Reply to EC1

Dear Editor,

Thank you for your editorial work and comments on our manuscript. We revised our manuscript and figures according to your and reviewer's recommendations and requests. We extended references to your papers. We addressed all the comment from the reviewers in detail in our replies, in a trackable way as you can find in the respective files.

To your minor comments:

EC1: *Please note that the anomaly you describe below the Bohemian Massif is very similar to the previously reported one in Kästle et al. 2018 ("Surface-wave tomography..."), why also imaged two fast anomalies in the uppermost mantle: one below the eastern Alps and a second anomaly below southern Germany and the southern part of the Bohemian Massif: "A second fast anomaly, also subparallel to the Periadriatic Fault, is visible approximately 1° farther to the north. It has its highest amplitude in southeastern Germany; hence, we denominate it the Eastern Alpine Northern Anomaly (Figure 12)." This would support your finding of a secondary slab/thickened and cold lithosphere north of the Alps.*

Reply: thanks for bringing this into our attention. We were aware of this second heterogeneity north of the Alps, but we lost our remark on your et al. 2018 paper. We incorporated into Section Introduction sentences as follows:

Kästle et al. (2018) identified approximately 1° to the north of the Periadriatic Fault a similar subparallel fast velocity heterogeneity in their surface-wave tomography.

Finding a secondary slab/thickened and cold lithosphere north of the Alps strengthens our motivation to determine its proper location and discuss hypotheses regarding its origin.

Modification of the last sentence of Introduction:
Besides linking the shallow heterogeneity beneath the Eastern Alps to subduction of the Adriatic plate, we also present and discuss in our paper three potential scenarios of the origin of the positive heterogeneity located beneath the southern Bohemian Massif (HV-BM).

EC1: *l. 37 For a review of different slab models under the Alps, Kästle et al. (2020, "Slab break-offs...") would also be a good reference that discusses the entire Alpine arc.*

Reply: We added the reference to Kästle et al. (2020) as recommended

EC1: *l. 271 Dando et al. 2011 never clearly state that they attribute the eastern Alpine slab to the subducting Adriatic plate. Instead they report a "Continuity of the Pannonian fast anomaly with the East Alpine fast anomaly" and state "The interpretation that emerges from our images is that a continuous collision zone extended from the Alps through present-day western and central Hungary. [...] When extension began in the Pannonian Basin, the higher velocity material detached from the lithosphere, indeed the Pannonian Basin extension may have been triggered by the detachment of this cold material produced by prior convergence." This would rather be in agreement with the European subduction that is interpreted to be continuous from Alps to Carpathians prior to 20 Ma (e.g., Handy et al. 2015).*

Reply: Similarly to our explanation in our replies to the reviewers, referring to Dando et al. (2011) relates to the northward dip of their heterogeneity beneath the E. Alps. The sentence was reformulated to:

Alps from data of regional passive experiments (Dando et al., 2011; Mitterbauer et al., 2011; Karousová et al., 2013) also retrieved the northward dipping high-velocity heterogeneity of similar geometries (Fig. 5) in 250 km of the upper mantle.