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Comment on gmd-2021-285

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Community comment on "Explicitly modelling microtopography in permafrost landscapes in a land surface model (JULES vn5.4_microtopography)" by Noah D. Smith et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2021-285-CC1, 2021

In this study (Noah et al. submitted; hereafter N2021), the standard JULES model is extended by implementing a two-tile representation of microtopography (JULES vn5.4_microtopography) that accounts for lateral flow of water, heat, and snow redistribution. The new model was validated at permafrost landscapes that included two polygonal and two palsas study sites. The model was able to accurately simulate the difference in snow depth between hollows and rims. Methane fluxes were estimated for the standard and vn5.4_microtopography versions of JULES using observed soil carbon profiles. While the difference in simulated methane fluxes for the two model versions of JULES was small for polygonal study sites, the difference was large for palsa sites. Additionally, parametric sensitivity analysis showed that the elevation difference parameter for the palsa sites had an insignificant impact on the simulations. However, the exclusion of lateral flow of water and energy modified simulation of soil saturation and soil temperature.

Previously, Bisht et al. (2018) implemented snow redistribution and lateral transport of subsurface hydrologic and thermal processes in the E3SM Land Model (ELM)-3D v1.0. The model simulations were performed for a transect across a polygonal study site in Alaska that is characterized by low-centered polygons. The inclusion of snow redistribution led to a significant reduction in the bias of the difference in snow depth between the polygon center and rim, in a manner similar to that found in N2021. The model was also able to accurately capture warmer winter soil temperature for the center than the rim because of higher thermal insulation from a larger snowpack in the polygon center, again similar to the results in N2021. Finally, the spatial variability of soil moisture and temperature were overestimated in the ELM-3Dv1.0 simulation that excluded lateral transport of water and energy.

Given the very strong relevance of Bisht et al. (2018) to the N2021 study and analogous conclusions for aspects of the results, it would be beneficial if the authors discussed the differences and similarities of their results with those found in Bisht et al. (2018).

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Reference

Bisht, G., Riley, W. J., Wainwright, H. M., Dafflon, B., Yuan, F., & Romanovsky, V. E. (2018). Impacts of microtopographic snow redistribution and lateral subsurface processes on hydrologic and thermal states in an Arctic polygonal ground ecosystem: a case study using ELM-3D v1. 0. Geoscientific Model Development, 11(1), 61-76.