

Dear Editor,

We sincerely thank you for your careful evaluation of our revised manuscript and for your constructive comments. We have addressed each comment point by point and revised the manuscript accordingly. Our detailed responses and the corresponding changes are provided below.

1. Replicate sampling: As requested by reviewer 1, please clarify how many replicate soil cores (n) were taken. If  $n = 1$ , please flag this as a limitation given high spatial variability in plateau wetland soils.

Response: Thank you for this comment. We have clarified the sample size and added the corresponding limitation in Section 2.1 as follows:

“To characterize the vertical soil structure, a total of 11 undisturbed soil cores were collected from 11 depth intervals, with one core collected from each interval ( $n = 1$  per depth). The lack of within-depth replication limits the quantification of local spatial variability. Therefore, the observed vertical patterns should be interpreted as profile-scale evidence from the study site.”

2. Single-point framework scope: As also highlighted by reviewer 1, the single-point modelling approach is sound, but the conclusions overreach by extrapolating to “broader cold region ecosystems.” Please clarify.

Response: Thank you for this important clarification. We agree that the implications of a single-point modeling study should not be extrapolated to broader cold-region ecosystems. We have therefore removed the phrase “broader cold region ecosystems” from the conclusion and revised the sentence to clarify that the findings are based on observations and numerical experiments at this site and may inform further evaluation in alpine wetlands with similar hydro-pedological characteristics.

3. Frozen soil assumption: Please also clarify your claim that frozen soil processes were “negligible in summer” and provide support.

Response: Thank you for pointing this out. Frozen-soil processes were represented using the Niu and Yang (2006) parameterizations for supercooled liquid water and frozen-soil permeability. We selected June–August for the sensitivity experiments to minimize the influence of active freeze–thaw processes because soil water phase changes involve complex coupled water and heat processes beyond the scope of this study. However, these effects were not separately evaluated; therefore, our original statement that frozen-soil processes were “negligible in summer” was inappropriate. We have removed this unsupported statement and revised the corresponding text in Section 2.8 as follows:

“Frozen-soil processes were represented using the Niu and Yang (2006) parameterizations for supercooled liquid water and frozen-soil permeability. The sensitivity experiments were restricted to June–August to minimize the influence of active freeze–thaw processes, which were not separately evaluated in this study.”

4. Please check the figure numbers.

Response: Thank you for pointing this out. We carefully checked all figure numbers, panel labels, and cross-references throughout the manuscript. The incorrect reference to the WP4C instrument has been corrected from “Fig. 2b” to “Fig. 2c”. We also standardized the figure-number formatting throughout the manuscript.