

Solid Earth Discuss., referee comment RC2
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Comment on se-2021-116

Anonymous Referee #2

Referee comment on "Radial anisotropy and S-wave velocity depict the internal to external zone transition within the Variscan orogen (NW Iberia)" by Jorge Acevedo et al., Solid Earth Discuss., <https://doi.org/10.5194/se-2021-116-RC2>, 2021

Review comment

The paper entitled "Radial anisotropy and S-wave velocity depict the internal to external zones transition within the Variscan orogen (NW Iberia)" by Acevedo et al. conducted ambient noise tomography using recently deployed seismic arrays to constrain the velocity and radial anisotropy of the upper crust in NW Iberia. The resulting seismic image shows a good correlation with major geological domains and known structural variation in the Variscan orogen. Interestingly, the seismic model shows a clear structural transition from the hinterland and external zones of the Variscan orogeny. This radial anisotropy model provides new seismic constraints to the study region and adds knowledge to the deformation processes in orogens. The topic is a good fit for the journal of *Solid Earth*. The manuscript is well structured and is generally well written. I think that this manuscript is suitable for publication after some minor revisions. I summarize my main concerns below, which are about the resolution analysis and the interpretation of anisotropic structures in regions with a suboptimal resolution, and hope these are helpful to further clarify some points and strengthen the paper.

- The actual inversion of group velocity used a grid size of 0.1 degree. In the checkerboard test shown in the supplementary material, the size of the grid to construct the anomaly seems to be quite big. Was the checkerboard test also using 0.1 grid, or the inversion grid was set to the same size as the anomaly? This needs some clarifications.
- Shear velocity structures of V_{sh} and V_{sv} are inverted separately. The results look reasonable, but could the authors elaborate on how the inversion parameters were properly chosen to ensure the same degree of amplitude recovery between the two models? In other words, how could you make sure that the velocities obtained from two separate inversions are comparable between each other?
- The resolution near the edges of the imaging area is really not ideal, and structures there may not be well constrained by the data. Therefore, I am a bit worried about the

interpretation of small-scale anomalies in these regions of suboptimal resolution. For example, on lines 414-415, a deeper transition depth of anisotropic structures beneath the CIZ-GTOMZ is used as an argument for the presence of a basal detachment fault. This is a good observation, but I feel that this may run into the risk of over-interpreting structures that are not well constrained by the data. Similarly, on lines 420-424, the resolution in CIZ and GTOMZ are relatively low, as also acknowledged by the authors, yet detailed interpretations are given here. Unless the authors can substantiate the robustness of these structures, I would suggest minimizing the discussion of structures with suboptimal resolution.

- In figure 6, I suggest using the same color range when plotting the two models. It is difficult to compare them.
- Figure 8, please label geographic locations such as CCB, NA, Allande and Vivero faults on cross-sections. Also, the top 1 km of the model is not shown, any reason for this?

I also have some minor suggestions referring to the line number.

Line 18, "orogenic grain" -> "orogenic belt"

The same line, "bulk properties of the rocks" sounds like the bulk composition of the rocks. Please consider using another word such as "elastic properties of the rocks".

Line 24, "caused by" -> "which we attribute to"

Line 25, 'the internal deformation of rocks either during the Variscan orogeny or prior to it' -> "the pre- or syn-orogenic deformation associated with the Variscan orogenesis".

Line 31, "shear waves" -> "shear wave velocities"

Line 37, "whose importance varies with depth" -> "that dominate different depth levels"

Line 42, "depth" -> "depths"

Line 45, "the features that govern the" -> "the governing features"

Line 50, "been" -> "been identified".

Line 51, "ancient orogenic belts (Wang et al., 2020)". Although there are some disputes on the age of the initiation of Cordilleran orogenesis, it is certainly a Phanerozoic orogeny and is likely as old as the Variscan orogeny (Paleozoic). So I would not use the word "ancient", which more properly refer to orogenesis in Precambrian.

Line 63, "an orogenic system, in the West, to the external zone, to the East" -> "an orogenic system (west) to the external zone (east)".

Line 64, "in the area" -> "in this area".

Line 67, "helped to broaden" -> "broadened".

Line 68, "In order to increase the resolution in the structure of the crust" -> "To improve imaging resolution at crustal depths".

Line 74, "for the unraveling of" -> "for unraveling"

Line 177, "that are mostly made of" -> "that they are mostly made of".

Line 186, "It is only in the first of the domains defined, in the CZ, that it has been reported a ...", this can be simplified, "Earlier studies have been reported in the CZ domain a"

Line 194, '11 stations' -> "Among them, 11 stations".

Line 208, "26% of overlap" -> "26% overlap".

Line 214 "with corner frequencies between 0.01-2.0 Hz"-> "with corner frequencies of 0.01 and 2.0 Hz".

Line 292 "keep delineating a large high" -> "delineate a consistent large high"

Line 315, "higher depths" -> "greater depths"

Line 354, "element of our models, both the surface- and the shear-wave ones, is" -> "element in both group and shear velocity models is"

Line 390, highlight the velocity contour of 3.1 km/sec using a thick line or another color.

Line 455, citation format issue, remove the extra comma, "Chen et al. (2009) and Guo et al. (2012)"