

Interactive comment on “Simulating the role of gravel on the dynamics of permafrost on the Qinghai-Tibetan Plateau” by S. Yi et al.

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We would like to referee 1 for very helpful suggestions. We made point-by-point responses to the comments in the following part.

General Comments I sincerely congratulate the authors for such an interesting, well written and timely paper. Generations of climate modellers have been dwelling on the Farouki formulation of thermal properties of frozen soils, sometimes questioning its applicability but less frequently looking for alternative parameterizations and associated effects. Your study provides a very concrete example of areas where the Farouki formulation fails, and illustrates how inaccurate projections performed with this formulation can be. You have also great merit in combining hydrological, thermal and slope effects, and precisely assessing the former two aspects on precise diagrams (Fig 4 and 5). The

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abstract is very informative and the findings are of high interest for climate modellers. However, the paper could benefit from an enhanced linkage to field data, as it relies upon a test site where some measurements exist. This would be my main remark. However, as a sensitivity-oriented study, it has the different merit of going through a wide scope of situations. Overall, I recommend the paper for publication, pending the minor and technical revisions mentioned below.

Reply: We will provide more comparisons of soil water and temperature between measurements and simulations.

Minor and technical revisions P4710 L7-8 : Editing problem. “are the dry thermal conductivities of mixed soils, gravel soils and finer mineral soils, respectively”

Reply: We will make changes as suggested.

P4711 : B-value for gravel. Do you have any retention or hydraulic conductivity – curve for gravel or mixed soil that would help you justify this choice based on equations (18) or (19) ? The absence of comparison to ground data lowers the confidence that you can have in the effect stated in Section 3.1.

Reply: Unfortunately, we don't have such data. We followed the method Lawrence and Slater (2008) in CLM to use weighted arithmetic mean to calculate the properties of mixed soil from pure gravel and pure fine mineral. We will make this point more clear.

P4712 : similarly, is there any local measurement that could support the Ksat formulation, along with local d_m and z_m values ? An example would be welcome, as some of the effects you discuss in your paper are induced by water content.

Reply: Unfortunately, we don't have such data.

P4712 L7 : What is A ?

Reply: Factor A does not exist in the original word manuscript. It is created by the conversion to pdf file. We will correct it.

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P4713 : explaining the physical “meaning” of equation (20) could help.

Reply: There was a mistake in the equation. We now provide the derivation of equation 20 in the supplementary material. And we will make changes in the text. These changes will not affect the results of sensitivity studies.

P4714 : I would suggest putting the description of gravel fraction used and model setup (L2-6) in Section 2.4. Origin of the atmospheric forcing data and time horizon of the simulations could also be added here, as well as the time period on which you perform most of your comparisons (2003-2011?). This would help assess the significance of the different behaviours that you point out.

Reply: Thanks for the suggestion; we will make changes as suggested.

P4715 : as the effects of gravel on soil properties are qualitatively similar for the 2 soil mixtures that you investigate, I would suggest choosing only one of the 2 Figures (4 or 5) for illustration, though explaining in the text that both soil types work similarly. By the way, it seems some lines are missing on Fig 5 d).

Reply: Thanks for the suggestion; we will make changes as suggested.

P4715 L8 : was -> is P4715 L9 : equals -> equals P4715 L12 : increasing of : suppress the “of”

Reply: Thanks for the above suggestion; we will make changes as suggested.

P 4717 L 16-19 : how does this modelling result compare with observational data ?

Reply: We will add the comparisons.

P4717 L 21-22 : Unless you specify that this effect is valid within the range of the 3 gravel fraction values you investigate in this section, this statement is not consistent with Fig 5.a) were only a local minimum is observed for porosity as a function of gravel content.

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Reply: We agree with the referee that there is a local minimum; we will rephrase these sentences.

Table 2 : most of the thermal conductivity-values are much greater than the ones used by Feng et al. (2012) for this site. Could you comment on that?

Reply: Thanks for careful reading. We made a mistake on calculating the average of thermal properties (thermal conductivity and heat capacity) by dividing the sum by 2. Actually, the sums should be divided by 3 (three months). The correct values are now presented in supplementary material.

Please also note the supplement to this comment:

<http://www.the-cryosphere-discuss.net/7/C2073/2013/tcd-7-C2073-2013-supplement.pdf>

Interactive comment on The Cryosphere Discuss., 7, 4703, 2013.

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