

Interactive comment on “CVPM 1.1: a flexible heat-transfer modeling system for permafrost” by Gary D. Clow

Anonymous Referee #2

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This nice paper describes a new and comprehensive heat-transfer modeling system for permafrost. The model implements a set of heat-transfer physics that are more detailed than in most commonly used large-scale permafrost models. It appears to be highly flexible and therefore applicable to a range of permafrost research problems across a range of spatial scales and timescales. This capacity is nicely demonstrated with three applications that span an impressive array of timescales and research topics (permafrost thermal evolution from 255ka years ago to present to examine permafrost evolution over ice age cycles; a 60 day detailed simulation of the impact of a bore hole drilling operation; and permafrost response to formation of a lake). The model is designed to work for a range of geologic settings as well.

The paper is clear and well-written and the model is described in sufficient detail to

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really understand how and why the model was constructed as it was. Overall, I find very little to criticize and I find the paper suitable for publication, essentially in its current form. The model should be an excellent resource for the permafrost research community.

A couple minor points.

1. Maybe I missed it, but I think it would be helpful if the author could explain in a bit more detail what is needed to force the model. Is it just surface temperature?
2. Are soil and rock water amounts prescribed and not allowed to change? There isn't any description of soil hydrology so that would suggest that that is the case. If so, then if one wanted to couple this into a large-scale permafrost or Earth System model, it would just replace the heat-transfer solution, and the host model would calculate water flow through the soil and sediment? Would there be any impediments to doing this?
3. Could the CVPM be coupled with a surface energy balance model?
4. Along similar lines, the author notes that the CVPM does not represent vegetation, snow, surface water, etc. This makes me wonder how the example simulations were executed. Is the model forced with ground surface temperature, i.e., the temperature from beneath the snow.
5. Would maybe be helpful to indicate what the timestep is for each of the example applications with a brief description of the implications of the timestep. If, for example, the timestep is annual or longer for the 255kyr simulation, then this obviously implies that these simulations cannot be used to track active layer thickness. If the timestep is shorter than annual, then how does one derive the forcing timeseries, which obviously isn't resolved. (Apologies if these are stupid questions, I don't usually think on timescales that long!).