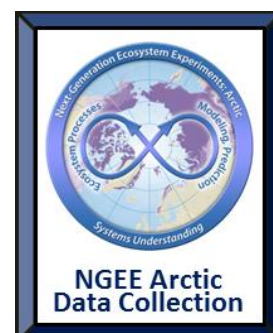


CO₂ and CH₄ Surface Flux, Soil Temperature and Moisture,
Barrow, Alaska, 2013, Ver. 1

For NGEE Arctic Project use only.

Review and follow the current NGEE Data and Fair-Use Policies prior to using these data (<http://ngee-arctic.ornl.gov/content/ngee-arctic-data-management-policies-and-plans>).



Summary:

This dataset consists of field measurements of CO₂ and CH₄ flux, as well as soil properties made during 2013 in Areas A-D of Intensive Site 1 at the Next-Generation Ecosystem Experiments (NGEE) Arctic site near Barrow, Alaska. Included are i) measurements of CO₂ and CH₄ flux made from June to September (ii) Calculation of corresponding Gross Primary Productivity (GPP) and CH₄ exchange (transparent minus opaque) between atmosphere and the ecosystem (ii) Measurements of the Los Gatos Research (LGR) chamber air temperature made from June to September (ii) measurements of surface layer depth, type of surface layer, soil temperature and soil moisture from June to September.

Please use this citation to reference the data.

M.S. Torn, Hahn, M.S, J.B. Curtis, V.L. Sloan, O. Chafe. 2014. CO₂ and CH₄ Surface Flux, Air Temperature, Soil Temperature and Soil Moisture, Barrow, Alaska, 2013, 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 DOI <http://dx.doi.org/10.5440/1167255>.

Data Characteristics

This dataset comprises the following:

1. One comma-separated (*.csv) files containing GHG flux, air temperature and soil measurements in 2013
2. User guidance document (*.pdf) data description file
3. A supplemental comma-separated (*.csv) file on plot locations.

Data Dictionary

Data Files:

Measurement data files:

CO₂_and_CH₄_surface_flux_soil_temperature_and_moisture_Barrow_Alaska_2013.csv

Missing numeric values are given the value -9999 and missing text values are marked as “unknown”.

column_name	units/format	Description
region		Values: North Slope
locale		Values: Barrow
administrative_area		Values: Barrow Environmental Observatory (BEO)
site		Values: Intensive Site 1
date	yyyymmdd	Dates on which measurements were taken.
DOY	decimal day of year	<p>Measurement date and time as decimal day of year in Alaska Standard Time Values: 1.00 to 365.00</p> <p>DOY = Day Of Year January 1 is day 1, 2012 or 2013. The number after the decimal points represent the hour of day as a fraction of 24 hours. For example, if the measurement was taken on 4th of July 2013 (which is the 184th day of the year) at 16:00 hours then the DOY value will be $184 + (16/24)$ i.e. 184.67</p>
time	hh:mm	<p>Time of measurement Values: 00:00 to 23:59 hours</p> <p>Alaska Standard time</p>
area		Values: A,B,C,D
polygon_ID		Values: 1, 2, 3, 4
polygon_sub_unit		<p>Values: Ce, Tr, Ed</p> <p>Ce - Center, Tr – Trough and Ed – Edge</p>
chamber_type		<p>Values: Opq, Trns</p> <p>Opq - Opaque chamber, Trns - transparent chamber</p>
measurement_timeseries		<p>Values: t0</p> <p>t0 represents that only one single measurement has been taken in a day.</p>

column_name	units/format	Description
plot_ID		<p>plot_ID is a unique plot nomenclature formed by concatenation of area, polygon_ID, polygon_sub_unit, Chamber_type and measurement_timeseries.</p> <p>For example, plot A1CeOpqt0 is the ID for the plot at area A, polygon 1, located in the Center of the polygon, measured in the Opaque chamber, representing one single measurement in a day.</p> <p>Please note that this nomenclature is different from the nomenclature used in earlier years. (See footnote 1)</p>
plot_ID_old		<p>This is the unique nomenclature used in previous years data sets and is given here to maintain consistency with previous years data. This ID is formed by concatenation of area (A,B,C or D), polygon_ID (1,2,3,4), old polygon sub unit (C,T,E) Where C represents center of polygon, T represents trough and E is edge. For example, plot A1C is the ID for the plot at area A, polygon 1, located in the Center of the polygon.</p>
chamber_air_temp	degree celsius	Value is one measurement of air temperature taken from the LGR chamber
CO2_flux	micromol CO2 m-2 s-1	<p>CO2 flux measured in the chamber.</p> <p>Values are with respect to atmosphere, i.e. negative values indicate that CO2 is moving out from the atmosphere into the ecosystem. And positive values indicate CO2 release from the ecosystem into the atmosphere.</p>
CH4_flux	nmol CH4 m-2 s-1	<p>CH4 flux measured in the chamber.</p> <p>Values are with respect to atmosphere, i.e. negative values indicate that CH4 is moving out from the atmosphere into the ecosystem. And positive values indicate CH4 release from the ecosystem into the atmosphere.</p>

column_name	units/format	Description
GPP	micromol CO ₂ m ⁻² s ⁻¹	Refers to Gross Primary Productivity. Value is calculated as the difference between the CO ₂ flux of the transparent chamber and the opaque chamber at a particular time. Values are with respect to atmosphere, i.e. negative GPP values indicate that CO ₂ is moving out from the atmosphere into the ecosystem. And positive values of GPP indicate CO ₂ release from the ecosystem into the atmosphere. Note: Because GPP is calculated from both transparent and opaque values, the resulting GPP values were presented in both the transparent and opaque chamber measurements. i.e. GPP values are the same for transparent and opaque chambers of a particular plot, for a given day and given time t0. i.e. GPP for A1CeOpqt0 and A1CeTrnst0 on 2013/08/07 is the same.
CH ₄ _transparent_minus_opaque	nmol CH ₄ m ⁻² s ⁻¹	This refers to CH ₄ flux difference between the transparent and the opaque chamber. Value is calculated by the difference between the CH ₄ flux of the transparent chamber and the opaque chamber at a particular time. Values are with respect to atmosphere, i.e. negative CH ₄ exchange values indicate that CH ₄ is moving out from the atmosphere into the ecosystem. And positive values of exchange indicate CH ₄ release from the ecosystem into the atmosphere. Note: Similar to the note on GPP, since this value is calculated from both transparent and opaque values, the resulting CH ₄ _transparent_minus_opaque values were presented in both the transparent and opaque chamber measurements. i.e. Values are the same for transparent and opaque chambers of a particular plot, for a given day and given time t0. i.e. CH ₄ _exchange for A1CeOpqt0 and A1CeTrnst0 on 2013/08/07 is the same.
surface_layer_type		Values: Water, Veg, Water and Veg, Unknown This describes whether the surface layer of the plot had standing water, a vegetation mat or both a vegetation mat and standing water. Where the surface layer has not been recorded, then it has been marked as “unknown”. (See footnote 2, 3)

column_name	units/format	Description
standing_water_depth	cm	Value is the average of multiple measurements of the depth of the surface layer of water. These values are only measured for the plots where the surface layer is 'water' or 'water and veg'. For the plots where the surface layer is 'veg' this column is not applicable and marked '-9999'.
water_depth_no_of_measurements		Value is the number of depth measurements taken based on which the average water depth was calculated. These values are only measured for the plots where the surface layer is 'water' or 'water and veg'. For the plots where the surface layer is 'veg' this column is not applicable and marked '0'.
vegmata_depth	cm	Value is the average of multiple measurements of the depth of the surface layer of the vegetation mat. These values are only measured for the plots where the surface layer is 'veg' or 'water and veg'. For the plots where the surface layer is 'water' this column is not applicable and marked '-9999'. (See footnote 2, 3)
vegmata_depth_no_of_measurements		Value is the number of depth measurements taken based on which the average vegetation mat depth was calculated. These values are only measured for the plots where the surface layer is 'veg' or 'water and veg'. For the plots where the surface layer is 'water' this column is not applicable and marked '0'.
soil_temp_5_cm	degree celsius	Value is the average of multiple measurements of soil temperature taken at 5cm below the top of the surface layer. Note: All soil temperatures are measured from the top of the vegetation layer or the top of the water layer depending on the type of surface layer of the plot. For e.g. plot B1CeOpqt0 has a veg mat depth of 6 cm and soil temperature was taken at 5cm. Therefore the 5 cm temperature reading was still in the vegetation mat.

column_name	units/format	Description
soil_temp_5_cm_no_of_measurements		Value is the number of temperature measurements that were taken based on which the average soil temperature at 5 cm depth was calculated.
soil_temp_7.5_cm	degree celsius	Value is the average of multiple measurements of soil temperature taken at 7.5cm below the top of the surface layer.
soil_temp_7.5_cm_no_of_measurements		Value is the number of temperature measurements that were taken based on which the average soil temperature at 7.5 cm depth was calculated.
soil_temp_10_cm	degree celsius	Value is the average of multiple measurements of soil temperature taken at 10 cm below the top of the surface layer.
soil_temp_10_cm_no_of_measurements		Value is the number of temperature measurements that were taken based on which the average soil temperature at 10 cm depth was calculated.
soil_temp_15_cm	degree celsius	Value is the average of multiple measurements of soil temperature taken at 15 cm below the top of the surface layer.
soil_temp_15_cm_no_of_measurements		Value is the number of temperature measurements that were taken based on which the average soil temperature at 15 cm depth was calculated.
soil_temp_20_cm	degree celsius	Value is the average of multiple measurements of soil temperature taken at 20 cm below the top of the surface layer.
soil_temp_20_cm_no_of_measurements		Value is the number of temperature measurements that were taken based on which the average soil temperature at 20 cm depth was calculated.
soil_temp_30_cm	degree celsius	Value is the average of multiple measurements of soil temperature taken at 20 cm below the top of the surface layer.
soil_temp_30_cm_no_of_measurements		Value is the number of temperature measurements that were taken based on which the average soil temperature at 20 cm depth was calculated.
soil_moisture_Ka_values_10_cm_waveguide		Value is the average of multiple measurements of soil moisture Ka values measured using a 10 cm waveguide. Ka refers to the apparent dielectric constant values determined by the MiniTrase (See footnote 4) based on the length of the waveguide and transit time of the pulse.

column_name	units/format	Description
soil_moisture_10cm_wg_no_of_measurements		Value is the number of measurements that were taken based on which the average soil moisture Ka value for the 10 cm waveguide was calculated.
soil_moisture_Ka_values_20_cm_waveguide		Value is the average of multiple measurements of soil moisture Ka values measured using a 20 cm waveguide.
soil_moisture_20cm_wg_no_of_measurements		Value is the number of measurements that were taken based on which the average soil moisture Ka value for the 20 cm waveguide was calculated.
soil_moisture_Ka_values_30_cm_waveguide		Value is the average of multiple measurements of soil moisture Ka values measured using a 30 cm waveguide.
soil_moisture_30cm_wg_no_of_measurements		Value is the number of measurements that were taken based on which the average soil moisture Ka value for the 30 cm waveguide was calculated.

Footnotes:

1. The nomenclature has been changed to improve clarity. E.g.: earlier C1C meant area C, polygon1, center where C denoted both area C and Center, now 'Ce' denotes center to avoid this confusion. The old plot ID is also provided in the data set, for consistency with earlier data sets.
2. Surface layer refers to the vegetation mat, standing water or both a vegetation mat and standing water on the surface of the ground.
3. Vegetation mat refers to moss or litter on the surface of the ground.
4. MiniTrase – measures soil moisture based on Time Domain Reflectometry (TDR) (Site accessed 11/20/2014. <http://www.soilmoisture.com/minitraser.html>).

Example Data Records:

```

region,locale,administrative_area,site,date,DOY,time,area,polygon_ID,polygon_sub_unit,chamber_type,measurement_timeseries,plot_ID,plot_ID_old,chamber_air_temp,CO2_flux,CH4_flux,GPP,CH4_transparent_minus_opaque,surface_layer_type,standing_water_depth,water_depth_no_of_measurements,vegmat_depth,vegmat_depth_no_of_measurements,soil_temp_5_cm,soil_temp_5_cm_no_of_measurements,soil_temp_7.5_cm,soil_temp_7.5_cm_no_of_measurements,soil_temp_10_cm,soil_temp_10_cm_no_of_measurements,soil_temp_15_cm,soil_temp_15_cm_no_of_measurements,soil_temp_20_cm,soil_temp_20_cm_no_of_measurements,soil_temp_30_cm,soil_temp_30_cm_no_of_measurements,soil_moisture_Ka_values_10_cm_waveguide,soil_moisture_10cm_wg_no_of_measurements,soil_moisture_Ka_values_20_cm_waveguide,soil_moisture_20cm_wg_no_of_measurements,soil_moisture_Ka_values_30_cm_waveguide,soil_moisture_30cm_wg_no_of_measurements
,,,yyyymmdd,,hh:mm ,,,,,,degree celsius,micromol CO2 m-2 s-1,nmol CH4 m-2 s-1,micromol

```

```

CO2 m-2 s-1,nmol CH4 m-2 s-1,,cm,,cm,,degree celsius,,degree celsius,,degree celsius,,degree
celsius,,degree celsius,,degree celsius,,,,,,
North Slope,Barrow,BEO,Intensive Site
1,20130627,177.07,1:39,A,1,Ce,Opq,t0,A1CeOpqt0,A1C,10,2.79,229.65,-9999,-
9999,Unknown,-9999,0,-9999,0,-9999,0,-9999,0,-9999,0,-9999,0,-9999,0,-
9999,0,-9999,0
North Slope,Barrow,BEO,Intensive Site
1,20130704,184.82,19:39,A,1,Ce,Opq,t0,A1CeOpqt0,A1C,10,1.59,129.73,-9999,-
9999,Unknown,-9999,0,-9999,0,14.58,1,-9999,0,11.41,1,-9999,0,-9999,0,-9999,0,-
9999,0,-9999,0
North Slope,Barrow,BEO,Intensive Site
1,20130704,184.67,15:55,A,2,Ce,Opq,t0,A2CeOpqt0,A2C,10,1.49,25.92,-9999,-
9999,Unknown,-9999,0,-9999,0,9.5,1,-9999,0,5.14,1,-9999,0,-9999,0,-9999,0,39.95,2,-
9999,0

```

Data Acquisition Materials and Methods

Net CO₂ and CH₄ fluxes between tundra surface and atmosphere were measured with a closed-dynamic-chamber system. Briefly, opaque chambers (30 cm diameter) were connected to a Los Gatos Research, Inc. (GLR) portable Greenhouse Gas Analyzer (<http://www.lgrinc.com/analyzers/ultraportable-greenhouse-gas-analyzer/>). For measurement, the chamber was placed on a PVC base (25 cm diameter, installed approximately 15 cm deep). To make an airtight seal, the chamber was placed in a water-filled moat at the top of the base. Bases were installed approximately 24 h before measurements were made. Each measurement was made over 4-8 minutes, depending on flux rate. Fluxes were calculated from the slope of the linear section of the LGR plot of greenhouse gas concentration versus time.

Supplemental files:

MST_plot_locations.csv

This file contains GPS coordinates of the plot locations. These coordinates are for the center of vegetation plots which are adjacent to BGC plots (vegetation and BGC plots share one side of m² grid).

column_name	units/format	Description
region		Values: North Slope
locale		Values: Barrow
		Values: BEO
administrative_area		BEO stands for Barrow Environmental Observatory
site		Values: Intensive Site 1
area		Values: A,B,C,D

column_name	units/format	Description
polygon_ID		Values: 1, 2, 3, 4
polygon_sub_unit		Values: Ce, Tr, Ed Ce - Center, Tr – Trough and Ed – Edge
Northing_UTM	meters	Coordinates are for the center of vegetation plots which are adjacent to BGC plots (vegetation and BGC plots share one side of m ² grid) recorded using differential GPS.
Easting_UTM	meters	Coordinates are for the center of vegetation plots which are adjacent to BGC plots (vegetation and BGC plots share one side of m ² grid) recorded using differential GPS.

Example Data Records:

region,locale,administrative_area,site,area,polygon_ID,polygon_sub_unit,Northing_UTM,Easting_UTM
,,,,,(meters),(meters)
North Slope,Barrow,BEO,Intensive Site 1,A,1,Ce,7910411.0,585530.5
North Slope,Barrow,BEO,Intensive Site 1,A,1,Ed,7910413.6,585529.1
North Slope,Barrow,BEO,Intensive Site 1,A,1,Tr,7910412.7,585530.6
North Slope,Barrow,BEO,Intensive Site 1,A,2,Ce,7910464.8,585611.7

Disclaimer of Liability

Data and documents available from the NGEE Arctic web site (<http://ngee.ornl.gov/>) were prepared as an account of work sponsored by an agency of the U.S. Government. Neither the U.S. Government nor any agency thereof, or any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Further, Oak Ridge National Laboratory is not responsible for the contents of any off-site pages referenced.

The complete ORNL disclaimer can be viewed at <http://www.ornl.gov/ornlhome/disclaimers.shtml>.

Data Center Contact:

support@ngee-arctic.ornl.gov