

Soil temperature, soil moisture and thaw depth, Barrow, Alaska, Ver. 1

For NGEE Arctic Project use only.



Summary:

This dataset consists of field measurements of soil properties made during 2012 and 2013 in areas A-D of Intensive Site 1 at the Next-Generation Ecosystem Experiments (NGEE) Arctic site near Barrow, Alaska. Included are i) weekly measurements of thaw depth, soil moisture, presence and depth of standing water and soil temperature made during the 2012 and 2013 growing seasons (June – September) and ii) half-hourly measurements of soil temperature logged continuously during the period June 2012 to September 2013.

Please use this citation to reference the data.

Sloan, V.L., J.A. Liebig, M.S. Hahn, J.B. Curtis, J.D. Brooks, A. Rogers, C.M. Iversen, R.J. Norby. 2014. Soil temperature, soil moisture and thaw depth, 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/10.5440.1121134>

Data Characteristics

This dataset comprises two comma-separated (*.csv) files containing weekly soil measurements from the 2012 and 2013 growing seasons, a comma-separated file of temperature logger output from June 2012 to September 2013, and an accompanying (*.pdf) User File. Supplementary information comprising a comma-separated (*.csv) file containing dGPS co-ordinates of plot locations and a map of the measurement locations (*.pdf) is provided.

Data Dictionary

Weekly Measurement Data Files:

V_soil_temperature_soil_moisture_thaw_depth_Barrow_2012_v1.csv

V_soil_temperature_soil_moisture_thaw_depth_Barrow_2013_v1.csv

The 2012 and 2013 files have the same organizational structure.

Missing numeric values are given the value -9999, and missing text values are given the value 'not_determined'. Further explanations relating to missing values can be found in Footnotes and Data Acquisition Materials and Methods sections.

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.
measurement_date	yyyy-mm-dd	
measurement_DOY		Day of Year 1 was January 1, 2012 or 2013.
volumetric_soil_moisture	m3 m-3	Value is the mean of five measurements taken adjacent to 1 x 1 m vegetation plots using a 5 cm probe
standing_water		Presence or absence of standing water within 1 x 1 m vegetation plots.
standing_water_depth	cm	Depth of standing water measured at the center of 1 x 1 m vegetation plots (nearest 0.5 cm). See Footnote 2 for further information.

Column name	Units/format	Description
thaw_depth	cm	Value is the mean of five measurements taken adjacent to 1 x 1 m vegetation plots (nearest 0.5 cm) 0 cm is the top of the green moss layer.
soil_temp_5_cm	deg C	Value is one measurement taken adjacent to 1 x 1 m vegetation plots using a hand-held temperature probe. Manufacturers report thermometer accuracy of $\pm 1^{\circ}\text{C}$.
soil_temp_10_cm	deg C	Value is one measurement taken adjacent to 1 x 1 m vegetation plots using a hand-held temperature probe. Manufacturers report thermometer accuracy of $\pm 1^{\circ}\text{C}$.
soil_temp_15_cm	deg C	Value is one measurement taken adjacent to 1 x 1 m vegetation plots using a hand-held temperature probe. Manufacturers report thermometer accuracy of $\pm 1^{\circ}\text{C}$.
soil_temp_20_cm	deg C	Value is one measurement taken adjacent to 1 x 1 m vegetation plots using a hand-held temperature probe. Manufacturers report thermometer accuracy of $\pm 1^{\circ}\text{C}$.
soil_temp_25_cm	deg C	Value is one measurement taken adjacent to 1 x 1 m vegetation plots using a hand-held temperature probe. Manufacturers report thermometer accuracy of $\pm 1^{\circ}\text{C}$.
soil_temp_30_cm	deg C	Value is one measurement taken adjacent to 1 x 1 m vegetation plots using a hand-held temperature probe. Manufacturers report thermometer accuracy of $\pm 1^{\circ}\text{C}$.
soil_temp_35_cm	deg C	Value is one measurement taken adjacent to 1 x 1 m vegetation plots using a hand-held temperature probe. Manufacturers report thermometer accuracy of $\pm 1^{\circ}\text{C}$.
soil_temp_40_cm	deg C	Value is one measurement taken adjacent to 1 x 1 m vegetation plots using a hand-held temperature probe. Manufacturers report thermometer accuracy of $\pm 1^{\circ}\text{C}$.
soil_temp_45_cm	deg C	Value is one measurement taken adjacent to 1 x 1 m vegetation plots using a hand-held temperature probe. Manufacturers report thermometer accuracy of $\pm 1^{\circ}\text{C}$.

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

Footnotes:

1. See associated files:
 - a. **V_Vegetation_plot_layout_diagram.pdf** (high resolution) for plot locations in each area. See figures below for same content.
 - b. **V_Vegetation_plot_locations.csv** for differential GPS coordinates of plot locations.
2. Standing water depth was measured only in 2013. This column is not included in the 2012 comma-separated (*.csv) data file.

Example Data Records: V_soil_temperature_soil_moisture_thaw_depth_Barrow_2012.csv

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region,locale,administrative_area,site,area,polygon_ID,polygon_sub_unit,plot_ID,plot_type,polygon_type,measurement_date,measurement_DOY,volumetric_soil_moisture,standing_water,thaw_depth,soil_temp_5_cm,soil_temp_10_cm,soil_temp_15_cm,soil_temp_20_cm,soil_temp_25_cm,soil_temp_30_cm,soil_temp_35_cm,soil_temp_40_cm,soil_temp_45_cm
,,,,,,,,,yyyy-mm-dd,,m3 m-3,,cm,deg C,deg C,deg C,deg C,deg C,deg C,deg C,deg C
North Slope,Barrow,BEO,Intensive Site 1,A,1,center,A1C,vegetation,low-center,2012-06-16,168,-9999,not_determined,6.22,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999
North Slope,Barrow,BEO,Intensive Site 1,A,1,edge,A1E,vegetation,low-center,2012-06-16,168,-9999,not_determined,6.7,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999
North Slope,Barrow,BEO,Intensive Site 1,A,1,trough,A1T,vegetation,low-center,2012-06-16,168,-9999,not_determined,4,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999
...
North Slope,Barrow,BEO,Intensive Site 1,D,4,center,D4C,vegetation,low-center,2012-09-13,257,-9999,not_determined,45.6,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999
North Slope,Barrow,BEO,Intensive Site 1,D,4,edge,D4E,vegetation,low-center,2012-09-13,257,-9999,not_determined,39.3,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999
North Slope,Barrow,BEO,Intensive Site 1,D,4,trough,D4T,vegetation,low-center,2012-09-13,257,-9999,not_determined,44.9,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999

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Example Data Records: V_soil_temperature_soil_moisture_thaw_depth_Barrow_2013.csv

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region,locale,administrative_area,site,area,polygon_ID,polygon_sub_unit,plot_ID,plot_type,polygon_type,measurement_date,measurement_DOY,volumetric_soil_moisture,standing_water,standing_water_depth,thaw_depth,soil_temp_5_cm,soil_temp_10_cm,soil_temp_15_cm,soil_temp_20_cm,soil_temp_25_cm,soil_temp_30_cm,soil_temp_35_cm,soil_temp_40_cm,soil_temp_45_cm
,,,,,,,,,yyyy-mm-dd,,m3 m-3,,cm,cm,deg C,deg C,deg C,deg C,deg C,deg C,deg C,deg C,deg C
North Slope,Barrow,BEO,Intensive Site 1,A,1,center,A1C,vegetation,low-center,2013-06-20,171,1,present,9,12.6,1.3,0.2,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999
North Slope,Barrow,BEO,Intensive Site 1,A,1,edge,A1E,vegetation,low-center,2013-06-20,171,0.774,absent,0,11.2,2.1,0.4,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999
North Slope,Barrow,BEO,Intensive Site 1,A,1,trough,A1T,vegetation,low-center,2013-06-20,171,1,present,13.5,12.4,0.8,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999
...
North Slope,Barrow,BEO,Intensive Site 1,D,4,center,D4C,vegetation,low-center,2013-09-13,256,-99999,not_determined,-99999,-99999,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999
North Slope,Barrow,BEO,Intensive Site 1,D,4,edge,D4E,vegetation,low-center,2013-09-13,256,-99999,not_determined,-99999,-99999,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999
North Slope,Barrow,BEO,Intensive Site 1,D,4,trough,D4T,vegetation,low-center,2013-09-13,256,-99999,not_determined,-99999,-99999,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999,-9999

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Soil Temperature Logger Data File:**V_soil_temperature_30_minutes_Barrow_2012_and_2013_v1.csv**

Missing values are given the value -9999.

column_name	units/format	description
Columns 1-10 in this file are the same as the above "V_soil_temperature_soil_moisture...." files.		
date	yyyy-mm-dd	
time	hh:mm	Time of measurement in AKST – Alaska Standard Time (UTC -9 hrs)
depth	cm	Values: 5, 15, 25
temperature	deg C	Logger accuracy ± 0.2 °C

Example Data Records:

```

region,locale,administrative_area,site,area,polygon_ID,polygon_sub_unit,plot_ID,plot_type,polygon_type,date,time,depth,temperature
,,,,,,,,,yyyy-mm-dd,hh:mm,cm,deg C
North Slope,Barrow,BEO,Intensive Site 1,A,1,center,A1C,vegetation,low-centered,2012-06-23,19:00,5,7.167
North Slope,Barrow,BEO,Intensive Site 1,A,1,center,A1C,vegetation,low-centered,2012-06-23,19:30,5,7.167
North Slope,Barrow,BEO,Intensive Site 1,A,1,center,A1C,vegetation,low-centered,2012-06-23,20:00,5,7.217
...
North Slope,Barrow,BEO,Intensive Site 1,B,2,trough,B2T,vegetation,high-centered,2013-09-01,11:00,25,1.262
North Slope,Barrow,BEO,Intensive Site 1,B,2,trough,B2T,vegetation,high-centered,2013-09-01,11:30,25,1.262
North Slope,Barrow,BEO,Intensive Site 1,B,2,trough,B2T,vegetation,high-centered,2013-09-01,12:00,25,1.262

```

Data Acquisition Materials and Methods

Weekly Measurements:

The measurements described below were made weekly during the growing seasons of 2012 and 2013 (mid-June to early-September) by the vegetation dynamics team. Additional measurements of thaw depth only were collected in mid-September of both years by the biogeochemistry team.

Volumetric soil moisture ($\text{m}^3 \text{m}^{-3}$) was measured at five random locations around the margins of each vegetation plot using a hand-held sensor (SM300 Soil Moisture Sensor, HH2 Moisture Meter, Delta-T, Cambridge, UK). Data provided are the mean of the five measurements. The moisture probe length was 5 cm, thus the measurement represents the moisture content of the 0 – 5 cm increment of soil.

A site specific calibration was undertaken according to the sensor and moisture meter manuals (<http://www.delta-t.co.uk/product-display.asp?id=HH2%20Product&div=Soil%20Science>, <http://www.delta-t.co.uk/product-display.asp?id=SM300%20Product&div=Soil%20Science>), using blocks of soil obtained from Areas A, B and C. All three calibrations produced similar results to the standard ‘organic’ soil setting, so this setting was used throughout measurement period.

The moisture sensor is unable to read in saturated soils: where this was the case, a value of $1.0 \text{m}^3 \text{m}^{-3}$ is recorded.

Standing water presence or absence was recorded in all vegetation plots at the same time as volumetric soil moisture measurements.

Standing water depth (cm) was recorded to the nearest 0.5 cm in center of vegetation plots using a metal ruler at the same time as volumetric soil moisture measurements.

Thaw depth was measured to the nearest 0.5 cm by inserting a metal probe with a taped scale at five random locations around the margin of each vegetation plot. Data provided are the mean of the five measurements. The top of the green moss layer was assumed to be 0 cm. Where standing water was present on the plot, the measurement was made by feeling for the soil surface beneath the water.

Soil temperature ($^{\circ}\text{C}$) was measured at 5 cm intervals throughout the thawed soil using an RT610B Waterproof Digital Thermometer (Thermoworks, Utah, USA, http://www.thermoworks.com/products/low_cost/RT610b.html). Missing values of -9999 for depths below measured values indicate that soil was not thawed at this time.

The thermometer was checked in ice / water mixture prior to initial field measurements in June 2012, when it read between 0 and 1°C . Probe was checked again on 27th August 2012, when readings in similar conditions were between $1 - 2^{\circ}\text{C}$. The battery was changed in the probe at this time; following which, readings in iced water were between 0 and 1°C . Probe was checked monthly during 2013 season, and readings were consistently close to 0°C .

On 1st July 2012, the temperature probe malfunctioned. It was repaired and the temperature data collected on the 2nd July. On 27th August 2012, weather conditions prevented a full set of temperature measurements. On 30th July 2012, and in the period 30th July – 2nd September 2013, no soil temperature measurements were attempted owing to time constraints.

Soil temperature loggers:

Soil temperature (°C) was recorded using HOBO Tidbit v2 loggers (Onset, Bourne, MA, USA, <http://www.onsetcomp.com/products/data-loggers/utbi-001>). Loggers were buried in the soil attached to zip-ties. Top of soil and locations with standing water were the same as for thaw depth measurements. All loggers recorded at synchronous half-hour intervals.

In 2012, loggers were installed at 5 cm depth in the centers, rims and troughs of two polygons in each of areas A, B, C and D. Loggers recorded from 23rd June 2012 to 17th June 2013.

In June 2013, loggers at 5 cm depth were retained as described in areas A and B, but were removed from areas C and D. Additional loggers were installed at 15 cm depth adjacent to the existing 5 cm depth loggers in areas A and B on 10th July 2013, and at 25 cm depth 8th August 2013.

Short data gaps (1-3 days) occur when loggers were removed for readout. This occurred on 2nd July 2012, 1st September 2012, 17th June 2013 and 1st September 2013. Loggers remain in situ as of March 2014.

Supplemental Files:**V_Vegetation_plot_locations.csv**

This file contain differential GPS coordinates of vegetation plot locations.

Column name	Units/format	Description
Columns 1-10 in this file are the same as the above "V_soil_temperature_soil_moisture...." 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 29th, 2012. Footnote 3.</p> <p>Co-ordinate 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 29th, 2012. Footnote 3.</p> <p>Co-ordinate 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:

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

Example Data Records:

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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,D,4,trough,D4T,vegetation,low-centered,7910493.022,585940.843
North Slope,Barrow,BEO,Intensive Site 1,D,4,trough,D4T,vegetation,low-centered,7910492.724,585941.739
North Slope,Barrow,BEO,Intensive Site 1,D,4,trough,D4T,vegetation,low-centered,7910491.806,585941.447
North Slope,Barrow,BEO,Intensive Site 1,D,4,trough,D4T,vegetation,low-centered,7910492.077,585940.545

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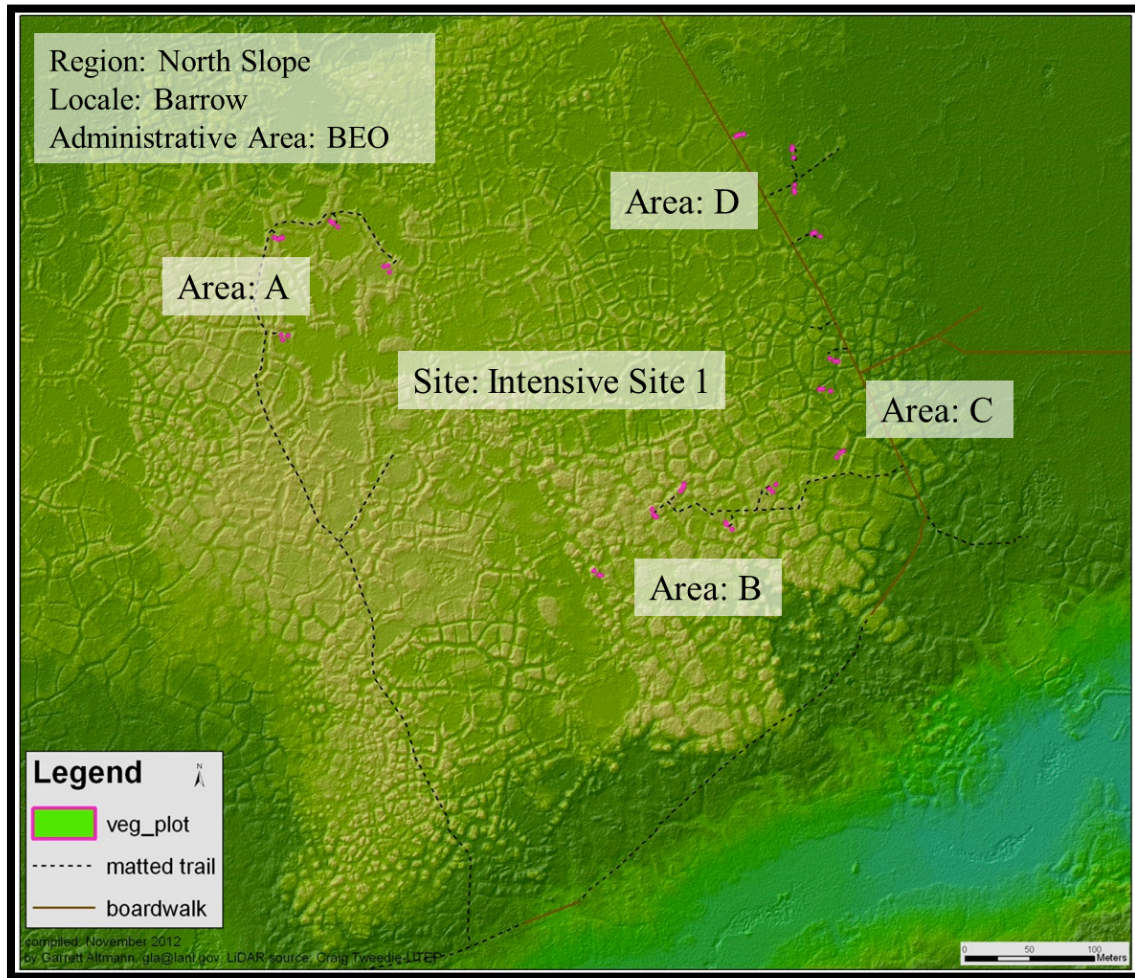


Figure 1: Locations of vegetation plots within areas A-D, Intensive Site 1, Barrow Environmental Observatory (BEO), Barrow, Alaska. LiDAR source: Craig Tweedie, University of Texas, El Paso.

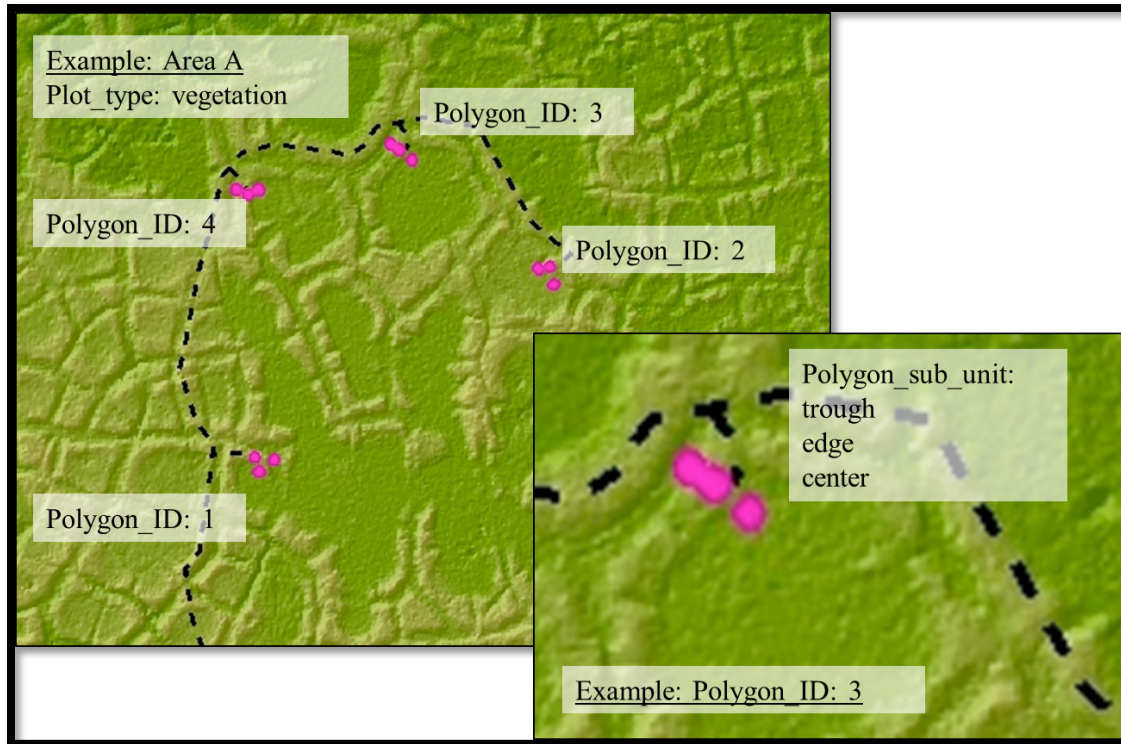


Figure 2: Schematic showing details of vegetation plot naming scheme within each area (example shown: area A). Plots were located in four polygons per area (polygon_ID, 1 – 4), and in each polygon, plots were placed in three micro-topographic positions: center, edge and trough (polygon_sub_unit: see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