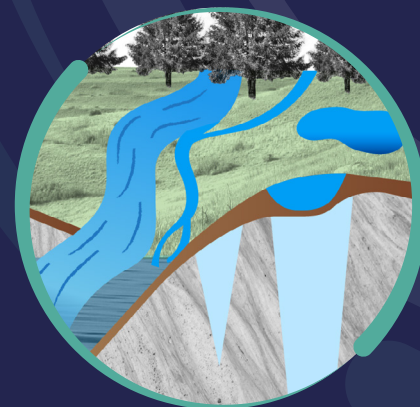


PERMAFROST THAW

HOW IS PERMAFROST THAW IN THE ARCTIC GOING TO DEVELOP UNDER DIFFERENT CLIMATE SCENARIOS AND STORYLINES?



RESEARCH

PolarRES conducted high-resolution simulations to assess how permafrost thaw and ground subsidence across the Arctic will change by the end of the 21st century. The CTSM-EXICE model was used and forced by outputs from two regional climate models driven by two global climate models under the medium to high-risk greenhouse gas emissions scenario SSP3-7.0. The analysis focused on permafrost extent, active layer thickness, and ground subsidence from 2015 to 2099, providing one of the most detailed regional assessments of Arctic permafrost future change.



RESULTS

All projections show a consistent and strong decline in Arctic permafrost throughout the 21st century. The most losses and associated ground subsidence exceeding one meter are projected in sub-Arctic regions between 60-70°N, where population and infrastructure are concentrated. As ground ice melts, surface subsidence is expected to accelerate after mid-century. The largest subsidence is projected in northern Canada and northeastern Russia, while even higher-latitude regions experience a gradual but persistent decline in near-surface permafrost. At the city scale, several major Arctic settlements are projected to face significant permafrost degradation, with implications for long-term urban development, transport systems, and safety.

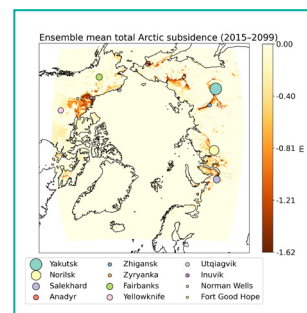


Figure: CTSM-EXICE ensemble mean total Arctic subsidence (2015–2099) at the city scale. The size of the circles on the map denotes the population of the considered Arctic cities.



POLICY ACTIONS NEEDED

To prepare for the impacts of thawing ground, **risk-informed infrastructure planning is essential**. Measures include integrating permafrost hazard mapping into construction standards, strengthening monitoring systems, and promoting cross-border collaboration among Arctic nations to share data, expertise, and adaptation strategies.

IMPORTANCE

Permafrost thaw releases greenhouse gases that accelerate global warming and destabilize the ground, threatening infrastructure and ecosystems. It also reshapes Arctic landscapes by altering the distribution of wet and dry areas, vegetation, and water quality—posing major challenges for local and regional governments, planners, and climate agencies.

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