

Subject: Detailed Responses to Reviewers: Liu, H., Maghoul, P., and Shalaby, A.: Seismic physics-based characterization of permafrost sites using surface waves, The Cryosphere Discuss. [preprint], <https://doi.org/10.5194/tc-2021-219>, in review, 2021.

Date: February 22, 2022

The authors are grateful for the valuable comments and kind consideration of our submission. Detailed responses and revisions based on these comments are listed below.

The third layer of your model needs more descriptions, perhaps, with some modifications to figure labels (Fig 4 and B.1-B.4). This should not take much effort.

We have provided more description for the third layer in line 210-213 in the revised manuscript. The degree of saturation of unfrozen water in the third layer is between 1%-100% (permafrost or unfrozen ground, which is to be determined). In our analysis, the third layer is assumed to be infinite. However, with the limited investigation depth constrained by the wavelength of the performed MASW tests, the inversion results beyond the maximum investigation depth are not considered in the paper.

It would be much appreciated if reviewers can specify the suggested modifications to the figure labels.

Line 18 (Shur Y., 2011) to (Shur, 2011)

We have corrected the reference Shur et al., 2011 in line 18 in the revised manuscript.

Line 159: Figure 2c and 2d illustrate into Figures.

We have corrected the 'Figure' into 'Figures' in line 159 in the revised manuscript.

Lines 178, 180 by (Glazer et al., 2020) to by Glazer et al. (2020).

Based on the recommended citation style by The Cryosphere, the original citation style (Glazer et al., 2020) seems appropriate.

Line 182 has a a thick - please, remove redundant "a".

It has been removed in line 182 in the revised manuscript.

Lines 185, 234 by (Szymanski et al., 2013) to by Szymanski et al. (2013) .

Based on the recommended citation style by The Cryosphere, the original citation style seems appropriate.

Line 193 Figure 3b, 3c ... show to Figures 3b, 3c

We have corrected the 'Figure' into 'Figures' in line 193 in the revised manuscript.

Line 195 (and similar at 203) (Figure 3e and 3f) to (Figures

We have corrected the 'Figure' into 'Figures' in line 195 and 203 in the revised manuscript.

Fig. 4 caption 0m and 120m - please add spaces 0 m and 120 m.

We have added space in Fig. 4 caption.

Fig. 6: I could not follow the figure caption. Please check these two entries: "(c) Distribution of the shear modulus of the solid skeletal frame." - but (c) shows the "Degree of saturation of unfrozen water"; while (e) provides the Shear modulus. "(e) Predicted average soil temperature distribution." - but (e) shows the shear modulus, while there is no subplot about the temperature..

We have updated the caption for Fig .6. (c): Degree of saturation of unfrozen water distribution. (e): Distribution of the shear modulus of the solid skeleton.

Lines 262, 479: "poro-mechanical" in the rest of the paper poromechanical has been used, please choose your favorite. .

We have replaced 'poro-mechanical' with 'poromechanical'.

Lines 339, 348 "in D" to in Appendix D .

We have updated them in line 341 and 350 in the revised manuscript.

Line 410 is given in F - are given in Appendix F.

We have updated them in line 412 in the revised manuscript.

Line 445: please, start a new line for equation " $\rho_{23} =$ ".

We have updated it in line 448 in the revised manuscript.

Line 477 Figure E.1 contains two colors (red and blue) - there is no red (green and blue).

We have updated it (green and grey) in line 480 in the revised manuscript.

Fig. E1... matrix.(a) ... missing space

We have updated it in Fig. E1 caption in the revised manuscript.

Appendix F: In several equations, I could not follow the difference between p_{33} and P_{33} .

P_{33} should be p_{33} and we have corrected it in Appendix F.

References: Albaric et al., 2021 - the correct journal name should be Seismol. Res. Lett. Dolnicki et al., 2013 - bibliographic information is incomplete.

We have updated references in the revised manuscript.