

General comments

- l. 31 It would be good to highlight this region on the map in Fig. 1 and refer to Fig. 1 in this paragraph.
- l. 35 All maps are cut in the west at 8 degrees, part of the western Alps and the Ivrea body are thus missing. So it is not the entire Alpine arc.
- l. 38-43 The sentences are repetitive, it is also not clear to me what is meant by "we include a dedicated study". Please rephrase for more clarity.
- l. 55 A hypothesis should not be a question. I would recommend to write something like "We address the question whether..." or "The working hypothesis is that the above mentioned..."
- l. 65 I am not sure whether the three faults/lineaments you name here can be classified as "tectonic systems". What is meant by tectonic system? Please rephrase to clarify.
- l. 63 Please give a reference for the Permian activity.
- l. 65 What does "first Eocene" mean? Maybe the beginning of the Eocene?
- l. 78 What is meant with "frame" here? Maybe not the right word?
- l. 90 What is meant with "confined with"? Maybe "was confined to"? But then I do not understand how a continental area can be confined to the oceanic domain of the western Tethys.
- l. 118 This is not exactly correct. The inversion includes the dataset of Ekstroem, 2011 which is a global dataset of phase-velocity measurements which is used to constrain the long-period velocity field, but it's not a starting model.
- l. 123-125 The numbers are not giving the resolution of the model in the sense of capability of resolving structures of that size. They only give the grid spacing of the model. The resolution is lower than the grid spacing and varies strongly across the model depending on station density, data quality and period. I would recommend to replace resolution with grid spacing in this sentence.
- l. 160 You should define all variables that haven't been defined before (r , GM , R , ϕ , ...).
- l. 168 "regional Bouguer values", meaning Bouguer values obtained with the local correction up to the Hayford radius?
- l. 184 It is not clear to me which of the gravity models you chose to fit? The Bouguer gravity disturbance corrected with topography model RET2014 shown in Fig. 3a or the one in Fig. 3c? What exactly is the model shown in Fig. 3c? Is it the one where you apply the Hayford radius correction? Or is it the one where you use only the band-limited models? Please clarify in the text and in the Figure caption.
- l. 266 How important is the choice of the reference co-PREM model for your results? Your gravity measurements are corrected using a reference ellipsoid, the densities are translated into an anomaly by comparing it to a simple 1D model. Could that introduce a bias?
- l. 303 Please show a Figure that illustrates the gravity residual after the last iteration (appendix or main manuscript). How many iterations are needed? I do not understand why the mantle component inversion needs an inner loop and the crustal part doesn't (Figure 8). Please explain. Are there any constraints on how far the density may deviate from the starting value?
- l. 350 Please show a figure that compares the initial density values (in the starting model generated from the V_s model) with the final density model. Elaborate in the text how large the density variations between initial and final models are. Are the final densities still in good agreement with the V_s parameters or do we have regions where V_s and density are so different that there is no rock type that could explain the modelled features?
- l. 354 What is "the positive gravity anomaly"? Is it the Vicenza-Verona anomaly or the Venetian Volcanic anomaly? Please say so explicitly and mark the anomaly in one of your maps.
- l. 356 In profile 1, I cannot really see the high-density plateau (RH). If I take the point marked RH in profile A and go further NW or further SE, the density seems to increase, so why should that point be called a density high? Maybe in mapview I can see a ridge-like high density feature (please show the profile traces also in Fig. 12b). But the average density high in map view is more likely to be solely due to the MB1 anomaly directly above RH.
- l. 361 What about the density high at about 9.8 deg in profile A? Why is this not categorized as anomaly?
- l. 385 Why does the Tauern window show up with lower densities? Often, the Tauern window is described as an area of exhumation after indentation of Adria and uplift of European crust. This would lead to lower/middle crustal material (normally denser) being transported to shallow depths (see for example Fig. 1 in Lüschen et al. 2006, TRANSALP - deep crustal Vibroseis...). Consequently, highly metamorphic, high-density material is found at the surface (e.g. Groß et al. 2020, Crustal-Scale Sheath Folding...). In this context, I would expect higher densities in the Tauern region, but the opposite seems to be the case. Do you have an explanation for this discrepancy?
- l. 411 What is lithospheric attenuation? I am not familiar with this term and doubt that it is the proper expression.

Comments on Figures

- Fig. 1 You refer to a lot of localities in sections 1 and 2. Maybe it would be possible to include some names in the map to guide the reader? The minimum would be the Periadriatic line, Giudicarie line, Tauern window and Venetian magmatic area. It's hardly possible to distinguish between Northern Alpine foreland and Triassic magmatics in the current color model. Please use a different color model, the magmatic and volcanic rocks should all have a similar color type, e.g. reddish/yellowish colors for magmatic rocks and blueish/greenish colors for Geological units, such that the reader can see at first glance the distribution of magmatic/volcanic rocks.
- Fig. 2 Please highlight the main gravity anomaly of the Venetian magmatic area discussed in the article. Maybe better/also in Fig. 3.
- Fig. 3 "(c) [...] corrected with topography", corrected for the effect of topography? Using which model/approach?
- Fig. 10 I do not like the shadow effect on the figures. The shading is easily confused with the greyish values around 2.6 g/cm³.
- Fig. 11 Some abbreviations are missing, e.g. what is SH?
- Fig. 12 The letters (A,B,C) in the profile traces in Fig. 12a should be at the same end of the profile as in the plots below. Please add also the geographical directions to the profiles. What are Fig. 12a and 12b showing? Is it the crustal averaged Bouguer anomaly and the averaged final crustal density distribution (looks different than Fig. 11)? Please describe in the caption.

Comments that are only related to language/expression (non extensive)

Throughout the manuscript, you change between present tense and past tense. Please stick to one of the two (e.g. l. 68 "develop", l. 70 "developed")

- l. 25 "added" -> additional
- l. 33 "thank's" -> thanks
- l. 49 and others "Infact" -> In fact
- l. 62 and others "Gudicarie" -> Giudicarie
- l. 68 ";" -> :
- l. 72 and others brackets for inline citations only around the year (In Latex use `\citet{...}` instead of `\citep{...}` for inline citations)
- l. 83 no comma after magmatism
- l. 98 "restitic" -> remnants of?
- l. 109 "Judicarie" -> Giudicarie
- l. 133 "consists in" -> consists of, better write the model is parameterized in terms of spherical harmonic...
- l. 136 "The layers building topography" -> The layers describing the topography?
- l. 160 "to which" -> from which
- l. 223-225 Not a very nice sentence, maybe write something like: In this work, we combine these two V_p/V_s relations for sedimentary and crystalline rocks by linking them at their intersection point as illustrated in Figure 5. (The following sentence, "The velocity is $V_p = \dots$ " is not necessary in my opinion).
- l. 228 "compared with" -> compared to
- l. 256 "has been argued" -> has been illustrated/described
- l. 267 "The Fig. 7" -> Fig. 7
- l. 283 "with" -> to
- l. 285 This sentence needs to be rephrased.
- l. 299 "represent" -> represents; "belong" -> belonging
- l. 309 "develops" -> better: stretches/is trending in/...
- l. 310 "straitens" -> straightens/becomes more elongated
- l. 316 "Always" -> Throughout the region?
- l. 335 "beyond" -> below; "orogens" -> orogen's/orogenic
- l. 342 "interesting the Po basin" -> ??
- l. 388 no comma after provinces
- l. 410 "As regards" -> Regarding, better: Geodynamic evidence suggests that...