in depth, with a grid node spacing of 10 km in longitude and latitude, and 0.5 km in depth. It results from the compilation of existing -published and unpublished - local earthquake and teleseismic body wave tomographic models, earthquake and ambient noise surface wave as well as receiver function inversion studies, and active source seismic experiments. Moho depth is estimated by interpolation of results from receiver function and deep seismic sounding using the reversible jump algorithm. Crust and mantle velocity field are then obtained separately by weighted average of the compiled models. This new 3D model, which combines the most recent seismic structure studies in Iberia and its surroundings, forms a reliable basis for earthquake location and source inversion, and for future local earthquake and teleseismic tomographic inversions.