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Hydrology and Earth System Sciences Discussions

Interactive comment on "Simulation of the snowmelt runoff contributing area in a small alpine basin" *by* C. M. DeBeer and J. W. Pomeroy

Anonymous Referee #2

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This manuscript deals with the influence of sub-pixel or sub-area variability in SWE and snowpack cold content on the simulation of snowmelt and the depletion of the snow-cover. For a case study in Alberta, Canada, measurements and simulations from two years are presented demonstrating that the effect of spatial variability in SWE and cold content on the melt rates and, thus, on the snow cover depletion is most pronounced in the early stage of melting. Later, once the snowcover is more or less completely isothermal, this spatial variablity impact diminishs. This is not very surprising per se, but it is worthwhile being demonstrated with this simulation exercise. All in all, the presented work nicely illuminates a relevant question related to the spatial simulation of the snowcover during the melt, but it is not a substantial step forward. Although the paper is rather well written and methodologically sound there are a few major shortcomings that need to be addressed and possibly improved before I can recommend its

publication: - Fig 2 is supposed to show simulated and measured SWE. But according to chapter 2 there has not been continuous measurements of SWE, only continuous measurements of snow depth. So I guess that what is labeled as "observed SWE" is actually "measured snow depth multiplied by a simulated snow density". This leads to the question how snow density is simulated in the model. So the validation of the SWE-simulation in Fig. 2 seems to be somewhat biased. - It is a particular problem of this manuscript that only results from one single winter (except Fig. 2, which is not a key-result of the addressed issue) are shown. This leaves the question unanswered how general the shown effect is. We don't know too much about the weather conditions of this particular spring. So it's hard to know if this spring was typical or special in some way. Consequently, we are not sure whether the observed effect of an inhomogeneous melt is typcial or maybe an exception. - One of the key-results, Fig. 3, is difficult to understand. It is a kind of sensitivity analysis of snowmelt to SWE for different dates of the spring. For me it was unclear wheather the SWE on the x-axis represents the initial SWE at the beginning of the melt period or the actual SWE of the corresponding date. If it is the first one (which I thought first) it is unclear why a snowpack with an initial SWE of 50 mm is still existing after two months of melting. If it is the second one, I don't understand completely how this several simulations were run. Did you start a simulation at each of these days with exactly the corresponding SWEs? I think you need to explain more in detail how this simulation was done. - I claim that the selection of the "maximum active layer thickness" (which is a parameter in the model) is quite critical for what we see in Fig. 3 at the beginning of the spring melt (the early melting for shallow snowpacks). Did you investigate that? - There are only few results presented demonstrating that a simulation with inhomogeneous melt yields a better correspondence with observations than a simulation with uniform melt. We see that on the south-facing slope for the period 26 April to 6 May (Fig. 4b and 5b), but for all other events and for the North-facing slope it is not clear to me. So in conclusion, there is not a strong evidence in the presented results that we improve the snowmelt simulation with the inhomogeneous melt. - The authors' awareness of related work that has been done is confined to studies in North America. There is actually also recent and ongoing work in other parts of the world dealing with the spatial simulation of the snowcover in alpine terrain. This should be referred to as well.

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