Solid Earth Discussions

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Reply on RC3

Duan Li et al.

Author comment on "Interpolation of magnetic anomalies over an oceanic ridge region using an equivalent source technique and crust age model constraint" by Duan Li et al., Solid Earth Discuss., https://doi.org/10.5194/se-2021-117-AC3, 2022

We are also grateful to the reviewers for the assessments, comments, suggestion and recommendations. All of them are carefully considered while revising the manuscript. Below we provide a point-by-point response to all pieces of suggestion and comments.

Reviewer #2:

The manuscript is well organized and the figures are clear although in some case too small to read and appreciate the values (Fig. 3e). I do not judge the method, that could be successfully applied to obtain useful magnetic anomaly map in area with a non uniform data coverage, but I suggest to the authors to better clarify and discuss some points.

Reply: We appreciate greatly your comments and suggestion that are very helpful for improving the manuscript. Below we clarify them point by point.

(1) As also reported by the other reviewer, the decision to use as constraint the model crustal age that is originally retrieved by magnetic data is at least controversial. If is true that other interpolation methods suffer the scattered data, the need to use constraints or a priori information in regions so complex could introduce additional errors. In addition to the dividing line of crust age, what other parameters concerning the magnetization of the source body did you use as a priori information?

Reply: Thank you for the question. The purpose of using crust age model as the constraint is to extract the direction information for extending the equivalent source in a certain direction, in which the trend information is used. The constraint information does not affect the fitting of observed data. The proposed method supports the application of a variety of prior information as constrain. In addition to the constraint information in the manuscript, other prior geological or geophysical data can also be converted into weighted factors to constrain equivalent source. Of course, only the crust age model was used in the work. More constraint information and methods will be tested in future work.

(2) About the synthetic model experiment, the magnetic properties in terms of susceptibility (or magnetic remanence) of the cells are not specified. Moreover, I do not understand how the background magnetic field was calculated. In this geological setting which is for the authors the source of this long wavelength? How the use of the deeper layer improve the synthetic model results? Is it necessary to add it to the model?

Reply: The background field is generated by a magnetic interface with random fluctuations in order to simulate the unpredictable long-wavelength information in practice. In some cases, the long-wavelength information not only contains Curie surface, but also other unknown signals. If the proposed method can obtain better results under the conditions in this manuscript, the calculation accuracy can also be guaranteed when the long-wavelength signal is simple.

(3) About the real data example, what magnetic properties did you get from the inversion of observed data? I do not understand if the obtained values are similar for both shallow and deep layers. This information imply the knowledge of the nature of the deep source or the origin of the background magnetic field. I suggest to discuss what represent the background magnetic field in the oceanic ridge region.

Reply: Thank you for the suggestion. The magnetization of equivalent source was obtained from the inversion of observed data. For the equivalent source, it cannot directly correspond to geological significance in some cases. Especially, when the deep equivalent source is placed deeper, it should be understood that the equivalent source a group of model coefficients rather than a group of physical sources. This case is very similar with the research by Kother et al. (GJI, 2015). They set the equivalent source depth as 100 km, which in fact also has no geological reasons but for obtaining the optimal results.

(4) I suggest to clarify how the authors chose the sizes of the model cells in both the synthetic and the real example. How the sizes of the cells influence the results? In particular, it is not clear the reasons behind the choice of the deeper layer; cells with size of 80 km*80km*40 km seem too big. Moreover, this level has been localized, as said by the authors, at the depth of the Curie point but in the oceanic ridge region the Curie point is shallow and cells with 40 km of thickness would fall in the mantle where the temperature is certainly higher than the Curie point (see Li et al., 2017, A global reference model of Curie-point depths based on EMAG2, Scientific Reports, 7).

Reply: Thank you for the suggestion. We place the top surface of deep layer near the Curie point, and its bottom extends to the deeper depth, in order to better rebuild the amplitude of magnetic anomaly. Relevant expressions have been revised in the updated manuscript.

(5) In the chapter 3 of supplementary materials have been reported the sizes of the cells used in the experiment. Being different from those reported in the text I do not understand if they refer to the synthetic model or to the real model. I suggest to clarify this point.

Reply: In the supplementary materials, the equivalent source was constructed for the theoretical model. In the report, the equivalent source was constructed for the real data. Because the different range and data spacing between these two data sets, these two equivalent sources are different.