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The changing spatio-temporal dynamics of thaw lake development, Seward Peninsula, Alaska.

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Contemporary anthropogenic climatic warming is having an accelerated, and more pronounced effect upon Arctic regions than any other environment on Earth. Increased surface temperatures have led to widespread permafrost degradation and a shift in dynamics.

One landscape manifestation of localised permafrost decay, seen to be ubiquitous across low-lying tundra regions of Alaska, Canada and Siberia, is the thermokarst lake – or 'thaw' lake. These features are seen to be truly dynamic, with a relatively rapid evolution and decay. The exact impacts of climatic perturbation on thaw lake development are in contention; however, recent studies have suggested an increased vulnerability of these features, owing to the susceptibility of the fundamental processes of initiation, expansion and drainage to climatic variation. It is often hypothesised that with current trends, thaw lakes will see a net increase in expansion rate, and areal extent, with a potential for increased drainage events.

Increased permafrost thaw and thermokarst activity has also led to shifts in biogeochemical cycles, leading to an amplified release from large carbon reservoirs currently sequestered within permafrost. An example of carbon release exhibited from thaw lakes is that of methane ebullition (gas bubble formation); this has been theorised to have the potential to initiate a major positive climatic feedback leading to a continued rise in global temperatures.

Due to the remote nature and large area over which these landforms occur, remotely sensed data has been widely used in order to both accurately classify features and measure change over spatially large and great temporal extents. As well as studies interpreting data collected in the visible and near-infrared spectra, studies have recently made use of radar or microwave products in order to capture imagery avoiding adverse atmospheric conditions, most notably cloud cover.

Data from Envisat ASAR operating in Wide Swath Mode was acquired for this study region; however, the core of this research relied upon the analysis of the changing lake morphology using visible and near-infrared spectra from MODIS and Landsat products. This research explored: (1) intra-annual variability of freeze-thaw cycles and resultant effects on thaw lake development; and (2) the spatio-temporal trends and changing dynamism of thaw lake activity. Research presented here within suggests that although climatic trends do indeed influence widespread changes within thaw lake characteristics, site-specific phenomena of sediment type and ice-content and fluvial activity also play integral roles. Understanding and observing changing spatio-temporal dynamics, particularly on an intra-annual basis, has helped to gather more information concerning complex lake processes, and increase the understanding of permafrost decay and thaw lake development.