Editor Decision: Reconsider after major revisions (11 May 2016) by Prof Christian Hauck

Comments to the Author:

Dear authors,

many thanks for your revised version and answers to the reports of the two reviewers. Due to the nature of the major comments of one of the reviewers, the manuscript was again sent out for review. This second review highlighted once more the two main concerns that still remain, also from my point of view:

(1) There are still (and even more so after your revision) some serious problems with the english language. Whereas the main part of the original manuscript can be well understood, this is not the case for most of your revision and also your answers to the reviewers comments. Sometimes it is not possible to understand at all what you want to say, e.g. the new lines in the abstract; also the lines 1-3 on page 6; and as well the new text on pages 11 and 12. Without an improvement of the english of the whole manuscript, at least to a point where the meaning of all sentences can be understood, the manuscript cannot be published. After this improvement, we can provide help for the final polishing of the english.

Reply: Thank you. I edited my revised manuscript by specialist of native English. Please seeing the attached file.

(2) In the original review the reviewer has formulated several questions that should be addressed in the manuscript: "What happens to the insulating vegetation layer when it is buried under the railroad grade? How thick is this vegetation layer, and how would the heat transfer through this layer interact with the heat transfer through the railroad grade/road bed during different times of the year? How would lateral heat transfer play a role? Could the different geometries of the roadbed/the railroad grade play a role? Is it certain that winter snow cover can entirely be neglected in the discussion (the authors state that there is no steady or winter-long snow cover)? Is there snow accumulation at the shoulders of the road/railroad? What causes the significant offset between MAAT and MAGT (Table 2) if it is not snow?Is this related to radiative heating of the surface and thereby caused difference between MAAT and MAGST?"
Although it is clear that most of these questions cannot be definitely answered within the present study (as you pointed out in your answer), their relative importance and/or their potential impact on the uncertainty of the results of your study can be discussed. These uncertainties should at least be mentioned, and their effect may be estimated using results from other studies. The reviewer suggested to include a discussion on the possible magnitude of each effect, e.g. how much additional heating and thus difference between MAAT and MAGST can one expect from radiative heating on an asphalt surface? Are there numbers for this effect on the Qinghai-Tibet Plateau presented in other publications? Furthermore, the author’s response on the effect of highway/railroad geometries could be included in the manuscript, including references

to the relevant studies.

Reply: Thank you for your comments and good suggestions. These problems is very important by editor and reviewer propose. We do our best to discuss these problems in discussion. The following text are added in discussion.

Generally, the vegetation layer in alpine meadow of the Qinghai-Tibet Plateau, including the humus and root-layer soils, is thin, with maximum thickness < 60 cm (Li et al., 2007). Vegetation roots mainly reach depths of ~10 cm, and mean root biomass makes up 60% of total root biomass (Yue et al., 2015). After the railway or highway embankment is constructed, soil within the vegetation layer of the alpine meadow is compressed and soil moisture decreases, modifying soil heat transfer. Because heat conductivity within the vegetation layer of alpine meadow from humus soil is less than that of filled soil of embankments, the vegetation layer can effectively prevent downward heat transfer, decreasing the amount of heat in permafrost. Meanwhile, moisture within the alpine meadow vegetation layer migrates upward in the embankment soil, redistributing its moisture. At present, we cannot quantitatively analyze such a process, so focused study is needed in that area. This process of heat and moisture transport through the vegetation may be affected by lateral heat transfer, different geometries of the roadbed/railroad, and snow cover on the lateral embankment slopes.

The effect of lateral heat transfer on permafrost beneath embankments has two sources. One is from horizontal heat exchange outside the embankment, and the other is a heat effect of its slope. The horizontal heat exchange is generally small owing to soil heat conduction. However, lateral convection heat transfer strongly influences permafrost beneath the embankment. Water flow can especially accelerate permafrost thaw (Grandpré et al., 2012). The heat effect of embankment slope on permafrost beneath the embankment is mainly from the thermal effect of sunny-shade slope (Chou et al., 2008a). The resulting difference in solar radiation has a thermal effect on the sunny and shaded slopes of embankments constructed within permafrost regions, producing differences in soil temperature and the permafrost table under the shoulder (Chou et al., 2008b; Wu et al., 2011). Monitoring data of soil temperature along the QTR show that the difference in temperature and APT between sunny and shaded slopes of the embankment at WD3, KL1 and KL3 in alpine meadow (Wu et al., 2012) is generally small, < 1 ℃ and 20 cm, respectively (Wu et al., 2011), but that difference in alpine steppe is > 1.5–3.0 ℃ and 100–300 cm (Wu et al., 2011). These results may indicate that the alpine meadow vegetation layer beneath embankments reduces differences in soil temperature and APT under the shoulder. However, a large embankment height strengthens that difference, because of greater radiation on the sunny slope (Hu, 2006). The varying geometries of the roadbed/railroad have a thermal effect on permafrost beneath the embankment. The embankment width affects the annual heat transfer rate at the bottom of the embankment (Yu et al., 2007). The annual rate increased by 60% with doubling of the width of asphalt pavement (Yu et al., 2007). This increased rate was mainly at the bottom of the embankment, resulting in thermal concentration. Therefore, substantial heat enters the permafrost through the vegetation layer.

On the Qinghai-Tibet Plateau, snow mainly accumulates in the high mountains, with little in the plateau interior (Li and Mi, 1983; Sun et al., 2014). Snow cover is generally thin, less than 6 cm on average, and the duration of cover is short (Li and Mi, 1983; French, 2007; Tian et al., 2014). The insulation of snow cover is weak when it is < 20 cm in thickness (Zhang, 2005; Jin et al., 2008). Although there is no steady snow cover in winter on the plateau, snow accumulation at the slope foot of embankments is possible, with thickness < 20 cm. Thus, snow accumulation at the slope foot may have no effect on permafrost beneath the embankment. However, thaw of accumulated snow increases soil moisture at the slope foot.

Ground temperatures in permafrost regions of the Qinghai-Tibet Plateau are mainly controlled by regional climate conditions, as indicated by strong regional zonation of elevation, latitude, and continentality (Cheng, 1982). The temperatures are also greatly affected by local factors such as vegetation, snow cover, sand cover and surface conditions. These influences can increase or decrease ground temperature under certain circumstances (Jin et al., 2008). The regional and local factors can cause significant offsets between mean annual air temperature (MAAT) and mean annual ground temperature (MAGT) (Zhou et al., 2000; Wang, et al., 2002). However, engineering surfaces such as asphalt pavement cause anomalously high surface temperatures through radiative heating. This causes a difference between MAAT and mean annual ground surface temperature, generating accelerated permafrost degradation under the embankment (Wu et al., 2011; Zhang et al., 2016).

Minor comments:
- P6, l. 11: 2cm/a
Reply: We Revised

- reference Zhao et al. 2004 (page 5) is missing in the reference list.
Reply: We Revised.

Both, the reviewer and myself feel that your revisions already made the paper scientifically much stronger, but the poor english of the revisions are prohibiting any publication at the moment.

Reply: Thank you. I edited my revised manuscript by specialist of native English. Please seeing the attached file.

Certificate of English Editing

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About the manuscript:

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