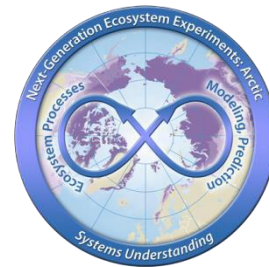# CO2 and CH4 Production and CH4 Oxidation in Low Temperature Soil Incubations from Flat- and High-Centered Polygons, Barrow, Alaska, 2012

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).

Please use this citation to reference the dataset:

Jianqiu Zheng, Taniya RoyChowdhury, and David E. Graham. 2016. CO2 and CH4 Production and CH4 Oxidation in Low Temperature Soil Incubations from Flat- and High-Centered Polygons, Barrow, Alaska, 2012. Next Generation Ecosystem Experiments Arctic Data Collection. Oak Ridge National Laboratory, Oak Ridge, TN, U.S.A. http://dx.doi.org/10.5440/1288688

Related Publications:

Roy Chowdhury, T., Herndon, E.M., Phelps, T.J., Elias, D.A., Gu, B., Liang, L., Wullschleger, S.D. and Graham, D.E. (2015), Stoichiometry and temperature sensitivity of methanogenesis and CO2 production from saturated polygonal tundra in Barrow, Alaska. Glob Change Biol, 21: 722–737. doi:10.1111/gcb.12762

Related Dataset:

For more detailed soil properties of the cores used in these incubations, please refer to:

RoyChowdhury, T., E.M. Herndon, T.J. Phelps, B. Gu, D.A. Elias, L. Liang, and D.E. Graham. 2014. Soil Physicochemical Characteristics from Ice Wedge Polygons, Barrow, Alaska, Ver. 1. Next Generation Ecosystem Experiments Arctic Data Collection, Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, Oak Ridge, Tennessee, USA. Dataset accessed at http://dx.doi.org/10.5440/1109232

Summary

The dataset consists of respiration and methane production rates and methane oxidation potential obtained from soil microcosm studies carried out under controlled temperature and incubation conditions. Soils cores collected in 2012 represent the flat- and high-centered polygon active layers and permafrost (when present) from the NGEE-Arctic Intensive Study Site 1, Barrow, Alaska.

Data presented here will improve our understanding of the temperature controls on the temporal variation in microbially mediated carbon loss potentials from soils impacted by a characteristic microtopographic feature in the Arctic tundra ecosystems. Such an understanding will in turn help

parameterize fine-scale models that constrain soil biogeochemistry, particularly relevant to methane cycle under water saturated and oxic conditions.

Data Characteristics

The data file contains the results of the incubation study for two cores: NGADG001 and NGADG003. Core and soil characteristics are provided along with the incubation conditions, replicates, and CO2 and CH4 analyses results.

Data Dictionary

Data Files: Two data files in *.csv format.

1. BGC_Soil_Incubation_Data_20160811
2. BGC_Methane_Oxidation_Data_20160811

Note the majority of the columns are common to both data files. The exceptions are:

- BGC_Soil_Incubation_Data contains:
  - Respiration_rate
  - Methane_production_rate

- BGC_Methane_Oxidation_Data contains:
  - Soil_sample_harvest_date
  - Methane_oxidation_rate

BGC_Soil_Incubation_Data_20160811

column_name	Units/Format	Description
Core_ID		Core collection: Hydraulic drill (Big Beaver) with a fitted liner was used to collect intact frozen soil cores to a maximum depth of 1m
Date_sampled	yyyy-mm-dd	Date core was collected.
Lab_processed		ORNL core processing: Soil cores were shipped frozen and returned to -20°C freezer and stored until further processing.
Date_processed	yyyy-mm-dd	Date core was processed at ORNL.
Region		Possible values: North Slope
Locale		Possible values: Barrow
Site		Possible values: Intensive Site 1
Area		Possible values: B, C
Soil_type		Possible values: organic
upper_depth_of_soil_layer	cm	Upper depth of soil layer as measured during core processing. Layers correspond to Soil_horizon.

lower_depth_of_soil_layer	cm	Lower depth of soil layer as measured during core processing. Layers correspond to Soil_type.
Incubation_condition		Possible values: anoxic, oxic
Incubation_temp	degree_Celsius	Temperature at which soil microcosms were incubated
Length_of_incubation	days	These represent the length of time i.e. day(s) for which the microcosms have been incubated.
Microcosm_Replicate		Represents the replicate of a microcosm under an Incubation_condition and Incubation_temperature for each soil_type.
Respiration_rate	umolesCO2gdwt-1	The calculated value of respiration rate: micromoles of Carbon dioxide per gram dry weight soil. Where values are "0", the gas concentration was below the analytical detection limit of 10 ppm. "-9999" values represent no measurement taken.
Methane_production_rate	umolesCH4gdwt-1	The calculated value of methane production rate: micromoles of methane per gram dry weight soil. Where values are "0", the gas concentration was below the analytical detection limit of 1 ppm.

BGC_Methane_Oxidation_Data_20160811

column_name	Units/Format	Description
Core_ID		Core collection: Hydraulic drill (Big Beaver) with a fitted liner was used to collect intact frozen soil cores to a maximum depth of 1m.
Date_sampled	yyyy-mm-dd	Date core was collected.
Lab_processed		ORNL core processing: Soil cores were shipped frozen and returned to -20°C freezer and stored until further processing.
Date_processed	yyyy-mm-dd	Date core was processed at ORNL.
Region		Possible values: North Slope
Locale		Possible values: Barrow
Site		Possible values: Intensive Site 1
Area		Possible values: B, C
Soil_type		Possible values: organic
upper_depth_of_soil_layer	cm	Upper depth of soil layer as measured during core processing. Layers correspond to Soil_horizon.
lower_depth_of_soil_layer	cm	Lower depth of soil layer as measured during core processing. Layers correspond to Soil_type.
Soil_sample_harvest_date	day	
Incubation_condition		Possible values: oxic
Incubation_temp	degree_Celsius	Temperature at which soil microcosms were incubated.
Length_of_incubation	days	These represent the length of time i.e. day(s) for which the microcosms have been incubated.

Microcosm_Replicate		Represents the replicate of a microcosm under an Incubation_condition and Incubation_temperature for each soil_type.
Methane_oxidation_rate	umolesCH4gdwt-1	The calculated value of methane oxidation rate: micromoles of methane per gram dry weight soil. "-9999" values represent no measurement taken.

Example Data Records:

BGC_Soil_Incubation_Data_20160811

```
Core_ID,Date_sampled,Lab_processed,Date_processed,Region,Locale,Site,Area,Soil_type,upper_depth_of_s
oil_layer,lower_depth_of_soil_layer,Incubation_condition,Incubation_temp,Length_of_incubation,Microcos
m_Replicate,Respiration_rate,Methane_production_rate
,yyyy-mm-dd,,yyyy-mm-dd,,,,,,cm,cm,,degree_Celsius,days,,umolesCO2gdwt-1,umolesCH4gdwt-1
NGADG0001,4/12/2012,ORNL,7/15/2014,North Slope,Barrow,Intensive Site 1,B,organic,10,30,oxic,-
2,3,1,0.47,0
NGADG0001,4/12/2012,ORNL,7/15/2014,North Slope,Barrow,Intensive Site 1,B,organic,10,30,oxic,-
2,3,2,0.3,0
NGADG0001,4/12/2012,ORNL,7/15/2014,North Slope,Barrow,Intensive Site 1,B,organic,10,30,oxic,-
2,3,3,0.35,0
NGADG0001,4/12/2012,ORNL,7/15/2014,North Slope,Barrow,Intensive Site 1,B,organic,10,30,oxic,-
2,3,4,0.44,0
NGADG0001,4/12/2012,ORNL,7/15/2014,North Slope,Barrow,Intensive Site 1,B,organic,10,30,oxic,-2,7,1,-
9999,0
```

BGC_Methane_Oxidation_Data_20160811

```
Core_ID,Date_sampled,Lab_processed,Date_processed,Region,Locale,Site,Area,Soil_type,upper_depth_of_s
oil_layer,lower_depth_of_soil_layer,Soil_sample_harvest_date,Incubation_condition,Incubation_temp,Lengt
h_of_incubation,Microcosm_Replicate,Methane_oxidation_rate
,yyyy-mm-dd,,yyyy-mm-dd,,,,,,cm,cm,day,,degree_Celsius,days,,umolesCH4gdwt-1
NGADG0001,2012-04-12,ORNL,2014-07-15,North Slope,Barrow,Intensive Site 1,B,organic,10,30,5,oxic,-
2,0.08,1,5.31
NGADG0001,2012-04-12,ORNL,2014-07-15,North Slope,Barrow,Intensive Site 1,B,organic,10,30,5,oxic,-
2,0.08,2,6.05
NGADG0001,2012-04-12,ORNL,2014-07-15,North Slope,Barrow,Intensive Site 1,B,organic,10,30,5,oxic,-
2,0.08,3,6.23
```

Data Acquisition Materials and Method

Headspace CO2 and CH4 gases in the microcosms were analyzed at regular intervals for up to 60 days of incubation.

Headspace gas was analyzed with a SRI 8610C gas chromatograph equipped with a methanizer and Flame Ionization Detector (FID) with a 1.82 m by 0.32 cm HayeSep D packed column (SRI Instruments, Torrance, CA). H2 gas and air flow rates for the FID were maintained at 25 mL min-1 and 250 mL min-1, respectively. Helium flow was maintained at 20 mL min-1 as the carrier gas. Detector and oven temperatures were 40 and 300 degrees C, respectively.

Headspace gas samples (0.5 mL) were injected onto the on-column injector and analyzed isothermally. All gas sample analyses were performed after calibration with standard gases (+/- 99.99 %; Scotty Specialty Gas Calibration Standards, Sigma-Aldrich). Every 10 measurements were bracketed by replicate working standards. The linear response of the detector was verified over the range 1-100 ppmv for both CO2 and CH4. The limit of detection for CH4 was determined at 1 ppmv and for CO2 at 10 ppmv. CO2 and CH4 concentrations were calculated from the linear regression analysis of five-point standard curves.

Gas production rates were calculated as the change in headspace gas concentrations (adjusted for headspace volume and ambient temperature and pressure) and dissolved gas concentrations with time. Dissolved gas concentrations were calculated based on headspace concentrations, soil water content, and Henry's constant for CH4 and CO2 equilibrium adjusted for temperature and soil pH.

Disclaimer of Liability

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