

General comments

This is my second review of this manuscript, now entitled: “Geophysical measurements of the Southernmost microglacier in Europe suggest permafrost occurrence in Bulgaria”.

I acknowledge the clear improvements done to the article. I can safely say it is a valuable piece of science and it will be a good contribution to the literature. However, still needs a bit more work before it can be published. At the moment, I cannot recommend it for publication.

First of all, the language issue still persists especially in the paragraphs where new text was added. There are still quite a lot of mistakes and several sentences difficult to understand. I have tried to help the authors with some suggestions as much as I could, but the whole text needs to be thoroughly examined and its language more rigorously improved.

There is a serious lack of detail about how ERT measurements were collected. You don't even mention the device used. How many measurements per profile? Did you acquire any reciprocal data? Any data filtering applied pre-inversion? Any error models applied to the data? Any temperature corrections? It looks like you used Res2DInv as an inversion software, but you are not referencing it. Why is that?

Finally, it would be useful to discuss the wider implications of your work. Why are your results relevant to the wider scientific community? Examples of a few discussion topics you might want to touch upon:

Does the discovery of permafrost make you rethink the pedo/geomorphology of the Pirin mountains?

Does it imply that we need to rethink the importance of permafrost formation factors?

Can permafrost be more common in Bulgaria than we previously thought? If that is the case, could it be that we are underestimating the permafrost distribution worldwide?

Specific comments

Abstract

You use the spelling “glaciarret”. One of the other reviewers used the spelling “glaciaret”. In Ganchev, (2011) I found it spelled as “glacieret”. What is the correct spelling? Please determine which one is appropriate and use it throughout the manuscript.

1. Introduction

Line 36: “also” / in addition of what? Please remove “also”.

Line 37: how is it visible? This is a rather vague sentence.

Line 51-53: references required

Line 54: “The ERT technique is one of the basic methods for permafrost evidence and studies”. I don’t know if basic is the best term here. A commonly used geophysical method maybe? Also, please add references.

Line 81: Electrical Resistivity Tomography (ERT) method

Line 81: is sensitive to the changes ...

Line 85: significant how? Please be specific e.g. “increases by ‘x’ orders of magnitude”, include a reference.

Line 86: Please delete this sentence. Either include this mention earlier in the paragraph or merge it with another sentence. On its own at the end of the paragraph doesn’t fit well with how the text flows.

Line 93: Did you want to say: "even though"? I think what you say before "there are some limitations" is redundant.

Line 95: please rephrase as “the complicated logistics of transporting ... and the aspects regarding a safe system of work”

Line 98-99: Not clear. Please rephrase.

Line 101: “To minimize the inaccuracies the relief can be estimated using unmanned aerial vehicle (UAV) for example.” Include a reference please.

Line 103: ERT has limitations when applied

Line 104: Use “firstly”.

Consequence of what?

Ground not “rock”

Line 93-108: I can see that the point of this paragraph is to justify the complementary use of GPR, ERT and UAV measurements. However, you didn’t say how exactly they benefit from each other. Please be a bit more specific. For example, ERT resulting subsurface images suffer inherently from non-uniqueness. GPR, as an independent method of subsurface investigation, can supply more accurate information about where the boundaries between layers are located. This in turn can be used to give some geological context to the ERT tomograms or even constrain the ERT inversion results.

Line 109: “a very short”

What is a surface capture? Maybe I am not familiar with the term. Is it a series of photographs of the ground surface?

“An UAV”

Line 112-113: rephrase as “there is not much information about the ice thickness”

Please delete “and one point of our work was to solve this”. You already said this above.

Line 115: Please delete what is in parenthesis.

Line 116: Move this sentence at the beginning of the paragraph where you state what you will be showing us in this manuscript, such as: “the aim was to investigate the thickness...the glacial bed). In addition, we investigated where the meltwater from Snezhnika disappears beneath the microglaciers’ bed.

Line 117: Last sentence is redundant.

2. Methods

2.1. Study site description

Line 134: Rephrase “In the Golyam Kazan Cirque we find low coverage alpine and subalpine vegetation.”

Line 135: “There is no evidence of surface water”

Line 136: This sentence is not well integrated in the text: “Pirin Mountain is on cross-roads of Mediterranean and Continental climate”. As it stands, it sounds redundant.

Line 138: Is this correct: “measured until 2005”? 2005 was 17 years ago, I am sure a lot has change in the meantime. Are these records still representative?

2.2. Ground-penetrating radar

Table 1: GPR measurements settings

SURVEY |space| PARAMETERS

Line 165: What does this mean “without additional security? “. I think you mean that you didn’t have the right gear, but you don’t need to justify that. Just say: “highest elevation area accessible with the gear and tools available at the time.”

Line 166: Change “the second reason” to “ In addition, most of...”

2.3. Electrical resistivity method

Line 186: Do you mean “safe access to...”?

Line 186: why was pole-dipole and dipole-dipole impossible? You have to explain if you decide to mention it.

Line 191-194: This bit of text still doesn't sound right. I have given you a nice example in the previous round of revision, but you chose not to correct it.

What is a real geoelectrical section? I think you mean the result you get post inversion, but it's the first time I come across this terminology. Please rephrase.

Line 198: rephrase to "harsh weather conditions did not allow us to work on the same date every year"

Line 201: rephrase to "This measurement window is relative, changing from one year to another, with 2017 and 2018 seeing the first snow fall in September, whereas in 2020, with a warm month of October, the first snow fall was recorded in []"

Figure 3. How did you obtain the outline of the glaciaret? Is that from UAV images/ photos? Please specify in text.

3. Results and discussion

This section as a whole does not have a lot of structure. I suggest the introduction of some subsections to aid the reader.

Line 210-211: I have no idea what this sentence means "and accordingly its lowest part consists of the" new" snow left from the last winter. This are profiles GPR(2018)-1, GPR(2018)-2 and partially GPR(2018)-3 (Fig. 4a,b and c)." Why is new in quotation marks? Do you mean those profiles are relevant because they are down the slope? Please rephrase and be clear.

Line 246: What depth of 11m? Is that what Gruenewald found? What aerial geophysical measurements? Is UAV photography a geophysical method? Please be clear. Rephrase.

Line 254: How is this sentence relevant here? - "Subsurface structure of microglacier bed was investigated using ERT and GPR measurements." Isn't this a generic sentence? How is it connected to the rest of the text?

Line 257: aren't the years implied by the survey names?

Fig 6 is barely discussed. Please expand the discussion around it or remove it.

Fig 7: You call those pseudosections in the text. Results obtained post inversions are not pseudosections. Pseudosections are a plot of apparent resistivity values, measurements obtained in the field.

An RMS error of 22.5 is quite high. Why is that? Don't you think this error might influence the validity of your conclusions regarding Fig 7c?

Line 259: It is definitely not just marble that can have resistivity values between 8000 and 40000 Ohm.m. Many mixtures of rock fragments, water and soil can have a resistivity response within the same resistivity range. Given the local lithology, I understand why you made such statement, but the phrase needs rephrasing. Presently, it sounds as if because it has that resistivity it must be marble, which is not true.

Line 284-286: Are you not just repeating what you said above?

Line 289: Figure number not included.

Line 300: Figure number not included.

Line 327-328: I don't understand this sentence. Please rephrase.

At the end of section 3 (and consequently at the end of the conclusion section) I would suggest including a short discussion about the wider implications of your study. Why is this work relevant/how is it useful for the study of permafrost/ geophysical methodology or geomorphology of Bulgarian mountains? How can future research build upon your results?

4. Conclusions

Line 332: rephrase "is a large-scale assessment of the ice-thickness"

Line 338: "by size"? do you mean surface area?

Line 342-343: "ERT measurements were repeated over three consecutive years, detecting the anomaly during every measurement campaign."

Line 344: rephrase "an answer to the question: where does the meltwater disappear?"

I would have my reservations about claiming you found the answer to that question. I feel that the evidence you present is not sufficient to claim that. You might however say that based on your observations you have formulated a new hypothesis.

References

Gachev, E. (2011). Inter-annual size variations of Snezhnika glacieret (the Pirin mountains, Bulgaria) in the last ten years. *Studia Geomorphologica Carpatho-Balcanica*, 45(October), 7–19.