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Interactive comment on "Process-level model evaluation: A Snow and Heat Transfer Metric" *by* Andrew G. Slater et al.

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This is an interesting paper with a data-driven and process-focussed approach that typifies the recently deceased first author's work. I expect that it will prove to be useful for model evaluation; indeed, this method has already been suggested for inclusion in the methods for evaluating models in the upcoming Earth System Model – Snow Model Intercomparison Project (http://www.climate-cryosphere.org/activities/targeted/esm-snowmip).

The observed relations ship between "temperature amplitude difference" and "effective snow depth" shown in Figure 3 has a great deal of scatter. A lot of this scatter will come from genuine physical processes. It would be useful to have some discussion of the influences of soil texture, soil moisture and freezing on the results. Without separating out these influences, it doesn't appear that this method could provide very strong constraints on models, but it is likely to still be useful because current models,

as shown in Figure 4, have an even larger range. It would be interesting to know if the results of this paper can be related to the performances of the same models in simulating permafrost extent, as discussed by Koven et al. (2013). The Hadley Centre model is identified as one in which soil temperatures under snow track air temperatures too closely because of the simplicity of the snow model used. The developers of this model are well aware of this limitation and have implemented a multi-layer snow model to address it; the model is described by Best et al. (2011) and its impacts on permafrost simulations by Chadburn et al. (2015).

The definition of effective snow depth in Equation (6) is curious and requires explanation. Why is it chosen so as to give an effective depth that is greater than the average depth for any month for the green line in Figure 1?

page 2, line 31 "the period over which the forcing is applied" is ambiguous. Something like "the frequency of the forcing" would be better.

page 4, line 3 The R parameter is an effective damping depth, not an effective thermal diffusivity.

Best, MJ, and 16 others, 2011. The Joint UK Land Environment Simulator (JULES), model description. Part 1: Energy and water fluxes. Geoscientific Model Development, 4, 677–699.

Chadburn, SE, EJ Burke, RLH Essery, J Boike, M Langer, M Heikenfeld, PM Cox and P Friedlingstein, 2015. Impact of model developments on present and future simulations of permafrost in a global land-surface model. The Cryosphere, 9, 1505–1521.

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