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Arctic Vegetation Plots, Toolik Lake, Alaska, 1989

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Summary

This dataset provides environmental, soil, and vegetation data collected in August 1989 from 81 study plots at the Toolik Lake research site, located in the southern Arctic Foothills of the Brooks Range, Alaska. Data includes the baseline plot information for vegetation, soils, and site factors for the study plots subjectively located in 26 communities and 4 broad habitat types across the glaciated landscape. Specific attributes include: dominant vegetation species, cover, indices, and biomass pools; soil chemistry, physical characteristics, moisture, and organic matter. This product brings together for easy reference all the available information collected from the plots that has been used for the classification, mapping, and analysis of geobotanical factors in the Toolik Lake region and across Alaska.

The dataset includes 4 data files in \*.csv format and one additional companion file.



Figure 1: Toolik Lake Permanent Vegetation Plot SWT-16.

Citation

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## 1. Data Set Overview

This dataset provides environmental, soil, and vegetation data collected in August 1989 from 81 study plots at the Toolik Lake research site, located in the southern Arctic Foothills of the Brooks Range, Alaska. Data includes the baseline plot information for vegetation, soils, and site factors for the study plots subjectively located in 26 communities and 4 broad habitat types across the glaciated landscape. Specific attributes include: dominant vegetation species, cover, indices, and biomass pools; soil chemistry, physical characteristics, moisture, and organic matter. This product brings together for easy reference all the available information collected from the plots that has been used for the classification, mapping, and analysis of geobotanical factors in the Toolik Lake region and across Alaska.

The Pre-ABoVE vegetation plot datasets were curated to create the Alaska Arctic Vegetation Archive (AVA-AK; Walker et al. 2016b, Walker 2013). The AVA-AK is a regional database that is part of the larger Arctic Vegetation Archive (Walker 2016a, Walker et al. 2013, Walker and Reynolds 2011). The database contains vegetation plots from homogeneous plant communities with tables of cover or cover-abundance scores for all species and accompanying environmental site data. Field data were collected using Braun-Blanquet, US National Vegetation Classification protocols, or comparable methods.

**Project:** [Arctic-Boreal Vulnerability Experiment](#) (ABoVE)

The Arctic-Boreal Vulnerability Experiment is a NASA Terrestrial Ecology Program field campaign that will take place in Alaska and western Canada between 2016 and 2021. Climate change in the Arctic and Boreal region is unfolding faster than anywhere else on Earth. ABoVE seeks a better understanding of the vulnerability and resilience of ecosystems and society to this changing environment.

**Acknowledgements:**

These data files were edited by Donald A. Walker, Amy L. Breen and Lisa A. Druckenmiller at the University of Alaska Fairbanks' Alaska Geobotany Center and obtained via the Arctic Geoecological Atlas (<http://arcticatlas.geobotany.org/>), which provides access to existing Arctic vegetation plot and map data in support of the ABoVE campaign.

## 2. Data Characteristics

**Spatial Coverage:** Area surrounding Toolik Lake, Alaska

ABoVE Grid Location: Ah1v0.Bh2v3

**Spatial Resolution:** Point samples

**Temporal Coverage:** 19890801 to 19890824

**Temporal Resolution:** Each plot was sampled once

**Study Area:** (All latitude and longitude given in decimal degrees)

Site	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
Toolik Lake, Alaska	-149.6506	-149.5873	68.6430	68.6228

**Data File Information:** There are four data files with this dataset in comma-separated (.csv) format.

**Table 1. Data and companion files**

Data File Name	Description
Toolik_Lake_Soil_Data.csv	Soil characterization data for Toolik Lake research plots
Toolik_Lake_Species_Data.csv	Species cover data for Toolik Lake research plots
Toolik_Lake_Spectral_Biomass_Data.csv	NDVI, LAI, iPAR and above ground biomass data for Toolik Lake research plots

Toolik_Lake_Environmental_Data.csv	Comprehensive set of environmental characterization data for Toolik Lake research plots including the descriptive site factors. Most measurement data have been processed to provide values at a common 10 cm depth. This measurement comparability facilitates analysis of geobotanical relationships across Alaska.
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**Data Descriptions:** The column names, their units and descriptions for each of the \*.csv data files are listed below.

**Table 2. Toolik\_Lake\_Soil\_Data.csv**

Column Name	Units	Description
SAMPLE_NO		Soil Sample number
PLOT_NO		Plot number where the soil sample was collected
HORIZON		Soil horizon
DEPTH	CM	Depth of the soil layer
WET_COLOR	MUNSELL	Color of wet soil in the soil sample following Munsell System of Color Notation
BULK_DENSITY	G/CC	Bulk density of the soil sample
GRAVEL_GREATER_THAN_2MM	%	Percentage of gravel that were greater than 2 mm in size in the soil sample
SAND	%	Percentage of sand in the soil sample
SILT	%	Percentage of silt in the soil sample
CLAY	%	Percentage of clay in the soil sample
TEXTURE		Texture of the soil in the soil sample
WATER_GRAVIMETRIC	%	Gravimetric water content in the soil sample
WATER_FIELD_CAPACITY_0_33_ATM	%	Percentage of moisture content in the soil sample at 15 atmospheres of pressure
WATER_WILTING_POINT_15_ATM	%	Percentage of moisture content in the soil sample at 1/3 atmosphere of pressure
ORGANIC_MATTER	%	Percentage of organic matter in the soil sample
PH_PASTE		PH of the soil sample
ELECTRICAL_CONDUCTIVITY_PASTE	MMHOS/CM	Electrical conductivity of the soil sample
NO3_NH4HCO3_DTPA_EXTRACT	ppm	Extractable NO3-NH4HCO3 in the soil sample
P_NH4HCO3_DTPA_EXTRACT	ppm	Extractable P in the soil sample
K_NH4HCO3_DTPA_EXTRACT	ppm	Extractable K in the soil sample
ZN_NH4HCO3_DTPA_EXTRACT	ppm	Extractable Zn in the soil sample
FE_NH4HCO3_DTPA_EXTRACT	ppm	Extractable Fe in the soil sample
MN_NH4HCO3_DTPA_EXTRACT	ppm	Extractable Mn in the soil sample
CU_NH4HCO3_DTPA_EXTRACT	ppm	Extractable Cu in the soil sample
CA_NH4OAC_EXTRACT	MEQ/100 G	Extractable Ca in the soil sample
MG_NH4OAC_EXTRACT	MEQ/100 G	Extractable Mg in the soil sample
NA_NH4OAC_EXTRACT	MEQ/100 G	Extractable Na in the soil sample
K_NH4OAC_EXTRACT	MEQ/100 G	Extractable K in the soil sample
CACO3_EQUIVALENT	%	CACO3 equivalent in the soil sample
CATION_EXCHANGE_CAPACITY	MEQ/100 G	Cation exchange capacity of the soil sample

P_BRAY_METHOD	ppm	Available P in the soil as detected by Bray method
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Table 3. Toolik\_Lake\_Spectral\_Biomass\_Data.csv

Column Name	Units	Description
SITE		Toolik Lake
PLOT_NUMBER		Plot Number
MICROSITE		Microsite description of the plots
PLOT_ID		Combination of plot number and microsite
PHYSIOGRAPHIC_CATEGORY		Physiographic category
ACIDIC_NONACIDIC		Description of acidic/non-acidic
ALLIANCE		Vegetation alliance
ASSOCIATION_NAME		Vegetation association name
SUBASSOCIATION		Vegetation subassociation
RED_BAND	%	Red/visible band
NIR_BAND	%	Near-infrared
SAVI		Soil Adjusted Vegetation Index
NDVI		Normalized Difference Vegetation Index
2ND_DERIV_AT_695NM		2nd Derivative at 695NM
2ND_DERIV_AT_743NM		2nd Derivative at 743 NM
TRANSMITTED	%	Percentage of transmitted radiation
IPAR	%	Percentage of incidental photosynthetically active radiation
0_58K_LAI		0.58K Leaf Area Index
0_65K_LAI		0.65K Leaf Area Index
0_61K_LAI		0.61K Leaf Area Index
MEAN_LAI		Average Leaf Area Index
PLOT_AVERAGE_LAI		Average Leaf Area Index for the plot
PLOT_AVERAGE_NDVI		Average Normalized Difference Vegetation Index for the plot
LIVE_GRAMINOID	G/SQUARE METER	Amount of live graminoid
DEAD_GRAMINOID	G/SQUARE METER	Amount of dead graminoid
LIVE_FORB	G/SQUARE METER	Amount of live forb
DEAD_FORB	G/SQUARE METER	Amount of dead forb
LIVE_DECIDUOUS_SHRUB	G/SQUARE METER	Amount of live deciduous shrub
DEAD_DECIDUOUS_SHRUB	G/SQUARE METER	Amount of dead deciduous shrub
WOODY_DECIDUOUS_SHRUB	G/SQUARE METER	Amount of woody deciduous shrub
LIVE_EVERGREEN_SHRUB	G/SQUARE METER	Amount of live evergreen shrub

DEAD_EVERGREEN_SHRUB	G/SQUARE METER	Amount of dead evergreen shrub
WOODY_EVERGREEN_SHRUB	G/SQUARE METER	Amount of woody evergreen shrub
SPHAGNUM	G/SQUARE METER	Amount of sphagnum
OTHER_MOSS	G/SQUARE METER	Amount of other types of moss
LICHENS	G/SQUARE METER	Amount of lichens
MISCELLANEOUS_DEAD	G/SQUARE METER	Other vegetation types that are dead
ALGAE	G/SQUARE METER	Amount of algae
LIVE_EQUISETUM	G/SQUARE METER	Amount of live equisetum
DEAD_EQUISETUM	G/SQUARE METER	Amount of dead equisetum
AQUATIC_MOSS	G/SQUARE METER	Amount of aquatic moss
TOTAL_BIOMASS	G/SQUARE METER	Amount of total biomass
GREEN_BIOMASS_INCLUDING_LICHENS	G/SQUARE METER	Amount of green biomass including lichens
GREEN_BIOMASS_WITHOUT_LICHENS	G/SQUARE METER	Amount of green biomass excluding lichens

Table 4. Toolik\_Lake\_Environmental\_Data.csv

Column Name	Units	Description
FIELD_PLOT_NUMBER		Field plot number
PRINCIPAL_HABITAT		Principal habitat in the plot
PRELIMINARY_COMMUNITY_NAME		Preliminary vegetation type within the plots based on habitat and dominant species
PLANT_COMMUNITY		Primary vegetation types
MICROSITE		Detailed description of microsite within the plots
DATE_SAMPLED	YYYYMMDD	Sampling date
LATITUDE	DD	Latitude of the center of the plots
LONGITUDE	DD	Longitude of the center of the plots
LANDFORM		Landform of the plots
LANDFORM_DESC		Description of landforms of the plots
SURFICIAL_GEOLOGY		Surficial geology of the plots



SURFICIAL_GEOLOGY_DESC		Description of surficial geology of the plots
GLACIAL_GEOLOGY		Glacial geology of the plots
GLACIAL_GEOLOGY_DESC		Description of glacial geology of the plots
SURFICIAL_GEOMORPHOLOGY		Surficial geomorphology of the plots
SURFICIAL_GEOMORPHOLOGY_DESC		Description of surficial geomorphology of the plots
MICROSITE		Microsite of the plots
MICROSITE_DESC		Description of microsite of the plots
TOPOGRAPHIC_POSITION		Topographic position of the plots
TOPOGRAPHIC_POSITION_DESC		Description of the topographic position of the plots
SLOPE	Degrees	Slope of the plots
ASPECT	Degrees	Aspect of the plots
EXPOSURE		Exposure of the plots
EXPOSURE_DESC		Description of the exposure of the plots
SITE_MOISTURE		Site moisture of the plots
SITE_MOISTURE_DESC		Description of the site moisture of the plots
ESTIMATED_SNOW_DURATION		Estimated snow duration within the plots
ESTIMATED_SNOW_DURATION_DESC		Description of estimated snow duration within the plots
STABILITY		Stability of the plots
STABILITY_DESC		Description of stability of the plots
CRYOTURBATION		Cryoturbation within the plots
MICRORELIEF_HEIGHT	CM	Microrelief height of the plots

THAW_DEPTH	CM	Depth to permafrost of the plots
WATER_COVER	%	Percentage of water cover in the plot
BARE_SOIL_COVER	%	Percentage of bare soil cover in the plot
ROCK_COVER	%	Percentage of rock cover in the plot
SOIL_UNITS		Soil units in the plot
SOIL_UNITS_DESC		Description of the soil units within the plot
SOIL_MOISTURE		Soil moisture content within the plots
SOIL_MOISTURE_DESC		Description of the soil moisture content within the plots
TALL_SHRUB_COVER	%	Percentage of tall shrub cover in the plot
LOW_SHRUB_COVER	%	Percentage of low shrub cover in the plot
DWARF_SHRUB_COVER	%	Percentage of dwarf shrub cover in the plot
MEAN_SHRUB_HEIGHT	CM	Average shrub height within the plot in the plot
GRAMINOID_COVER	%	Percentage of graminoid cover in the plot
FORB_COVER	%	Percentage of forb cover in the plot
LICHEN_COVER	%	Percentage of lichen cover in the plot
BRYOPHYTE_COVER	%	Percentage of bryophyte cover in the plot
HORSETAIL_COVER	%	Percentage of horsetail cover in the plot
DISTURBANCE_HUMAN		Disturbance by humans
DISTURBANCE_HUMAN_DESC		Description of disturbance by humans
DISTURBANCE_FOX		Disturbance by fox
DISTURBANCE_FOX_DESC		Description of disturbance by fox
DISTURBANCE_BEAR		Disturbance by bear



DISTURBANCE_BEAR_DESC		Description of disturbance by bear
DISTURBANCE_CARIBOU		Disturbance by caribou
DISTURBANCE_CARIBOU_DESC		Description of disturbance by caribou
DISTURBANCE_SQUIRREL		Disturbance by squirrel
DISTURBANCE_SQUIRREL_DESC		Description of disturbance by squirrel
DISTURBANCE_LEMMING_VOLE		Disturbance by lemming vole
DISTURBANCE_LEMMING_VOLE_DESC		Description of disturbance by lemming vole
DISTURBANCE_MOOSE		Disturbance by moose
DISTURBANCE_MOOSE_DESC		Description of disturbance by moose
DISTURBANCE_BIRD		Disturbance by birds
DISTURBANCE_BIRD_DESC		Description of disturbance by birds
DISTURBANCE_INSECT		Disturbance by insect
DISTURBANCE_INSECT_DESC		Description of disturbance by insect
HORIZON_AT_10_CM		Soil horizon at 10 cm depth
HORIZON Depths	CM	Depth of the soil horizon
WET_COLOR_AT_10_CM	MUNSELL	Color of wet soil at 10 cm depth following Munsell System of Color Notation
BULK_DENSITY_AT_10_CM	gm/cm^3	Bulk density of the soil at 10 cm depth
GRAVEL_GT_THAN_2MM_AT_10_CM	%	Percentage of gravel that were greater than 2 mm in size in the soil at 10 cm depth
SAND_AT_10_CM	%	Percentage of sand in the soil at 10 cm depth
SILT_AT_10_CM	%	Percentage of silt in the soil at 10 cm depth
CLAY_AT_10_CM	%	Percentage of clay in the soil at 10 cm depth

TEXTURE_AT_10_CM		Texture of the soil at 10 cm depth
SOIL_TEXTURE_TOP_MINERAL_HORIZON		Soil texture at the top of the mineral horizon
WATER_GRAVIMETRIC_AT_10_CM	%	Gravimetric water content in the soil at 10 cm depth
WATER_FIELD_CAPACITY_0_33_ATM_AT_10_CM	%	Percentage of moisture content in the soil at 10 cm depth at 15 atmospheres of pressure
WATER_WILTING_POINT_15_ATM_AT_10_CM	%	Percentage of moisture content in the soil at 10 cm depth at 1/3 atmosphere of pressure
ORGANIC_MATTER_AT_10_CM	%	Percentage of organic matter in the soil at 10 cm depth
PH_PASTE_AT_10_CM		PH of the soil at 10 cm depth
SOIL_PH_TOP_OF_MINERAL_HORIZON		PH of the soil at the top of the mineral horizon
ELECTRICAL_CONDUCTIVITY_PASTE_AT_10_CM	MMHOS/CM	Electrical conductivity of the soil at 10 cm depth
NO3_NH4HCO3_DTPA_EXTRACT_AT_10_CM	PPM	Extractable NO3-NH4HCO3 in the soil at 10 cm depth
P_NH4HCO3_DTPA_EXTRACT_AT_10_CM	PPM	Extractable P in the soil at 10 cm depth
K_NH4HCO3_DTPA_EXTRACT_AT_10_CM	PPM	Extractable K in the soil at 10 cm depth
ZN_NH4HCO3_DTPA_EXTRACT_AT_10_CM	PPM	Extractable Zn in the soil at 10 cm depth
FE_NH4HCO3_DTPA_EXTRACT_AT_10_CM	PPM	Extractable Fe in the soil at 10 cm depth
MN_NH4HCO3_DTPA_EXTRACT_AT_10_CM	PPM	Extractable Mn in the soil at 10 cm depth
CU_NH4HCO3_DTPA_EXTRACT_AT_10_CM	PPM	Extractable Cu in the soil at 10 cm depth
CA_NH4OAC_EXTRACT_AT_10_CM	MEQ/100 G	Extractable Ca in the soil at 10 cm depth
MG_NH4OAC_EXTRACT_AT_10_CM	MEQ/100 G	Extractable Mg in the soil at 10 cm depth
NA_NH4OAC_EXTRACT_AT_10_CM	MEQ/100 G	Extractable Na in the soil at 10 cm depth
K_NH4OAC_EXTRACT_AT_10_CM	MEQ/100 G	Extractable K in the soil at 10 cm depth
CACO3_EQUIVALENT_AT_10_CM	%	CACO3 equivalent in the soil at 10 cm depth

CATION_EXCHANGE_CAPACITY_AT_10_CM	MEQ/100 G	Cation exchange capacity of the soil at 10 cm depth
P_BRAY_METHOD_AT_10_CM	PPM	Available P in the soil at 10 cm depth as detected by Bray method
ELEVATION	M	Elevation of the plot
PLOT_SIZE	M^2	Size of the plot
PLOT_SHAPE		Shape of the plot
SOIL_ORGANIC_DEPTH	CM	Depth of soil organic layer

Table 5. Toolik\_Lake\_Species\_Data.csv

Column Numbers	Column Name	Units	Description
1	PASL_TAXON_SCIENTIFIC_NAME_NO_AUTHORS		Current Taxonomy according to the Panarctic Species List (PASL) includng authors names
2	PASL_TAXON_SCIENTIFIC_NAME_WITH_AUTHOR(S)		Current Taxonomy according to the Panarctic Species List (PASL)
3	DATASET_TAXON		Dataset taxonomy
4 to 84	SWT1 to SWT81		Column headings are all 81 plot numbers. The data values are Species Cover Classes (Braun-Blanquet cover-abundance scale): where r (rare), + (common, but less than 1 percent cover), 1 (1-5 percent), 2 (6 to 25 percent), 3 (25 to 50 percent), 4 (51 to 75 percent), 5 (76 to 100 percent).

**Companion Files:** There is one companion file with this dataset in .pdf format.

Table 6. Companion files

File name	Description
Toolik_Lake_Veg_Plots_Report_WalkerBarry1991.pdf	Summary report of all the data collected, methods of collection, maps/plots etc. for the 81 study plots at the Toolik Lake research site. Walker and Barry (1991).

### 3. Application and Derivation

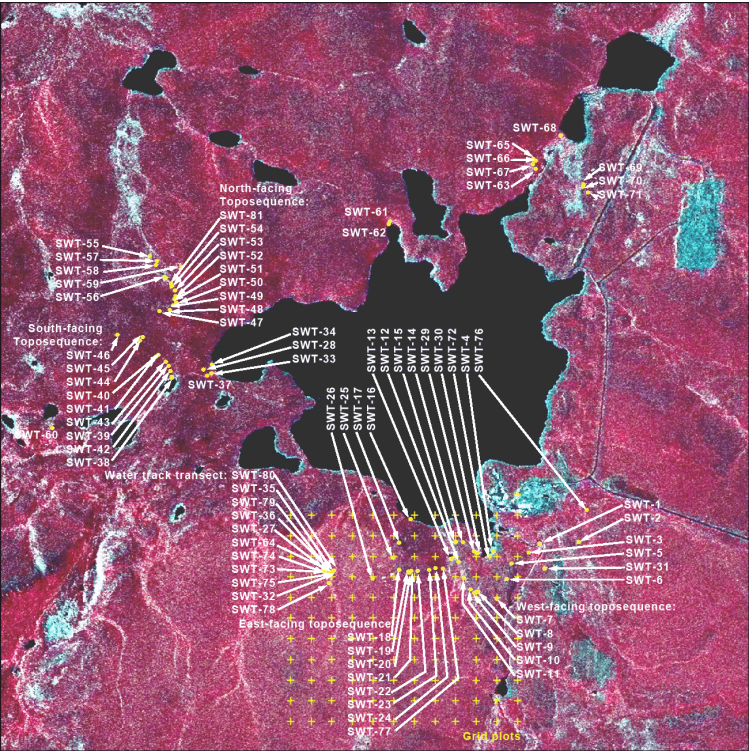
These data bring together for easy reference all the available information collected from the plots and have has been used for the classification, mapping and analysis of the geobotanical factors in the Toolik Lake region (Hobbie and Kling, 2014; Shippert et al., 1995; Walker et al, 1994; Walker et al., 1995 ). Derived regional maps of these data will be used in regional models of fluxes of trace gases, water, and energy from tundra surfaces. In addition, a circumpolar vegetation classification resulting from these datasets would be highly desirable to extend the results to the entire arctic region.

## 4. Quality Assessment

No specific quality assessment information provided.

## 5. Data Acquisition, Materials, and Methods

The eighty-one study plots at the Toolik Lake research site located in the southern Arctic Foothills of the Brooks Range, Alaska (shown in Figure 2) were subjectively located in 26 plant communities and 4 broad habitat types including: dry tundra (19 plots), snowbeds (7 plots), moist tundra (27 plots), and wet tundra (15 plots).



**Figure 2.** Location map of the 81 Toolik Lake Permanent Vegetation Plots.

### Vegetation Plot Sampling

A formal relevé sampling of the designated plots was done during the period 1-24 August, 1989 to sample the diversity of vegetation types of the region. For more details see *Toolik\_Lake\_Veg\_Plots\_Report\_WalkerBarry1991.pdf*.

Sampling of the plots included:

1. Taking photographs of the general site (Figure 1), vegetation (Figure 3), and soil profiles (Figure 4). Photos are provided in Walker and Barry (1991).
2. Measuring site factors listed in Table 4 plus measurements of thaw depth, estimates of cover of bare soil, rocks, and the major plant growth forms as summarized in Table 4.
3. Field sampling of soils where soil pits were dug adjacent to the plots and described and classified according to the U.S. soil taxonomy [Walker and Barry, 1991]. Soil variables for each plot, typically at 10 cm depth was derived from the complete soils data in Table 2. Soil texture is primarily from the top mineral horizon per the soil text descriptions; secondarily from 10 cm, or listed as 'organic' when no mineral horizon is present.
4. Laboratory analysis of soil samples
5. Estimating vegetation cover using the Braun-Blanquet cover-abundance scale (r = rare; + = common but less than 1 % cover; 1 = 1-5%; 2 = 6-25%; 3 = 25-50%; 4 = 51-75%; 5 = 76-100%)



**Figure 3.** Vegetation at one of the Toolik Lake permanent plots (Plot SWT-72).



**Figure 4.** Soil profile at one of the Toolik Lake permanent plots (Plot SWT-16).

**6. Data Access**

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

Arctic Vegetation Plots, Toolik Lake, Alaska, 1989

Contact for Data Center Access Information:

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

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