

Review of the manuscript entitled: “Rockwall permafrost dynamics evidenced by Repeated and Automated Electrical Resistivity Tomography at Aiguille du Midi (3842 m a.s.l., French Alps)”. This manuscript reports the use of an automated system capable of recording periodic electrical resistivity tomography profiles over a permafrost dominated high altitude site in the French Alps. As much as I admire the authors for being able to instrument such a challenging site, and despite slight improvements from the previous iteration, the manuscript requires a thorough revision and potential reorganisation of scope and narrative. A few major issues prohibit me from recommending it for publication:

1. There is a certain ambiguity around the methods used in this work. Authors need to be clearer and add more details about methods around field water sampling, laboratory complex impedance measurements, electrical resistivity data processing pre and post geophysical inversion.
2. There is a serious lack of detail regarding the cross-peak tomograms (produced using two electrode cables). As these are not repeat measurements they need to be presented separately from the A-ERT measurements.
3. As was mentioned by the authors, data acquisition was plagued by issues along the way. Whereas this is somewhat to be expected in such a challenging site, I cannot refrain from doubting the quality of the data and suspect the overinterpretation of the results. As mentioned in Table C1, each individual timestep does not contain that many datapoints, post filtering, which it is worrying with regards to the tomogram’s sensitivity and ability to resolve thin layers (such as the active layer) and other features within the profile. There is also quite a lot of inferences regarding the near subsurface but the distance between electrodes within a quadrupole would indicate there are little or no measurements in the near subsurface (top 5m).

My suggestion to the authors is to reorganise the manuscript and put forward only the datasets which can 1) be backed up by a clear and appropriate methodology and 2) have data processing metrics that clearly attest its validity. On a previous round of revisions, the novelty of this manuscript was put under scrutiny. And I would agree, A-ERT alone is not novel for the study of permafrost stability. However, I see a lot of value and potential fruitful discussions in aligning temperature datasets derived from geophysical measurements with temperature datasets measured in boreholes (as was done for Figure 10). I also like the idea of having pseudo boreholes to compare temperature variability with depth at different locations along the profiles. If you have a good resistivity-temperature conversion model, why not present a series of 2D temperature profiles corresponding to the different timesteps?

I will also list line specific comments below, some of which refer to the aforementioned issues (red headings) and help put them into context.

Line 28: To give the narrative a better flow you should first say something like "Borehole temperature measurements are often used to monitor such geohazard susceptible areas, but they lack sufficient ..."

Line 33: 3.5 years.

Line 33: It would be better if you said what instrumentation you installed along the profiles.

Line 34: Autonomous is not synonym to automated. Do you mean automated here as in A-ERT?

Line 73: Delete “On the other side”.

Line 79-89: I don't really understand the need of this section here. Apart from ERT you are not using any of these other techniques. Why not save it for the discussion arguing how can an ERT survey be enriched by other geophysical information.

Line 110: “from a fixed”.

Line 114: Might want to add Cimpoiasu et al., (2025). It talks about capturing freeze-thaw transitions in the active layer with an automated ERT system.

**Cimpoiasu, M.O.**, Kuras, O., Harrison, H., Wilkinson, P. B., Meldrum, P., Chambers, J. E., Liljestr and, D., Oroza, C., Schmidt, S. K., Sommers, P., Vimercati, L., Irons, T. P., Lyu, Z., Solon, A., and Bradley, J. A. (2025). High-resolution 4D electrical resistivity tomography and below-ground point sensor monitoring of High Arctic deglaciated sediments capture zero-curtain effects, freeze–thaw transitions, and mid-winter thawing. *The Cryosphere*, 19, 401–421, <https://doi.org/10.5194/tc-19-401-2025>.

Line 127: Do you mean “of the same site”?

Line 128: “pluriannual permafrost dynamics”.

Line 131: “three linear electrode arrays were deployed”.

Line 135-137: Suggest rephrasing to: “temperature estimated using geophysical measurements of electrical resistivity is quantitatively evaluated by comparison with borehole temperature measurements.”

Line 142: Explain the acronym AdM before using it in text.

Line 142: “by around 5000 visitors...”. What is the point of this information? I think you want to say that it is an important landmark that deserves to be protected and monitored.

Line 166: I’d save this for the discussion.

Line 169: “different dates”.

**Line 219:** How was this collected? Please be clearer and more specific when you are explaining your methods.

Line 221: Small s in “sample”.

**Line 227:** Have you steadily increased the temperature of the bath within that range? It is not clear at all what were the temperature increments used and when you have collected resistivity measurements.

**Line 227:** How was the impedance meter attached to the rock sample? It really isn't clear.

Figure 3: Do you happen to have a photo/schematic of the lab setup? It would help a lot to understand your experiment.

Line 237: No need to mention both electrical conductivity and electrical resistivity.

Line 242: How do you work out  $T_f$ ? Is it the inflection point of these model fit lines?

Line 244: How is  $\theta_r$  calculated?

Line 258: Again, it would be very valuable if you had a photo. Do you mean "jumper cable"?

Line 270: "number"

Line 271: Between June 2020 and ...

Line 272: Does "occasionally" mean not automated and periodical? What were the dates?

**Line 278:** What is the CR threshold?

Line 283: Do you mean CR not RC?

Line 283: Figure B1 doesn't indicate when the improvements were made to the cables, and it doesn't discuss the improvements. I personally can't see the improvements reflected in the datasets; the authors need to explain them a bit better by pointing at features in the plot shown.

Line 298: Do you mean three orders of magnitude instead of "decades"?

**Figure 4:** Different colours should be appropriately explained. What were the quadrupoles used?

Line 308: Do you mean CR?

**Line 310:** How do you define an outlier here?

Line 311: "analysed individually a subset of the pseudosections recorded"

Line 311: "(at different times of year (spring, summer))"

Line 311: ". As a result..."

**Line 311:** It is not very clear what the analysis procedure was.

Line 312: "we decided to filter outliers out of the range"

Line 314: Do you mean "more high resistivity data was filtered..."

**Line 315:** I thought you collected a dataset daily. What was the criteria used to subselect these datasets for analysis?

**Line 317:** It is not very clear what kind of inversion it is. Is it a timelapse inversion or have you inverted timesteps individually? Is it a timelapse inversion where all timesteps use only one timestep as reference or a timelapse inversion which uses the preceding timestep as reference.

Line 320: “in the absence of a”.

Line 321: “reciprocal errors” - explain what they are.

**Line 326:** Which one is the reference dataset?

Figure 5: change X-axis label to “distance between electrodes”.

Figure 5: “at different distances between electrodes within a quadrupole”

Line 348-350: remove from caption, keep for discussion.

Line 365: between the sun exposed ... strong isolation) and the shaded ...”

**Figure 6:** Your rms is quite high. In your methods you only discuss the daily profiles and their processing, you don't mention anything about data quality corresponding to this tomogram. How many measurements do you have? Were they filtered? What is the resulting sensitivity?

Line 395-396: It is not very clear which one is the reference model? Is the preceding timestep the reference model?

Line 398: “acquired along the NW profile”

Line 399: “can be observed”

Line 400: “The permafrost layer associated with high...”

Line 402: “was cooler than both...”. A colder year? On average? You need to rephrase this sentence.

Line 412: I think it is pretty obvious you are above the water table.

**Line 413:** I generally prefer it to be presented as percentage difference rather than ratio. My main concern is that I was expecting a distinct region with values around 1 (white) for where the gallery is and I can't see that in your figure.

Figure 8: Label where the gallery is on these figures as you did for figures 6 and 7.

Figure 8: You don't have to repeat the X-axis label for all subplots.

Line 443: Why would that be? More fractures in that area? More water retention?

Line 446: Remove semicolon.

Line 449: Are you expecting porosity to be very different in P2?

**Line 451:** Are you basically saying there are no electrical resistivity measurements in the active layer? You do make quite a lot of inferences about the active layer though.

Line 466: Explain the acronym before using it.

Line 484: Which one is the dominant factor then? Water content?

Line 487: Please rephrase, I don't know what you are trying to say here.

**Line 496:** How did you extract resistivity at P1? This is yet another thing not well explained. Are you selecting the mesh element with the closest coordinates to a specific depth along P1 and report its resistivity?

Line 505: “part of datasets”? This is vague.

Line 507: Do you mean “whereas”?

**Figure 11:** There is a lot to unpack here. I don't think the field and lab agree very well so the strategy needs to be revised for future work. Perhaps a list of suggestions on how to improve this would help the readers. It is possible that the sample's resistivity evolution with temperature is not representative for the area extracted from the inversion result.

Figure 12: As before, superimposing the approximate location of the gallery would help interpret these results. Please explain the red arrow.

Line 551: “high altitude mountainous site”

Line 551-554: This is phrased as if high CR is an A-ERT problem, but it is not, it is a problem that appears when collecting ERT data in frozen environments.

Line 563: Decide between using words like "two" or numbers "4" to describe numerals. I think for numerals <10 you should use words and for numerals  $\geq 10$  use numbers.

Line 574: “of the used electrode array”. Remove other instances of “dispositive”.

Line 579 and equation 2: Around 0C it is known that the supercooling effect takes place and Wu et al., (2017) showed it is reflected in geoelectrical data too. Your model doesn't seem to be able to reproduce that. Why is that? I think it is worth a talking point.

Wu, Y., Nakagawa, S., Kneafsey, T. J., Dafflon, B., & Hubbard, S. (2017). Electrical and seismic response of saline permafrost soil during freeze - Thaw transition. *Journal of Applied Geophysics*, 146, 16–26. <https://doi.org/10.1016/j.jappgeo.2017.08.008>

Line 585: “some datasets” is a vague statement. Please be specific.

Line 588: Gradual? Is it not a linear increase on a log plot which makes it an exponential increase in resistivity below 0C.

**Line 591:** Didn't you say electrodes are not close enough so you cannot reliably infer what is happening in the near-surface? Please clarify.

Figure B1: Electrode “number” for the Y-axis label; “Date” for the X-axis label.

Figures D1-3: Please label the approximate position of the gallery.