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Changing surface water systems in the discontinuous permafrost zone: implications for streamflow

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Abstract This study was conducted in the wetland-dominated, southern margin of continental permafrost at Scotty Creek, NWT, Canada over the period 2001–2010. In this region permafrost is discontinuous and occurs predominately below tree-covered peat plateaus. The southern margin of continental permafrost is experiencing unprecedented rates of permafrost thaw, yet the effect of this thaw and the resulting ecosystem changes on northern water resources is poorly understood. A distinction between primary and secondary runoff pathways that supply basin drainage networks was identified and incorporated into a new conceptual model that describes the flow and storage of water in the wetland-dominated terrains that dominate the southern margin of permafrost. The objectives of this study were to: (a) estimate primary runoff from the plateaus using the Cold Regions Hydrological Model and relate to basin runoff; and (b) evaluate the impact of changing primary runoff on basin discharge. A strong, positive correlation between primary runoff from plateaus and basin discharge was demonstrated, indicating that with the representation of other flow and storage processes, such as secondary runoff and the routing of water through connected bogs and channel fens, hydrograph simulation for basins with thawing permafrost plateaus is attainable.

Key words permafrost thaw; land-cover change; runoff simulation; northern water resources