# Alaska Frost Tube Data Analysis Poster Report

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## Abstract

Alaska is located in an arctic and sub-arctic climate with the presence of permafrost. Permafrost conditions range from isolated, sporadic, discontinuous, to continuous extent, depending on location (Yoshikawa, 2013). The Frost Tube Protocol monitors the depth and timing of the freezing of the ground, which is considered the active layer, in places with permafrost. Measurements are taken from ground depth, not the permafrost depth (Frost Tube Protocol). Frost depth can be influenced by air, surface, and soil temperature, as well as the snow depth and vegetation cover (Frost Tube Protocol). According to Iwata et al., soil frost depth influences the amount of snowmelt infiltration (2011), which could influence crop cultivation, plant growth, rate of decomposition of organic matter, and other biological, chemical, and physical properties that occur within soil (Frost Tube Protocol). Data gathered from this research will contribute to a greater understanding of climate change and its resonating effects on natural environments and local ecosystems, as well as how permafrost and active layer change over time (Yoshikawa, 2013).

## Research Question

Research was conducted to explore how frost depth varies between geographic location; how air and surface temperature influence soil freeze; and investigate if there is an influence of elevation, within UAF campus grounds.

## Research Methods

Data collected from 2007 to 2011, by Yoshikawa, was manually entered into the GLOBE database as a frost tube measurement. A map showing the regions being compared was creating in ArcMap. Another map was then created within the GLOBE website to visualize the extent of frost tube locations throughout Alaska. After selecting the date range of frost tube data, frost tube locations represented with dots are sized to correlate with the number of frost tube measurements taken at that site.

Frost depth averages taken from the data from September 2008 through May 2009 were organized and graphed to show the comparison of frost depth between interior, southern, and coastal regions throughout the state.

Weekly measurements of air, surface, and frost depth were taken at the UAF ski trail frost tube and entered into the Globe database. The UAF ski trail frost tube is located in the woods on the northwest corner of the UAF campus. Additionally, photos of the frost tube area were taken at each measurement. Air temperature was taken with a calibration thermometer. Surface temperature was taken with an infrared laser thermometer. Each measurement was taken between 12:45 and 12:55 o’clock.

Additionally, frost depth data collected from the Moosewood Farm frost tube were compared with frost depth data from the UAF ski trail tube. Elevation data were provided with frost tube installation data from Yoshikawa.

## Results

Graph 1: Regional Comparison

The comparison of the 2008-2009 regional data shows the soil freezing sooner and at a quicker rate in the interior region compared to the southern and coastal regions.

Graph 2: UAF Ski Trail Frost tube

The UAF ski trail graph shows the relationship between air and surface temperature and frost depths.

 Graph 3: Comparison Moosewood Farm / UAF Ski Trail

There is a slight pattern of soil freezing at deeper depths, and more variability, at the UAF ski trail location compared to the Moosewood Farm location.

## Conclusion

The following research provides evidence of relationships between frost depth, air temperature, surface temperature, elevation, and geographic location.

There was an adequate sample set of frost depth data for a regional comparison 2008-2009. Ideally, for future analysis, consistent air and surface temperatures, as well as snow depth should be collected with each frost depth measurement, in order to compile a thorough data set. Additionally, consistent snow depth measurements should have been recorded at the UAF ski trail.

Entering data from 2007 through 2011, contributing additional data to the GLOBE database, organizing and analyzing data, along with mentorship of Buffington, proved a valuable learning experience, as this data will contribute to a greater extent of on-going permafrost and climate change research.

## Bibliography

Frost Tube Protocol, GLOBE.gov, 2019.

Iwata, Yukiyoshi et al., Comparison of soil frost and thaw depths measured using frost tubes and other methods. *Cold Regions Science and Technology*, (71) 2012, 111-117.

Yoshikawa, Kenji. *Permafrost in Our Time: Community-Based Permafrost Temperature Archive*. University of Alaska Fairbanks Permafrost Outreach Program, 2013.