

1 • One concern is the lack of discussion regarding the representativeness of the seismic catalog used in the study. Although the authors have selected the events according to the location error and the magnitude, the limit of the catalog extracted from ISC and the potential bias linked to the seismic station distribution aren't discussed. This should be addressed, in order to be able to compare the modeled strength of the lithosphere with the epicenters and the depth distribution of the events.

We thank the reviewer for their suggestion. This has been dealt with through the addition of a 'Seismicity Catalogue' section from lines 137 – 167. Two new figures (figures 5 and 6) have also been added to show how the ISC catalogue compares to regional catalogues and the magnitude of completeness.

2 • More generally, it's also essential to add a synthesis of the knowledge of the factors controlling the seismicity localization in the area, based on previous studies (e.g. Schmid, S. M., and Kissling, E. (2000), The arc of the western Alps in the light of geophysical data on deep crustal structure, *Tectonics*, 19(1), 62– 85, doi:10.1029/1999TC900057; Singer, J., Diehl, T., Husen, S., Kissling, E. and Duretz, T. Alpine lithosphere slab rollback causing lower crustal seismicity in northern foreland. *Earth and Planetary Science Letters*, 397, pp.42-56, <https://doi.org/10.1016/j.epsl.2014.04.002>, 2014; Thouvenot, F., Jenatton, L., Scafidi, D., Turino, C., Potin, B., & Ferretti, G. (2016). Encore ubaye: earthquake swarms, foreshocks, and aftershocks in the southern french alps. *Bulletin of the Seismological Society of America*, 106(5), 2244–2257) to the ms. Actually, it would help to better contextualize the study and highlight its importance.

We thank the reviewer for this suggestion and have now added a number of paragraphs into the 'Geological and Seismic History' section of the manuscript at lines 67 – 91 in order to rectify this.

3 • A large part of the description of the results and the discussion refers to the spatial variability of several parameters (viscosity, integrated strength, maximum depth of seismicity, etc.). These sections are however difficult to follow because this spatial distribution isn't explicit enough with respect to the areas of interest. Using systematically the annotation in the figures (AS, vo, urg, . . .), or naming clearly the regions would greatly help to understand the reasoning of the authors. E.g. in the sentence L314-316 (" We do however note regions where the maximum temperature of seismicity greatly exceeds 600°C, corresponding to the presence of both actively subducting and previously subducted slabs, shown as high velocity features at a depth of 100km (Figure 10b) from a recent shear wave velocity model of the region (El-Sharkawy et al., 2020)"), it's unclear which regions the authors are referring to.

We thank the reviewer for bringing this to our attention. This has now been changed throughout the text so that all locations mentioned correspond to an annotation used within the figures. As such, additional captions were also added to the cross sections in figures 8 and 10.

4 • L21-22. This sentence is referring to a debate about the "seismicity distribution in the Alps". This is vague, please explain in more detail what is the issue (see comments above).

We thank the reviewer for pointing this out. We feel that the very introduction to the work benefits from the use of such a general statement, however to address this in detail, new paragraphs from line 67 – 91 have been added.

5 • Geological History, This section should include geologic and seismotectonic details, in particular a paragraph describing the seismicity distribution and its origin according to previous studies.

As mentioned in prior responses this change has been made. The section is now renamed 'Geological and Seismic History' and new sentences have been added from lines 62 – 91.

6 • Method I would suggest to split this part into “data” and “method”.

We thank the reviewer for this suggestion and have renamed this section '2 Workflow' and split it into subsections '2.1 Data' and '2.2 Method'.

7 • L8 : Please, replace “varying seismicity distribution” by “varying spatial seismicity distribution”.

Thanks for pointing this out, this has now been changed.

8 • L18 : Please explicit the acronym URG.

This has been changed, in the abstract as suggested and also in the main body of the manuscript at line 229.

9 • L24 : Please, indicate the type of model you are referring to.

We thank the reviewer for pointing out this lack of clarity. It refers to seismic focal mechanisms and the manuscript has been changed to reflect this.

10 • L26 : Please replace cross-correlation by “link” or “relation” or “correlation”.

Thanks for this suggestion, this has now been changed.

11 • L196 : The sentence “Viscosities for the lithospheric mantle tend to be between $19 - 23 \log_{10} \text{Pa s}$ and for the lower crust between $21 - 23 \log_{10} \text{Pa s}$ with both largely aseismic across the region” is difficult to understand, please rephrase it.

We thank the reviewer for pointing out the lack of clarity. This sentence has now been split into two sentences and rephrased to add clarity at lines 262 - 264.

12 • L225 : I would suggest replacing “thereof to” by “on”.

Thanks for this suggestion, this has now been changed.

13 • L310 : “In thick felsic crustal regions that also lie above a weak lithospheric mantle, such as the crustal root of the orogen, maximum depths of seismicity are significantly shallower than on the forelands and as such maximum temperatures of seismicity are also significantly lower at $\sim 350 \text{ }^\circ\text{C}$ ”. This sentence is difficult to understand, please rephrase it.

We thank the reviewer for bringing this to our attention. This sentence has now been removed, as upon review we found that it did not contribute meaningfully to the crux of the paragraph.

14 • L331 : The end of the sentence (“and”) has to be corrected.

Thanks for pointing this out, this has now been corrected.

15 • Fig1 : Plotting the seismicity on this map would be nice.

We thank the reviewer for this suggestion, this change has been made.

16 • Fig 2 and/or 3 : indicate in the caption that numbers correspond to density values.

We thank the reviewer for bringing this to our attention. This was already present in the caption of figure 3 but has now also been added to the figure 2 caption.