Variation in Depths to Permafrost in the Vicinity of Kongiganak, Alaska

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Introduction

The Kuskokwim River courses through hundreds of kilometers of southwestern Alaska. This is part of the "discontinuous" zone of permafrost. Kongiganak is a small village that lies near the mouth of the Kuskokwim River. It is considered a coastal village and it is influenced by wind and tides. This study investigated changes in depths to permafrost observed at several different locations in the village.

Fig. 1. This image is an aerial view of the village of Kongiganak. Permafrost data collection points are marked in yellow.

Materials and methods

Materials used for this study included a Garmin eTrex GPS unit, a digital thermometer with data storage capabilities, a one meter measuring stick, a 2 x 4 about four feet long, a 1.5 meter steel pipe, a Dell Inspirion 6400 laptop computer, a field notebook, and a pen.

Methods included marking waypoints on the GPS receiver, pounding the steel pipe into the ground with the 2 x 4, measuring the depth to permafrost (as indicated by the pipe) with a meter stick, measuring the surface temperature of the site, measuring the ambient temperature of the site, annotating the elevation, and recording our observations.

Fig. 2.The GIS/GPS were important to the study because we mostly use these materials.

Data

Data collected showed that depth to permafrost varied, but it did not seem to correspond with changes in temperature of the soil near the surface.

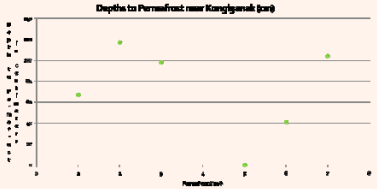

Fig. 4a. Line chart showing depth to permafrost measured at different GPS waypoints.

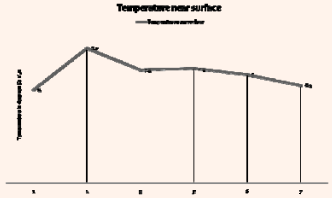

Fig. 4b. Line chart showing temperature measured near surface at Permafrost test sites.

Results

Temperature near surface and depth to permafrost were measured concurrently. Ambient temperature during sampling remained constant within 1˚ Celsius. According to preliminary findings, there appears to be no correlation between depth to permafrost and temperature near the surface of the soil.

Discussion

One hypothesis students generated about depths to permafrost seems to be supported by the study we have done thus far. That is: depth to permafrost will be greater near bodies of surface water than depth to permafrost further from bodies of surface water. Note in figure 4a that the depth to permafrost was greatest near Waypoints 2, 5, and 7. A zoomed in view of the study area below shows that Waypoints 2, 5, and 7 are located closer to bodies of surface water than the other waypoints. Permafrost was never even encountered at waypoint 5, which is located along the quickly eroding river bank.

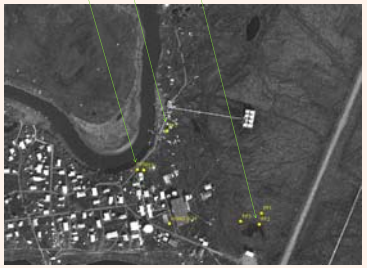

Fig. 5. Waypoints 2, 5, and 7 are located closer to standing water than the other waypoints. They were also observed to have a greater depth to permafrost.

Miller & Whitehead (1999) indicate that surface water can influence the presence of permafrost. "The warming effect of streams, rivers, lakes, and the ocean may extend to a depth of several hundred feet and result in local areas where permafrost is thin or absent." This statement was supported by our preliminary findings.

Conclusions

The thermal effects of surface water cause permafrost to migrate to greater depths or not be present at all. This is another factor that will compound the effects of global warming on tundra communities, many of which are almost completely surrounded by water. As the permafrost thaws, erosional processes are accelerated. River banks erode quickly and buildings in villages must be moved.

An interesting follow-up investigation to this study would involve testing soil temperatures around the perimeter of a tundra lake, to see how far beyond the lake perimeter the thermal effects extend.

Literature cited

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For further information

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