---DATASET TITLE: Large scale water manipulation experiment in the Arctic tundra (2005-2008)

---AUTHOR(S):

PI:
Walter C. Oechel
Director, Global Change Research Group
San Diego State University
San Diego, CA 92182
Tel: 619-594-4818
Cell: 619-980-6827
E-mail: oechel@sunstroke.sdsu.edu

Co-PI:
Donatella Zona
Postdoctoral Researcher (Marie Curie fellow)
Research Group of Plant and Vegetation Ecology
University of Antwerp
Universiteitsplein 1, B-2610 Wilrijk, Belgium
tel: ++3232652831
fax: ++3232652271

Adjunct Professor at San Diego State University
Department of Biology and Global Change Research Group
San Diego State University
San Diego, CA 92182
Tel: +32 492 85 22 30
E-mail: Donatella.Zona@sciences.sdsu.edu

---FUNDING SOURCE AND GRANT NUMBER:
National Science Foundation, award number OPP 0421588

---DATA SET OVERVIEW:

Because trace gas fluxes are so tightly linked to soil moisture and water table in the Arctic, we initiated a large-scale manipulation in the Alaskan Arctic at the Barrow Environmental Observatory (BEO) in 2005 as part of the NSF Biocomplexity Program. The target of this manipulation includes increasing and decreasing the water table over large areas of tundra and observing the effects over the diverse microtopography of the region. The

differences in water table reported were caused by the installation and initiation of the dikes, as well as by seasonal progression in water table, and pumping of water from the BEC (drained section) and from Cake Eater Lake, to the BEN (flooded section). BEC was the control site until 2008.

-Time period covered by the data

2005 to 2008

-Physical location of the measurement or platform

Three eddy covariance towers for CO2, H2O vapor, and energy flux were installed in the vegetated drained lake in July 2005, one in each of the three manipulation sites--Biocomplexity Experiment North, Central and South. These three sites are described in detail in Zona et al., 2009.

BEN: North 71°17'11.80"N 156°36'12.23"W
BEC: Central 71°17'1.71"N 156°35'54.77"W
BES: South 71°16'51.17"N 156°35'47.28"W)

---INSTRUMENT DESCRIPTION:

CO2 and H2O fluxes were measured through the use of an open path infrared analyzer (Li-7500, Li-COR, Lincoln, NE, USA) with a sampling rate of 10Hz [Oechel et al., 1998b; Vourlitis and Oechel, 1997; 1999; Harazono and Miyata, 1997]. The Li-7500 was positioned 10 cm from the center of the sonic anemometer. CO2 and H2O vapor were calibrated every 2 to 4 weeks using ultra high purity nitrogen as the H2O and CO2 zero and 729 ppm CO2 in air standard gas (certified grade +/- 1 ppm) (Matheson Gas Product, Montgomeryville, Pennsylvania, USA) for the CO2 span. A dew point generator (Li-610, Li-COR, Lincoln, NE) was used to produce an air stream with a known water vapor dew point (typically 7 °C lower than the ambient air temperature). A sonic anemometer (WindMasterPro, Gill Instruments Ltd., Lymington, Hampshire, UK) was used to measure the three wind velocity components and to determine the high-speed sonic temperature fluctuations.

Micrometeorological variables were recorded continuously at each site. Soil moisture was measured at three depths (0-30 cm, 0-10 cm, 20-30 cm) in five different locations in proximity to the eddy covariance towers using Time Domain Reflectometry (TDR) (CS616 Campbell Scientific, Logan, Utah, USA) moisture probes. Soil temperature was recorded by type T thermocouples,

(Omega Engineering, Stamford, CT, USA) in nine different locations at 6 different depths (at surface, -1 cm, -5 cm, -10 cm, -20 cm and -30 cm depth). Surface temperature was recorded using an Apogee infrared sensor (Apogee Instruments, Inc.™, Logan UT) pointing into the footprint of the tower at an angle of about 45° with the ground (with field of view 22°, a height above surface of 2.31 m, corresponding to a footprint of about 1.82 m2). Air temperature and relative humidity was recorded at three heights on the eddy tower structure (0.46, 1.6 and 2.95 m from the ground) using Vaisala HMP45C probes (Vaisala, Helsinki, Finland). Air pressure was measured with an electronic barometer (model PTB 101B, Vaisala, Helsinki, Finland). Incoming, reflected and surface PAR (400-700 nm) was recorded using quantum sensors (Li-190, Li-COR, Nebraska, USA). Net radiation was recorded using a net radiometer (REBS Q7, 0.25-60 μm), shortwave global solar radiation measurements in the spectral range from 310 to 2800 nm incoming and reflected from the ground was collected using two pyranometers (model CMP3, Kipp & Zonen, Delft, The Netherlands). The PAR sensors (except for a surface sensor placed in the vegetation layer), the net radiometer and the pyranometers were mounted on a tripod at about 1.5 m above the ground and at about 5 m to the side of the eddy covariance towers. To obtain a representative ground heat flux measurement, five heat flux plates (HFT3, REBS Inc., Seattle, Washington, USA) were installed near each tower positioned at 2 cm depth. Wind speed and wind direction were measured using a wind vane (RM Young Wind Sentry, R.M. Young Company, Traverse, MI, USA). Precipitation was recorded using tipping bucket rain gauges (TR-525M, Texas Electronics, Dallas, Texas, USA). All the instruments were connected to a data logger (model 23X, Campbell Scientific, Logan, Utah, USA) and each environmental variable was read once every 10 seconds and the 30 minutes averages were recorded.

Water table and thaw depth measurements were made every 3-4 days about every 13 m along first 200m downwind from the towers during summer 2007. Thaw depth was measured using a graduated, pointed metal rod approximately 6 mm in diameter. Water table was measured in 2.5 cm diameter pvc pipe water wells installed at 12 locations randomly selected within the first 200 m of an upwind transect at each site. Three boardwalks were installed across the vegetated drained lake basin to provide access for sampling while avoiding disturbance of the vegetation

---DATA COLLECTION and PROCESSING:

Eddy covariance flux data

Fluxes of CO2 and H2O vapor, sensible heat and momentum were calculated using the EdiRe program and software (version 1.4.3.1169, Robert Clement, University of Edinburgh). Time delays were calculated through the use of a cross-correlation function of the scalar fluctuation and the vertical wind velocity. A two component rotation was applied to set mean vertical (w) and lateral (v) velocity components to zero. Correction for density change was applied to CO2 and H2O fluxes according to Webb et al., [1980]. Data quality was assessed through the analysis of energy budget closure and by comparing co-spectra [Kaimal et al., 1972]. The data were filtered by wind direction, and only wind directions from 350 to 180 degrees were used, excluding all results when the winds were coming from the back of the tower and outside of the experimental area and the footprint of interest. A friction velocity (u*) threshold 0.1 m/s was used as a cut off, and data below this value were removed. For more details refer to Zona et al. [2009]. The data are formatted according to the standard CarboEurope protocol: http://www.bgc-jena.mpg.de/bgc-mdi/html/eddyproc/

With the exception that Rn is the net radiation not the solar radiation.

A more update version of the data are currently being processed. Please contact Donatella.zona@ua.ac.be if you plan to use the data.

---DATA FORMAT:

Data format are standard carboeurope quality flag as described on their web site at http://www.bgc-jena.mpg.de/bgc-mdi/html/eddyproc/ :

The data format is quite simple, but is the key to a successful processing. In the testing 99% of errors were related to this issue The data should be provided as column-oriented ASCII file, e.g. TAB-delimited, as you can simply achieve by saving in EXCEL as text, TAB delimited. For a test you can download this file that represents the Tharandt 1998 data from the CARBODATA CD. Then you'd have to specify in the input form whereto you downloaded the file locally, the year="1998", the time format: "Julian Day, decimal hour", Delimiter="<TAB>"

Variables:

Day, Hour,
qc (quality flags according to the carboeurope methodology)
NEE (net ecosystem exchange)
LE (Latent heat)

H (Sensible Heat)
Rg (net radiation)
Tair (air temperature
Tsoil (Soil temperature at 0-5 cm)
rH (relative humidity)
VPD (vapor pressure deficit)
Ustar (friction velocity)

---DATA REMARKS:

Edire: http://www.geos.ed.ac.uk/abs/research/micromet/EdiRe/

Missing data: autumn, winter, spring each year: instruments not working under cold conditions

---REFERENCES:

Zona, D., Oechel W.C., Kochendorfer J., Paw U K.T., Salyuk A.N., Olivas P.C., Oberbauer S.F., and Lipson D.A. 2009. Methane fluxes during the initiation of a large-scale water table manipulation experiment in the Alaskan Arctic tundra, Global Biogeochemical Cycles 23, GB2013, doi: 10.1029/2009GB003487.