Permafrost Change

What It Means to Alaskans and How We Can Adapt

How is Alaska permafrost changing?

Alaska's distinctive ground feature known as permafrost is starting to thaw, which could mean big changes for the state and its people. Permafrost is a combination of soil, rock, and organic materials (partially decomposed plant matter) that has been at or below 0°C (32°F) for at least two consecutive years. Most permafrost is many thousands of years old, and in some places it is as deep as 650 m (about 2,000 ft). The *active layer*—the upper 30-100 cm (about 1-3 ft) of soil—is not part of the permafrost because it thaws during the summer months.

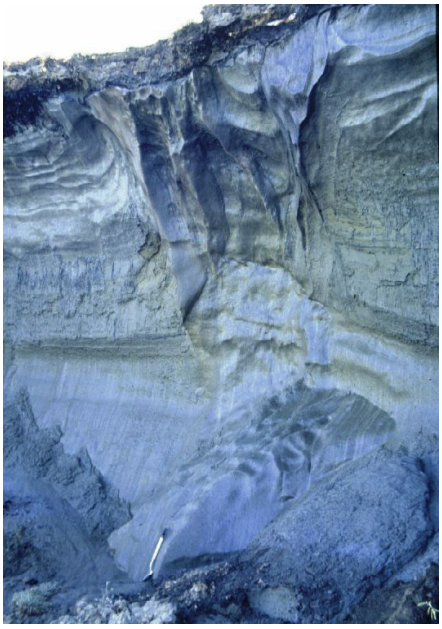
Permafrost is found on about 80% of the land surface of Alaska. *Continuous* permafrost (covering 90% or more of the surface area) begins just south of the Brooks Range and extends north to the Beaufort Sea, west to the shores of the Chukchi Sea, and east to the Canadian border. *Discontinuous* permafrost (50-90% coverage) extends south to about the latitude of Anchorage, where the permafrost becomes sporadic and isolated. Kodiak Island, the Alaska Peninsula, the Aleutian Islands, and Southeast Alaska lack permafrost.

What are scientists telling us?

Scientists say their measurements indicate that the active layer is getting deeper as the seasonal thaw extends farther into the ground. They are finding, primarily through data collected at boreholes, that permafrost temperatures have warmed as much as 2°C (about 3°F) during the last 20 to 30 years, not just in Alaska but also across Russia, the Scandinavian countries, and Canada. Lakes expand when runoff finds its way to overlie continuous permafrost, or disappear when underlying permafrost thaws and water seeps out through the bottom. In the Russian north more than 125 known lakes already have vanished.

Why does it matter?

Thawing permafrost affects vegetation, water supplies, transportation, infrastructure, and even human health. As it thaws, cavernous pits develop when water that was previously frozen drains from the soil. Changing hydrology affects the way water moves through the country. A major thaw in northwestern Alaska a few years back dammed the Selawik River, disrupting the fishing important to nearby villagers. Ice cellars that are used to keep meat frozen have thawed and turned into pits of standing water, and food stored underground



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Thawing permafrost on the Ikpikpuk River.

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in warmer soil is more susceptible to botulinum toxin. In some places lake and river transportation routes have turned to dry tundra, and elsewhere previously dry terrain and trails have flooded.

Buildings whose foundations originally rested on solidly frozen ground are tilting and even breaking apart. Roads, airstrips, sewer and water supply pipelines, and other kinds of infrastructure are sustaining damage. A study by the Institute of Social and Economic Research at the University of Alaska Anchorage estimates that climate change will increase repair and maintenance costs for public infrastructure in Alaska by about 10%.

Thawing permafrost allows nitrates and phosphates previously locked in frozen soil to reach the tundra, essentially changing the chemistry of the soil and allowing invasive species a foothold. It is estimated that the world's permafrost may contain three times the amount of carbon as is held in the atmosphere. As temperatures increase, bacterial action in the soil breaks down plant material and releases carbon dioxide. The huge volumes of organic material in the world's permafrost reinforce the view that the climate will warm even faster than it is now if this gas is released by thawing soil.

Why is it happening?

Scientists say that increased permafrost thawing is a result of global climate change, which is evidenced in the far north earlier and more dramatically than across most of the globe. Debate continues on the causes but it is clear that the "greenhouse effect" of carbon dioxide and other byproducts from burning fossil fuels is raising atmospheric temperatures.

How can we stop permafrost thaw?

As long as global temperatures continue to rise, the zone of thawing permafrost will continue to expand and the active layer will increase in depth. Once thawed, permafrost will not return to its continuously frozen state unless the earth enters another ice age.

How can Alaskans adapt?

Adaptation to permafrost thaw can take many forms, depending on local conditions. Adaptations could include:

- Construct roads, buildings, and other kinds of infrastructure with techniques that don't require frozen subsurface soils for foundations.
- Relocate ice cellars or turn to other means for preserving frozen subsistence foods.
- Reroute transportation corridors to avoid vulnerable areas of permafrost.
- Look for more secure sources of water supply to minimize potential for contamination.
- Most important is to begin a community dialog about permafrost and other local environmental change. Encourage participation by all members, and record observations. Monitor conditions to document changes. Seek input on possible adaptation measures, and draft a plan.

Federal, state, and university resources are available to provide technical assistance and in some cases financial assistance as well. Adaptation is most effective when done before a situation reaches the crisis stage.

For more information or assistance

Climate Change Adaptation, Alaska Sea Grant Marine Advisory Program
http://www.marineadvisory.org/climate

Alaska Center for Climate Assessment and Policy (ACCAP)
http://ine.uaf.edu/accap/alaska_arctic.html

Scenarios Network for Alaska Planning (SNAP)
http://www.snap.uaf.edu

Alaska Climate Change Impact Mitigation Program, Division of Community and Regional Affairs (DCRA)
http://www.commerce.state.ak.us/dcra/ACCIMP.htm

Permafrost Lab, Geophysical Institute, University of Alaska Fairbanks
http://www.permafrostwatch.org

Article on permafrost changes by Vladimir Romanovsky
http://www.arctic.noaa.gov/essay_romanovsky.html

Interview with Vladimir Romanovsky, Geophysical Institute, University of Alaska Fairbanks
http://www.arcticwarming.net/node/70

This Alaska Sea Grant Marine Advisory Program (MAP) project is supported by the Alaska Center for Climate Assessment and Policy (ACCAP). MAP is a statewide outreach and technical assistance program that helps Alaskans sustain economic development, traditional cultural uses, and conservation of marine and coastal resources. ACCAP's mission is to assess the socioeconomic and biophysical impacts of climate variability in Alaska, make this information available to local and regional decision-makers, and improve the ability of Alaskans to adapt to a changing climate.

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