# Conceptualization and Application of Arctic Tundra Landscape Evolution Using the Alaska Thermokarst Model

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Thermokarst topography forms whenever ice-rich permafrost thaws and the ground subsides due to the volume loss when excess ground ice transitions to water. The Alaska Thermokarst Model (ATM) is a large-scale, state-and-transition model designed to simulate transitions between [non-]thermokarst landscape units, or cohorts. The ATM uses a frame-based methodology to track transitions and proportion of cohorts within a 1-$km^2$ grid cell. In the arctic tundra environment, the ATM tracks thermokarst-related transitions between wetland tundra, graminoid tundra, shrub tundra, and thermokarst lakes. The transition from one cohort to another due to thermokarst processes can take place if thaw reaches ice-rich ground layers either due to pulse disturbance events such as a large precipitation event or fires or due to gradual active layer deepening that eventually results in penetration of the protective layer. The protective layer buffers the ice-rich soils from the land surface and is critical to determine how susceptible an area is to thermokarst degradation. The rate of terrain transition in our model is determined by the ice-content of the soil, the drainage efficiency (or ability of the landscape to store or transport water), and a cumulative probability of thermokarst initiation. Tundra types are allowed to transition from one type to another (ie wetland tundra to a graminoid tundra) under favorable climatic conditions. In this study, we present our conceptualization and initial simulation results from the ATM model for an 1792 $km^2$ area on the Barrow Peninsula, Alaska. The area selected for simulation is located in a polygonal tundra landscape under varying degrees of thermokarst degradation. The goal of this modeling study is to simulate landscape evolution in response to thermokarst disturbance as a result of climate change.