Simulating hydrological processes at two mountainous sites underlined by continuous permafrost in northern Yukon, Canada

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High latitude mountainous regions are typically underlined by sporadic, discontinuous or continuous permafrost, which plays a key role in the energy and mass fluxes exchange between the atmosphere, surface and sub-surface. However, a robust and reliable representation of the active layer thickness remains a great challenge in this remote and poorly understood environment. This study presents observations and simulations of permafrost thaw and snow accumulation and melt at two research sites in the mountains of northern Yukon, Canada. The stations are operative since 2014 and measure standard meteorological variable, liquid and solid precipitation, and soil temperature and water content profile. Point-scale models were set up at both sites using the Cold Regions Hydrological Model (CRHM) platform, including new modules to simulate permafrost. The model was set up using observed physical characteristics and parameters taken from previous studies under similar hydrological conditions. The model showed to properly simulate daily ground surface temperature with small bias (≤±0.5°C) and high correlation (r^2>0.85), and the active layer depth with a mean bias of -1.6 and -11 cm at the northern and southern site, respectively. Observed snow water equivalent from snow survey is underestimated by the model (mean bias ≤41 mm), likely due to snow undercatch. A sensitivity analysis of the key soil thermal properties and porosity to the active later simulations was performed using reference values from the literature. This study demonstrates the capabilities of the new modules included in CRHM that can be used to inform other studies in cold region environments.