

## Specific comments on se-2021-117

Anonymous Referee #1

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Referee 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-RC2>, 2021

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### Specific comments

I have also some specific comments/recommendations:

- It seems that the method uses a topocentric Cartesian system with x pointing to North, y to East, and z pointing down, but I could not find this information in the manuscript.
- On page 6 is written that "Regularization and precondition techniques were utilized to stabilize the inversion process and balance the decay of the potential field". I understand that a preconditioning technique, in this case, does not introduce a priori information about the parameter vector  $m$  (eq. 1), but only controls the convergence. So, could you please explain what is the a priori information introduced by matrix  $P$  (eq. 1) and how it contributes to stabilizing the inversion?
- I think that the elements forming matrices  $G$  and  $P$  (eq. 1) must be clearly defined in the manuscript. Note that, without specifying the elements of matrix  $G$ , the reader cannot know what type of equivalent sources (prisms, dipoles, etc) form the equivalent layer.
- I recommend using a tool model to illustrate how matrices  $W_x$  and  $W_y$  (eq. 3) are defined.
- According to page 7, matrices  $W_x$  and  $W_y$  (eq. 3) impose smoothness only on the physical property distribution of the shallow layer. Why they are not used to also impose smoothness on the deep layer?
- What are the criteria to define the depth/geometry of shallow and deep layers?
- On page 7, it is written that "A layer with larger ES cell sizes at larger depth was utilized to simulate the background magnetic field.". I understand that "changing cell sizes" is possible only if the layer is formed by 3D sources. How to change the cell sizes of a layer formed, for example, by dipoles?
- Apparently, the weights  $w_x$  and  $w_y$  (elements of matrices  $W_x$  and  $W_y$ , eq. 3) do not have any normalization. In this case, it is expected that their numerical values depend on the particular characteristics of the study area and the interpretation model. As a consequence, it is not possible to use a fixed  $10^{-4}$  in all situations. I recommend including some discussion about this.
- What is the "geophysical meaning" of the synthetic magnetic interface presented in Section 3? Could it be related to the Curie isotherm? In this case, I think it should be smooth. It seems that this simulated magnetic interface is a purely mathematical way of generating long-wavelength data.
- The simulated main geomagnetic field presented in Section 3 is constant, with

intensity, inclination, and declination of 35000 nT, 40°, and 3°, respectively. The crust model, however, covers an area of approximately 5° x 5°. Is it reasonable to consider that the main field is constant throughout this area?

- In my opinion, a detailed description of the parameters used to generate the results shown in Figure 2 with all methods must be included in the manuscript. Otherwise, it is not possible to obtain a proper comparison.
- The study area in Section 4 covers an approximately 5° x 5° area. Is it reasonable to consider that the main geomagnetic field is constant throughout this area? How the variability of the main field affects the results?
- I think that Figure 3 should be improved. I could not understand the relationship between the axes "Northing" and "Distance" in panel (b). Apparently, panel (e) shows the two layers, their equivalent sources, and the weights  $w_x$  and  $w_y$  (elements of matrices  $W_x$  and  $W_y$  in eq. 3) associated with them, but it is not clear for me.