Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2020-193-RC4, 2020

Hydrology and Earth System Sciences
Discussions

Interactive comment on "The challenges of an in situ validation of a non-equilibrium model of soil heat and moisture dynamics during fires" *by* William J. Massman

Anonymous Referee #3

Received and published: 12 August 2020

The paper is well written and clearly structured. I enjoyed reading the manuscript and find much of the work is explained such that it is also understandable for those without a background in fundamental soil physics. I think it is appropriate for HESS readership. I have two major comments and several others, included below.

A first main comment is regarding the framing of this work to aim to model soil temperatures in fires, but being only validated in one burn, and a very specific one. The manuscript could benefit from more careful explanation of the differences between various types of fire and the implications for this for the modeling performed. L32 Please update this sentence to clarify you are talking about slashpile burns, and cite work

Printer-friendly version

Discussion paper

that supports your statement. Prescribed burns that use moving fire fronts rather than static pile burns typically have fire residence times of mere minutes and usually take place when soils are wet, usually keeping mineral soil temperatures very low or barely changed. Somewhere in this intro it would also be good to explain what slash pile burns are and how they differ from moving fire fronts in prescribed and wildfires in terms of residence time and soil heating L62: please discuss somewhere (probably in the discussion) how the results of your work are applicable in dynamic (not static) fires like moving fire fronts, especially given the fact that you describe that heating processes differ between static and dynamic burns (L 215) and that the model was only validated with data from static fire, but that your aim was to model 'soil temperatures during fires' (plural, L441)? L341: what is the rationale of calibrating this model on a slash pile burn site and not in a moving fire front? Line 513 Discuss here whether these soil changes are likely to occur or not in wildfires and prescribed fires that have moving fire fronts. I agree with this being relevant for static burns but this paragraph needs context regarding the likelihood of this happening in other types of fires. In light of that, which types of fires do require this explicit inclusion of dynamic feedbacks? The current text makes it seem that all fire is the same, which is too simplistic. My second main comment is regarding the goal of this study to provide a tool to support management (L596). I wonder about both the inputs to this model and the ease at which others can use this model. As far as I know there is not a simple model (or model at all) available online that allows prediction of soil temperature curves given a set of soil properties and fire duration. It is good that the MATLAB code will be released but that will only be accessible to a very select group of people, also within science. Release of the model as an R package or as R shiny could considerably increase its potential use amongst scientists – and R shiny may make it available to those outside of science. I think there is great potential for this that would increase the impact of this work. Related to that, it was not entirely clear to me how broad a range of input data is needed to run the model for easy use. Are all the complicated parameters needed or can the model be run just with information on readily available soil characteristics

like texture, bulk density and organic matter content, and that the software does the rest? That would also considerably increase the accessibility of this work for further use. Additional comments: L39: can you clarify here what the need is for an updated model? What has gone wrong with the previous model and what is the risk of using the previous model without the changes proposed here? Are temperatures off, or does it not work in a specific soil type or moisture conditions, and by how much are the temperatures off? I.e. can you explicitly mention the improvement that is made to modeling soil temperatures zooming out from the fact that the equations may be more accurate? L49: what are these less extreme conditions, just diurnal fluctuations? L141 How does this work in wetter soils? In temperate regions fires typically occur in Spring when soils are wet. Is the model valid then as well? If so, is there a potential error because of this assumption? L299: how realistic is it that the initial soil temperature is uniform with depth and how would a change in this approximation alter the model outcome? L356: to make this info more accessible for a European readership please include the name of this soil type using the FAO WRB system (World reference base for soil resources, http://www.fao.org/3/i3794en/I3794en.pdf) L358: suggest replacing soil organic material by soil organic matter, and please indicate the depth across which this organic matter percentage is valid. L360: I dont understand, how can grazing and harvesting disturb the soil, do you mean the very soil surface? Or were there very deep ruts or something? I can imagine this affects soil cover but not the soil. Maybe good to indicate to which depth this disturbance occurred. L402: I'm intrigued, could you explain how it could never have been measured during the fire? Never at all or never during the fire? L452: include info on how realistic it is that the sensor was indeed installed at this other depth. And how were sensor depths determined, before or after fire? How accurate are they? Related to a previously posted reviewer comment: for accessibility and ease of use it would be helpful if the model input uses bulk density rather than porosity since bulk density is more easily available from soil databases. And does the model allow for bulk density to vary with depth? That would be useful given the typical increase of soil bulk density with depth.

Printer-friendly version

Discussion paper

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2020-193, 2020.

Printer-friendly version

Discussion paper