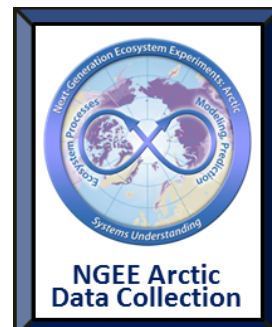


Plant Available Nutrients, Barrow, Alaska, Ver. 1

For NGEE Arctic Project use only.

Summary:

This dataset reports measurements of plant available nutrients made using Plant Root Simulator (PRS) probes (Western Ag Innovations Inc.) during 2012 and 2013 at the Next-Generation Ecosystem Experiments (NGEE) Arctic field site near Barrow, Alaska. In 2012, Ca, Mg, K, P, Fe, Mn, Cu, Zn, B, S, Pb, Al, Cd, NO₃-N and NH₄-N availability were measured during spring, summer and winter from probes installed in the centers, edges and troughs of four polygons in each of four areas of contrasting moisture regime and polygon type (Areas A, B, C, and D of Intensive Site 1). In 2013, probes were installed in centers, edges and troughs of four polygons in each of two areas (A and B, with low-centered and high-centered polygons respectively) at two-week intervals and at 3 soil depths to capture fine-scale seasonal dynamics of NO₃-N and NH₄-N.



PRS probes are ion exchange resin membranes held in plastic supports that are inserted into soil to measure ion supply in situ. The anion and cation exchange with the membrane is intended to mimic plant uptake and thus provide a relevant measure of soil nutrient bioavailability. Measurements are made per area of probe membrane and cannot be converted to concentrations or related to soil volume.

Please use this citation to reference the data.

Sloan, V.L., C.M. Iversen, J.A. Liebig, J.B. Curtis, M.S. Hahn, J. Siegrist, R.J. Norby. 2014. Plant Available Nutrients, Barrow, Alaska Ver. 1. Next Generation Ecosystem Experiments Arctic Data Collection, Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, Oak Ridge, Tennessee, USA. Data set accessed at <http://dx.doi.org/10.5440/1120920>

Data Dictionary

Data Files:

V_3.2_Plant_available_nutrients_all_Barrow_2012_v1.csv

V_3.2_Plant_available_nutrients_all_Barrow_2012_blanks_v1.csv (QC Sample Results)

V_3.2_Plant_available_nutrients_nitrogen_Barrow_2013_v1.csv

V_3.2_Plant_available_nutrients_nitrogen_Barrow_2013_blanks_v1.csv (QC Sample Results)

The 2012 and 2013 files have the same organizational structure.

Missing values are given the value -9999.

Column name	Units/format	Description
Region*		Values: North Slope
Locale*		Values: Barrow
Administrative_area*		Values: Barrow Environmental Observatory (BEO)
Site*		Values: Intensive Site 1
Area*		Values: A, B, C, D
Polygon_ID		Values: 1, 2, 3, 4 Vegetation plots are located on four separate polygons within each larger area.
Polygon_sub_unit		Values: center, edge, trough Three vegetation plots are located in each polygon. One plot is located in each of three 'sub-units' or micro-topographic positions.
Plot_ID		Plot_ID is a unique plot code formed by concatenation of Area, Polygon_ID, and Polygon_sub_unit. For example, plot A1C is in area A, polygon 1, and is specifically located in the Center of the polygon. See Footnote 1 for further information.
Plot_type*		Values: vegetation
Polygon_type		Values: high-centered, low-centered, transitional Type of polygon characteristic of respective area.
Probe_installation_date	yyyy-mm-dd	Date that Plant Root Simulator (PRS) probes were installed.
Probe_removal_date	yyyy-mm-dd	Date that Plant Root Simulator (PRS) probes were removed.
Probe_installation_DOY	DOY	DOY 1 was January 1, 2012 or 2013.
Probe_removal_DOY	DOY	DOY 1 was January 1, 2012 or 2013.
Burial_length	days	Number of days Plant Root Simulator (PRS) probes were buried.
Burial_depth_top_of_membrane	cm	0 cm is the top of the green moss layer.
Burial_depth_bottom_of_membrane	cm	Depth to bottom of the membrane is 5.5 cm from top depth.
Western_Ag_Sample_Number		Numbering system for samples sent to Western Ag.

Column name	Units/format	Description
Western_Ag_Sample_ID		Unique sample identifier from Western Ag records.
Number_anion_probes		<p>Values: 1, 2, 3, 4</p> <p>Four anion probes were installed adjacent to each vegetation plot. Where value is <4, some probes were not recovered from the field.</p> <p>Details of how missing probes affect laboratory analyses can be found in the accompanying manual (Footnote 2).</p>
Number_cation_probes		<p>Values: 1, 2, 3, 4</p> <p>Four cation probes were installed adjacent to each vegetation plot. Where value is <4, some probes were not recovered from the field.</p> <p>Details of how missing probes affect laboratory analyses can be found in the accompanying manual (Footnote 2).</p>
Ca Ca_dl Ca_fl	micrograms 10 cm-2 burial length-1	Calcium dl = 2 micrograms 10 cm-2 (Western Ag) See Footnotes 3, 4, 5
Mg Mg_dl Mg_fl	micrograms 10 cm-2 burial length-1	Magnesium dl = 4 micrograms 10 cm-2 (Western Ag) See Footnotes 3, 4, 5
K K_dl K_fl	micrograms 10 cm-2 burial length-1	Potassium dl = 4 micrograms 10 cm-2 (Western Ag) See Footnotes 3, 4, 5
P P_dl P_fl	micrograms 10 cm-2 burial length-1	Phosphorus dl = 0.2 micrograms 10 cm-2 (Western Ag) See Footnotes 3, 4, 5
Fe Fe_dl Fe_fl	micrograms 10 cm-2 burial length-1	Iron dl = 0.4 micrograms 10 cm-2 (Western Ag) See Footnotes 3, 4, 5
Mn Mn_dl Mn_fl	micrograms 10 cm-2 burial length-1	Manganese dl = 0.2 micrograms 10 cm-2 (Western Ag) See Footnotes 3, 4, 5
Cu Cu_dl Cu_fl	micrograms 10 cm-2 burial length-1	Copper dl = 0.2 micrograms 10 cm-2 (Western Ag) See Footnotes 3, 4, 5
Zn Zn_dl Zn_fl	micrograms 10 cm-2 burial length-1	Zinc dl = 0.2 micrograms 10 cm-2 (Western Ag) See Footnotes 3, 4, 5

Column name	Units/format	Description
B B_dl B_fl	micrograms 10 cm-2 burial length-1	Boron dl = 0.2 micrograms 10 cm-2 (Western Ag) See Footnotes 3, 4, 5
S S_dl S_fl	micrograms 10 cm-2 burial length-1	Sulfur dl = 2 micrograms 10 cm-2 (Western Ag) See Footnotes 3, 4, 5
Pb Pb_dl Pb_fl	micrograms 10 cm-2 burial length-1	Lead dl = 0.2 micrograms 10 cm-2 (Western Ag) See Footnotes 3, 4, 5
Al Al_dl Al_fl	micrograms 10 cm-2 burial length-1	Aluminum dl = 0.4 micrograms 10 cm-2 (Western Ag) See Footnotes 3, 4, 5
Cd Cd_dl Cd_fl	micrograms 10 cm-2 burial length-1	Cadmium dl = 0.2 micrograms 10 cm-2 (Western Ag) See Footnotes 3, 4, 5
NO3-N NO3-N_dl NO3-N_fl	micrograms 10 cm-2 burial length-1	N as nitrate (NO_3^-) dl = 2 micrograms 10 cm-2 (Western Ag) See Footnotes 3, 5
NH4-N NH4-N_dl NH4-N_fl	micrograms 10 cm-2 burial length-1	N as ammonium (NH_4^+) dl = 2 micrograms 10 cm-2 (Western Ag) See Footnotes 3, 5
Total_N Total_N_fl	micrograms 10 cm-2 burial length-1	Total_N is the sum of NO3-N and NH4-N See Footnotes 3, 5

* Values for these location fields have been standardized for NGEE Arctic and are required fields for all data dictionaries. (https://ngee-arctic.ornl.gov/sites/ngee.ornl.gov/files/NGEE_Arctic_Data_Management_Guides_stylesheet_20131127.pdf)

Footnotes:

- See associated files:
 - V_Vegetation_plot_layout_diagram.pdf** (high resolution) for plot locations in each area.
See figures below for same content.
 - V_Vegetation_plot_locations.csv** for differential GPS coordinates of plot locations.
- Plant Root Simulator (PRS) probes were supplied by Western Ag Innovations Inc.
Probes were installed and analyzed as detailed in attached file
PRS_Operations_Manual_6th_Edition_June_2010 (Western Ag Innovations Inc., Saskatoon, Canada; downloaded from website June 2012).
To install and remove probes at depths of 11 and 22 cm, lengths of nylon twine were tied securely through the hole in the plastic casing.

3. Plant Root Simulator (PRS) analytical blanks.

No blank corrections were made to final values, based on email advice received from technical support at Western Ag on October 30th, 2013 (below)

“Blanks are useful as indicators of contamination, but should not be used to correct sample values. Some reasons for this include:

- The counter-ion used for regeneration of cation probes is Na⁺, but samples will have little Na⁺ remaining after exposure because Na⁺ is easily exchanged. However, probe blanks are still saturated with Na⁺, and thus more likely to sorb NH₄-N that is present in wash water or ambient air.
- Any NH₄-N remaining on regenerated probes may be displaced during exposure for sample probes, but will not be for blank probes.
- Blank probes are not exposed to same environment as samples probes (e.g., wet/dry cycles)”

4. Analyses not carried out in 2013

5. Column name `_*_dl` is the detection limit provided by Western Ag in units of micrograms 10 cm⁻², Column_name `_*_fl` is the Data Quality Flag with values and descriptions in the following table.

NGEE-Arctic standard Data Quality Flag values and definitions

Flag Value	Description
V0	Valid value
V1	Valid value but comprised wholly or partially of below detection limit data
V2	Valid estimated value
V3	Valid interpolated value
V4	Valid value despite failing to meet some QC or statistical criteria
V5	Valid value but qualified because of possible contamination (e.g., pollution source, laboratory contamination source)
V6	Valid value but qualified due to non-standard sampling conditions (e.g., instrument malfunction, sample handling)
V7	Valid value but set equal to the detection limit (DL) because the measured value was below the DL
M1	Missing value because no value is available
M2	Missing value because invalidated by data originator
H1	Historical data that have not been assessed or validated

Source: https://ngee-arctic.ornl.gov/sites/ngee.ornl.gov/files/NGEE_Arctic_Data_Management_Guides_stylesheet_20131127.pdf

Example Data Records: V 3.2 Plant available nutrients all Barrow 2012 v1.csv

Region,Locale,Administrative_area,Site,Area,Polygon_ID,Polygon_sub_unit,Plot_ID,Plot_type,Polygon_type,Probe_installation_date,Probe_removal_date,Probe_installation_DOY,Probe_removal_DOY,Burial_length,Burial_depth_top_of_membrane,Burial_depth_bottom_of_membrane,Western_Ag_Sample_Number,Western_Ag_Sample_ID,Number_anion_probes,Number_cation_probes,Ca,Ca_dl,Ca_fl,Mg,Mg_dl,Mg_fl,K,K_dl,K_fl,P,P_dl,P_fl,Fe,Fe_dl,Fe_fl,Mn,Mn_dl,Mn_fl,Cu,Cu_dl,Cu_fl,Zn,Zn_dl,Zn_fl,B,B_dl,B_fl,S,S_dl,S_fl,Pb,Pb_dl,Pb_fl,Al,Al_dl,Al_fl,Cd,Cd_dl,Cd_fl,NO3-N,NO3-N_dl,NO3-N_fl,NH4-N,NH4-N_dl,NH4-N_fl>Total N>Total N_fl

,,,,,,,yyyy-mm-dd,yyyy-mm-dd,,,days,cm,cm,,,,micrograms 10 cm-2 burial length-1,micrograms 10
cm-2,,micrograms 10 cm-2 burial length-1,micrograms 10 cm-2,,micrograms 10 cm-2 burial length-
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burial length-1,micrograms 10 cm-2,,micrograms 10 cm-2 burial length-1,

North Slope,Barrow,BEO,Intensive Site 1,A,1,center,A1C,vegetation,low-centered,2012-06-23,2012-07-

27,175,209,34,0,5.5,1,107312,4,4,802.08,2,V0,560.76,4,V0,14.96,4,V0,0,0.2,V1,988.94,0.4,V0,3.94,0.2,V0,0.06,0.2,V1,4.48,0.2,V0,5.08,0.2,V0,28.18,2,V0,0,0.2,V1,36.38,0.4,V0,0.02,0.2,V1,1.5,2,V1,13.16,2,V0,14.66,V1

North Slope,Barrow,BEO,Intensive Site 1,A,1,edge,A1E,vegetation,low-centered,2012-06-23,2012-07-27,175,209,34,0,5.5,2,107313,4,4,960.7,2,V0,594.18,4,V0,13.1,4,V0,2.4,0.2,V0,40.5,0.4,V0,3.06,0.2,V0,0.34,0.2,V0,1.54,0.2,V0,0.88,0.2,V0,28.44,2,V0,0.08,0.2,V1,45.48,0.4,V0,0.06,0.2,V1,14.7,2,V0,5.4,2,V0,20.1,V0

Example Data Records: V_3.2_Plant_available_nutrients_nitrogen_Barrow_2013_v1.csv

Region	Locale	Administrative_area	Site	Area	Polygon_ID	Polygon_sub_unit	Plot_ID	Plot_type	Polygon_type	Probe_installation_date	Probe_removal_date	Probe_installation_DOY	Probe_removal_DOY	Burial_length	Burial_depth_top_of_membrane	Burial_depth_bottom_of_membrane	Western_Ag_Sample_Number	Western_Ag_Sample_ID	Number_anion_probes	Number_cation_probes	NO3-N	NO3-N_dl	NO3-N_fl	NH4-N	NH4-N_dl	NH4-N_fl	Total_N	Total_N_fl																		
,,,,,,,,,	yyyy-mm-dd	yyyy-mm-dd	,,	days	cm	cm	,,	micrograms 10 cm-2	burial_length-1	micrograms 10 cm-2	,,	micrograms 10 cm-2	burial_length-1	micrograms 10 cm-2	,,	micrograms 10 cm-2	burial_length-1	North Slope	Barrow	BEO	Intensive Site 1	A	3	edge	A3E	vegetation	low-centered	2013-06-18	2013-07-02	169	183	14	0	5.5	50	118377	4	4	0	2	V1	4.64	2	V0	4.64	V1
North Slope	Barrow	BEO	Intensive Site 1	A	1	trough	A1T	vegetation	low-centered	2013-06-18	2013-07-02	169	183	14	0	5.5	51	118378	4	4	0	12	2	V1	15.42	2	V0	15.54	V1																	

Data Dictionary

Supplemental File:

V_vegetation_plot_locations.csv

This file contains differential GPS coordinates of vegetation plot locations.

Column name	Units/format	Description
Columns 1-10 in this file are the same as the “*_nutrients” files.		
Northing_UTM	meters	<p>Coordinates of four corners of 1 x 1 m vegetation plots, recorded using differential GPS.</p> <p>Survey was carried out by UMIAQ on September 29, 2012 (Footnote 6).</p> <p>Coordinate system is Universal Transverse Mercator (UTM). Details: UTM Zone 4, horizontal datum is NAD83, vertical datum is NAVD88 using GEOID09. UNAVCO CORS Station SG27 was held fixed to generate co-ordinates, and station BASC used as a check.</p>
Easting_UTM	meters	<p>Coordinates of four corners of 1 x 1 m vegetation plots, recorded using differential GPS.</p> <p>Survey was carried out by UMIAQ on September 29, 2012 (Footnote 6).</p> <p>Coordinate system is Universal Transverse Mercator (UTM). Details: UTM Zone 4, horizontal datum is NAD83, vertical datum is NAVD88 using GEOID09. UNAVCO CORS Station SG27 was held fixed to generate co-ordinates, and station BASC used as a check.</p>

Footnotes:

6. UMIAQ -
<http://www.uicprofessionalservices.com/services/category/uic-science/arctic-science-logistics-support/>

Example Data Records:

Region,Locale,Administrative_area,Site,Area,Polygon_ID,Polygon_sub_unit,Plot_ID,Plot_type,Polygon_type,Northing_UTM,Easting_UTM

''''''''''

North Slope,Barrow,BEO,Intensive Site 1,A,1,center,A1C,vegetation,low-centered,7910413.488,585530.849

North Slope,Barrow,BEO,Intensive Site 1,A,1,center,A1C,vegetation,low-centered,7910413.638,585529.925

North Slope,Barrow,BEO,Intensive Site 1,A,1,center,A1C,vegetation,low-centered,7910414.625,585530.097

North Slope,Barrow,BEO,Intensive Site 1,A,1,center,A1C,vegetation,low-centered,7910414.442,585531.05

North Slope,Barrow,BEO,Intensive Site 1,A,1,edge,A1E,vegetation,low-centered,7910409.429,585531.847

North Slope,Barrow,BEO,Intensive Site 1,A,1,edge,A1E,vegetation,low-centered,7910410.015,585531.092

North Slope,Barrow,BEO,Intensive Site 1,A,1,edge,A1E,vegetation,low-centered,7910410.736,585531.671

North Slope,Barrow,BEO,Intensive Site 1,A,1,edge,A1E,vegetation,low-centered,7910410.118,585532.438

North Slope,Barrow,BEO,Intensive Site 1,A,1,trough,A1T,vegetation,low-centered,7910412.771,585535.482

North Slope,Barrow,BEO,Intensive Site 1,A,1,trough,A1T,vegetation,low-centered,7910413.751,585535.272

North Slope,Barrow,BEO,Intensive Site 1,A,1,trough,A1T,vegetation,low-centered,7910413.929,585536.216

North Slope,Barrow,BEO,Intensive Site 1,A,1,trough,A1T,vegetation,low-centered,7910412.976,585536.397

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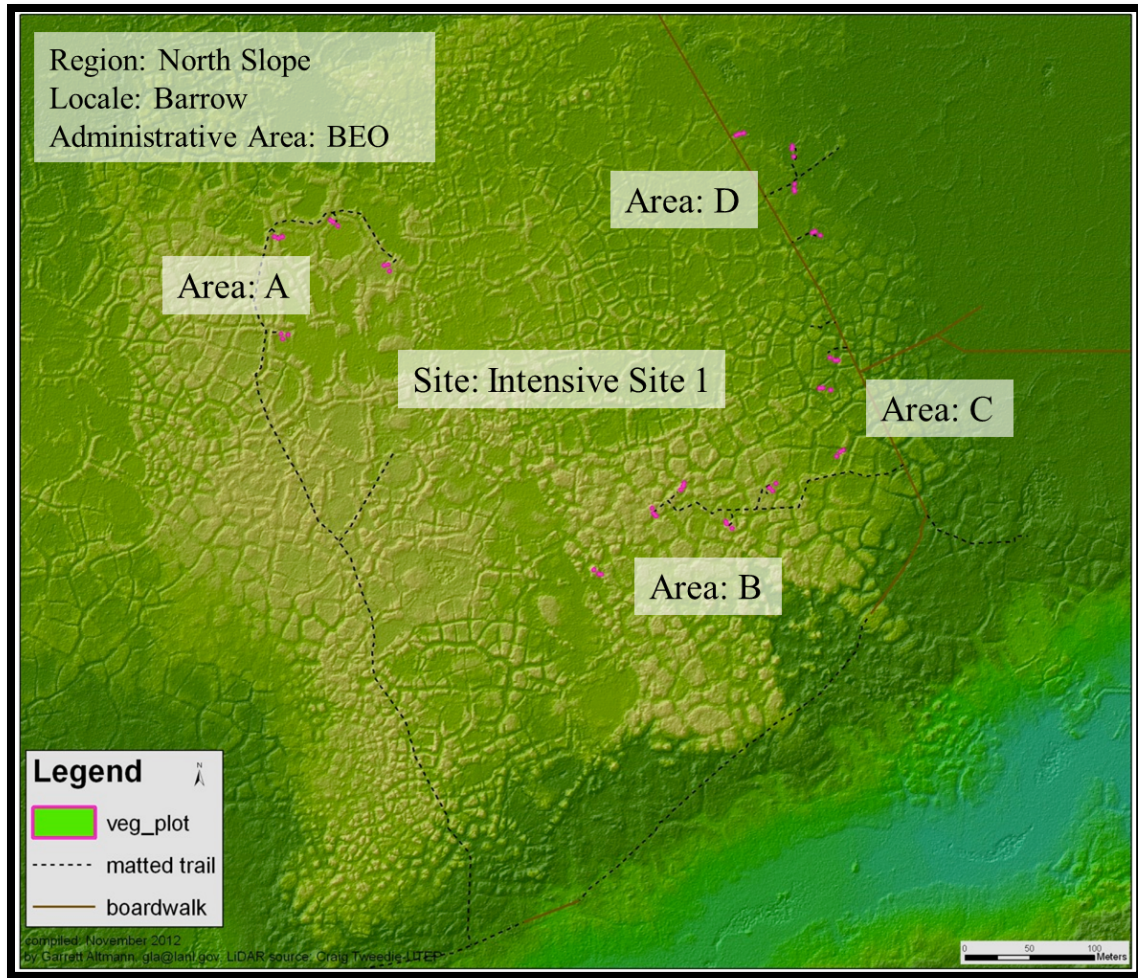


Figure 1: Locations of vegetation plots within areas A-D, Intensive Site 1, Barrow Environmental Observatory (BEO), Barrow, Alaska. LiDAR source: Craig Tweedie, University of Texas, El Paso.

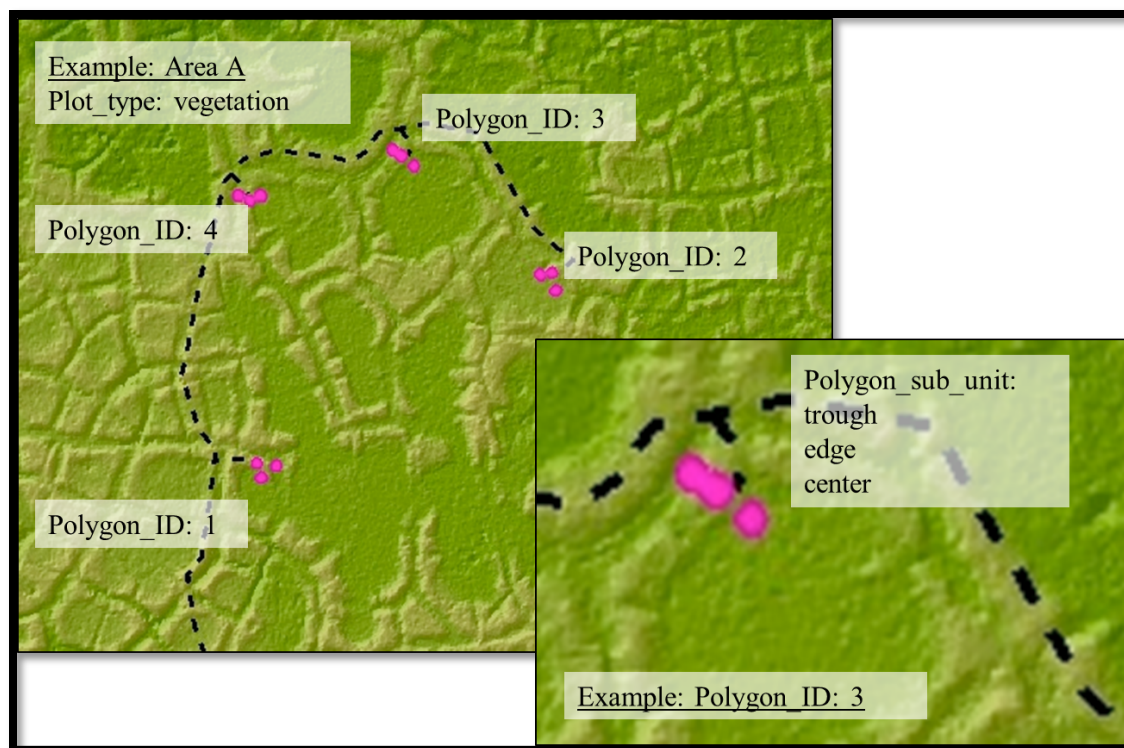


Figure 2: Schematic showing details of vegetation plot naming scheme within each area (example shown: Area A). Plots were located in four polygons per area (Polygon_ID, 1 – 4), and in each polygon, plots were placed in three microtopographic positions: center, edge and trough (Polygon_sub_unit: see inset). Plot_ID is formed by concatenation of Area, Polygon_ID and Polygon_sub_unit.



Figure 3: Cation (purple) and anion (orange) Plant Root Simulator (PRS) probes installed at 0 - 5.5 cm depth in a polygon 'edge', area A, NGEE-Arctic Intensive Site 1, Barrow, Alaska (right). Nylon twine (left) marks the location of a second pair of probes installed at 11 cm depth. Photo Credit: Victoria Sloan. July 16, 2013. Next-Generation Ecosystem Experiments. Oak Ridge National Laboratory.