ABoVE: Active Layer Soil Characteristics at Selected Sites Across Alaska

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Dataset Version: 1

Summary

This dataset provides soil active layer characteristics from nine locations across Alaska. Soil samples were collected in 2016 except for one site which was sampled in 2018. Soil cores were collected from each site using a steel barrel and plastic sample tube attached to a hand drill. At the majority of sites, samples were taken from each end of three 30-m transects (i.e. samples collected at the 0 m and 30 m location of each transect). The entire thawed horizon (active layer) was sampled where possible, and the length of cores varies among sites. Cores were kept frozen until analysis in the lab. Samples were sectioned by horizon (organic and mineral), and the organic horizon was split into subsections so that no section was longer than approximately 10 cm. Coarse roots were removed, dried and weighed. Soils were measured for gravimetric water content, percent soil organic matter (SOM), pH, and bulk density. Locations were selected to investigate fire disturbance, to span the range of permafrost regions from continuous to sporadic, and to cover vegetation types from boreal forests, tussock tundra, upland willow/herbaceous scrub, and lowland fen and wet tundra sites across Alaska. The data are provided in comma-separated values (CSV) format.

There are two files with this dataset: one file in comma-separated values (CSV) format and a compressed Zip archive holding images in JPEG format.

Figure 1. Site location map. More than one site may be indicated with a marker due to close proximity of some sites.

Citation

Ludwig, S., C. Minions, S. Natali, and J.D. Watts. 2023. ABoVE: Active Layer Soil Characteristics at Selected Sites Across Alaska. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/2315

Table of Contents

1. Dataset Overview

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Project: ABoVE

The Arctic-Boreal Vulnerability Experiment (ABoVE) is a NASA Terrestrial Ecology Program field campaign being conducted in Alaska and western Canada, for 8 to 10 years, starting in 2015. Research for ABoVE links 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 to, and societal implications of, climate change in the Arctic and Boreal regions.

Related datasets

The following datasets provide soil data at selected sites across Alaska:

Minions, C., S. Natali, J.D. Watts, and S. Ludwig. 2021. ABoVE: Soil Temperature and VWC at Unburned and Burned Sites Across Alaska, 2016-2022. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1869

Minions, C., S. Natali, J.D. Watts, S. Ludwig, and D. Risk. 2019. ABoVE: Year-Round Soil CO2 Efflux in Alaskan Ecosystems, Version 2.1. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1762

Natali, S., S. Ludwig, C. Minions, and J.D. Watts. 2018. ABoVE: Thaw Depth at Selected Unburned and Burned Sites Across Alaska, 2016-2017. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1579

Acknowledgements

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2. Data Characteristics

Spatial Coverage: Alaska

ABoVE Reference Locations:

Domain: Core ABoVE
State/territory: Alaska
Grid cells: Ah001v000, Bh006v004, Bh006v005, Bh007v005, Bh008v003,
Ch036v033, Ch039v032, Ch040v029, Ch042v032, Ch048v021

Spatial resolution: Point

Temporal coverage: 2016-08-09 to 2018-07-07

Temporal resolution: Each site was sampled one time

Study Areas: Latitude and longitude are given in decimal degrees (bounding box)

Site	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
Alaska	-149.5333	-146.5575	68.5596	63.8800

Table 1. Individual Study Site Locations.

Site Name (Site Code)	Latitude	Longitude
Hess Creek Burned (HCB)	65.56876	-148.9234
Hess Creek Unburned (HCU)	65.56739	-148.92516
Nome Creek Burned – Old (NCB-OLD)	65.34009	-146.91007
Nome Creek Unburned – Old (NCU-OLD)	65.28556	-146.56002
I-Minus High (IMNH)	68.55716	-149.53291
I-Minus Low (IMNL)	68.55930	-149.51605
Bonanza Creek (BNZ)	64.69600	-148.32568

Eight Mile Lake (EML)	63.88012	-149.25601
Nome Creek Burned – New (NCB-NEW)	65.28603	-146.5583

Data file information:

There are two files in this dataset.

Alaska_Active_Layer_Soils.csv is the main data file holding soils data in comma-separated values (.csv) format.

Alaska_Active_Layer_Soils_photos.zip is a compressed Zip archive holding 121 images in JPEG format. These images are photographs of soil samples taken in the laboratory. The images are linked to the respective soil sample by the file name listed in the "horiz1_photo" and "horiz2_photo" fields in the CSV file. The file naming convention for the images is *<sample_ID>_<core_type>_<horizon>.jpg* (e.g., "BNZ_1-0_MS_horiz1.jpg"), where

- *<sample_ID>* = Sample identification combining site code and sample location; same as in CSV file.
- *<core_type>* = Core type identified as either "OL" (organic layer) or "MS" (mineral soil).
- *<horizon>* = horizon of soil sample: "horiz1" (horizon 1) or "horiz2" (horizon 2)

Soil cores were taken from the 0 m and 30 m sampling locations at three 30-m transects until the frozen layer was reached or as deep as possible. Some sites only have data from select transects.

Missing numeric data are recorded as -9999; missing text data are recorded as NA.

Table 2. Variables in the data file.

Column Name	Units	Description
sample_date	YYYY-MM-DD	Sample collection date.
sample_ID		Sample identification combining site code and sample location.
site_name		Name of site where samples were collected.
site_code		Abbreviated site name. **See Table 1**.
transect		Transect number, 1-3.
meter		Meter location along 30-m transect.
burn_history		Fire history of the study site.
latitude	degrees north	Latitude at the beginning and end of each sampling transect in decimal degrees.
longitude	degrees east	Longitude at the beginning and end of each sampling transect in decimal degrees.
core_type		Core type identified as either OL = organic layer, or MS = mineral soil.
field_top	cm	Top of the core measured in the field. 0 cm indicates top of soil surface, other values indicate where the top of the soil core was located within the soil profile.
field_thickness	cm	Length of core measured in the field.
horiz1_length	cm	Length of core for processing in lab. OL cores were split and the top ~10 cm were processed as horizon 1, and the remaining length of the OL core was processed as horizon 2. MS cores were not split – all processed as horizon 1.
horiz1_top	cm	Same as field_top
horiz1_thickness	cm	Length of the core re-measured in the lab.
horiz1_bottom	cm	The bottom of whole core noted in the lab (i.e. soil depth where the bottom of the soil core is).
horiz1_soil_type		Classification of soil sample. **See Table 4** for more details.
horiz1_photo		File name of photo of core sample of horizon 1 taken in the lab.
horiz1_notes		Any notes about horizon 1.
horiz2_length	cm	Length of the second horizon from the soil core being processed.
horiz2_top	cm	The depth of soil where the top of the core is located. For example, the top of this sample core begins at a depth of 10 cm within the soil profile.
horiz2_bottom	cm	The bottom of core noted in the lab (similar as horiz1_bottom).
horiz2_soil_type		Classification of soil sample. **See Table 4** for more details.
horiz2_photo		File name of photo of core sample of horizon 2 taken in the lab.
horiz2_notes		Any notes about horizon 2 sample.
total_volume	cm^3	Total volume of whole soil core (horizon 1+2).
total_dry_mass	g	Total dry mass of whole soil core (horizon 1+2).

total_BD	g cm^{-3}	Total core bulk density (horizon 1+2).
horiz1_wetmass	g	Wet mass for horizon 1.
horiz1_volume	cm^3	Volume of horizon 1.
horiz1_BD	g cm^{-3}	Bulk density of horizon 1.
horiz1_rock_mass	g	Rock mass from horizon 1.
horiz1_rock_volume	ml	Volume of rocks from horizon 1.
horiz1sub_tin_mass	g	Tin mass for horizon 1 subsample.
horiz1_rootmass	g	Root mass dried.
horiz1sub_tin_wetmass	g	Tin mass + wet soil mass of horizon 1 subsample.
horiz1sub_tin_dry	g	Tin mass + dry soil mass of horizon 1 subsample.
horiz1sub_tin_ashed	g	Tin mass + ashed soil mass of horizon 1 subsample.
horiz1sub_soil_moisture	%	Horizon 1 subsample soil moisture as percent.
horiz1sub_SOM	%	Horizon 1 subsample Soil Organic Matter (SOM) as percent.
horiz1sub_pH	1	Horizon 1 pH.
horiz1sub_comments		Any comments on horizon 1 subsample.
horiz2_wetmass	g	Wet mass of horizon 2.
horiz2_volume	cm^3	Volume of horizon 2.
horiz2_BD	g cm^{-3}	Horizon 2 bulk density.
horiz2_rock_mass	g	Rock mass from horizon 2.
horiz2_rock_volume	ml	Rock volume from horizon 2.
horiz2sub_tin_mass	g	Tin mass for horizon 2 subsample.
horiz2_rootmass	g	Horizon 2 dried root mass.
horiz2sub_tin_wetmass	g	Tin mass + wet soil mass of horizon 2.
horiz2sub_tin_dry	g	Tin mass + dry soil mass of horizon 2.
horiz2sub_tin_ashed	g	Tin mass + ashed soil mass of horizon 2.
horiz2sub_soil_moisture	%	Horizon 2 subsample soil moisture as percent.
horiz2sub_SOM	%	Horizon 2 subsample Soil Organic Matter (SOM) (%).
horiz2sub_pH	1	Horizon 2 pH.
horiz2_comments		Any comments on horizon 2 subsample.

3. Application and Derivation

These data are part of a larger study to investigate how the magnitudes, fates, and land-atmosphere exchanges of carbon pools are responding to environmental change, and the biogeochemical mechanisms driving these changes.

4. Quality Assessment

All cores were processed following the same methodology. Any suspect values within the data set were flagged and removed.

5. Data Acquisition, Materials, and Methods

Site Selection

Sites were selected to investigate fire disturbance, to span the range of permafrost regions from continuous to sporadic, and to cover vegetation types from boreal forests, tussock tundra, upland willow/herbaceous scrub, and lowland fen and wet tundra sites across Alaska.

Methods

Soil cores were collected from each site using a steel barrel and plastic sample tube attached to a hand drill. At the majority of sites, samples were taken from each end of three 30-m transects (i.e. samples collected at the 0 m and 30 m location of each transect). The entire thawed horizon (active layer) was sampled where possible, and the length of cores varies among sites. Cores were kept frozen until analysis in the lab. Samples were sectioned by horizon (organic and mineral), and the organic horizon was split into subsections so that no section was longer than ~10 cm. Coarse roots were removed, dried and weighed. Soils were measured for gravimetric water content, percent soil organic matter (SOM), pH, and bulk density.

To determine gravimetric water content and SOM, the mass of the sampling tin was subtracted first before proceeding with any calculations. To calculate gravimetric water content, the difference between the wet mass and dry mass was divided by wet mass, and then multiplied by 100. To calculate SOM,

the difference between dry mass and ashed mass was divided by dry soil mass, and then multiplied by 100. Bulk density of the soil was calculated by dividing the total dry mass by the total volume for each soil core.

Table 3. Site Descriptions

Site Name	Sampling Date	Description
Hess Creek Burned	August 9, 2016	The site is located just off the Dalton Highway between mile 11 and 12 within a burned boreal black spruce forest (1995).
Hess Creek Unburned	August 9, 2016	The site is located just off the Dalton Highway between mile 11 and 12 within an unburned boreal black spruce forest.
Nome Creek Burned – Old	August 10, 2016	The site is located within the White Mountain Recreation Area on a south facing slope characterized by willow/herbaceous scrub vegetation which had been previously burned (2004).
Nome Creek Unburned - Old	August 10, 2016	The site is located within the White Mountain Recreation Area on a south facing slope characterized by willow/herbaceous scrub vegetation.
I-Minus High	August 21, 2016	The site is located approximately 1-km off the Dalton Highway a few miles south of Toolik Field Station. The station is located on top of a hillside, and is characterized by tussock tundra.
I-Minus Low	August 21, 2016	The site is located approximately 1-km off the Dalton Highway, a few miles south of Toolik Field Station. The station is in a lowland, wet sedge fen area (Riparian).
Bonanza Creek	August 24, 2016	The site is located near the Bonanza Creek LTER Site within a boreal black spruce stand.
Eight Mile Lake	August 30, 2016	The site is located off the Stampede Trail in Healy. The area is characterized by moist tundra and sedge/shrub vegetation.
Nome Creek Burned – New	July 7, 2018	Located less than a 1 km off the Steese Highway near mile 63. The station is in a burned area (2004), and the vegetation is characterized by willow/herbaceous scrub.

Table 4. Soil Type Classification*

Soil Type	Name	Description
D	Dead moss	Dead moss.
F	Fibric	Organic horizon where the botanical origin of the material can be easily identified. Organic material is in early stages of decomposition. High amount of fiber.
M	Mesic	Organic horizon in an intermediate stage of decomposition between fibric and humic horizons. Organic material is partly altered.
H	Humic	Organic horizon in advanced stage of decomposition. Lowest amount of fiber.
LT	Litter	Leaves, twigs, and woody materials. Organic material where original structures are easily identifiable.
A	A-layer	Mineral horizon. Located near the surface following the organic horizons.
B	B-layer	Mineral horizon. Characterized by color change and the development of soil structure (ex. Clay).

* Referencing the Canadian System of Soil Classification (Soil Classification Working Group, 1998)

6. Data Access

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

ABoVE: Active Layer Soil Characteristics at Selected Sites Across Alaska

Contact for Data Center Access Information:

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

7. References

Minions, C., S. Natali, J.D. Watts, and S. Ludwig. 2021. ABoVE: Soil Temperature and VWC at Unburned and Burned Sites Across Alaska, 2016-2022. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1869

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