

# ***Interactive comment on “PIC: Comprehensive R package for permafrost indices computing with daily weather observations and atmospheric forcing over the Qinghai–Tibet Plateau” by Lihui Luo et al.***

## **Anonymous Referee #1**

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### General comments:

In this manuscript the authors introduce the "PIC" R-package for computing permafrost indices over the Qinghai-Tibet Plateau (QTP). The package can calculate 16 temperature/depth-related indices to estimate the possible change trends of frozen soil in the QTP, and provides over 10 statistical methods, a sequential Mann-Kendall trend test and spatial trend method to evaluate the permafrost indices. The package also provides multiple visual options to display the temporal and spatial variabilities on the stations and region. Along with the package, a dataset from 52 permanent meteoro-

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logical stations across the QTP is prepared and the authors use it to demonstrate the temporal-spatial change trends of Tibetan permafrost with the climate.

The manuscript demonstrates some basic usages of PIC package. Although the authors state that the PIC package can be employed for a comprehensive analysis and can be used to validate the simulated results of the region, there's no such application presented in the current manuscript, therefore it's difficult to find the advantages of this package. On the other hand, a reasonable summarizing and categorizing the frozen indices developed in this package would be very useful for permafrost community, it's not available in the current manuscript. Overall, the manuscript is not well written and needs to be better organized. I do not recommend it for publication at the current stage, it could be reconsidered if the following points are addressed.

Specific comments:

1. It's mentioned that GLDAS and the weather station data of the surrounding QTEC were merged to produce a new data set, while it's not clear how this is done.
2. Please give concrete description on the parameters for the ground conditions, such as thermal conductivity of ground in thawed/frozen states, how were these parameters estimated or retrieved? their typical values and ranges at QTP.
3. It's mentioned several times that the PIC package integrates meteorological observations, remote sensing data, and field measurements to compute the factors or indices of permafrost and seasonal frozen soil. But from the manuscript, there's no description on how remote sensing data is integrated. It's also mentioned that the package integrates model simulations, it's not clear what model simulations refer to.
4. In Discussion, the authors state the simulation results from the PIC package show widespread permafrost degradation in QTP and the temporal-spatial trends of the permafrost conditions in QTP are consistent with previous studies. While there's no material results presented here to validate or compare with previous published literatures.

5. In Discussion, it's mentioned the spatial modeling at QTEC region classifies land cover and topographic features to determine the input spatial parameters, it's necessary to provide details and rationalities. It's also mentioned that the spatial modeling uses the GLDAS satellite data, but no detailed information.

6. The authors claim the PIC package will serve engineering applications and can be used to assess the impact of climate change on permafrost. Currently the package targets specifically QTP, how's the extensibility of this package? Is it possible to apply or extent the PIC package to other permafrost regions easily? If so, the PIC package will benefit a larger community.

Minor comments:

1. P2, L13: Change "Such an increase..." to "Such an increase in temperature of QTP..."
2. P2, L14-15: Add "Understanding" before "The distribution and changes of permafrost with climate..."
3. P3, L4: Change "depends on the size of" to "depends on the magnitude of"
4. P3, L15: Change "with" to "at".
5. P3, L16: Change "These indices consist..." to "The permafrost indices consist..."
6. P3, L19: Change "multi-dimensional simulation" to "multi-dimensional permafrost simulation"
7. P3, L21: Be more concise on the problem.
8. P3, L23: Change "the current condition" to "the current situation".
9. P3, L25: I doubt the word "determine" used here.
10. P5, L5: Change "function" to "functions".
11. P5, L6: Change "max and min" to "maximal and minimal".

12. P5, L14-20: The signs of equations from (3) to (6) are not consistent with equations (7) and (8).
13. P5, L21: Add "defined" before "in".
14. P8, L3: Please add a proper citation to R.
15. P8, L5: Change "functionality" to "functionalities".
16. P12, L9-10: What does "based on the 52 observation stations" mean? What index is used to detect the permafrost here?
17. P12, L11: Why does ALT decrease here?
18. P13, L8-11: It's better to mention that you're discussing technical implementation here. It will be more informative by giving the specification of the computer used to run the performance tests.
19. P13, L14-15: The point (2) is not clear.
20. P14, L1: Change "approximately" to "partially".
21. P14, L19: Please describe how the soil input parameters are handled in PIC directly.
22. Table 1: The units of thermal conductivity usually are written as "W m<sup>-1</sup> K<sup>-1</sup>".

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