

Review of the Manuscript: Thermal impacts of engineering activities on permafrost in different alpine ecosystems in Qinghai-Tibet Plateau, China by Q. Wu et al.

MS No.: tc-2015-218

General Comments

The authors demonstrate the role of vegetation layer in long-term permafrost change beneath embankments, e.g., Qinghai-Tibet Highway and Railway. They analyze the permafrost changes including the artificial permafrost table (APT), permafrost temperatures at APT and the depth of 10 m over a period of 2002/2004-2014, and conclude that the preserved vegetation layer in the alpine meadow will have adverse effect on the permafrost beneath embankments in the long term, although it can alleviate permafrost temperature rise in the short term.

I generally agree with the authors' conclusions, which are based on the valuable long-term in-situ observations. The findings are of great importance for the permafrost engineering community. However, more rigorous arguments should be provided as recommended in the specific comments below. This would further consolidate the paper's conclusions. I therefore recommend the paper for publication, pending the revisions detailed below.

Specific Comments

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

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 from 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.

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 originates 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.

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.

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.

Technical Corrections

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

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

3. Line 76: “Figure 1” --> Fig. 1. Same problems in other places.

4. Line 88 and 90: “in situ” --> in-situ

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

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.

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

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 ...”

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

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

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

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 ...

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?

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

16. Line 255: “Li, R., ZHAO L.,...” --> Li, R., Zhao L.,...
17. Please revise carefully the references as required style.