Comments of Editor on the revised manuscript

The authors have done an admirable job of amending the manuscript to address the major points raised by the two reviewers. The manuscript will be acceptable pending some minor corrections, mostly to improve the semantics and clarity of the text, as well as the clarity of Figure 1. I have marked all suggested changes below in red.

Mark R. Handy

Responses to Editor

Abstract:
"The group velocity and shear-wave velocity results compare well to existing large-scale studies that partly include the study area. Onshore France, we observe a high-velocity area beneath the Argentera Massif, roughly 10 km below sea level. We interpret this as the root of the Argentera Massif. Our results add spatial resolution to known seismic velocities in the Ligurian Basin, thereby augmenting existing seismic profiles. In agreement with existing seismic studies, our shear-wave velocity maps indicate a deepening of the Moho from 12 km at the southwestern basin centre to 20-25 km at the Ligurian coast in the northeast and over 30 km at the Provençal coast. The maps also indicate that the southwestern and northeastern Ligurian Basin are structurally separate. The lack of high crustal v_P/v_S ratios beneath the southwestern part of the Ligurian Basin preclude mantle serpentinization there."

L38:
"Today, the Ligurian Sea is 150-225 km wide, whereas the basin itself has a width of 70-170 km (Dannowski et al., 2020), broadening from the northeast to the southwest. The continental margin is narrow (10-20 km) and steep along the Ligurian coast (Finetti et al., 2005) and broader (20-50 km) on the Corsican side (e.g. Rollet et al., 2002).

L317:
"Similarly, the Po Basin has an average sedimentary thickness of 7-8 km "

L352:
"We deduce that for fast areas along the basin axis, the velocity gradient is stronger than away from the basin axis. This is probably caused by the thinning of continental crust (Dannowski et al., 2020) and possible exhumation of denser lower crust and upper mantle rock (Gailler et al., 2009; Jolivet et al., 2015) observed further to the southwest. Both scenarios would lead to a higher S-wave velocity near the basin axis."

L421:
"Rollet et al. (2002) raised the question of whether an offshore prolongation of the Alpine front can be observed onshore France and onshore Corsica. These authors suggested that the Alpine front separates the southwestern and northeastern parts of the Ligurian Basin. This proposed front is roughly located at the boundary between the northeastern and southwestern crustal domains observe in our data (illustrated by the dashed line in Fig. 8e). However, the location and even existence of such a prolongation of the Alpine front beneath the Ligurian sea is not yet resolved. As mentioned above, the seismic records indicate no spreading this far northeast in the basin. Therefore, detection of the proposed offshore Alpine front in the crust is feasible. Dannowski et al. (2020) observe a gradual thickening of the continental crust towards the northeastern Ligurian

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Basin. They do not need the sharp step that Makris et al. (1999) introduced between Corsica and the Liguro-Provencal coast to explain the free-air anomaly derived by Sandwell et al. (2014). Our spatial shear-wave velocity data also supports their interpretation. We do not observe a sharp lateral boundary but a gradual change of the velocity layers that fits the model of Dannowski et al. (2020). With the given resolution, an offshore prolongation of the Alpine front is not detectable."

There is an apparent contradiction in the following sentences of the paragraph above:
"However, the location and even existence of such a prolongation of the Alpine front beneath the Ligurian sea is not yet resolved. As mentioned above, the seismic records indicate no spreading this far northeast in the basin. Therefore, detection of the proposed offshore Alpine front in the crust is feasible."

First, the authors seem to call into existance the location and even existance of the orogenic front. Then, two sentences later, they say that the detection of this front is possible. Another problem is a logical disconnect between the lack of seismic evidence for spreading in the NE and the existance or non-existance of the Alpine front. The reader is left asking "What does spreading have to do with the front?" They are structures associated with two separate events (spreading in Oligo-Miocene, Alpine orogenic front in Eo-Oligocene) oriented at high angles to each other.

Therefore, I would recommend the following change (which includes the small changes above):
"Rollet et al. (2002) raised the question of whether an offshore prolongation of the Alpine front can be observed onshore France and onshore Corsica. These authors suggested that the southwestern and northeastern parts of the Ligurian Basin form, respectively, the footwall and hangingwall of the Alpine front. Thus, the Alpine front would be located approximately at the boundary between the northeastern and southwestern crustal domains distinguished in our data (illustrated by the dashed line in Fig. 8e). Dannowski et al. (2020) observe a gradual thickening of the continental crust towards the northeastern part of theLigurian Basin. They did not need the sharp step that Makris et al. (1999) introduced between Corsica and the Liguro-Provencal coast to explain the free-air anomaly derived by Sandwell et al. (2014). In keeping with Dannowski et al. (2020), our spatial shear-wave velocity data does not show a sharp lateral boundary, but a gradual change of the velocity layers. Detection of an offshore Alpine Front is therefore not feasible with the current resolution."

Responses to Reviewer 1:

Introduction:
"The marine bedrock is covered by a sedimentary layer (e.g. Schettino and Turco, 2006) of variable Thickness: less than 3 km thick near the Tuscany coast, increasing towards the southwest to a thickness of up to 8 km offshore Marseille."

L318:
"At up to 9 km depth (Fig. 8a-c), we observe laterally varying shear-wave velocities on land that we assume to be caused by variations in the geology. At the Rhône delta (Fig. 1), where the sedimentary cover is up to 12 km thick (Pichon et al., 2010), we observe $v_s \cong 2.7$ km s^{-1} in the layer at 4-6 km depth (Fig. 8b) and $v_s \cong 3$ km s^{-1} in 6-9 km depth range (Fig. 8c). Similarly, the Po Basin has an average sedimentary thickness of 7-8 km (Molinari et al., 2015a) with shear-wave velocity increasing from $v_s \cong 2.5$ km s^{-1} to $v_s \cong 3.1$ km s^{-1} at 4-9 km depth. In contrast to the sedimentary basins, we observe higher $v_s \cong 3$-3.5 km s^{-1} (4-9 km depth) beneath the Alpine belt, composed of crystalline and metamorphic rocks (e.g. Molinari et al., 2015b). This S-wave variation is most probably caused by the different rocks and structure of the Alpine belt and the sedimentary basins."

Figure 1

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Responses to Reviewer 2:

L76

We decided not to mention the stations that we did not use. Instead, we only focus on the 22 stations that did record all components for the complete deployment, in order to increase the focus of the manuscript. The other stations were not used, because they did not record (enough) data. Please state this in the text explicitly, if not done already.

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Section 5.2

"Dannowski et al. (2020) suggest that continental crust was (extremely) thinned along their profile, but that no spreading occurred. This is in-line with our results. A possible spreading centre must be located to the southwest. At the Gulf of Lion margin along the southwestern edge of our research area, Gailler et al. (2009) interpreted their results as oceanic crust, also observing a transition zone made up of "lower crustal material or mixture of serpentinized upper mantle material with lower crustal material" (Gailler et al., 2009). Later, Jolivet et al. (2015) attributed the shallow high velocities to exhumed lower crust and possibly also partially serpentinised mantle. Therefore, a spreading center may have been located southwest of our research area, possibly as close as the Gulf of Lion margin."

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Actually, this is misleading given the tremendous variation in depth of the Po Basin, which ranges from ony 0-1 km along the southern front of the Alps to 9 km beneath the foreland of the Apennines (see isopachs in sheet 1 of the Structural Map of Italy, Bigi et al. 1989). Therefore, the average thickness is closer to 4-5 km. Molinaris larger estimate is valid only for the the S part of the basin.

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"Geology" is a generic term for everything from lithology to structure to fluids to the geological history. It's too general. Try to be more specific, in this case, referring to the two characteristics of geology (rock type and structure) that are almost always related to changes in rock physical perpoerties.