Responses to the Comments from Reviewer #2

The paper aims to develop a method for permafrost stability mapping on the Tibetan Plateau, which integrates InSAR and random forest. The work is an innovative and very worthwhile attempt, and it has a good guiding for disaster research in some regions with a complex geological environment like the Qinghai Tibet Plateau particularly. However, some minor issues still need to be improved. The specific comments are given as follows.

Response: Thank you for the careful reading and kind words. We sincerely appreciate the comments that have helped sharpen this paper. Specific responses to the review comments are presented immediately after the respective review comments.

1. There are two spelling mistakes in line 48 and 305 that “too that many” and a sudden “s”.

Response: Thank you for the careful reading and comment. The spelling mistakes will be modified in our revision.

2. Line 177: please explain why do you use vertical ground deformation, but not LOS ground deformation, i.e. what are the advantages over here by doing so?

Response: Thank you for the careful reading and comment. Note that the main ground deformation in permafrost areas is the thaw subsidence or frost heave, which can be manifested in the vertical ground deformation. Thus, the vertical ground deformation, rather than the LOS deformation, was adopted for analyzing the permafrost stability. According to the suggestion, more clarifications will be added in our revision.

3. It is mentioned in line 265 that permafrost instability mainly distributed in the valley areas with low altitude. However, in your Fig. 4(a), there are many areas with high deformation that distribute in high altitude mountainous areas. Please explain!

Response: Thank you for the careful reading and comment. The ground deformation zones are mainly concentrated in the valley areas with low altitudes, where the water content is relatively high. However, permafrost stability can be affected by various environmental factors. For example, the land cover type in some high-altitude mountainous areas is the bare lands with no vegetation coverage, which are also susceptible to ice melting and thaw subsidence. To avoid this confusion, more clarifications will be provided in our revision.

4. It is mentioned in line 266 that the ground deformation mainly took place in the west-facing slopes. In theory, it is right due to the “descending” approach of the satellite. However, in Figure 4b and 4c it seems that there are more points on the east-facing slopes. Why?

Response: Thank you for the careful reading and comment. The terrain visibility of the descending SAR images in east-facing slopes is mainly foreshortening, which causes the ground deformation results obtained in east-facing slopes not reliable. As such, although there are lots of deformation points located on east-facing slopes, the deformation results are not reliable, which could not be adopted to indicate permafrost degradation. More deformation points in Figure 4(b), compared to Figure 4(c), might be attributed to the higher coherence of the interferograms. To avoid this confusion, more clarifications will be provided in our revision.

5. In line 370, the threshold values are set as ±0.15 mm/year and -40 mm/year. Please state or provide a scientific basis of setting up such values.

Response: Thank you for the careful reading and comment. According to the Google Earth images, the permafrost instability areas with obvious unstable characteristics (e.g., retrogressive thaw slumps and failed slopes) are usually located in the areas with a ground deformation rate smaller than -40 mm/year. Thus, in this study, the ground point with a ground deformation rate smaller than -40 mm/year and obvious unstable characteristics is classified as an unstable ground point.

Further, the stable ground points are determined according to the ground deformation rate and the image characteristics. In general, the area with a ground deformation rate close to 0 mm/year could be classified as a stable area, thus the threshold value of the ground deformation rate for stable ground should be set at a value close to 0 mm/year; and, an equal number of stable ground points should be identified in the high-quality area to avoid the potential bias in the selection of samples. Based on these two reasons, the threshold value of the ground deformation rate for stable ground was set at ±0.15 mm/year. Thus, the ground point with a deformation rate ranging from -0.15 mm/year to 0.15 mm/year and no obvious unstable characteristics is classified as a stable point.

In the potential revision, more clarifications of the criteria adopted for determining the stable and unstable ground points will be added in our revision to avoid confusions.

6. In line 397, the ROC curve is used to evaluate the accuracy of the model, but where

is the ROC figure?

Response: Thank you for the careful reading and comment. The ROC curve shown in Figure R1 will be added in our revision.

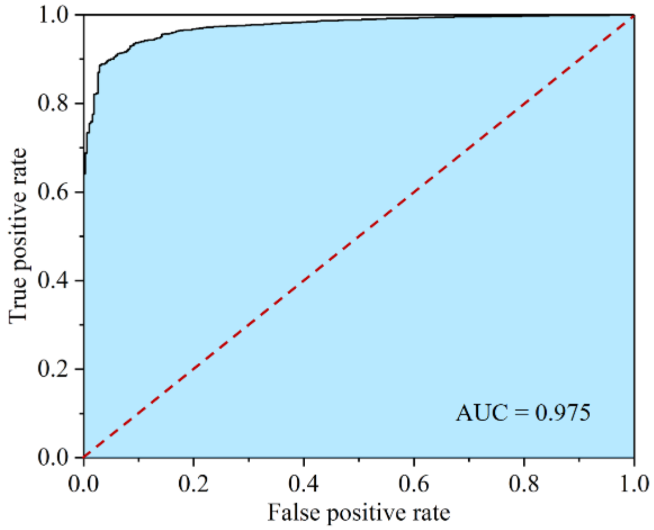

Figure R1. Validation of the trained random forest model using ROC curve