

Interactive comment on “Impacts of microtopographic snow-redistribution and lateral subsurface processes on hydrologic and thermal states in an Arctic polygonal ground ecosystem” by Gautam Bisht et al.

Anonymous Referee #1

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General comments:

Manuscript by Bisht et al. presents simulation results in an Arctic polygonal ground ecosystem using an improved ALM model including lateral processes and snow redistribution. The conclusions are partly supported by modeling results, e.g., 1) snow depth variation was affected by snow redistribution, but not by lateral processes of thermal flow, 2) active layer depths was affected by lateral energy fluxes. Like many others, this work again stresses that advances in the land surface modeling is needed. In fact, the simple snow redistribution approach in the paper can be readily

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incorporated into land models. My main reservations are the selection of the 2D transect and model validation. Why the transect is not selected where the sensors (as shown In Figure 1) are located? It makes the comparison between the model and observation meaningless.

Specific comments:

- 1) Lengthy texts in the Introduction that are not directly related to the study.
- 2) Line 100-101: define "active layer thickness" for general readers.
- 3) Line 126: define ALM.
- 4) Line 158-160: redundant as already described in lines 126-128.
- 5) Line 169: check unit of Q.
- 6) Define z in Eq. 2 and other variables in Eq. 4.
- 7) Eqs. 17 and 18, check the third term on the RHS.
- 8) Eq. 23: write c_n as $c_{i,j,k}$
- 9) Define ω' in Eqs. 25-31
- 10) Line 312: from Fig. 2, I see less dependence of average snow depth on topography with SR.
- 11) How well is the 3D model developed in the paper compared to analytical solutions or other well established numerical models?
- 12) Where are the locations of center and rim in the model simulations? Fig. 1 shows two snow sensors and five temperature sensors. At what locations are the simulation compared to the corresponding observations?
- 13) As the authors noted on line 246 that PETSc is a scalable solver, so what is constraining the 3D simulation (statement on line 447)?
- 14) Because of the computational constraint, I don't agree with the last statement on line 510-512.
- 15) Figure 1: what's the legend? DEM?

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