

## ***Interactive comment on “Evaluation of alternative formulae for calculation of surface temperature in snowmelt models using frequency analysis of temperature observations” by C. H. Luce and D. G. Tarboton***

**Anonymous Referee #2**

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The authors present two alternative formulae to calculate the conduction of heat from the snow surface into the snowpack in single layer snow models, which normally represent the snowpack vertical variability with only the snow surface temperature and an averaged snowpack temperature. The formulae are based on the analytical solution of the heat equation with constant coefficients in a semi-infinite space with a sinusoidal forcing, and are tested against 8-days field data in a 35–40 cm cold snowpack measured at the Utah State University Drainage Research Farm. The mathematical

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method is well described.

I have the following comments:

1) The method uses the analytical solution with constant coefficient, and assumes constant snow density. This seems a very strong simplification of the non-linear nature of the heat transfer in the snowpack, and may not work especially in deep alpine snowpacks, characterized by high vertical variability of temperature and liquid water content. In addition, the assumption of only a forcing with periodicity of 24 hours may also be limitative. For these reasons the sentence (page 3879 line 21) “so presents the potential to replace more complex multilayer models with a single layer model that tracks aggregate energy content” is not fully correct, even though a good agreement against field data is shown. In the reviewer’s opinion, only with multilayer snow models and the numerical solution of the heat equation it is possible to capture the physical processes in a very large number of different environments. I would recommend the authors to better show where single layer snow models can perform well and in which condition they may fail.

2) However, the purpose of the paper is clear, and is to improve the description of the conduction of heat in single layer snow models, and this method considerably improves the parameterization of conduction in UEB model, even if it is known that single layer models may fail in some conditions.

3) It would be very interesting to perform a comparison with a simple configuration multilayer snow model. However, the reviewer agrees with the answer to a similar question asked by reviewer #1.

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