Reply comments on reviewer 1#:

Specific comments

1. The title deviates from the focus of the study. The dominant thermal impact of engineering activities on permafrost origins from the embankment itself (e.g., type), while the vegetation layer should be secondary issue. A more precise title is required to address the role of vegetation layer.

Reply: Thank you. I still find a more precise title to reflect the issue of our manuscript. Title is revised as following:

Thermal impacts of engineering activities and vegetation layer on permafrost in different alpine ecosystems in Qinghai-Tibet Plateau, China

2. Line 157-161 in Section 3.2: an increasing trend of permafrost at a depth of 10 m beneath embankments in both alpine meadow and alpine steppe systems is deduced for overall observations at all sites by using a linear regression. However, concerning the delaying response of permafrost temperature at 10-m depth to previous climate warming and later engineering effects, the regression can mislead the trend. For instance, after an evident increasing trend, a slight decreasing trend occurs after around 2010 at sites FHH1 and BLR2 in Fig. 7a, CMR1 and CMH1 in Fig. 7b. The effect of engineering activities at these sites might be over that of climate. Otherwise, it means the temperature-controlling measures for the QTR failed at these sites. Please clarify the sentence in Line 168-169. This point is a major comment.

Reply: Thank you for your opinions. But, these sites which we chose is general embankment without no measures, thermal disturbance of engineering activities is gradually becoming lower. So, the decreasing trend after 2010 is attributed to climate change. So, we revised into:

While, the effect of engineering activities on permafrost is gradually becoming lower. Therefore, the effect of climate warming on permafrost at that depth beneath embankment might be stronger than that of engineering activities.

3. Line 178-189 in Section 4: the variation of soil temperature with depth beneath embankments in the alpine meadow is related to the isolation effect of the vegetation layer. The thermal isolation effect of the vegetation layer in natural ground usually origins from shielding of radiation and variably thermal properties. However, how well this mechanisms work beneath the embankment are not introduced in the study, which is essential to the conclusion. This point is a major comment. Please clarify.

Reply: Thank you. We are neglect to this problem. We add some explanation:

This is because the vegetation layer in an alpine meadow has thicker humus soils with a small thermal conductivity, reducing heat amount conduct down.

4. The terms of vegetation layer and alpine ecosystems are misused in the text, and the later is confusing when used for the layer beneath embankment. Please revise it.

Reply: Thank you. We read in detail the text, we revised misuse terms.

5. Line 130-133: Comparing to the secondary role of vegetation, the difference in embankment type should play a dominant role in influencing soil thermal regime. How do you distinguish the effect of vegetation layer with the primary factor? Add explanation as line 175-188.

Reply: Thank you. We add some explanation as following:

Under overlapping effect of climate change and engineering activities, soil

temperature upper the vegetation layer has an obvious deceasing trend, but soil temperature at the range of definite depth beneath the vegetation layer has an obvious rising trend for railway with the vegetation layer in alpine meadow (Figure 8a, 8b and Table 4). However, soil temperature in all observation depth beneath show obvious rising trend for highway removing vegetation layer (Figure 8c, 8d and Table 4).

Technical Corrections:

1. Table 1 in P3: add space in “Altitude(m)”, and correct the altitude value for CMR2.

Reply: We revise into Altitude (m) and correct the altitude of 45.83 to 4583 in Table 1

2. Table 2 in P4: add sources for the values of climate conditions.

Reply: We add two references for the value of climate conditions, Zhao et al., 2004; Wu et al., 2012; Wu et al., 2015.

3. Line 76: “Figure 1” --> Fig. 1. Same problems in other places.
4. Line 88 and 90: “in situ” --> in-situ

Reply: We revised.

5. Line 88-91: one datalogger used at all sites? How simultaneously collect at different sites?

Reply: one or two data loggers used at every sites, for all sites, data are corrected at 10:00 a. m. Beijing Standard Time. We explain this problems in P5, Lines 90-91.

6. Line 109: “decrease” --> reduce
7. Line 111: “with average 3.54 cm/s” --> with an average of 3.54 cm/s. Same in other places. Line 110.

Reply: We revised.

8. Line 110-114: any comments for the different warming rates between alpine meadow and alpine steppe?

Reply: We add a sentence in Line 114.

The difference of mean ALT increasing rate between alpine meadow and alpine steppe is more than 2.0m/a.

9. Line 123-126. “This great difference in annual APT change rate between the QTH and QTR contributed to strong heat absorption by asphalt pavement ...” --> This great difference in annual APT change rate between the QTH and QTR is attributed to strong heat absorption by asphalt pavement ...”

Reply: Thank you. We revised.

10. Line 126: “Another contribution was engineering activity increase of interannual APT variation beneath embankments” --> not clear.

Reply: Thank you, this sentence seems to be repeated. We cancel it.

11. Table 4: “change rate of soil temperature beneath Embankment, °C/10a” --> Change rate of soil temperature beneath embankment, °C/10a.

Reply: We revised.

12. Figure 4 in P9: please detail the caption.

Reply: We revised into:

Figure 4 Soil temperature at 0.5 m depth beneath embankment, near artificial permafrost table and at 10 m depth.

13. Line 197: “Based on soil temperature data of nine monitoring sites over the period ...” --> Based on soil temperature observations at nine monitoring sites over the period ...

Reply: Thank you. We revised.

14. Line 203: “These findings indicate that alpine ecosystems can control APT magnitude beneath embankments but cannot control the rate of APT change” --> the controlling factor on APT magnitude is the alpine ecosystem? Why not climate or embankment?

Reply: Thank you. Except the effect of climate change and embankment on APT, Alpine ecosystem can influence APT magnitude beneath embankment but cannot affect the change rate of APT. So, we revised into:

These findings indicate that alpine ecosystems can influence APT magnitude beneath embankments but cannot affect the change rate of APT, except the effect of climate change and embankment.

15. Line 226: “Callaghan, T.V., Jonasson, S.: ...” --> Callaghan, T.V., and Jonasson, S.:. Similar error occurs in several references.

Reply: Thank you. We revised all references.

16. Line 255: “Li, R., ZHAO L.,...” --> Li, R., Zhao L.,...

Reply: We revised.

17. Please revise carefully the references as required style.

Reply: Thank you. We revised carefully the references as required style.