Review of SE-manuscript Anderlini et al. 2020

The study regards a topic of importance and interest and the manuscript in general is well structured and well written. The study area along the southern boundary of the Italian Eastern Southern Alps (ESA) is known for a high seismic hazard in combination with a low-to-moderate plate tectonic strain that is difficult to locally pinpoint to specific faults. The paper reviews the various publications that recently documented different parts of the geodetically determined (mainly horizontal) strain and the seismic deformation rates that exhibit significant discrepancies across the ESA thrust fault system. As the title of the manuscript implies, new insight is gained by combining the existing tectonic, seismic and geodetic information with additional vertical geodetic velocity data integrated from GPS, InSAR and leveling measurements.

I congratulate the authors to a good study and manuscript. I do have only a few general points for consideration by the authors and a number of smaller issues with some of the figures that I list below. Overall, I believe the entity of these issues would require just MODERATE REVISION.

In the first of their main chapters –chapter 3 Geodetic Observations- the authors provide not only a careful evaluation and combination of InSAR and GPS observations but also a discussion of the different geodetic measurement techniques and their resulting data. This certainly denotes a very useful commented summary review of geodetic techniques also for the non-specialist readership. In the subsequent second main chapter of the paper, the authors develop a 2D fault model to represent the ESA front fault system and to interpret the horizontal and vertical strain gradients measured across the fault system. Again the modelling is characterized by careful evaluation and balanced weighting of the different geodetic data. While the model seems to generally „reproduce the observed velocity gradients from all (geodetic) data sets“, „geological and geomorphological data appears not to be fully consistent“ and I would also list the seismologic information as not being fully consistent. I fully agree with the conclusions by the authors, but I do believe that in correspondance with the careful evaluation and interpretations of the fit and the discrepancies (1) between different geodetic data sets and (2) between the best-fit 2D fault model and the geodetic data, an additional conclusion would not only be appropriate but necessary: we need better seismicity and better geological subsurface structure information. The former obviously does not understandably correspond with the geodetic data assembly and the latter is very poorly constrained or entirely speculative (see also comment below).

The seismicity shown in Figures 1 and 3 suffers from several questions regarding the consistency. (1) the time periods are not the same but do overlap between 2012 and 2017. Are you showing events from both data sets for this overlap time? (2) How to the events of the two data sets compare during this overlap time? (3) How comes much fewer events yellow-red are seen within broken line box in Fig. 1 than visible in cross section in Fig. 3? (4) Where does the obvious cluster seen in Fig. 3 at 10km depth between 45km and 65km profile distance locate in Fig1 map view? (5) Why do you project the seismicity across a band

50km wide onto a profile where you project the geodetic data only across a band 20km wide? How do the fault plane solutions compare with each other, with the geologic fault geometries (Fig. 3) and with your final model (Fig. 7)?

In Figure 3 you show the subsurface geometries of the ESA frontal fault system and as reference you refer in Figure caption and in text (lines 255 and 267) to Castellarin et al. 2006 („The gray continuous and dashed lines represent major and secondary faults digitized from the TRANSALP profile interpretation (modified from Castellarin et al., 2006). MT = Montello thrust, MBT = Montello backthrust, BV = Bassano–Valdobbiadene thrust, BL = Belluno thrust, VS = Valsugana thrust. “). In Castellarin et al. 2006 Fig. 7 is showing a geologic interpretation of vibroseismic image (down to 5km) and in Fig.8 a geologic interpretation of seismic time section again down to 5km and these figures document a profile that runs across the Montello Hill within the study region of this paper. These high-resolution seismic images and their geologic interpretations significantly differ in even the most prominent geometries with the interpretation shown in Fig. 3 of this study. Rather, in Castellarin et al. 2006 Fig. 11 (see included figure below) entitled „simplified general interpretation oft he TRANSALP profile there is shown a major detachment fault system separating and translating the imbricated upper crust at about 10km-12km depth from the middle and lower continental crust of Adria. It is the geometry of these fault

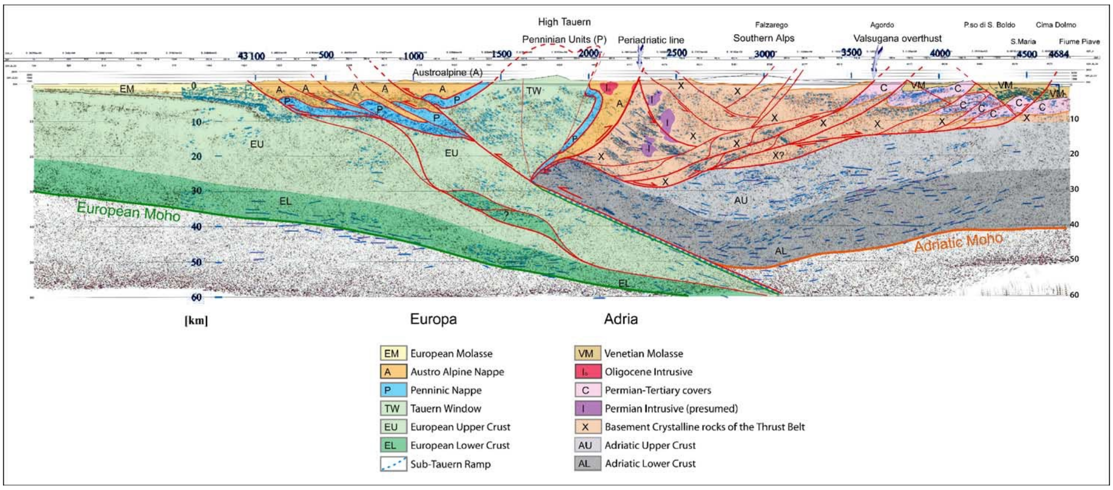

Fig. 11 Castellarin et al. 2006

system shown in red solid lines that seems to have been used for the model shown in Figure 3 of the current study. It seems difficult though to correlate the reflectivity image in fig.11 with the presented fault interpretation since (1) the reflectivity ends at 8km depth, (2) the shallow parts of the fault cut across well-documented continuous seismic signals and (3) no seismic evidence is visible for the detachment fault system at 10km to 12km depth. It is difficult to understand why the local high-resolution images and geologic interpretation would be ignored and a „simplified general interpretation“ of regional scale would be used for a local study like the current one. You must provide details of what and why you „modified from Castellarin et al. 2006“ and you must refer to the precise Figure that you used from Castellarin et al. 2006 and provide reasons for your specific choice. Finally, it seems the major change you imposed regards the introduction of the SRDD (Figs. 6 and 7) that seems to play a major role in your model. However, please consider that the introduction of this and the stipulated other parallel faults dipping down to 20km are purly speculative as no evidence in the TRANSALP seismic data can be found in Castellarin et al. 2006 and in addition such fault contradict the concept and model documented in Fig. 11 with a pronounced and important subhorizontal detachment fault at 10-12km depth reaching far to the North beneath ESA.

Specific comments:

Figure 1. Much to busy figure. Reduce opacity of topography grey. Sizes of circles blue-purple and yellow-red reflect magnitude, please show scale. Rotation of Adria relative to Europe – what exactly is used as stable Europe relative point? What portion of Adria is rotating – your inset suggests all of Adria but this is difficult to justify for westernmost Adria. Explain why two different periods 2000-2017 and 2012-2018 are combined and what does this mean for the seismicity to be representative for?

Figure 2. increase size of colored circles. If Adria is rotating relative to Europe as shown in Fig. 1, what would be the local motions of the stations within ESA relative to the rotating Adria look like?

Figure 3. red dots and their uncertainty estimates: since profile runs oblique to rotation minor circles of Adria, do these uncertainty estimates include the relative differences of rotating Adria?
Note that the seismicity shown along the profile AB extends beyond the dashed box shown in Fig.2, box in Fig. 2 should be as long as AB profile in Fig. 1 and 3. What are the hypocenter location uncertainties? Are the hypocenter parameters of the two earthquake data sets calculated with the same velocity model, with the same magnitude? Please add hypocenter depth color codes as in Fig. 1. Regarding geometry of proposed fault system see critical comment above.

Figure4. „(after the ramp removal)“ please explain or refer to text. bottom panels please refer to red dots in figure caption.

Figure 6. Regarding geometry of subsurfae model see critical comment above.