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Vulnerability assessment of Arctic coastal communities to the effects of coastal erosion and permafrost warming.

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This study assesses the escalating vulnerability of Arctic coastal communities due to the combined impacts of coastal erosion and permafrost warming. With the Arctic experiencing heightened temperatures, coastal permafrost areas face increased instability, endangering vital infrastructures. The study focuses on a pan-Arctic evaluation of settlements and infrastructures at risk, enhancing the existing Arctic coastal infrastructure dataset (SACHI) to include road types, airstrips, and artificial water reservoirs.

By analyzing coastline change rates from 2000 to 2020, alongside permafrost ground temperature and active layer thickness trends from the ESA Permafrost Climate Change Initiative datasets, the research identifies settlements at risk for the years 2030, 2050, and 2100. The accuracy of the dataset is rigorously evaluated. Results indicate that by 2100, 23% of coastal settlements will face the impacts of coastal erosion. Projections based on linear trends suggest an 8°C increase in coastal permafrost ground temperature and a 0.9-meter growth in active layer thickness by the same year.

Crucially, the study reveals that 65% of all infrastructures and settlements will be affected by permafrost warming within the range of 5-15°C, with 35% experiencing active layer thickening between 1-5 meters. This research marks the first regional-scale identification of settlements at risk from coastal erosion along Arctic and permafrost-dominated coasts in the northern hemisphere. The findings emphasize the urgency of adapting to current and future environmental changes to mitigate the deterioration of living conditions in permafrost coastal settlements. Immediate action is imperative to counteract these challenges and ensure the resilience of these vulnerable communities.