

The Cryosphere Discuss., referee comment RC1
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Comment on tc-2022-60

Anonymous Referee #1

Referee comment on "Exploring the capabilities of electrical resistivity tomography to study subsea permafrost" by Mauricio Arboleda-Zapata et al., The Cryosphere Discuss., <https://doi.org/10.5194/tc-2022-60-RC1>, 2022

In this paper, the authors use layer-based parameterizations of the inverse problem to improve characterization of subsea permafrost conditions. Their 2D results look very promising and the robustness of the results are thoroughly investigated with 1D inversions and multiple sensitivity analyses. I think the authors have presented an extremely well-written and scientifically rigorous paper that is of interest to readers of The Cryosphere and the broader permafrost and geophysics communities. Below, I have made some suggestions to improve the manuscript. Following these minor changes I believe this article will be ready for publication.

Line 29: "layer (or body)" -> "layer or body". There are many spots throughout the paper where parentheses are unnecessary and are actually a bit distracting, as they disrupt the flow of the sentence. Revising throughout the paper will improve the flow and make your ideas easier to understand.

Line 66: "the less conductive is the medium" -> "the more resistive the medium", since you've been using resistivity to describe the water and sediments throughout the paragraph.

Line 86: The phrasing of this sentence makes it sound like Arboleda-Zapata et al. (2022) also looked at the IBPT. I think it makes more sense to omit "also around the IBPT" to avoid this confusion.

Figure 1 caption, line 3: "read line" -> "red line"

Figure 1 (b) and (f): I would use a different color besides red to indicate historical coastlines (since you've already indicated the red lines show the ERT profiles). Maybe a black dashed line to agree with Figure 1e would be better.

Line 159: I disagree – I don't find these plots particularly useful and would omit them in the final paper. Even with your interpretation of higher noise levels in levels 7 and 8 in the Bykovsky dataset, I think this is easier to see in Figure 1c than it is in 1d (and would argue that this is better described as variability than noise, because it may be caused by real features).

Line 181: It would be nice to specify that these are features you might expect to see at your study sites. Maybe something like "Allowing for abrupt changes is important in permafrost environments where high structural variability is often found. At our sites, we could expect to see sharp boundaries due to..."

Line 202: So every mesh is different? How is the mesh structure determined? More explanation is needed here.

Line 232: "we not" -> "we do not"

Line 264: It's not clear to me what "considering five nodes for each interface" is referring to. Does this mean that each interface is parameterized by five depths along the survey line? Clarification would be helpful here.

Line 284: This phrasing could be interpreted as a general observation that more resistive permafrost = deeper boundary. I think it's important to specify two things: 1) that this is specific to your model, not a general observation, and 2) that this is due to a model equivalence/non-uniqueness problem (which will also help to introduce the following section).

Figure 2: It would be nice if you showed the smooth inversion here as well, as it would provide a nice comparison for the layer-based models. Same comment for Figure 7.

Line 318: "because" -> "and". This statement is more of an observation than an explanation. Same comment for line 526.

Line 351: Here, you could explicitly state that the low sensitivity to permafrost resistivity causes the error in your 1D models and contributes to the uncertainty in your 2D models.

Figures 4 and 9: This is mostly personal preference, but I would find the correlation matrices easier to read if they only showed the lower left portion and omitted duplicate cells. I also find it difficult to estimate the magnitude of the correlations using the color scale alone and suggest printing the numerical values on each cell in addition to the color.

Line 487: "especially, for marine data," -> "especially for marine data"

Line 499: You could also note that this highlights the importance of having an accurate estimate of data noise. Since the misfits for the model in Figure 7d were higher, this set of models could potentially be ruled out if they were found to exceed expected error levels.

Line 533: "resistivity" -> "ice-bearing permafrost resistivity"

Line 615: It's great that the data are available. If possible, you could share your code as well so that others can easily reproduce and build on your work.