Solid Earth Discussions

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Comment on se-2021-33

Anonymous Referee #1

Referee comment on "Moho and uppermost mantle structure in the Alpine area from S-to-P converted waves" by Rainer Kind et al., Solid Earth Discuss., https://doi.org/10.5194/se-2021-33-RC1, 2021

This work is based on a large amount of data coming from experiments within the framework of the AlpArray experiment (AlpArray, SWATH-D) and permanent networks, and the application of a novel method using S-to-P conversions ('causal' SRF or C-RF). The objective was to investigate the Moho and lithospheric structure of the greater Alpine region. The size of the analized area allows for an overall view of this region and the general trends along-strike of the Alps, although the paper focuses particularly on the Tauern window, a key area, and the change that occurrs across 13°E all the way to the Pannonian basin. The paper is well written, the comparison with previous studies interesting and the results clearly stated.

In regard to the observations, it is nice to see the stacked waveforms in the profiles but it is hard to understand how the discontinuities are plotted from the first arrivals. In fact, in general the choice of the line representing the discontinuity often seems arbitrary. Even when the choice of the converted phase "bump " is clear it might be difficult to ascertain where the line representing the discontinuity should be placed, particularly when there is an emergent "bump". This is especially true for the small signals converted below the lithosphere, that are identified as NVG (negative velocity gradient). It seemes that it is possible to identify some clear patterns in the profiles but in many cases it is not so. For example, below-Moho Profile 9B (Figure 11) is convincing, it really shows a jump in the NVG across lat 48.5°, but other profiles are very noisy, for example the discontinuity traced for profile 1B (Figure 3) seems arbitrary. Also, in profile 4B how can you trace such smooth discontinuity when the arrivals are jumping up and down? In profile 5B one cannot really see the arrivals, amplitude is too small, they are flat.....For this reason the suggestion is to have a more cautious approach in identifying the interfaces where S-to-P takes place, and state clearly which are the reliable observation. Some question marks would be appropriate on the figures in dubious cases or when there is more than one choice. This is particulary the case for the B part of the profiles. It seems that the authors are aware of these uncertainty since in the conclusions they only summarize the observations that are more reliable.

Finally, filtering and any additional processing of the waveform can cause unwanted

effects that might lead to misintepretation. On the other hand, not filtering can also lead to problems due to unsupressed noise which might also lead to misintepretation. The strenghts and weaknesses of both approaches should be pointed out.

Specific comments (line numbers on the left)

59-60 "corrected for the sign of the onset", does it mean that negative phases are multiplied by -1 so all SV bumps are positive?

67-68 data selection 50% noise, it is ok for the Moho signal (~10% amplitude) but perhaps not for deeper conversions (~few%). It seems that this is a key aspect determining if sub-Moho signals can be detected. Perhaps in such a heterogeneous area (high signal generated noise) the threshold on the noise on the P component should be lower. It is explained in the text that to have enough waveforms this threshold cannot be too small, but another way to increase the number of wavefomr in each cell is to increase the cell size.To increase the S/N, especially for the sub-Moho part, it might be necessary to loose some (hypothetical) resolution.

94 "The signal forms of the Moho (and other) conversions are determined mainly by the signal forms of the incident SV signals." Is this the way the curves are identified in the profiles? If yes, this is also a key aspect, stated this way it is vague. Please explain more clearly, possibly with an example (maybe a figure as Supplementary material).

97-99 How can we be sure that the negative phases below the Moho that make up the NVG are real features and not part of the intereference pattern between the "real" phases or an effect of the interference of signal generated noise ? Is there a way to determine the signficance of these scattered negative bumps ?

113-116 I agree for profiles 2-4, but for profiles 4-6 the Adriatic Moho between 45 and 46 is completely inferred since there is no data. For profiles 4-6 I think it is not possible (at least with these display) to see the culmination of the Adriatic Moho coming from the observations.

117-119 perhaps from the profiles since the culmination of the Adriatic Moho is seen in profiles 2-4 it would be safer to say change "at least west of 11°" --> "west of 11°"

Figure 3a. In Profile 1A (figure 3) it is not clear how is the Moho signal onset is identified on the waveforms. The dotted curve does not seem to fall on the first arrival of several traces, it seems it should be more wavy. In particular, the dotted curve does not seem to follow the data (origin time) between 46.5 and 45, in fact it is difficult to identify the

arrival time. Similar comments can be applied to other Moho profiles. In general, a clear example on how this interface is identified should be shown.

120-133 In Figure 9A it appears that the onset of the Moho signal under the black arrow corresponds to about 45-47km depth. Also, the waveforms of the dipping (European) Moho within about 48°-49° seem to interfere and cause the Moho signal to be very broad and extended at depth. It is very difficult to identify the onset on these very emergent arrivals. This is true also for other profiles, for example profile 8 in Figure 10A.
Since this are key observations for the interpretation of a change of the subduction style across 13° the authors need to show how this interfaces are constructed from the data in a clearer and more convincing way.

234-236 Figure 17B is very difficult to read. In particular, one cannot see the values on the lines with constant velocity of Paffrath et al. so the comparison with the present work is also difficult.

250-254 From Figure 17B seems that the positive velocity anomaly gradient of Paffrath et al starts at 4° and continues up until about 11° and that the agreement with the present work is between 11° and 14°.

259-260 It seems that, given the seemingly arbitrary choice of the Moho interface it is difficult to compare the two results. Perhaps, there seems to be an asymmetry but it should be more precisely shown.

286-287 Can't see a dotted black line in Figure 20B

317-321 It is true that filtering and any additional processing of the waveform can cause unwanted effects that might lead to misintepretation. On the other hand not filtering can also have problems due to unsupressed noise which might also lead to misintepretation. The strenghts and weaknesses of both approaches should be pointed out.