ABoVE: Soil Temperature Profiles, USArray Seismic Stations, AK and Canada, 2016-2019

Get Data

Documentation Revision Date: 2020-06-30

Dataset Version: 1

Summary

This dataset includes soil temperature profile measurements taken at 16 monitoring sites in Alaska, USA, and at one site in Yukon, Canada. The six sites are collocated with seismic stations of the USArray program. The measurement dates and depths vary per site as does measurement frequency (hourly or every 6 hours). Measurements were made from the soil surface to a maximum depth of 1.5 m. Measurements were made from 2016-2018 at two sites, 2017-2019 at four sites, and 2018-2019 at 11 sites using temperature sensors attached to HOBO data loggers. These measurement stations complement existing temperature monitoring networks allowing for better characterization of ground temperatures and permafrost conditions across Alaska.

This dataset is the second set of soil temperature profile measurements collected at USArray stations. The previously archived dataset, Nicolsky et al. (2019), reported comparable data from 20 USArray sites.

There are 17 data files in comma-separated (.csv) format with this dataset with one file per site. There is a companion file in comma-separated (.csv) format that provides additional site descriptions.

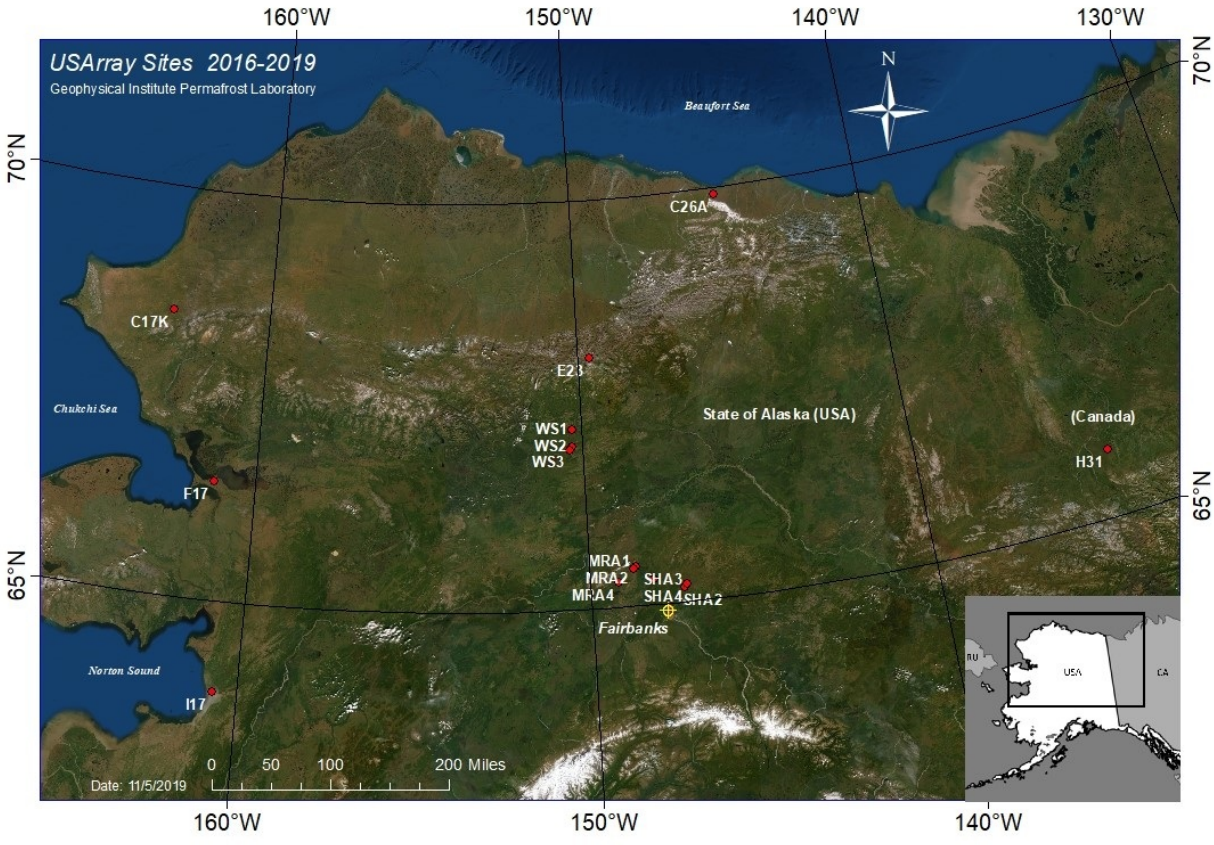

Figure 1. Map of 16 measurement sites located across interior Alaska, USA, and at one site in Yukon, Canada. Sites C17K, C26K, E23, F17, H31, and I17 are collocated with the seismic stations. Source: D.J. Nicolsky.

Citation

Nicolsky, D.J., V.E. Romanovsky, A.I. Kholodov, K. Dolgikh, and N. Hasson. 2020. ABoVE: Soil Temperature Profiles, USArray Seismic

Stations, AK and Canada, 2016-2019. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1767

Table of Contents

1. Dataset Overview
2. Data Characteristics
3. Application and Derivation
4. Quality Assessment
5. Data Acquisition, Materials, and Methods
6. Data Access
7. References

1. Dataset Overview

This dataset includes soil temperature profile measurements taken at 16 monitoring sites in Alaska, USA, and at one site in Yukon, Canada. The six sites are collocated with seismic stations of the USArray program. The measurement dates and depths vary per site as does measurement frequency (hourly or every 6 hours). Measurements were made from the soil surface to a maximum depth of 1.5 m. Measurements were made from 2016-2018 at two sites, 2017-2019 at four sites, and 2018-2019 at 11 sites using temperature sensors attached to HOBO data loggers. These measurement stations complement existing temperature monitoring networks allowing for better characterization of ground temperatures and permafrost conditions across Alaska.

This dataset is the second set of soil temperature profile measurements collected at USArray stations. The previously archived dataset, Nicolsky et al. (2019), reported comparable data from 20 USArray sites.

Project: Arctic-Boreal Vulnerability Experiment

The Arctic-Boreal Vulnerability Experiment (ABoVE) is a NASA Terrestrial Ecology Program field campaign in Alaska and western Canada from 2016 to 2021. Research for ABoVE will link field-based, process-level studies with geospatial data products derived from airborne and satellite sensors, providing a foundation for improving the analysis, and modeling capabilities needed to understand and predict ecosystem responses and societal implications.

Related Dataset

Nicolsky, D.J., V.E. Romanovsky, A.L. Kholodov, K. Dolgikh, and N. Hasson. 2019. ABoVE: Soil Temperature Profiles at USArray Seismic Stations, Alaska, 2016-2018. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1680

- This related dataset reports comparable data from 20 USArray sites.

Acknowledgment

This work was funded by NASA ABoVE, grant NNX16AH96G. The data acquisition would not have been possible without the support of many USArray team members. Special thanks to all of them.

2. Data Characteristics

Spatial Coverage: Sixteen sites in Northern Alaska, USA and one site in Yukon, Canada

> **ABoVE Reference Locations**
>
> Domain: Core
>
> State/Territory: Alaska and Canada
>
> Grid cells: Ch056v021, Ch036v006, Ch031v013, Ch024v019, Ch046v022, Ch043v023, Ch043v024, Ch039v030, Ch040v030, Ch041v030, Ch041v031, Ch041v032, Ch058v042

Spatial Resolution: Point locations

Temporal Coverage: 2016-06-25 to 2019-08-22

Temporal Resolution: hourly or every 6 hours

Study Areas (All latitude and longitude given in decimal degrees)

Site	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
Alaska and Canada	-163.17784	-134.34272	69.91752	63.8863

Data File Information

There are 17 data files in comma-separated (.csv) format—one file per site. The file naming convention consists of the USArray site name followed by the first and last day (YYYY-MM-DD) of data contained within the file: *site_start-time_end-time*.csv (e.g., **I17K_2017-06-08_2019-04-15.csv**)

Data File Details

Missing data are represented as -9999. The USArray site name appears only in the file name and not as a data variable. **User Note:** Site C17K is the only site also reported in the related dataset Nicolsky et al. (2019). August, 2017 to August 18, 2018, data are identical in both datasets. The current dataset provides additional new data from August 19, 2018, to May 2019.

Table 1. Variables in the data files *site_start-time_end-time*.csv.

Variable	Units	Description
date_time	YYYY-MM-DD hh:mm	Date timestamp of reported measurement; either a 1-hour or a 6-hour reporting frequency in Alaskan standard time (AKST)
tsoil_X (e.g., tsoil_0m, tsoil_1.5m)	Degrees C	Soil temperature at the indicated depth in meters; the vertical offset below the soil surface (X) is included in the variable name

Table 2. USArray Site information **e**xcerpt from **USArray_site_metadata.csv**. Latitude and Longitude columns are in decimal degrees and Start_Time and End_Time are in Alaska Standard Time (AKST),

USArray_Site	Country	Latitude	Longitude	Start_Time	End_Time	Vegetation
C17K	USA	68.47557	-163.17784	2017-08-29	2019-05-14	Lichen and moss among shattered rock
C26A	USA	69.91752	-144.91223	2016-06-25	2018-07-09	Moss and lichen; high tundra
E23K	USA	68.05841	-149.61642	2016-06-27	2018-07-13	Very low intermittent shrubs
F17	USA	66.44199	-161.25018	2017-07-28	2019-04-02	Sparse lichen and moss; mostly barren
H31	CA	65.80527	-134.34272	2017-07-16	2019-05-30	
I17K	USA	63.88636	-160.69498	2017-06-08	2019-04-15	Upland spruce
MRA1	USA	65.483305	-148.658208	2018-10-19	2019-02-21	Black spruce forest; lots of moss > 20 cm thickness
MRA2	USA	65.449811	-148.730488	2018-10-19	2019-04-04	Mixed forest, black spruce, and birch forest; some moss < 5cm thickness
MRA3	USA	65.302714	-148.161944	2018-10-19	2019-03-02	Tussock tundra; site near small spruce tree
MRA4	USA	65.29665	-149.17632	2018-10-19	2019-04-20	Black spruce forest; short trees; abundant moss > 20cm thickness
SHA1	USA	65.171203	-147.29108	2018-10-13	2019-03-19	Spruce and birch; moss 10 cm depth; peat 20 cm depth; no tussocks
SHA2	USA	65.171796	-147.290316	2018-10-13	2019-05-31	Black spruce forest, tussocks, moss, cloud berry
SHA3	USA	65.209122	-147.207102	2018-10-13	2019-05-31	Black spruce forest and birch shrub; moss 15 cm depth; peat 15 cm depth no tussock
SHA4	USA	65.209466	-147.20758	2018-10-13	2019-05-31	White spruce forest with aspen and birch on a hill; moss 2 cm, depth; peat 5 cm depth mineral soil
WS1	USA	67.197486	-150.277801	2018-08-25	2019-08-22	White spruce
WS2	USA	66.980492	-150.323731	2018-08-25	2019-08-22	White spruce
WS3	USA	66.952119	-150.405318	2019-08-25	2019-08-22	White spruce

Companion File Information

There are two companion files with this dataset. One is a .csv file that provides additional site descriptions and the other is .pdf file which is a manual of the HOBO data logger used to measure the soil temperatures. **User Note:** As a companion file, the column names have not been edited for consistency. Missing values may be blank cells or NA.

Table 3. Variables in the companion file **USArray_site_metadata.csv.**

Column Name	Units/Format	Description
USAR_site		Name of site
StartTime	YYYY-MM-DD	Date of first measurement, Alaskan standard time (AKST)
EndTime	YYYY-MM-DD	Date of last measurement, Alaskan standard time (AKST)
latitude_WGS84	decimal degrees	Latitude of site, WGS84
longitude_WGS84	decimal degrees	Longitude of site, WGS84
country		Country where site is located
max_depth		Maximum soil depth measurement
nearest_hubs		Research hub or hubs closest to the collection site, and their distance in NM
nearby_landmark		A landmark close to the site
elevation	m	Altitude of site in meters
vegetation		Description of the plants at the site
terrain		Physical description of the terrain
soil_bedrock		Notes related to the soil or bedrock of the site

access		Means of accessing the site
installation_date	YYYY-MM-DD	Date when sensors were installed, AKST (AKST)
field_notes		Miscellaneous notes regarding the site

3. Application and Derivation

Seventy-eight of the USArray transportable sites are instrumented with soil temperature profilers, the majority provided by the NASA ABoVE program but also by the Yukon Geological Survey. These stations complement an existing temperature monitoring network, allowing for better characterization of ground temperatures and permafrost conditions in northern and western Alaska. Subsurface temperatures depend on many variables, including snow cover, vegetation, terrain, and soil properties. Mean temperatures for a study region may not account for “hot spots” of change, which can significantly contribute to thaw and associated carbon emissions. A solution is to record temperature regimes within different ecotypes in order to build a portfolio of subsurface thermal regimes across various ground conditions.

4. Quality Assessment

All specifications on the HOBO data logger and cable accuracy, resolution, range, can be found in HOBO_Datalogger_Manual.pdf listed as a companion file. Sensors were calibrated in an ice bath at Permafrost Lab to determine the certainty of temperature. The temperature attained during the calibration is subtracted from the regular measurement result. Installation depth uncertainty is ±0.025 m.

5. Data Acquisition, Materials, and Methods

The USArray (http://www.usarray.org/) is a 15-year program to place a dense network of permanent and portable seismographs across the continental United States. In Alaska, the grid of stations is spaced about 85 km apart covering all of mainland Alaska and parts of the Yukon, British Columbia, and the Northwest Territories. Seventy-eight of the array sites were instrumented with soil temperature profilers, the majority provided by the NASA ABoVE program but also by the Yukon Geological Survey. This dataset provides temperature measurements recorded at 16 of those sites in Alaska and one site in Yukon, Canada. Measurements were recorded with Onset TMCx-HD sensors attached to the HOBO (Onset UX120-006M) data logger at varying depths.

A slide hammer, attached to a 1.5 m steel rod, was used to make a hole in the ground that had a 1.6 cm in diameter. Penetration varied with substrate composition, and several attempts were made to reach the target depth of 1.5 m.

Temperature sensors were inserted into the hole, always including one at the bottom and one at a depth between 0.01 m and 0.02 m to represent the ground surface temperature. A typical profile included sensors at 0.01 m, 0.2 m, 1.0 m, and 1.5 m depths. The hole was filled, and the cables leading to the data logger were buried.

6. Data Access

These data are available through the Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

ABoVE: Soil Temperature Profiles, USArray Seismic Stations, AK and Canada, 2016-2019

Contact for Data Center Access Information:

- E-mail: uso@daac.ornl.gov
- Telephone: +1 (865) 241-3952

7. References

Earthscope. 2019. USArray: A Continental-scale Seismic Observatory. http://www.usarray.org/

Nicolsky, D.J., V.E. Romanovsky, A.L. Kholodov, K. Dolgikh, and N. Hasson. 2019. ABoVE: Soil Temperature Profiles at USArray Seismic Stations, Alaska, 2016-2018. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1680