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DAAC Home > Get Data > NASA Projects > Arctic-Boreal Vulnerability Experiment (ABoVE) > User guide

# ABoVE: Soil Temperature Profiles, USArray Seismic Stations, 2016-2021

## Get Data

Documentation Revision Date: 2022-04-20

Dataset Version: 1.1

## Summary

This dataset includes soil temperature profile measurements taken at 63 monitoring sites associated with the USArray program, located across the NASA ABoVE domain in interior Alaska. 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 from 2016-2021 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 station data complement an existing temperature monitoring network, allowing for better characterization of ground temperatures and permafrost conditions in northern and western Alaska. The temperature measurements are provided for each site in 64 data files in comma-separated values (.csv) format. Site descriptive data are also provided for soil, vegetation, and location.

There are 64 data files in comma-separated values (.csv) format (there are 63 sites; one site has two files) with temperature measurements. There are three files with site soil, vegetation, location and other descriptive data provided in three formats (all files provide the same data): one file in .csv format, one shapefile (.shp), and one file in Keyhole Markup Language (.kmz) for viewing in Google Earth.

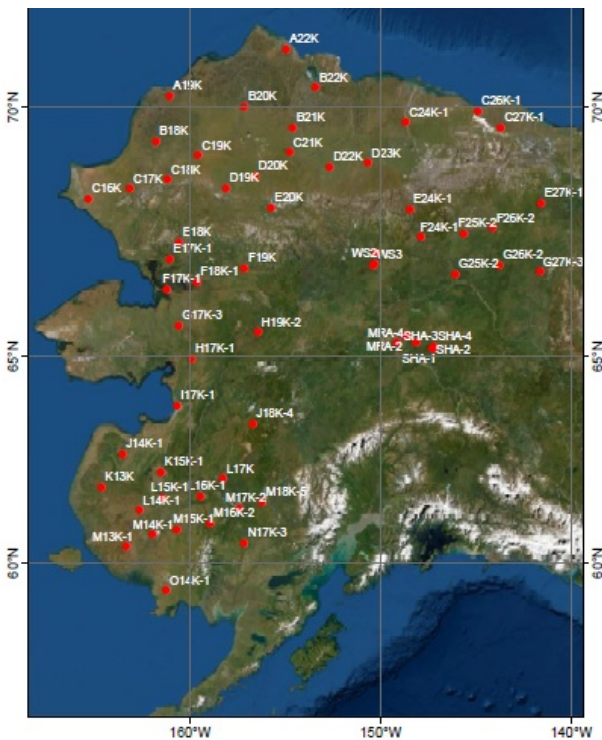


Figure 1. Map showing USArray measurement sites.

## Citation

Nicolosky, D.J., V.E. Romanovsky, A.L. Kholodov, K. Dolgikh, and N. Hasson. 2022. ABoVE: Soil Temperature Profiles, USArray Seismic Stations, 2016-2021. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/1680>

## 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](#)
8. [Dataset Revisions](#)

## 1. Dataset Overview

This dataset includes soil temperature profile measurements taken at 63 monitoring sites associated with the USArray program, located across the NASA ABoVE domain in interior Alaska. 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 from 2016-2021 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 station data complement an existing temperature monitoring network, allowing for better characterization of ground temperatures and permafrost conditions in northern and western Alaska. The temperature measurements are provided for each site in 64 data files in comma-separated values (.csv) format. Site descriptive data are also provided for soil, vegetation, and location.

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**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

Nicolisky, D.J., V.E. Romanovsky, A.L. 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>

- **User Note:** Data are also reported in the related dataset Nicolisky et al. (2020) listed above for sites C17K, C26K (C26A in the 2020 dataset), F17K, I17K, MRA1-4, SHA1-4, and WS1-3. The files provided for those sites with this new dataset contain data reported in the 2020 dataset as well as new data.

Nicolisky, 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>

### Acknowledgment

This work was funded by NASA ABoVE program (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:** 63 sites in Alaska, USA

### ABoVE Reference Locations

Domain: Core

State/Territory: Alaska

Grid cells: Ch009v028, Ch010v022, Ch013v024, Ch014v018, Ch014v022, Ch014v025, Ch016v023, Ch017v028, Ch017v031, Ch018v017, Ch018v021, Ch018v025, Ch019v029, Ch021v026, Ch021v030, Ch024v019, Ch026v025, Ch028v018, Ch029v015, Ch031v013, Ch033v012, Ch033v014, Ch033v021, Ch036v006, Ch036v017, Ch039v030, Ch040v030, Ch041v030, Ch041v031, Ch041v032, Ch043v023, Ch043v024, Ch046v017, Ch046v022, Ch047v025, Ch047v029, Ch048v018, Ch048v023, Ch049v027, Ch050v031, Ch051v028, Ch052v018, Ch052v033, Ch055v029, Ch056v021, Ch056v023, Ch058v042

**Spatial Resolution:** Point locations

**Temporal Coverage:** 2016-05-13 to 2021-07-08

**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	-165.3463	-141.59575	71.0033	59.25329

### Data File Information

The temperature measurements are provided for each site in 64 data files in comma-separated values (.csv) format (there are 63 sites, and two files for one site). In addition, there are three files with site soil, vegetation, location and other descriptive data provided in three formats (all files provide the same data): one file in .csv format, one shapefile (.shp), and one file in Keyhole Markup Language (.kmz) for viewing in Google Earth.

### Temperature measurements

The files are named as **site** followed by the **first and last day (YYYY-MM-DD)** of data contained within the file: **site\_start-time\_end-time.csv**

Example file name: **C27K-1\_2016-06-23\_2021-03-27.csv**.

**User Note:** Data are also reported in the related dataset Nicolsky et al. (2020) for sites C17K, C26K (C26A in the 2020 dataset), F17K, I17K, MRA1-4, SHA1-4, and WS1-3. The files provided for those sites with this dataset contain new measurements as well as the measurements reported in the 2020 dataset.

#### Variables in the data files

**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)
timezone		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. When the vertical offset was not provided, the variable is tsoil_NaN. Negative vertical offsets are above ground

#### Location and descriptive data

Site soil, vegetation, location and other descriptive data provided in three files: **USArray\_Sites.csv**, **USArray\_Sites.shp (provided in USArray\_Sites.zip)**, and **USArray\_Sites.kmz**.

**Table 2.** Variables in the data files. Data not provided or not applicable are noted as -9999 for numeric variables and NA for text variables.

Column Name	Units/Format	Description
site		Name of site
access		Means of accessing the site
slope_aspect_description		Description of the slope, slope in degrees, or aspect of the site
installation_date	YYYY-MM-DD	Date when sensors were installed
elevation	m	Altitude of site in meters
country		Country where site is located (USA)
start_time	YYYY-MM-DD	Starting date of measurement (site first measurement date in data files)
end_time	YYYY-MM-DD	Last date of measurement (site last measurement date in data files)
latitude	decimal degrees	Latitude of site
longitude	decimal degrees	Longitude of site
max_depth	m	Maximum measurement depth
area		Research hub or hubs closest to the collection site, and their distance in NM
landmark		A landmark close to the site such as a river, lake, mountain, etc
soil_type		Notes related to the soil or bedrock of the site
vegetation		Description of the plants at the site
nearest_hubs		Nearest hubs to the sites
field_notes		Miscellaneous notes regarding the site

### 3. Application and Derivation

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 the HOBO UX120-00UM Datalogger Manual ([https://www.onsetcomp.com/files/manual\\_pdfs/17384-E%20UX120-006M%20Manual.pdf](https://www.onsetcomp.com/files/manual_pdfs/17384-E%20UX120-006M%20Manual.pdf)). 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  $\pm 0.025$  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 and the Yukon Geological Survey. This dataset provides temperature measurements recorded at 63 of those sites in Alaska. 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, 2016-2021](#)

Contact for Data Center Access Information:

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

## 7. References

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

## 8. Dataset Revisions

Data Version	ORNL DAAC Release Date	Description
Version 1.1	2022-04-20	Additional sites were added to the existing dataset as well as new data were added to existing sites
Version 1	2019-06-17	Soil temperature measurements from 2016 to 2018



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Mission  
Data Use and Citation  
Policy  
User Working Group  
Partners

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Science Themes  
NASA Projects  
All Datasets

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Submit Data Form  
Data Scope and  
Acceptance  
Data Authorship Policy  
Data Publication Timeline  
Detailed Submission  
Guidelines

### Tools

MODIS  
THREDDS  
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Soil Moisture Visualizer  
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