Reviewer 3 comments and author answers:

This paper employs the Petrophysical Joint Inversion (PJI) method, combining the Geometric Mean Model and Clustering approach to quantify the ground ice content of mountain permafrost across different landforms. It compares these results with those obtained using Conventional Electrical Resistivity Tomography (ERT) Inversion and Archie's Law (PJI-AR) methods, evaluating the applicability of PJI-GM in mountain permafrost under various landforms. This study fills a data gap regarding the extent of ground ice in the Tien Shan and Pamir regions (Central Asia) and analyzes the respective advantages and disadvantages of PJI-GM and PJI-AR in mountain permafrost areas. The research is at the forefront of the field, the overall logic of the paper is clear, and I recommend acceptance after necessary revisions. Below are specific suggestions for modifications:

- Line 202: The authors mentioned using a modified PJI approach, which appears to refer to the PJI-GM method. However, in the introduction, the authors state that Mollaret et al. (2020) proposed the PJI-GM method (Line 107). It is unclear what are the modifications compared to Mollaret et al. (2020).

Thank you for pointing this out. We agree that the term modified might be misleading in this context, and we will remove it to avoid confusion. To clarify, Mollaret et al. (2020) primarily presented a proof of concept, demonstrating the use of the Geometric mean model within PJI for well-characterized profiles with known ground truth. In contrast, our study extends this approach by systematically testing its performance across a variety of conditions, including sites where no independent ground truth is available. Additionally, our implementation includes iterative inversion loops and cluster analysis, which allow for a more refined assessment of the method's applicability. By applying PJI-GM in these new settings, we aim to evaluate its robustness and potential for broader geophysical applications beyond the proof-of-concept stage.

- Line 292: Although authors mentioned defining the zone of interest (ZOI) for each profile according to the method of Hilbich et al. (2022) to calculate the potential ground ice content, I suggest that the authors provide a detailed explanation of how the ZOI is defined, as the extent of the ZOI directly affects the subsequent calculation of ground ice content for each profile.

Thank you for your suggestion. We acknowledge that the definition and delineation of the Zone of Interest (ZOI) involve a certain degree of subjectivity. However, we tested a range of ZOI extents for each profile and found that, in general, the variations had only a minor impact on the final ground ice content calculations. The ZOIs are, furthermore, shown in the Annexe Figure A2.

To improve clarity, we added a more detailed explanation of how the ZOIs were defined:

To define the ZOIs, we typically selected a zone below the active layer that extends horizontally across as much of the profile as possible within the area where frozen conditions are expected. The depth and width of the ZOI was adjusted to each profile's resolution capacity in the relevant depth range to ensure a representative selection..

- Line 294: The term "zone of interest" seems to refer to Figure A2 rather than Figure A1.

You are correct, thank you for noticing. We changed the manuscript accordingly.

- Line 313: "(Rücker et al., 2017)" should be changed to "Rücker et al. (2017)".

Thanks for noticing, we changed the citation accordingly.

- Line 363: "Figure A" should refer to "Figure A3," right?

Yes, thanks again for noticing, we changed the reference accordingly.

- The subfigure numbering format in all figures within the paper is inconsistent. Some use lowercase letters (a., b., c., d.), while others use uppercase letters (A, B, C, D).

We now use lowercase letters for all figures.

- Figure 5a: The y-axis is missing a label, and the legend of the colorbar could be adjusted slightly to the right.

We added a label for the y-axis.

- Figure 8: What do the blue dotted lines on the surface represent? I did not find an explanation in the legend.

The blue dotted lines on the surface indicate the location of the electrodes. We added this to the caption:

Examples of interpreted ERT profiles of different landforms. (a) rock glacier with high resistivities below an active layer of about 4 m; (b) moraine, high resistivities may point to buried glacier ice; (c) Rock glacier and fine grained sediments (d) talus slope; (e) fine-grained sediments; (f) fine-grained sediments, where a borehole confirmed saturated ground ice conditions in uppermost layers. The blue dotted lines on the surface indicate the location of the electrodes.

- Figure 11: A label indicating depth should be added to the y-axis.

We added the y-axis label.

- Figure 13: Similarly, a label indicating depth should be added to the y-axis.

We added the y-axis label.

- Lines 531, 533, and 556: The references to figures in the text are incorrect.

This was also indicated by the other reviewers and the correct figure references were added.

- Line 190: The extra question mark seems to indicate an incorrect citation?

Yes, we added the correct citation. Thanks for pointing this out.