

Interactive comment on “Density distribution across the Alpine lithosphere constrained by 3D gravity modelling and relation to seismicity and deformation” by Cameron Spooner et al.

Anonymous Referee #1

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This paper presents a novel seismically constrained, 3D, structural and density model of the lithosphere of the Alps and their respective forelands. It was constructed through the integration of numerous geoscientific datasets, and was adjusted to fit the observed gravity field. The obtained results show that significant more heterogeneity is required in the crust than in other model layers to replicate the gravity field, and that notable differences exist between the crust of the European and Adriatic plates. Moreover, it is observed that the distribution of seismicity and deformation within the studied region strongly correlates with thickness and density changes within the crust. These results are novel and original, and constitute a great contribution to the understanding of the geological setting and geodynamic evolution of the studied area. The conclu-

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sions of this paper are of interest to the broad geoscience community, particularly for researchers focused on the investigation of Alpine crustal evolution and configuration. It is also very important to highlight that the model presented in this paper is available for open access, being possible to use it to further discuss and investigate crustal provenance and crustal properties variations across the studied region.

However, I have a couple of concerns that surely can be properly addressed by the authors:

1) It would be worthy to provide some kind of sensitivity analysis about the impact of subtle changes in density and/or density domains boundaries geometries on the gravity response of the model. Such sensitivity analysis could further support and reinforce your interpretations and conclusions and contribute to reduce the inherent ambiguity of the gravity method. 2) You should discuss the causes and/or possible origin of the differences observed between the densities you calculated for each modelled body from P wave velocities and the densities you finally used, which are shown in Table 1. Particularly when considerable differences exist (e.g. Upper Crust North East Adria, Lower Crust Northern Adria) and when opposite tendencies arose (e.g. Lithospheric Mantle Less Dense vs. Lithospheric Mantle More Dense). 3) You should also provide possible explanations or at least discuss the fact that very low densities had to be assigned to lower crustal bodies (Lower Crust Europe, Lower Crust Northern Adria) corresponding to some sectors of the European and Adriatic plates, in order to fit observed and calculated gravity anomalies. Mostly, considering that such very low densities are more typical of the upper than of the lower crust. 4) Language should be polished. Some sentences are too long. Wording and phrasing should be improved.

Finally, other comments, suggestions, questions and corrections are indicated in the attached pdf file.

Best regards,

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Please also note the supplement to this comment:
<https://www.solid-earth-discuss.net/se-2019-115/se-2019-115-RC1-supplement.pdf>

Interactive comment on Solid Earth Discuss., <https://doi.org/10.5194/se-2019-115>, 2019.