Pre-ABoVE: Arctic Vegetation Plots near Spine Road, Prudhoe Bay, Alaska, 2014

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Summary

This dataset provides environmental, soil, and vegetation data collected from study plots in the vicinity of Lake Colleen off the Spine Road at Prudhoe Bay, Alaska, during August of 2014. Data include vegetation species, leaf area index (LAI), percent cover classes, soil moisture and color, and plot characteristics including geology, topographic position, slope, aspect, and plot disturbance.

Permanent vegetation and soil plots were established along two, 200-meter transects in polygon centers and troughs. Five additional vegetation plots were established outside the transects; three in heavy dust areas, and two plots in relatively undisturbed mesic tundra. Plant communities were noted in four broad habitat types including: 1) Coastal salt marsh vegetation (1 plot), 2) Dry coastal beach and sand dune vegetation (1 plot), 3) Sedge grass and dwarf shrub mire and fen vegetation (19 plots), and 4) Dry and mesic dwarf-shrub and graminoid vegetation on non-acidic substrates (10 plots).

Spine Road was constructed in 1969, and is the oldest, most heavily traveled road in the region. Compared to sites further south, this study site was unusual for its exceptionally high volumes of dust, probably due to the higher wind velocities and the contributions from numerous road sources in the Prudhoe Bay Oilfield.

There are four data files in comma-separated format (.csv) with this dataset.

Figure 1. Study area in the vicinity of Lake Colleen off the Spine Road at Prudhoe Bay, AK. Vegetation and soil plots were established along two, 200-meter transects in polygon centers and troughs. Spine Road is the most heavily traveled road in the region. The photo captures the exceptionally high volumes of dust that accumulates along the roadside (photo from the cover of Walker et al., 2015).

Citation

Walker, D.A., and M.K. Raynolds. 2017. Pre-ABoVE: Arctic Vegetation Plots near Spine Road, Prudhoe Bay, Alaska, 2014. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1555

Table of Contents

1. Data Set Overview

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The study area for this dataset was the Lake Colleen region (Prudhoe Bay, Alaska) along the Spine Road, the oldest most heavily traveled road in the

region. Constructed in 1969, the road is presently elevated about 1 m above the general tundra level to protect the underlying permafrost, which is more prevalent now than in 1969, and is most extensive on the southwest side. Compared to sites further south, this study area was unusual for its generally windier conditions, greater percentage of high velocity winds, and for exceptionally high volumes of dust recorded at over 100 m from the road.

Permanent vegetation and soil plots were established along the transects in the polygon centers and troughs. Five additional vegetation plots were established outside the transects, three placed in heavy dust areas within five meters of the road on the south side, and two plots placed in relatively undisturbed mesic tundra at approximately 435 m along Transect 1. Plant communities were noted in four broad habitat types. Soil temperature loggers were installed at all plots, and air and snow temperature loggers were installed along T1. A soil core was extracted for laboratory analysis. Soils were classified using the USDA Soil Taxonomy (Soil Survey Staff 1999). Peat samples were classified using the von Post scale (von Post et al.,1926). The fiber and roots were estimated following Malterer et al. (1992).

Project: Arctic-Boreal Vulnerability Experiment

The Arctic-Boreal Vulnerability Experiment (ABoVE) is a NASA Terrestrial Ecology Program field campaign based 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.

Related datasets:

Walker, D.A. 2016. Pre-ABoVE: Arctic Vegetation Plots at Prudhoe Bay, Alaska, 1973-1980. ORNL DAAC, Oak Ridge, Tennessee, USA. http://dx.doi.org/10.3334/ORNLDAAC/1360

Walker, D.A., M.K. Raynolds, K. Everett, P.J. Webber, J. Brown, W. Acevedo, K.J. Ambrosius, M. Kanevskiy, Y. Shur, G. Kofinas, and V.E. Romanovsky. 2017. Pre-ABoVE: Geobotanical and Impact Map Collection for Prudhoe Bay Oilfield, Alaska. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1387

Acknowledgements:

These data were obtained from the Alaska Arctic Geoecological Atlas (http://agc.portal.gina.alaska.edu), which provides access to existing Arctic vegetation plot and map data in support of the ABoVE campaign.

The work was funded by the National Science Foundation, Arctic Science, Engineering, and Education for Sustainability (NSF, ArcSEES) Program, Award No 1233854, and the National Aeronautics and Space Administration, Land-Cover and Land-Use Change (NASA, LCLUC) Program, Award No. NNX14AD906.

2. Data Characteristics

Spatial Coverage: Spine Road in the Lake Colleen area, Prudhoe Bay, Alaska

ABoVE Grid Locations: Ahh1Avv0Bh2Bv2

Spatial Resolution: Point resolution

Temporal Coverage: August 2014

Temporal Resolution: One-time data collection at each plot

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

Site	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
Lake Colleen area off the Spine Road at Prudhoe Bay	-148.474	-148.467	70.22479	70.22136

Data File Information

There are four data files with this dataset in comma-separated (.csv) format. The files provide vegetation species as well as the percent ground cover occupied by the species, soil characterization, plot environmental data, and leaf area index (LAI).

There were 29 releves. Releve number indicates: 1) Transect 1 (T1) or Transect 2 (T2), 2) distance from road measured in meters, and 3) polygon center (C) or polygon trough (T). Extra plots are indicated only by the year of collection (14-2014) and a plot number.

Missing data are reported as -9999 or as not available (n/a).

Table 1. Data files

Data File Names	Description
spine_rd_prudhoe_bay_veg_plots_environmental.csv	Environmental characterization data
spine_rd_prudhoe_bay_veg_plots_lai.csv	Leaf Area Index (LAI) data

spine_rd_prudhoe_bay_veg_plots_species.csv	Species cover data in comma separated (.csv) format. Both the author's determination and the current taxonomy according to the Panarctic Species List (PASL)
spine_rd_prudhoe_bay_veg_plots_soils.csv	Soil data

Table 2. Variables in the file **spine_road_prudhoe_bay_environmental.csv**

These data describe the environment of the plots in the vicinity of Lake Colleen off the Spine Road at Prudhoe Bay. Refer to the companion file **aava_pruarc_dwalker_2015_envlegend_anc.pdf** for the ordinal scale descriptions and associated codes.

Column number	Variable	Units/format	Description
1	releve_number		Releve number
2	date	yyyymmdd	Date plot was investigated
3	latitude	decimal degrees	Plot latitude
4	longitude	decimal degrees	Plot longitude
5	elevation	m	Elevation in meters
6	slope	degrees	Slope of plot
7	aspect	degrees	Aspect-Too flat to determine
8	landform	code	Landform
9	surficial_geology	code	Surficial geology-parent material
10	surficial_geomorphology	code	Surficial geomorphology
11	glacial_geology	code	Glacial geology
12	topographic_position	scalar	Topographic position
13	soil_moisture	code	Soil moisture
14	soil_grab_samples		Number of soil grab samples taken
15	mean_thaw_depth	cm	Mean thaw depth
16	snow_duration	scalar	Estimated snow duration (+ slightly more; - slightly less)
17	organic_layer	cm	Depth of the soil organic layer
18	microrelief	cm	Microrelief
19	lai		Leaf area index
20	vegetation_type_and_dust	code	(CODE from Walker and Webber 1980)
21	vegetation_type		Vegetation type
22	cover_low_shrubs	%	Percent of plot covered with low shrubs, live/standing dead
23	cover_erect_dwarf_shrubs	%	Percent of plot covered with dwarf shrubs, live/standing dead
24	cover_prostrate_ dwarf_ shrub	%	Percent of plot covered with prostrate dwarf shrubs. live/standing dead
25	cover_evergreen_shrubs	%	Percent of plot covered with evergreen shrubs, live/standing dead
26	cover_deciduous_shrubs	%	Percent of plot covered with deciduous shrubs, live/standing dead
27	cover_erect_forbs	%	Percent of plot covered with erect forbs, live/standing dead
28	cover_mat_cushion_forbs		Percent of plot covered with mat cushion forbs, live/standing dead
29	cover_tussock_graminoids	%	Percent of plot covered with tussock graminoids, live/standing dead
30	cover_nontussock_graminoids	%	Percent of plot covered with nontussock graminoids, live/standing dead
31	cover_foliose_lichens	%	Percent of plot covered with foliose lichen, live/standing dead

32	cover_fruticose_lichen	%	Percent of plot covered with fruticose lichen, live/standing dead
33	cover_crustose_lichen	%	Percent of plot covered with crustose lichen
34	cover_pleurocarpous_bryophytes	%	Percent of plot covered with bryophytes, live/standing dead
35	cover_acrocarpous_bryophytes	%	Percent of plot covered with acrocarpous bryophytes
36	cover_horsetails	%	Percent of plot covered with horsetails
37	cover_liverworts	%	Percent of plot covered with liverworts
38	cover_algae	%	Percent of plot covered with algae
39	cover_rocks	%	Percent of plot that was bare rock
40	cover_bare_soil	%	Percent of plot that was bare soil
41	cover_water	%	Percent of plot that had water
42	water_depth	cm	Water depth
43	cover_litter	%	Percent of plot that had litter cover
44	dwarf_shrub_ht	cm	Height of dwarf shrubs
45	herbaceous_ht	cm	Height of herbaceous vegetation
46	live_moss_ht	cm	Height of live moss
47	dead_moss_depth	cm	Depth of dead moss
48	dust_thickness	cm	Dust thickness
49	disturbed		Site disturbed, yes or no
50	disturbance_degree	code	Degree of disturbance
51	disturbance_type	code	Disturbance type
52	physical_stability	code	Plot physical stability
53	exposure	scalar	Exposure to wind and other elements
54	plot_photos		Numbered photos taken at the plots
55	soil_photos		Numbered photos of the soils
56	notes		
57	observers		Field study observers: D.A. Walker and M.K. Raynolds

Table 3. Variables in the file **spine_rd_prudhoe_bay_veg_plots_species.csv**

These files contain species cover data collected in 2014 for the vegetation studies. Both the author's determination and the current taxonomy according to the Panarctic Species List (PASL) are listed. Taxa are listed in alphabetical order according to the accepted PASL name.

Column number	Column header	Description
1	PASL_taxon_scientific_name	Current nomenclature according to the Panarctic Species List (PASL)
2	PASL_taxon_scientific_name_author	Current nomenclature according to the Panarctic Species List (PASL) with the data authors name
3	dataset_taxon	Dataset taxonomy
4	field_species_code	Species code name
		Two rows of column headers which are plot numbers/accession numbers. The first row is TURBOVEG accession numbers. Column headers (TURBOVEG accession numbers): 12763-12791. The 2nd row is dataset_plot_number_author, the plot numbers as named in the original dataset: 1) Transect 1 (T1) or Transect 2 (T2), 2) distance from road measured in meters, and 3) polygon center (C) or polygon trough (T). Extra plots are indicated only by the year of collection (14-2014) and a plot number. Species cover classes are the old Braun-Blanquet cover-abundance scale:

5-38	TURBOVEG_plot_accession_number and dataset_plot_number_author	r= (rare) + (common, but less than 1 percent) 1 (1-5%) 2 (6-25 %) 3 (26-50%) 4 (51-75%) 5 (76-100%)

Data note: In one instance, taxa were lumped into a single taxon in the PASL: Unknown crustose lichen (Black soil crust and White soil crust).

Table 4. Variables in the file **spine_rd_prudhoe_bay_veg_plots_soils.csv**

Soils were classified using the USDA Soil Taxonomy (Soil Survey Staff 1999). *Layer code: indicates if the soil samples were taken from the dust horizon (1) or organic horizon (2) immediately below the dust layer.

Column number	Variable	Units/format	Description
1	releve_number		Releve number
2	sample_number		Sample number
3	transect_number		Transect number
4	distance	m	Distance from road
5	layer	code	
6	soil_color_dry_hue		Dry soil color hue according to the Munsell chart
7	soil_color_dry_value		Dry soil color value according to the Munsell chart
8	soil_color_dry_chroma		Dry soil color chroma according to the Munsell chart
9	soil_color_moist_hue		Moist soil color hue according to the Munsell chart
10	soil_color_moist_value		Moist soil color value according to the Munsell chart
11	soil_color_moist_chroma		Moist soil color chroma according to the Munsell chart
12	gravimetric_soil_moisture	percent	Soil gravimetric moisture
13	volumetric_soil_moisture	percent	Soil volumetric moisture
14	bulk_density	g/m3	Soil bulk density
15	pH	code	Soil pH
16	gravel	percent	Percent dry weight of soil composed of gravel
17	undecomposed_organics	percent	Percent dry weight of soil composed of undecomposed organics
18	organic_matter	percent	Percent dry weight of soil composed of organic matter

Table 5. Variables in the data file **spine_rd_prudhoe_bay_veg_plots_lai.csv**

Leaf Area Index measured using an AccuPAR LP-80 PAR/LAI ceptometer. Data were not collected at the extra plots.

Column number	Variable	Description
1	releve_number	Releve where LAI measurements were made
2	lai	Leaf area index

Table 6. Companion files

File names	Descriptions
aava_pruarc_dwalker_2015_envlegend_anc.pdf	Provides the codes and scalar definitions for the environmental data

walkerd_2015_datarpt_agc15-01_prudhoebaythermokarst.pdf	A summary report of the research at the Lake Colleen area, Spine Rd
pruarc_dwalker_2015_plotphotos_anc.pdf	Plot and soil photos
Prudhoe_Bay_ArcSEES_Veg_Plots.pdf	PDF of this guide document

3. Application and Derivation

These data could be of use to climate change, environmental impacts, and environmental policy analysis.

4. Quality Assessment

Refer to the full study report **walkerd_2015_datarpt_agc15-01_prudhoebaythermokarst.pdf** provided as a companion file with this dataset.

5. Data Acquisition, Materials, and Methods

Site description

The study area was the Lake Colleen region (Prudhoe Bay, Alaska) along the Spine Road, the oldest most heavily traveled road in the region. The area of the study site is defined as a 60 m swath centered on two transects, T1 on the northeast side of the road and T2 on the southwest side (Walker et al., 2015). Lake Colleen is completely surrounded by roads with few culverts. Several areas between the lake and roads experience flooding during spring and summer.

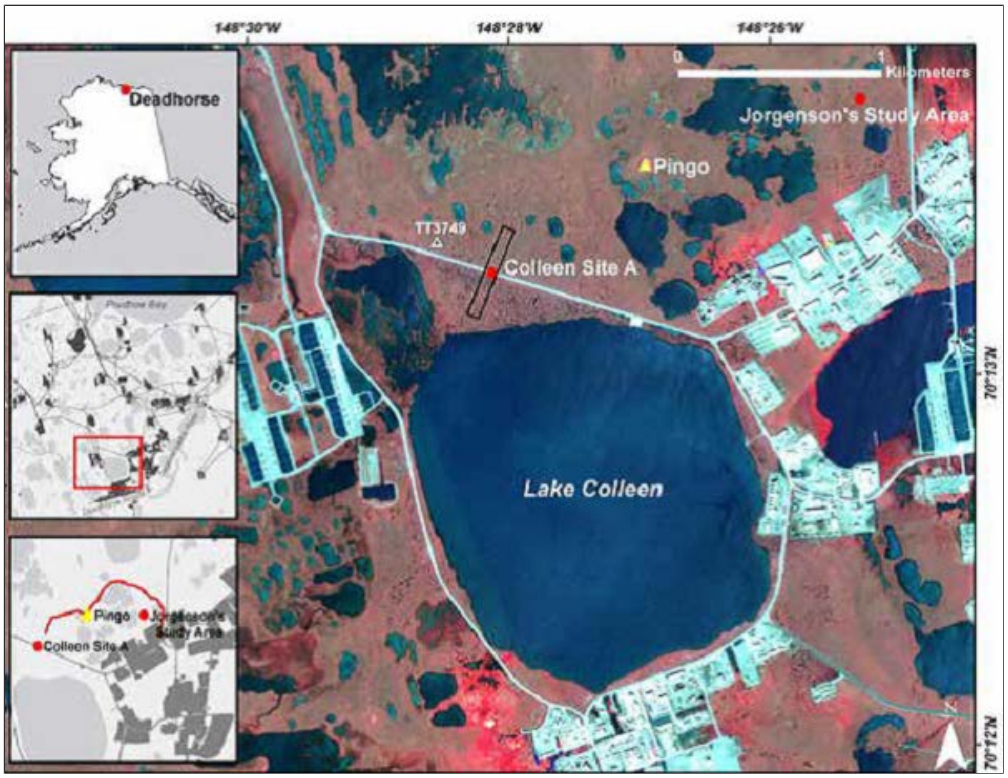

Figure 2. The Lake Colleen region. The Colleen Site A study area is located along a straight section of the road on the north side of Lake Colleen, 2.9 km north of the main Deadhorse airport. Several partially drained thaw lakes are on the east, north, and west sides of the lake. Colleen Site A and Jorgenson's study area are both on a residual surface that shows no apparent history of thaw lake processes. Note that the lake is surrounded by roads and other infrastructure. TT3749 is a benchmark that provided reference for the topographic survey. The bright red tones show areas of highly productive vegetation, mainly in drained lake basins and in areas of altered drainage near roads and gravel pads.

The Spine Road was constructed in 1969, and is presently elevated about 1 m above the general tundra level to protect the underlying permafrost, which is more prevalent now than in 1969, and is most extensive on the southwest side. Compared to sites further south, this site was unusual for its generally windier conditions, greater percentage of high velocity winds, and for exceptionally high volumes of dust recorded at over 100 m from the road. The volume of dust at 1,000 m was two to nine times greater than at the other sites, probably reflecting both the transport of dust to greater distances from the road caused by higher wind velocities and the contributions from numerous road sources in the Prudhoe Bay Oilfield. High dust volumes, earlier snow melt, warmer soil temperatures, and extensive new wetlands near the roads affect the phenology of vegetation and use of the roadside areas by wildlife (Walker et al., 2015).

Figure 3. Heavy dust area adjacent to the southwest side of Spine Road. Up to 18 cm of dust and gravel were measured in areas 5 m from the road. This photo shows deeper accumulations within 5 m have elevated the surface creating a relatively well drained gentle slope from the foot of the road that is colonized mainly by a few coastal and dune species (photo from Walker et al., 2015).

Methods

Transects

Two 200-meter transects (Transect 1 (T1) on the northeast side of the road, and Transect 2 (T2) on the southwest side) were established through polygon centers and troughs extending through 5, 10, 25, 50, 100, and 200 meters from the road. Pin flags were placed at one-meter intervals to 100 m from the road and then at 5 m intervals to 200 m. Vertical 150 cm PVC posts were placed at 50, 100, and 200 m.

Figure 4. Transect 2, at 50 m mark, polygon trough (T2-050-T) (photo from Walker et al., 2015).

Vegetation

Permanent vegetation and soil plots were established along the transects in the polygon centers and troughs. Five additional vegetation plots were established outside the transects, three placed in heavy dust areas within five meters of the road on the south side, and two plots placed in relatively undisturbed mesic tundra at approximately 435 m along Transect 1. Plant communities were noted in four broad habitat types including: 1) Coastal salt marsh vegetation (1 plot), 2) Dry coastal beach and sand dune vegetation (1 plot), 3) Sedge grass and dwarf shrub mire and fen vegetation (19 plots), and 4) Dry and mesic dwarf-shrub and graminoid vegetation on non-acidic substrates (10 plots).

At each pin flag, thaw depth was measured with a 1 m steel thaw probe, water depth and plant canopy heights were measured with a meter stick, and LAI was measured with an AccuPAR LP-80 PAR/LAI Ceptometer. Vegetation type and microrelief were recorded at each meter. Elevations along the transect were measured using a Topcorn RTK (real-time kinematic) GPS HiPer Lite+ and robotic Topcon IS3 surveying instrument. Dust layer thickness was measured at five m intervals by removing a core of soil using a Sharpshooter shovel.

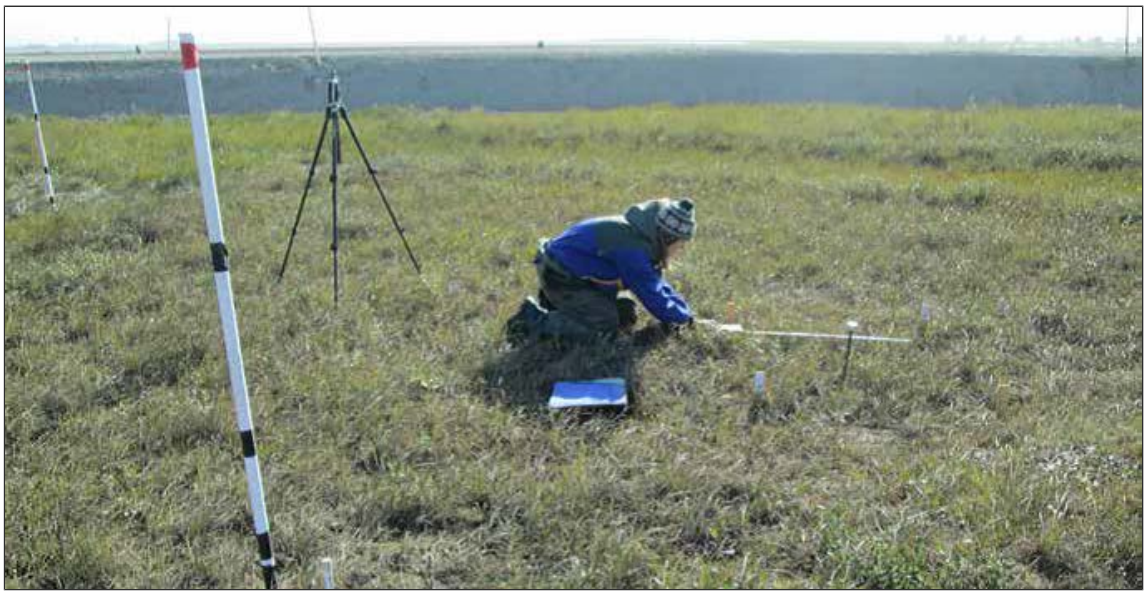

Figure 5. Measurements and instrumentation at a permanent 1 m plot. The plot is marked by short wooden stakes in the four corners and a photo point in the center of the plot with the plot number engraved on the aluminum cap that is attached to an 18-inch piece of steel rebar rod. Temperature loggers are attached to the short white stake in the foreground; the tall stake is for measuring snow depths and has temperature loggers attached to record air and snow temperature (once the logger is covered by snow). Martha Raynolds is measuring leaf-area index (LAI) (photo from Walker et al., 2015).

Soils

Soils were classified using the USDA Soil Taxonomy (Soil Survey Staff 1999). *Layer code: indicates if the soil samples were taken from the dust horizon (1) or organic horizon (2) immediately below the dust layer. Soil temperature loggers were installed at all plots, and air and snow temperature loggers were installed along T1. A soil core was extracted using a Sharpshooter shovel for laboratory analysis. Peat samples were classified using the von Post scale (von Post et al.,1926). The fiber and roots were estimated following Malterer et al. (1992).

Figure 6. Soil plug from center of an ice-wedge polygon at 5 m from the road along Transect 2. Note the 13-cm thick mineral surface horizon, which is the dust layer above the original organic surface horizon (photo from Walker et al., 2015).

To determine gravimetric and volumetric soil moisture and bulk density, the soils were weighed wet then dried at 105 degrees C for 48 hours and

reweighed. Gravimetric soil moisture was calculated as mass of water divided by the mass of dry soil times 100%. Volumetric soil moisture was calculated as the volume of water divided by the volume of the soil can (190 cm3) times 100%, noting that 1 cm3 of water weighs 1 g. The bulk density of the soil was calculated from the dry mass of the soil divided by the volume of the soil can and reported as g/cm3.

Dry and moist soil colors were determined in the lab after the soils were dried using a Munsell color book. To determine percentage soil organic matter, the soils were first put through a 2-mm sieve to remove gravel and undecomposed plant material. These components were weighed and reported as percent of total soil sample. Organic matter content was determined from 5-10 g samples of the < 2-mm soil component. The samples were dried to 105 degrees C, then put in a combustion oven at 550 degrees C for seven hours. Samples were reweighed after drying and after combustion, and kept in desiccators to cool to minimize moisture absorption before reweighing.

This dataset was edited and processed by Dr. Amy Breen and Lisa Druckenmiller and provided by the GINA repository at http://agc.portal.gina.alaska.edu/plot-archive/plot-datasets/28-prudhoe-bay-arcsees-road-study

6. Data Access

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

Pre-ABoVE: Arctic Vegetation Plots near Spine Road, Prudhoe Bay, Alaska, 2014

Contact for Data Center Access Information:

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

7. References

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