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Interactive comment on "Joint inversion of the lithospheric density struture in the North China Craton based on GOCE satellite gravity gradient data and surface gravity data" *by* Yu Tian and Yong Wang

Anonymous Referee #2

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Referee's comments on the manuscript se-2019-181 Title: "Joint inversion of the lithospheric density structure in the North China Craton based on GOCE satellite gravity gradient data and surface gravity data" Authors: Yu Tian and Yong Wang

In this work, the authors jointly inverse GOCE satellite gravity gradient data and surface gravity data for the distribution of their source density anomalies in the North China Craton lithosphere. The inversion method is based on the preconditioned conjugate gradient inversion algorithm and is implemented in two "independent" parts. The first one concerns the inversion of surface gravity data after corrections. The resulting

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density distribution is then used in the second part as the initial density model in the preprocessed remaining gravity gradients inversion. The gravity gradients inversion results are then discussed in terms of geological structures in the North China Craton.

General comments The paper presents an interesting method allowing the combination of the gravity and gravity gradients data in the same inversion scheme, which remain rare in the community. Their inversions exploit both the high quality of gravity and gradiometric data and their mutual supplementation, which can greatly reduce the non-uniqueness of the inversion and enhance the reliability of the results. The paper is well-written in a good English, well-structured, generally clear and detailed. The quality of the figure is adequate and the number of them is sufficient.

However, I have major comments that need to be addressed before publication. One of the major issue of the paper is that the authors never discuss and quantify the impact of each correction applied on the data before the inversion on the resulting density models in terms of resolution and amplitude. The authors choose to use gravity and gravity gradient data obtained from measurements and not derived from the gravity field models in order to preserve their high precision, which is indeed relevant. However, the applied corrections imply the use of models not well constrained as the CRUST 1.0 model which highly compromise the high quality of the data and thus the resolution of the inversion results. Another major issue concerns the inversion methodology of the gravity gradients. In this paper, the authors focus on the 4-high accuracy GOCE satellite gravity gradient tensor components (Txx, Txz, Tyy, Tzz). The authors do not explain if their method inverts these components separately or simultaneously and do not discuss the contribution of each component in the inversion results. The last major issue regards the discussion of the results in terms of geological structures and geodynamical processes in the North China Craton. The authors should remind what is/are the fundamental question(s) in this region and in what this study brings answers or at least new constraints. This is not clearly specified in the current version of the paper. Finally, the authors interpret some density anomalies as thermal variations in

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the mantle without any quantification. They can easily calculate the density anomalies produced by such thermal variations and verify if their interpretation is plausible. In a general way, in their interpretation, the authors should systematically and clearly relate the density anomaly to the geological structure or to the geodynamic process which is not the case in this current version.

This manuscript responds to the Solid Earth criteria for publication. I recommend this paper for publication once the above main concerns will be addressed as detailed as possible.

Please find attached to this message the pdf file containing the detailed revision.

Please also note the supplement to this comment:
https://www.solid-earth-discuss.net/se-2019-181/se-2019-181-RC2-supplement.pdf

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