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Interactive comment on "A non-equilibrium model for soil heating and moisture transport during extreme surface heating" *by* W. J. Massman

Anonymous Referee #2

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Comments for "A non-equilibrium model for soil heating and moisture transport during extreme surface heating" by Massman.

In this manuscript the author has developed and evaluated the model that takes a non-equilibrium process into account during evaporation and condensation of soil water. This topic fits well to the scope of Geoscientific Model Development. I think, however, there is a major flaw that needs to be addressed prior to considering publication.

My major concern is the performance of the non-equilibrium model. Neither soil temperatures nor soil moisture contents were well predicted using the model developed by the author as can be seen in Figs. 1-6. Discrepancies between observed and simulated values are just too large. For example, in Figure 1, differences between observed and simulated temperatures at some given times are greater than 100 degree

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C. Changes in soil moisture contents depicted in Figure 2 also show that the model cannot reproduce observations at all. At some depths, they are not even close. This kind of simulation is simply not acceptable in my opinion. If observed data are not well predicted, how can we know that the theory behind the model is correct? The idea of considering the non-equilibrium processes may be a significant step to understand coupled water and heat transfer in soils during fire. However unless the author shows much better simulation result, it will be difficult for readers to be convinced that the non-equilibrium process has to be taken into account or plays an important role. If simulation can be improved by calibrating some parameters, I think the author should consider doing that. By doing that, the author may be able to discuss sensitivity of each parameter.

Unless the author shows much better simulation results, I do not think the manuscript should be accepted.

I have some specific comments as well. 1. Recently there have been many studies to model soil water retention curves and unsaturated hydraulic conductivities in very dry range (low potential) to account for, for example, film-type flow. This may be triggered as we now have some new devices to measure soil water potential in very dry range. I am wondering if a HCF model which considers film-type flow may improve the simulation result under fire as non-capillary-type residual water seems to play an important role here. 2. Related to the comment above, it is well accepted that soil water and heat transfer simulation performance strongly relies on how WRC and HCF are modeled. The author therefore needs to show soil hydraulic data used in this study and models fit in a figure. 3. It is not necessary to show synchronized model profiles in Figs 5 & 6. There is also typo in both figures: “Synchronized” not “Synchonized”

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