Last update: December 4, 2015

CO_2 and CH_4 surface flux, soil profile concentrations, and stable isotope composition, Barrow, Alaska, 2012-2013

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:

In August-October 2012 and June-October 2013, co-located measurements were made of surface CH_4 and CO_2 flux, soil pore space concentrations and stable isotope compositions of CH_4 and CO_2, and subsurface temperature and soil moisture. Measurements were made in intensive study site 1 areas A, B, and C, and from the site 0 and AB transects, from high-centered, flat-centered, and low-centered polygons, from the center, edge, and trough of each polygon.

Please use this citation to reference the data.

Vaughn, L.S., Conrad, M.S., Torn, M.S., Bill, M., Curtis, J.B., Chafe, O. 2015. CO_2 and CH_4 surface fluxes, soil profile concentrations, and stable isotope composition, Barrow, Alaska, 2012-2013. 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:10.5440/1227684.

.

Data Characteristics

Measurements of surface trace gas flux, soil pore space trace gas concentrations and stable isotope compositions, and depth-resolved soil temperature and soil moisture were made in August and October 2012 and monthly June-November 2013. There are 4 comma-delimited data files (.csv) within this dataset.

Data Dictionary

Data Files:

flux_CO2_CH4_Barrow_2012_2013
isotopes_concentrations_Barrow_2012_2013
temperature_profiles_Barrow_2012_2013
soil_moisture_Barrow_2012_2013

column_name	units/format	Description
region*		
locale*		
administrative_area*		
site*		
plot_type*		
UTM_northing		location in UTM coordinates, zone 4
UTM_easting		location in UTM coordinates, zone 4
area*		area within the site. May be the same as "site" if site is not divided into sub-sections
polygon_ID		individual polygon within specified area
polygon_sub_unit		Position within polygon: Ce - Center, Ed - Edge, Tr - Trough, P - Pond
polygon_type		polygon type (low, flat, or high-Ceed)
plot_ID		unique identifier for each plot
sample		unique identifier for individual sample
sampletype	gas/water	whether the sample was soil pore water or soil pore gas
date	yyyy-mm-dd	field sample collection date
depth	cm	depth in the soil profile from which the sample was collected. If depth = 0, sample was collected from a static chamber at the soil surface. Depths are measured from the top of the moss layer.
thawdepth	cm	depth to frost table. Measurement made from the top of the moss layer
CH4_13C	‰	δ13C of CH4 in gas sample or water sample headspace relative to Pee Dee Belemnite
CH4_13C_n		number of averaged δ13C-CH4 measurements
CH4_13C_sd	‰	standard deviation of δ13C-CH4 measurements
CH4_2H	‰	δ2H of CH4 in gas sample or water sample headspace relative to V-SMOW
CH4_2H_n		number of averaged δ2H-CH4 measurements
CH4_2H_sd	‰	standard deviation of δ2H-CH4 measurements
CO2_13C	‰	δ13C of CO2 in gas sample relative to Pee Dee Belemnite
CO2_13C_n		number of averaged δ13C-CO2 measurements
CO2_13C_sd	‰	standard deviation of δ13C-CO2 measurements
DIC_13C	‰	δ13C of DIC in water sample relative to Pee Dee Belemnite
DIC_13C_n		number of averaged δ13C-DIC measurements

column_name	units/format	Description
DIC_13C_sd	‰	standard deviation of δ13C-DIC measurements
CO2_18O	‰	δ18O of CO2 in gas sample or water sample headspace relative to V-SMOW
CO2_18O_n		number of averaged δ18O-CO2 measurements
CO2_18O_sd	‰	standard deviation of δ18O-CO2 measurements
CH4_conc_headspace	ppmv	concentration of CH4 in water sample headspace. If CH4_conc_headspace = 0, value was below the instrument detection limit of 1ppmv
CH4_conc_headspace_n		number of averaged CH4 concentration measurements
CH4_conc_headspace_sd	ppmv	standard deviation of CH4 concentration measurements
CH4_conc_dissolved	uM	concentration of dissolved CH4 in water sample, calculated from headspace CH4 concentration, headspace pressure, and Henry's law
CH4_conc_dissolved_n		number of averaged dissolved CH4 concentration measurements
CH4_conc_dissolved_sd	uM	standard deviation of dissolved CH4 measurements
DIC_conc	mM	concentration of DIC in water sample, calculated from GC-IRMS peak area
DIC_conc_n		number of averated DIC concentration measurements
DIC_conc_sd	mM	standard deviation of DIC measurements
CO2_conc	ppmv	concentration of CO2 in gas sample or water sample headspace, measured on a GC. If CO2_conc_headspace = 0, value was below the instrument detection limit of 70ppmv
CO2_conc_n		number of averaged CO2 concentration measurements
CO2_conc_sd	ppmv	standard deviation of CO2 concentration measurements
N2O_conc_headspace	ppmv	concentration of N2O in gas sample or water sample headspace, measured on a GC. If CH4_conc_headspace = 0, value was below the instrument detection limit of 0.1 ppmv
N2O_conc_dissolved	ppmv	concentration of dissolved N2O in water sample, calculated from headspace N2O concentration, headspace pressure, and Henry's law

column_name	units/format	Description
chamber_type	Opq/Trns	whether the static chamber used to make the measurement was opaque or transparent (Opq = opaque; Trns = transparent)
flux_CO2	umol m-2 s-1	CO2 flux, calculated from the linear portion of the CO2 concentration vs. time regression
flux_CO2_se	umol m-2 s-1	standard error of the CO2 flux regression slope
flux_CO2_Pvalue		p-value of the CO2 flux regression. If p < 0.05, flux is significantly different from 0 umol m-2 s-1
flux_CO2_Rsquared		adjusted R squared value of the CO2 flux regression
flux_CH4	nmol m-2 s-1	CH4 flux, calculated from the linear portion of the CH4 concentration vs. time regression
flux_CH4_se	nmol m-2 s-1	standard error of the CH4 flux regression slope
CH4_Pvalue		p-value of the CH4 flux regression. If p < 0.05, flux is significantly different from 0 nmol m-2 s-1
CH4_Rsquared		adjusted R squared value of the CH4 flux regression
inundated	Y/N	whether the plot was inundated when the measurment was taken
standing_water_depth	cm	depth of standing water
standing_water_depth_n		number of averaged water depth measurements
standing_water_depth_sd	cm	standard deviation of water depth measurements
depth_probe	cm	depth of temperature measurement, measured from the top of the moss layer. If standing water present, measurement is from the water surface.
instrument		instrument used to make temperature measurement
time	AKDT	local time when the measurement was taken (Alaska daylight time)
soil_temp	degrees C	soil temperature
soil_temp_n		number of averaged soil temperature measurements
soil_temp_sd	degrees C	standard deviation of soil temperature measurements
air_temp	degrees C	air tempreature
air_temp_n		number of averaged air temperature measurements

column_name	units/format	Description
air_temp_sd	degrees C	standard deviation of air temperature measurements
upper_depth_of_soil_layer	cm	depth at top of soil increment section over which moisture measurement is integrated. 0 indicates top of moss layer or top of standing water
bottom_depth_of_soil_layer	cm	depth at bottom of soil increment section over which moisture measurement is integrated
Ka		apparent dielectric constant, measured with a Soilmoisture Minitrase TDR
Ka_n		number of Ka measurements averaged in reported Ka
Ka_sd		standard deviation of Ka measurements
VWC	%	volumetric water content, calculated using the intstrument's internal calibration
VWC_n		number of VWC measurements averaged in reported VWC
VWC_sd	%	standard deviaton of VWC measurements

* Values for these location fields have been standardized for NGEE Arctic and are required fields for all data dictionaries. (http://ngee-arctic.ornl.gov/content/metadata-entry-data-upload-and-data-management-help)

Example Data Records:

flux_CO2_CH4_Barrow_2012_2013

region,locale,administrative_area,site,plot_type,UTM_northing,UTM_easting,plot_ID,area,polygon_ID,polygon_sub_unit,chamber_type,date,flux_CO2,flux_CO2_se,flux_CO2_Pvalue,flux_CO2_Rsquared,flux_CH4,flux_CH4_se,CH4_Pvalue,CH4_Rsquared,,,,,,
,,,,,,,,,,,Opq/Trns,yyyy-mm-dd,umol m-2 s-1,umol m-2 s-1,,,nmol m-2 s-1,nmol m-2 s-1,,,,,,,
North Slope,Barrow,BEO,Intensive site 1,Biogeochemistry,7910413.488,585530.849,A1C,A,1,Ce,Opq,2013-08-07,1.19,0.016,2.00E-16,0.9962,93.447,1.175,2.00E-16,0.9967,,,,,,
North Slope,Barrow,BEO,Intensive site 1,Biogeochemistry,7910413.488,585530.849,A1C,A,1,Ce,Trns,2013-08-07,-2.647,0.01105,2.00E-16,0.9994,83.413,0.3214,2.00E-16,0.9995,,,,,,
North Slope,Barrow,BEO,Intensive site 1,Biogeochemistry,7910413.488,585530.849,A1C,A,1,Ce,Trns,2013-08-14,-1.956,0.01799,2.00E-16,0.9969,76.75,0.5166,2.00E-16,0.9983,,,,,,

isotopes_concentrations_Barrow_2012_2013

region,locale,administrative_area,site,plot_type,UTM_northing,UTM_easting,area,polygon_ID,polygon_sub_unit,polygon_type,plot_ID,sample,sampletype,date,depth,thawdepth,CH4_13C,CH4_13C_n,CH4_13C_sd,CH4_2H,CH4_2H_n,CH4_2H_sd,CO2_13C,CO2_13C_n,CO2_13C_sd,DIC_13C,DIC_13C_n,DIC_13C_sd,CO2_18O,CO2_18O_n,CO2_18O_sd,CH4_conc_headspace,CH4_conc_headspace_n,CH4_conc_headspace_sd,CH4_conc_dissolved,CH4_conc_dissolved_n,CH4_conc_dissolved_sd,DIC_conc,DIC_conc_n,DIC_conc_sd,CO2_conc,CO2_conc_n,CO2_conc_sd,N2O_conc_headspace,N2O_conc_dissolved
,,,,,,,,,,,,,gas/water,yyyy-mm-dd,cm,cm,‰,,‰,‰,,‰,‰,,‰,‰,,‰,‰,,‰,ppmv,,ppmv,uM,,uM,mM,,mM,ppmv,,ppmv,ppmv,ppmv
North Slope,Barrow,BEO,Site 0 transect,Biogeochemistry,7910007,585571,Site 0 transect,53,Ce,High,Z53C,Z53C0-7/13-G-4,gas,2013-07-12,0,20,NA,NA,NA,NA,NA,NA,-10,1,NA,NA,NA,NA,4.51,1,NA,0,1,NA,NA,NA,NA,NA,NA,NA,0,1,NA,0.00,NA
North Slope,Barrow,BEO,Intensive site 1,Biogeochemistry,7910369.982,585955.904,C,3,Ce,Flat,C3C,C3C0-9/13-G-4,gas,2013-09-06,0,50,NA,NA,NA,NA,NA,NA,NA,-18.9,1,NA,NA,NA,NA,-5.66,1,NA,1,1,NA,NA,NA,NA,NA,NA,NA,410,1,NA,0.31,NA

soil_moisture_Barrow_2012_2013

region,locale,administrative_area,site,plot_type,plot_ID,date,upper_depth_of_soil_layer,bottom_depth_of_soil_layer,area,polygon_ID,polygon_sub_unit,polygon_type,Ka,Ka_n,Ka_sd,VWC,VWC_n,VWC_sd,UTM_northing,UTM_easting
,,,,,,yyyy-mm-dd,cm,cm,,,,,,,,%,,%,,
North Slope,Barrow,BEO,Intensive site 1,Biogeochemistry,A1C,2012-08-10,0,10,A,1,Ce,Low,49.60,2,2.26,71.85,2,1.91,7910413.488,585530.849
North Slope,Barrow,BEO,Intensive site 1,Biogeochemistry,A1C,2013-10-03,0,10,A,1,Ce,Low,52.20,3,11.47,73.73,3,9.76,7910413.488,585530.849

temperature_profiles_Barrow_2012_2013

region,locale,administrative_area,site,plot_type,UTM_northing,UTM_easting,plot_ID,date,area,polygon_ID,polygon_sub_unit,polygon_type,inundated,standing_water_depth,standing_water_depth_n,standing_water_depth_sd,depth_probe,instrument,time,soil_temp,soil_temp_n,soil_temp_sd,air_temp,air_temp_n,air_temp_sd
,,,,,,,,yyyy-mm-dd,,,,,Y/N,cm,,cm,cm,,AKDT,C,,C,C,,C
North Slope,Barrow,BEO,Intensive site 1,Biogeochemistry,7910413.488,585530.849,A1C,2013-08-14,A,1,Ce,Low,Y,9.9,4,1.5,5,Thermistor,14:10,9.21,3,0.1,8.4,1,NA
North Slope,Barrow,BEO,Intensive site 1,Biogeochemistry,7910413.488,585530.849,A1C,2013-07-10,A,1,Ce,Low,Y,4.8,4,0.6,20,Thermistor,14:00,3.09,2,0.62,6.8,1,NA

Data Acquisition Materials and Methods

- Fluxes of CO_2 and CH_4 were measured using opaque or transparent static chambers (25 cm diameter, 15-20 cm height). Chambers were tall enough to enclose vegetation and were vented according to Xu *et al.*, (2006) to minimize pressure excursions due to the Venturi effect. In inundated plots, a floating chamber was used whose base extended 4 cm below the water surface. In all other plots, chambers were seated on PVC bases extending ~15 cm below the soil surface. To minimize disturbance, bases were installed at the beginning of the sampling season and left in place throughout the remainder of the season season. For each flux measurement, the chamber was seated in a 3 cm-deep, water-filled trench in the base's top rim to create an airtight seal. A Los Gatos Research, Inc. (LGR) portable Greenhouse Gas Analyzer was used to record CO_2 and CH_4 concentrations within the chamber over 4-8 minutes, and the flux rate of each gas was calculated from the slope of the linear portion of the concentration vs. time curve.
- Volumetric water content was measured with a MiniTrase TDR (Soilmoisture Equipment Corp). Soil temperature was measured with a thermistor or thermocouple probe, as indicated. As vegetation and inundation status varied between plots, depths of moisture and temperature measurements were determined from the top of the moss layer, bare soil, or water surface.
- Soil pore gas for trace gas stable isotope and concentration analyses was collected through ¼" diameter stainless steel probes into 60mL syringes using a peristaltic pump. Water samples were filtered in the field through 0.1 um syringe filters and injected directly into evacuated glass vials sealed with 14 mm-thick chlorobutyl septa (Bellco Glass, Inc). Gas samples were injected directly into vials. In cases where syringes contained a mixture of water and gas, both sample types were collected and analyzed separately
- All isotope and concentration analyses were conducted at the Center for Isotope Geochemistry (CIG) at Lawrence Berkeley National Laboratory, Berkeley, CA. We report isotope ratios using the conventional δ-notation where $\delta^{13}X$ = (Rsample/Rstandard - 1) x 1000 and R is the abundance ratio of the light to heavy isotope. Carbon isotope ratios are reported relative to Vienna Peedee Belemnite (VPDB), and hydrogen isotope ratios are reported relative to Vienna Standard Mean Ocean Water (VSMOW).
- We measured carbon isotope ratios of dissolved inorganic carbon (DIC) in water samples and CO_2 in gas samples using a variation on the technique outlined in Torn et al. **(2003)**. The carbon isotope ratios of DIC or CO_2 are accurate to ±0.33 ‰ (1σ) based upon repeated analyses of the laboratory standards.
- Carbon isotope ratios of CH_4 were measured using a Trace Gas Ultra system interfaced to a Delta V Plus mass spectrometer (Thermo Fisher Scientific, Bremen, Germany). CH_4 was chromatographically separated from other gases in the Trace Gas Ultra using an HP-molesieve fused silica capillary column (30 m x 0.320 mm). The CH_4 was then combusted to CO_2 at 1000°C in a capillary ceramic tube loaded with Ni, Cu, and Pt wires, dried and transferred to the IRMS for the carbon isotope measurements. The reproducibility of measured CH_4 $\delta^{13}C$ values is estimated to be ± 0.16 ‰ (1σ) based on repeated analyses of an in-house laboratory standard
- Concentrations of CH_4, CO_2, and N_2O in gas samples were determined using a 2014 Shimadzu GC. 4.5 mL of gas headspace from sample vials were flushed through a 1 mL stainless steel loop. The gases were then isolated on a HayeSep-D packed column (4 m x

1/8"), then quantified with a flame ionization detector. For water samples, we used Henry's law with measured headspace pressures and water volumes to convert headspace CH_4 and N_2O concentrations to dissolved gas concentrations. DIC concentrations were calculated from IRMS results, using known sample aliquot volumes and calibrated mass 44 (CO2) peak areas.

References

Torn MS, Davis S, Bird JA, Shaw MR, Conrad ME (2003) Automated analysis of 13C/12C ratios in CO2 and dissolved inorganic carbon for ecological and environmental applications. *Rapid Communications in Mass Spectrometry*, **17**, 2675–2682.

Xu L, Furtaw MD, Madsen RA, Garcia RL, Anderson DJ, McDermitt DK (2006) On maintaining pressure equilibrium between a soil CO_2 flux chamber and the ambient air. *Journal of Geophysical Research*, **111**.

Supplemental Files:

[*Insert any additional contextual information for describing and understanding the dataset such as pictures, maps, etc.]*

Data Access:

Example: This data set is available through the Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

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

Data Center Contact:

support@ngee-arctic.ornl.gov