Solid Earth Discussions

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Comment on se-2021-67

Anonymous Referee #1

Referee comment on "1-D velocity structure modelling of the Earth's Crust in the NW Dinarides" by Gregor Rajh et al., Solid Earth Discuss., https://doi.org/10.5194/se-2021-67-RC1, 2021

This is my formal review of the paper "1-D velocity structure modeling of the Earth's Crust in the NW

Dinarides" by Gregor Rajh et alii.

As general comment, I find that the authors use a a well corroborate approach to compute the 1D minimum velocity model (the Velest code). The use of Velest is also performed in a correct way. However the lacking of S-wave readings in the inverted dataset suggest me to require major revisions in order to see published final models and final locations performed by the joint use of P and S phases.

In the following parts, I describe my specific comments.

English: I am not a native speaker and I skip any comment on this matter

Main Points

The main criticism to this work is the use of a dataset lacking of S-wave readings. In the supplementary part (table S1), the authors describe the dataset in terms of P and S waves readings. In the first 3 uncertainty classes, the number of the S waves picks is about 98,000 while P readings are about 120,000. I think that S waves were read by analysts with the same care used for P waves.

Since hypocentral depths are strongly influenced by S-phases, I think that the final velocity models may change with respect to those presented.

Furthermore, I suggest to select the arrival time not only by using the reading class (0, 1, 2, 3) and the event RMS (in general weighted) but also including, as selection criterion, the absolute residual of each observation. For example, if we consider a 100 km long raypath, we have an absolute residual of about 0.60 s if P-velocity increase from 5.8 to 6.0 km/s s (approximately 3.4% of velocity perturbation). Longer raypaths may

accumulate even strong residuals leading to a event RMS > 0.50 s. Therefore I suggest to improve the sampling of lower crust including a great number of long rays accepting residuals up to 1.0 s. In addition, for these phases, the reading class 3 should be retained, since a great uncertainty could be tolerated for long raypaths.

I have not other criticisms. The selection of earthquakes by cell division and the use of Velest is well performed.

Minor points

-) The tectonic setting should be shortened. Many details are not useful in this type of study that is focused on the 1D structure of the region. I find more interesting to report, in a simple and schematic view (for example in figure as an additional inset), the values of crustal thickness as reported by previous studies.

-) At lines 196-198: "The 1-D model approaches the average of the 3-D velocity model blocks, weighted by the total ray length in each block": I find that this phrase is misleading since the block discretization is more appropriate for a tomographic approach. I suggest to remove it and to continue with ". In other words, the layer velocities of a 1-D velocity model approximate the average velocity of a 3-D velocity model in the same depth interval"

-) At lines 211-212 we have "The differences between the adjacent layers were kept as small as possible to ensure stability during the inversion": could you explain better, difference of thickness, velocity?

-) Cell division of earthquakes: the crustal volume discretization was not performed along Z but only along X and Y. Then, along Z you check the inter distance among hypocenters. Why this choice? Why not discretize along Z?

I think that an important parameter that must enter to defined the score of one event for a cell hierarchy is the distance of the first station that it is used to locate the event.

-) Figure 11 should be improved: the comparison between ARSO and M2 locations is difficult to be appreciated since circles overlap. I suggest to remove the gray circles.

I suggest drawing a thin line to connect the M2 and ARSO location, then only the M2 circle should be drawn.

-) Add kilometric scale on the maps.

-) In figure 2 remove points from the profiles.

-) As additional point, could your traveltimes give informations about the Moho depth? This study region is very close to the place where Mohorovicic conducted his pioneeristic studies on the crust-mantle discontinuity. Using simply the analyst locations, probably the plot of traveltimes versus distance could gives significant indications. Assuming a simple crustal structure with a Moho depth of 40 km, the cross-over distance is about 200 km. I think that you may obtain a general plot for the whole region and, pivoting on the center of the map of figure 12, you may construct different 2D profiles.