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Runoff from organic-covered permafrost terrains: improving process understanding and parameterisations

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Subsurface flow through peat plays a critical role in the hydrology of organic-covered, permafrost terrains, which occupy a large part the continental arctic, subarctic and boreal regions. Hillslope drainage in these terrains occurs predominantly through the active flow zone between the relatively impermeable frost table and the water table above it. The hydraulic conductivity profile within this zone controls the subsurface drainage of snowmelt and storm water. In the active layer, the increasing degree of decomposition with depth below the ground surface results in a decrease in the size of organic particles, as well as an increase in the proportion of small, closed and dead-end pores, and the amount of dry material per unit volume, with depth. As a result, the saturated hydraulic conductivity has been found to decrease by two to three orders of magnitude between 0.1 and 0.3 m below the surface. The depth of soil thaw is therefore a critical factor in controlling the timing and magnitude of subsurface drainage from hillslopes to stream channels. Thaw depth, a function of the ground heat flux, is governed by the surface energy balance and is thus strongly influenced by properties of the ground surface, overlying shrub or tree canopy, and soil thermal properties. This paper will summarise recent advances in runoff hydrology in northern Canada. Emphasis will be upon the discontinuous permafrost zone, which is believed to be particularly sensitive to the effects of climatic warming because pronounced changes in water storage and runoff pathways could occur with small additional ground heating. The research presented is driven by the need to improve 1) our understanding of cold regions hydrometeorological processes and their interactions with the atmosphere, hy-

drological system and biophysical properties of the surface; and 2) the mathematical parameterisation of cold regions processes for small to medium scales.