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Abrupt changes across the Arctic permafrost region endanger northern development

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Extensive degradation of near-surface permafrost is projected during the 21st century, which will have detrimental effects on northern communities, ecosystems and engineering systems. This degradation will expectedly have consequences for many processes, which most previous modelling studies suggested would occur gradually. Here, we project that soil moisture will decrease abruptly (within a few months) in response to permafrost degradation over large areas of the present-day permafrost region, based on analysis of transient climate change simulations performed using a state-of-the-art regional climate model. This regime shift is reflected in abrupt increases in summer near-surface temperature and convective precipitation, and decreases in relative humidity and surface runoff. Of particular relevance to northern systems are changes to the bearing capacity of the soil due to increased drainage, increases in the potential for intense rainfall events and increases in lightning frequency, which combined with increases in forest fuel combustibility are projected to abruptly and substantially increase the severity of wildfires, which constitute one of the greatest risks to northern ecosystems, communities and infrastructure. The fact that these changes are projected to occur abruptly further increases the challenges associated with climate change adaptation and potential retrofitting measures.