

Geosci. Model Dev. Discuss., referee comment RC2  
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## Comment on gmd-2022-88

Italo Goncalves (Referee)

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Referee comment on "3D geological modelling of igneous intrusions in LoopStructural v1.4.4" by Fernanda Alvarado-Neves et al., Geosci. Model Dev. Discuss.,  
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The manuscript presents a novel methodology to model the geometry of igneous intrusions. Developments from previous works are employed along an adaptation of the ODSIM algorithm. External knowledge can be inputted through parametric functions.

The first reviewer already made substantial points about the work's structure, clarity, and methodology. My contributions are the following:

Major comments:

I believe the authors should try to isolate the strengths, limitations, and benefits of the three main components of the proposed methodology, namely the use of (i) structural frames, (ii) ODSIM, and (iii) parametric conceptual models. Experiments using (i) and (ii), (i) and (iii), just (i), etc. would be too much work perhaps, but their isolated effects and their contribution to the final result must be measured somehow. It might be that one of the three is completely unnecessary or redundant, at least for the case studies provided.

Please clarify the mathematical notation. It is common to use lowercase for scalars, bold lowercase for vectors, and bold uppercase for matrices.

Section 2.1 - A figure with a conceptual explanation would be interesting. If a 3D example becomes too convoluted, cross-sections or a 2D example can be used.

It is not clear whether the  $g$ ,  $p$ , and  $l$  fields are scalar or vector fields. Lines 314-326 present some ambiguity in this regard. The text mentions isovalues, supporting the notion

of scalar fields, but it also mentions orthogonality between  $p$  and  $l$ , suggesting that they are in fact vectors. Do you mean orthogonality between their gradients? If  $g$ ,  $p$ , and  $l$  were in fact vector fields, then one would have to interpolate 9 variables instead of 3.

Why use simulations? Wouldn't it be possible to use kriging or RBF (even if you must compute normal scores first) to obtain a "mean" surface?

Section 5.1 and lines 473-477 - For the sake of fairness to RBF, you could employ an elliptical conceptual model in this case as well. It should be simple to define a parametric base field and subtract it from the signed distances data.

Figures 7, 8, 10c, and 10d: please discuss the possible causes for the jagged aspect of the models. I suspect it has to do with the use of simulations.

Lines 555-556: I see it as an advantage, rather than a limitation. User input in this form allows for more flexible and realistic models. It may require extra work and thought, but that is why professionals are trained.

Minor comments:

Figure 3 - do you mean  $(g, p, l)$  or  $g(p, l)$ ?

Figure 4, legend - "The starting points for the search is the shortest path is  $J_{in}$ "; please rephrase

Section 4.2.1 - The gradients of the  $g$ ,  $p$ , and  $l$  fields have a constant direction? I assume that this is the case in the presented example, but not a requirement for the methodology to work.

Line 309: "The gradient of this scalar field is a normalized vector parallel to the propagation direction of the intrusion." Does this mean that the field  $p$  is linear? Looking at Figure 5 the direction of the gradient appears to be constant, but the slope seems variable (for instance, the green region is thicker than the cyan one). This might be an artifact of the color scale. I recommend the use of visually uniform color maps (Crameri et

al., 2020)

Lines 339-344: The text seems to repeat the explanation of lines 350-356 after the equation.

Line 361: What do you mean by a variogram of infinite range? A range larger than the extent of the  $g$ ,  $p$ ,  $l$  coordinates?

Figure 7, legend: "sills" -> "sill's"; "shows" -> "show"

Line 455: Do you mean Figure 10d?

Figure 11: In the first line,  $V_b$  is equal to model volume. Is this correct?

Figure 14, legend: "thought" -> "through"

Line 569: "realization" -> "realizations"

Line 576: "restricted" -> "constrained"

References:

Cramer, F., Shephard, G. E., & Heron, P. J. (2020). The misuse of colour in science communication. *Nature Communications*, 11(1), 1–10.  
<https://doi.org/10.1038/s41467-020-19160-7>