



Rapid Permafrost Warming Underway in Gates of the Arctic



The National Park Service is monitoring climate and ground temperatures in Gates of the Arctic at several stations like this one near Chimney Lake. Cold, high-mountain landscapes like this have permafrost that is less vulnerable to thaw.



The boreal forest landscapes of the Kobuk (above) and Koyukuk River Valleys in Gates of the Arctic have permafrost that is relatively warm and susceptible to thaw. The high ice content of permafrost in these lowlands results in formation of pits and ponds if permafrost thaws.

Most of Gates of the Arctic is underlain by permafrost, ground that stays frozen year 'round except for a surface layer that thaws each summer. Permafrost is very important in the arctic and subarctic because it stops the infiltration of water into the ground, which keeps the surface wet in many places. Also, permafrost can contain considerable amounts of ice, and if the ground thaws, melting ground ice can cause subsidence that creates pits and ponds; it can also cause small landslides.

The old-timers are right: it used to be colder in Alaska

The National Park Service is monitoring ground temperatures at several locations in Gates of the Arctic to understand the condition of permafrost. Most of Gates of the Arctic is high, cold mountains, where warming of permafrost has minor effects. Warming causes summer thaw to penetrate a little deeper into the ground than before, but most of the permafrost remains securely frozen, and there is so little ice in the rocky ground that any thaw that does occur has minor effects.

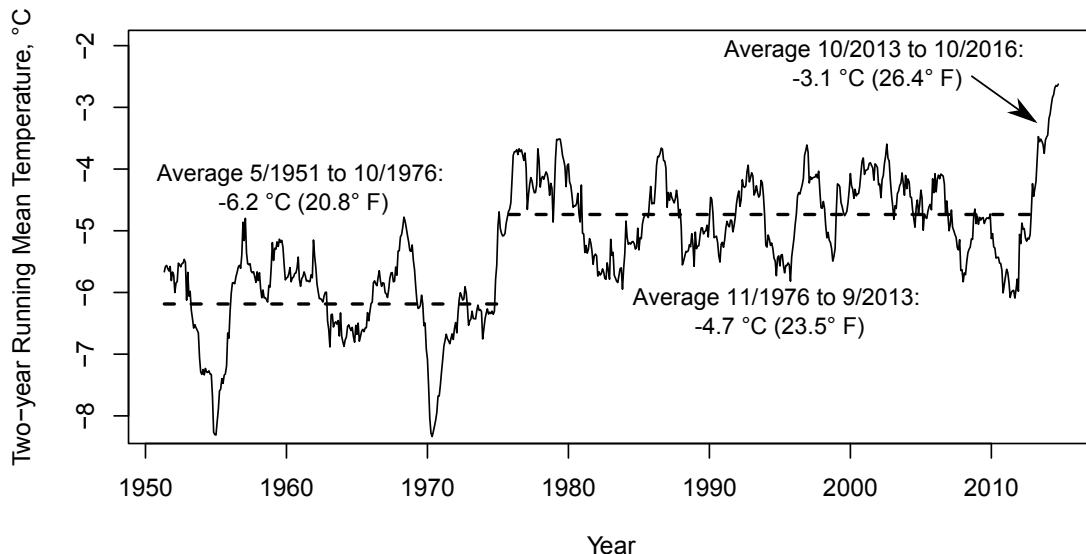
The situation is different in the southern, low-elevation parts of the park. Here temperatures are warmer and much of the ground is ice-rich. Sensors in the ground from 2014 to

2016 in the Kobuk Valley, along the route of the proposed Ambler Mining District Access Road, revealed permafrost temperatures close to the freezing point of water, between 0° and -1° C (32° and 30° F). The winter of 2015-2016 was so mild that the upper permafrost stayed close to freezing all winter instead of chilling down several degrees like it usually does.

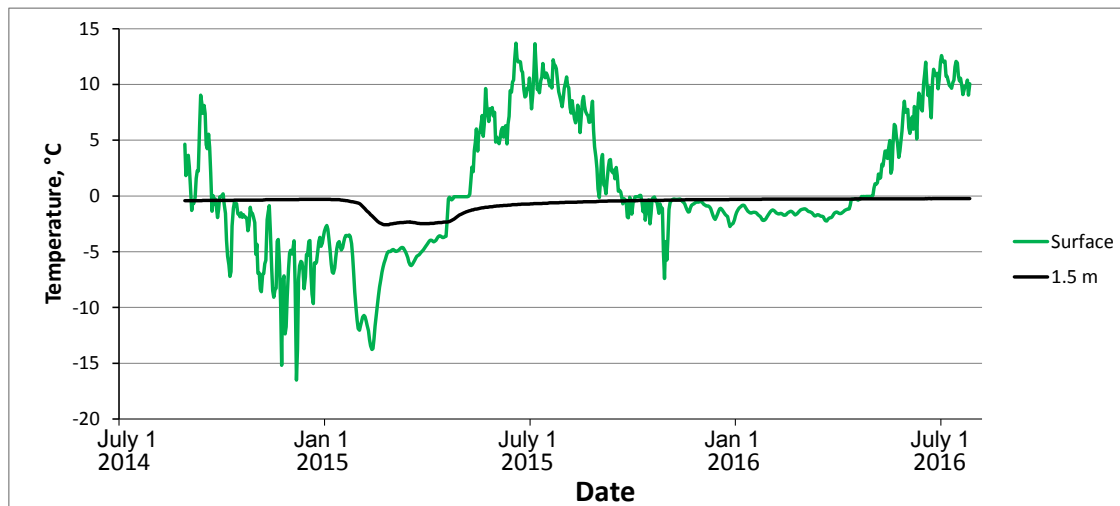
The effects of warming permafrost in Gates of the Arctic have been subtle so far, because long-term temperatures were stable until just a few years ago and permafrost takes some time to thaw. But the record warmth of the past few years is causing permafrost to warm, and we expect ground subsidence and other effects to become apparent soon.



Thaw of ice-rich permafrost can create pits and ponds like these in southern Gates of the Arctic National Park and Preserve.



This graph shows the 2-year running mean annual air temperatures at Bettles, Alaska, just south of Gates of the Arctic. From the early 1950s, when weather records began in Bettles, until the mid-1970s, the annual average air temperature was a chilly -6.2°C (20.8°F). Temperatures rose abruptly in Bettles late in 1976, as they did over much of Alaska. Since then the average has been -4.7°C (23.5°F)—until recently. Late in 2013, temperatures took another hop: the average for the last 3 years has been -3.1°C (26.4°F), and it is still rising. Deep underground in the permafrost, temperatures change little throughout the year, and are usually a few degrees warmer than the mean annual air temperature. As the mean annual air temperature has risen in recent years, so too has the permafrost temperature underground.



Two years of monitoring ground temperatures near the Kobuk River in southern Gates of the Arctic. The temperature sensors were at the ground surface (green) and in the permafrost, 1.5 m (5 feet) below the surface. The winter of 2014-2015 was mild compared to the long-term average, but the ground stayed frozen all year at 1.5 m depth and managed to chill down a few degrees by late winter. The winter of 2015-2016 was so mild that the permafrost at 1.5 m depth stayed right near 0°C —barely frozen—all through the winter.



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