

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

### **Anonymous Referee #1**

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#### 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 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

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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.

#### Minor and technical revisions

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

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.

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

P4712 L7 : What is A ?

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

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.

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).

C1881

P4715 L8 : was -> is

P4715 L9 : equales -> equals

P4715 L12 : increasing of : suppress the "of"

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

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.

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?

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