Authors present an interesting application of SIP on a permafrost site. The study is exhaustive and well presented, results are supported by the data presented and the work is of interest for TC readers. I have no doubt the paper deserves publication after some minor corrections on text and graphics.

Thank you for the constructive and helpful comments. We considered each comment carefully and address them in detail in the following text.

1) **Line 73 and 76 seems describe the same concept, maybe the lab tests can be presented in one sentence.**
   To avoid repeating the description of the laboratory tests, we summarized the concept in one sentence in lines 74-76.

2) **line 140 ρ is the here the real component (Ω m) ?**
   We agree that using another word for the real component of the complex resistivity (i.e. the in-phase resistivity) is misleading and removed it from the text.

3) **Ln 176 Maybe the relaxation frequency of ice should be here better introduced**
   According to this comment, we specified the relaxation frequency earlier in chapter 2.1 (lines 175-180), so that in line 176 (now lines 184-185), the parameter is already introduced.

4) **chap. 3.2 The SIP setup description should include essential information as the electrode spacing, the arrays lengths, to etc. to be specified line by line**
   Electrode spacing, profile length and other information about the measurement setup are summarized in Table 1. Nevertheless, we reference this table now more clearly and add the most important details also to the text (Section 3.2.1).

5) **chap.3.2.2 . August or September 2019 ? (see line 218). I think part of this paragraph is setup (3.2) rather than mapping. You assert resistance contact was in the range 5-60 kΩ , a very low values in such a debris condition (if compared to the literature ones, in the common order of hundreds). Did you help the contact some way ? and if yes, how do you increase the contact locally? This is of extreme importance in SIP results obtained below, and of huge interest for the TC community**
   - Thank you for the remark, we wrote the wrong date in line 218 (now lines 223-224) and changed it accordingly.

- Additionally, we changed the titles of subchapters 3.2.1 and 3.2.2 to make clear that all subchapters are part of the SIP measurement setup and describe different aspects of SIP data acquisition.
- The electrode contact was improved by adding salty water containing a small amount of salt in the solution and some mud found in proximity to the profile. This led to a reduction in the contact resistances of a few tens of kΩ, higher current injections and an enhanced IP data quality. We added this description to chapter 3.2 where we specified the improvement of contact resistances.

6) **Ln 258 is it always 5 m the spacing ? did you collect dip dip data also with 10 m spacing?**
We added a sentence clarifying that we collected DD data with 4 m, 5 m and 10 m electrode spacing and different dipole lengths, which we specified in lines 267-269.

7) **ln 302-304. This last sentence about robust inversion is not clear, is it real necessary?**
In the presence of data outliers, i.e. errors in DC and complex resistivity measurements due to poor galvanic contact or incomplete removal of electromagnetic coupling, or in the case of unknown error parameters, LaBrecque and Ward (1990) suggest a robust inversion algorithm in which errors of data with large misfits are successively increased during the inversion. Morelli and LaBrecque (1996) tested its efficiency within a DC resistivity tomographic inversion algorithm and Kemna (2000) applied the scheme of LaBrecque and Ward (1990) to complex data errors. Within our analysis, we noticed stable reconstruction results when applying the robust scheme to noisy data (i.e. SIP data collected with multicore cables or in other permafrost environments). Whereas for the use of coaxial cables, where outliers are being minimized we saw no improvement in applying a robust inversion. We tried to better explain this approach in lines 319-325 (revised version).

8) **Fig.2, I suggest to label the figures (a,b,c,d) to help reader's comprehension. Modify the text and caption accordingly.**
We adapted the figures, caption and text accordingly. Due to the similar structure of Figure 2 and Figure 3, we added labels to both figures.

9) **Ln 402. Sentence is not clear, I think the concept is ρa has no frequency dependence but it is still able to discern frozen parts.**
We agree with the reviewer and introduce the term of apparent resistivity in our manuscript (in lines 146-147) and improved the formulation in lines 424-425 to better transport the message.

10) **Ln 546-549, Sentence about Duvillard work is not clear.**

We clarified the findings of Duvillard et al. (2021) in lines 576-581 as follows: Duvillard et al. (2021) applied a petrophysical model parametrized with a laboratory calibrated freezing curve to conductivity and induced polarization tomography data to assess the temperature distribution of a permafrost-affected rock ridge. They postulate that it only supports ERT data in assessing the contribution of the surface conductivity to the total conductivity of the material. However, they did not investigate the frequency dependence of the IP, and thus, did not exploit polarization processes occurring in another frequency range, as TDIP field data were acquired at a dominant frequency of ~1 Hz.

11) **Fig.8 the c) panels must be differentiated, cause they are not clear in the caption. Please label the different depths in the figure.**

We modified Fig. 8 and its caption accordingly by adding the labels of the different depths to the legend of Fig. 8a and Fig. 8b, added a title to each subplot and defined a common legend for the whole figure.

12) **Ln 584-87 As I understood you performed lab test on Lapires sample rocks. This is part of the research (and then Method) and should no be presented here in the discussion section.**

We are investigating here the capabilities of the SIP imaging method for the investigation of alpine permafrost sites. The analysis of the micro-scale polarization processes is not the scope of the study. Thus, we prefer to avoid presenting details on the methodology and discussing details of laboratory SIP measurements. This has been discussed in Limbrock et al. (2021).

13) **Ln 601 Since the spacing was 5 m, why you average pixel of 1 m width. Maybe keeping the same spacing address more your survey lateral resolution.**

We agree with the reviewer and changed the pixel width corresponding to the electrode spacing for all figures and in the description of the figures (line 485, line 597, line 648, Fig. 7, Fig. 8, Fig. 9).

14) **Ln 614 How Coperey work differs from Limbrock one? This is of interest in the discussion of your results.**

Coperey et al. (2019) investigated the effect of temperature changes on the SIP response of porous media and concentrates on the Stern layer polarization mechanism; while Limbrock et al. (2021) consider the polarization effects at a broader frequency range to include the polarization of ice. To address your comment, we added the

following line in the Introduction Section: “Limbrock et al. (2021) characterized the textural and mineralogical controls on the SIP behavior different rock samples collected in the Alps and analyzed the temperature dependence of its polarization response in the laboratory.”

15) **Fig. 9 I suggest label the panel. Looking the figure, the frequency dependence of AL and permafrost seems to have the same behaviour. This should be more emphasised in yours discussion.**
We added the labels to Fig. 9 and adapted the caption and description of the figure accordingly. We agree with the reviewer that the complex conductivity values of the active layer and permafrost example are quite similar and both spectra (active layer and permafrost) show an increase in the polarization response with increasing frequency. However, for frequencies above 10 Hz, we clearly can see an increase of the polarization (i.e. the imaginary conductivity and the phase) with a larger slope for the permafrost compared to the active layer. To compare the slope of active layer and permafrost quantitatively, we computed the slope for the phase of the complex conductivity between 112.5 Hz and 7.5 Hz. The slope of the permafrost is with a value of ~3 mrad/Hz higher compared to the active layer with ~1.6 mrad/Hz slope. This information was added in the Discussion Section in lines 665-673.

Thank you for the very interesting reading