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Crustal velocity structure beneath the NW Dinarides from 1-D hypocenter-velocity inversion

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The investigated area of the NW Dinarides is bordered by the Adriatic foreland, the Southern Alps, and the Pannonian basin at the NE corner of the Adriatic Sea. Its complex crustal structure is the result of interactions among different tectonic units. Despite numerous seismic studies taking place in this region, there still exists a need for a detailed, smaller scale study focusing mainly on the brittle part of the Earth's crust. Therefore, we decided to investigate the velocity structure of the crust using concepts of local earthquake tomography (LET) and minimum 1-D velocity model. Here, we present the results of the 1-D velocity modeling and the catalogue of the relocated seismicity. A minimum 1-D velocity model is computed by simultaneous inversion for hypocentral and velocity parameters together with seismic station corrections and represents the best fit to the observed arrival times.

We used 15,579 routinely picked P wave arrival times from 631 well-located earthquakes that occurred in Slovenia and in its immediate surroundings (mainly NW Croatia). Various initial 1-D velocity models, differing in velocity and layering, were used as input for velocity inversion in the VELEST program. We also varied several inversion parameters during the inversion runs. Most of the computed 1-D velocity models converged to a stable solution in the depth range between 0 and 25 km. We evaluated the inversion results using rigorous testing procedures and selected two best performing velocity models. Each of these models will be used independently as the initial model in the simultaneous hypocenter-velocity inversion for a 3-D velocity structure in LET. Based on the results of the 1-D velocity modeling, seismicity distribution, and tectonics, we divided the study area into three parts, redefined the earthquake-station geometry, and performed the inversion for each part separately. This way, we gained a better insight into the shallow velocity structure of each subregion and were able to demonstrate the differences among them.

Besides general structural implications and a potential to improve the results of LET, the new 1-D velocity models along with station corrections can also be used in fast routine earthquake location and to detect systematic travel time errors in seismological bulletins, as already shown by some studies using similar methods.