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A new crustal model of the western Alpine region derived by combining controlled-source seismology and local earthquake tomography data

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We present a newly developed approach of combining controlled-source seismology (CSS) and local earthquake tomography (LET) data to obtain a new 3D crustal model in the western Alpine region. Our approach takes into account the strengths of each seismic method and the quality of each individual seismic information. Therefore, our western Alpine 3D model includes a well-defined Moho, constrained by CSS and LET data, as well as smooth lateral variations in seismic velocities. The consistent combination of results from two different seismic methods is feasible due to the definition of LET Moho elements and their uncertainty estimates. Identification of LET Moho elements is based on a characteristic P-wave velocity (7.25 km/s); uncertainty estimates are derived from the diagonal element of the resolution matrix (RDE), absolute P-wave velocities that are typical for crust and mantle, and a specific velocity gradient around Moho depth. We validate our approach by comparing highest quality Moho elements from both methods coinciding in 353 localities. We find only four Moho elements for which the difference in Moho depth is greater than the error sum of the uncertainty estimates and these four Moho elements are all located close to plate boundaries, where 3D migration of CSS reflector elements is poorly constrained. Our model clearly shows three Moho surfaces, being Europe, Adria, and Liguria, as well as major tectonic structures like suture zones and the high-velocity Ivrea body. Compared to previous studies, our model allows for a more accurate definition of plate boundaries at Moho level. We attribute this to the larger number of available Moho elements derived from LET data. Therefore, the new model allows better insights in the deep crustal structure of the Alpine collision zone.