

Interactive comment on “Soil Moisture and Hydrology Projections of the Permafrost Region: A Model Intercomparison” by Christian G. Andresen et al.

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In this manuscript the authors describe how most of the models examined project soil drying despite increases in net precipitation. Drying is attributed to increased drainage via active layer deepening and/or permafrost loss. This research is important, as soil moisture is a key control on the fate of carbon losses from soils. In Rawlins et al. (2013) my coauthors and I pointed to a likelihood of future soil drying based on simulations with the Permafrost Water Balance Model (PWBM, formerly the ‘Pan-Arctic Water Balance Model’). In that study we discussed model validation results and explored potential thermal and hydrological changes for a representative area encompassing the

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Bonanza Creek Experimental Forest research site in Alaska. Hydrological cycle intensification was manifested in higher spring SWE in the future simulation relative to present day, consistent with other research which points to future significant increases in cold season precipitation in Arctic regions. The model simulations showed that much of the snowmelt will become river runoff as opposed to soil recharge. This is intuitively expected, as the landscape is often frozen, or the active layer is very shallow, when thaw occurs. In turn, infiltration limits can also be easily reached at that time of year. A deeper snowpack in late winter would contribute to soil warming, which might lead to higher soil evaporation rates during early summer. These changes captured by the model simulations also suggest that drying may occur in areas of discontinuous and/or sporadic permafrost. Implications of permafrost thaw on cold season river discharge, subsurface runoff, and other hydrological quantities across northern Alaska were investigated using the PWBM as described in a manuscript currently under review for publication in The Cryosphere (Rawlins et al., 2019).

Rawlins, M.A., Nicolsky, D.J., McDonald, K.C. and Romanovsky, V.E., 2013. Simulating soil freeze/thaw dynamics with an improved pan-Arctic water balance model. *Journal of Advances in Modeling Earth Systems*, 5(4), pp.659-675.

Rawlins, M. A., Cai, L., Stuefer, S. L., and Nicolsky, D.: Changing Characteristics of Runoff and Freshwater Export From Watersheds Draining Northern Alaska, *The Cryosphere Discuss.*, <https://doi.org/10.5194/tc-2019-28>, in review, 2019.

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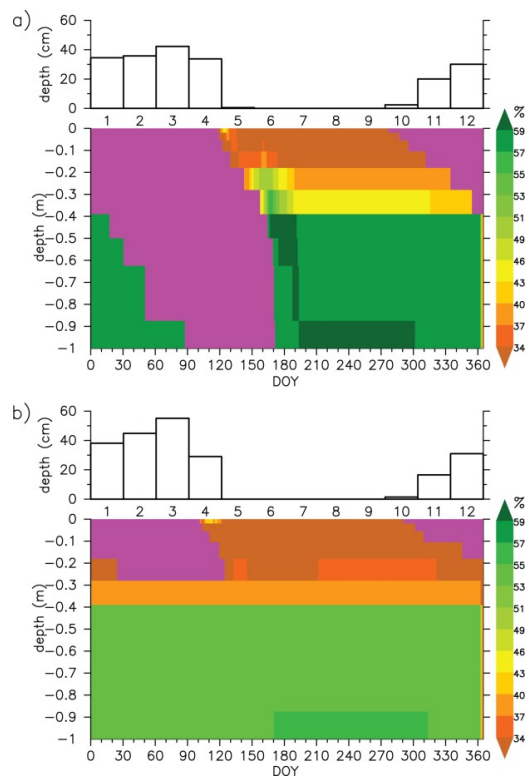


Fig. 1.

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