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# LBA-ECO CD-10 CO<sub>2</sub> PROFILES AT KM 67 TOWER SITE, TAPAJOS NATIONAL FOREST

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## Summary:

This data set contains a single text file which reports vertical profiles of CO<sub>2</sub> concentrations measured at the Pará Western (Santarém) - km 67, Primary Forest Tower Site. This site is in the Tapajos National Forest located in north central Brazil. Measurements extend from January 2002 through January 2006.

The profile concentration data were used to estimate the change in vertical average concentration between the ground and flux measurement height in order to calculate the column average storage of CO<sub>2</sub> (Saleska et al., 2003). CO<sub>2</sub> concentrations were measured at 8 levels on the tower (62.2, 50, 39.4, 28.7, 19.6, 10.4, and 0.91 m). Sample air was drawn at 1000 sccm (standard cubic centimeters per minute) through 8 profile inlets in sequence (2 minutes at each level) and then a mixed air sample was simultaneously drawn from all 8 levels to obtain a total column integral (once every 20 minutes) and analyzed with an infrared gas analyzer (IRGA, LI-6262, Licor, Lincoln, NE). Data were averaged over a 1 hour interval. The profile IRGA was zeroed between each profile sequence and an absolute calibration at 325, 400, and 475 ppm was made every 6 hours. High accuracy for CO<sub>2</sub> was obtained by these frequent calibrations and long-term precision was verified by a single cylinder of long-term surveillance standard (375 ppm), measured weekly, and that remained onsite for as long as the experiment operated.

Co-located measurements included eddy fluxes of CO<sub>2</sub> and H<sub>2</sub>O were measured at two levels (58m and 47m) using tower-mounted closed-path Licor 6262 gas analyzers and Campbell CSAT3 sonic anemometers. And a comprehensive set of meteorological parameters (air temperature, pressure, PAR, net radiation, precipitation, etc) were also measured.

With the permission of the author, Hutyra, L.R. 2007. Carbon and water exchange in Amazonian rainforests. Ph.D. Thesis, Department of Earth and Planetary Sciences, Harvard University, Cambridge, Massachusetts., is included as a companion file.



## Data Citation:

Cite this data set as follows:

Hutyra, L.R., J. W. Munger, E. W. Gottlieb, B. C. Daube, P. B. Camargo and S. C. Wofsy. 2008. LBA-ECO CD-10 CO2 Profiles at km 67 Tower Site, Tapajos National Forest. Data set. Available on-line [http://daac.ornl.gov] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, U.S.A. doi:10.3334/ORNLDAAC/855

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This data set was archived in May of 2008. Users who download the data between May 2008 and April 2013 must comply with the LBA Data and Publication Policy.

Data users should use the Investigator contact information in this document to communicate with the data provider. Alternatively, the LBA Web Site [http://lba.inpa.gov.br/lba/] in Brazil will have current contact information.

Data users should use the Data Set Citation and other applicable references provided in this document to acknowledge use of the data.

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1. Data Set Overview:

**Project:** LBA (Large-Scale Biosphere-Atmosphere Experiment in the Amazon)

**Activity:** LBA-ECO

**LBA Science Component:** Carbon Dynamics

**Team ID:** CD-10 (Wofsy / Kirchhoff)

The investigators were Munger, J. William; Daube, Bruce C.; Wofsy, Steven C.; Saleska, Scott R. and Hutyra, Lucy . You may contact Saleska, Scott Reid (saleska@email.arizona.edu) ; Wofsy, Steven C (scw@io.harvard.edu) ; Hutyra, Lucy (lrhutyra@u.washington.edu) and Gottlieb, Elaine W. (gottlieb@deas.harvard.edu)

**LBA Data Set Inventory ID:** CD10\_CO2\_Profiles\_Tapajos

CO2 profile concentration measurement at the km67 flux tower sites, Tapajos National Forest, Santarem, Para, Brazil. Measurements extend from January 2002 - January 2006.

These data may be updated or reprocessed from time to time, and it is the user's responsibility to insure that you have the most recent version of the data. For the latest version, please see the following web site: Harvard University, LBA Web Page (http://atmos.seas.harvard.edu/lab/data/lbadata.html)

Related Data Sets:

LBA-ECO CD-10 H2O Profiles at km 67 Tower Site, Tapajos National Forest

2. Data Characteristics:

The CO2 profile data are reported in one comma separated ASCII text file, km67\_co2\_profile\_2002\_2006.txt .

Data File Description

column	variable (column heading)	description
1	JDstart(GMT)	decimal day (GMT, continuous from 1/1/00) NOTE 1: Tapajos Forest Local time (LT) = GMT - 4 hours NOTE 2: these times are time at the BEGINNING of the hour-long data aggregation interval, i.e., data at 12:00 are from aggregating measurements between 12:00 and 13:00

2	1	CO2 concentration (ppm) at level 1 @ 62.24m
3	2	CO2 concentration (ppm) at level 2 @ 50.05m
4	3	CO2 concentration (ppm) at level 3 @ 39.41m
5	4	CO2 concentration (ppm) at level 4 @ 28.71m
6	5	CO2 concentration (ppm) at level 5 @ 19.57m
7	6	CO2 concentration (ppm) at level 6 @ 10.42m
8	7	CO2 concentration (ppm) at level 7 @ 3.05m
9	8	CO2 concentration (ppm) at level 8 @ 0.91m
10	9	CO2 concentration (ppm), instantaneous average of levels 1-8
11	flaggedDATA	0=good data, 1=bad data flagged and removed (NA)
Missing value code is "NA"		
Values are comma separated		

Sample Data Records:

All of the profile data are reported in **km67\_co2\_profile\_2002\_2006.txt**.

JDstart(GMT),1,2,3,4,5,6,7,8,9,flaggedDATA

733.708333333333,372.79,373.27,373.29,373.1,372.69,372.365,372.34,392.98,373.84,0

733.75,371.613333333333,371.65,373.22,372.265,372.38,372.58,377.925,385.745,376.046666666667,0

741.875,376.38,376.72,376.91,376.97,373.55,374.34,443.22,433.56,NA,0

742.458333333333,NA,NA,NA,NA,NA,NA,389.33,404.19,381.48,NA

742.5,376.816666666667,377.1,376.405,377.585,376.115,374.89,383.07,416.435,385.9,0

...

Site boundaries: (All latitude and longitude given in degrees and fractions)

Site (Region)	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude	Geodetic Datum
Para Western (Santarem) - km 67 Primary Forest Tower Site (Para Western (Santarem))	-54.959	-54.959	-2.857	-2.857	World Geodetic System, 1984 (WGS-84)

Time period:

- The data set covers the period 2002/01/01 to 2006/01/18.
- Temporal Resolution: 1 hour

Platform/Sensor/Parameters measured include:

- TOWER / IRGA (INFRARED GAS ANALYZER) / CARBON DIOXIDE

3. Data Application and Derivation:

The profile concentration data were used to estimate the change in vertical average concentration between the ground and flux measurement height in order to calculate the column average storage of CO<sub>2</sub> (Saleska et al., 2003).

4. Quality Assessment:

This data set can be considered final, but as always with data sets this large there are occasional individual points that are bad, but which for one reason or another, have not yet been removed.

5. Data Acquisition Materials and Methods:

A 64 m tower (Rohn 55G, Peoria, IL) was instrumented for eddy covariance measurements which commenced in April, 2001 and continued until the tower was destroyed when a falling tree hit the guy wires in January 2006. Three modular enclosures (approximately 1m x 0.6 m x 0.2 m) containing all the key instruments and dataloggers were mounted on the tower to keep inlet tubes short (~ 2 m) (Figure 1). Eddy-flux measurements were made at a height of 57.8 m with a sample rate of 8 Hz. A 3-axis sonic anemometer (CSAT-3, Campbell Scientific, Logan UT) was mounted with the air sample inlet located 20 cm from the anemometer. The flux system drew sample air from the inlet through a 50 mm diameter Teflon filter and 9.5 mm (inner diameter) Teflon PFA tubing to a closed-path infrared gas analyzer (IRGA, LI-6262, Licor, Lincoln, NE). The eddy system sample cell (11.9 cm<sup>3</sup>) was pressure-controlled at 66.6 kPa with a

mass flow rate of 6000 sccm, providing a cell-flushing time of 0.078 s. This system design maintains the advantages of the closed-path sensor (e.g. precise instrument calibration, constant pressure and temperature), while also adding some of the advantages (e.g. minimal attenuation of high-frequency fluctuations) attributed to open-path designs. This system is particularly suitable for deployment with very tall vegetation where problems accrue due to long sample-tubes from the top of the tower.

Calibrations of the eddy system for CO2 were made every 6 hours (April 2001 - November 11, 2002 & March 29, 2003 - November 15, 2003) or 12 hours (November 12, 2002 - March 29, 2003 & November 15, 2003 - January 24, 2006 ) using 325, 400, and 475 ppm CO2 standard gases. The instrument was zeroed every 2 hours. The long-term accuracy of the instruments was ensured by measuring a surveillance standard (traceable to NOAA/CMDL standards at 380.45 ppm) once per week, this tank lasted through the duration of the measurements. Calibrations for water vapor were made using the daily fluctuations of  $T_v - T_k$ , where  $T_v$  is the sonic temperature (related to the speed of sound provided by the sonic anemometer) and  $T_k$  is the ambient temperature. This approach was necessary due to failures in the chilled mirror hydrometers originally installed for this purpose (see Hutyrá et al, submitted).

Vertical profiles of CO2 and H2O concentrations were measured at 8 levels on the tower (62.2, 50, 39.4, 28.7, 19.6, 10.4, and 0.91 m). Sample air was drawn at 1000 sccm through the 8 profile inlets in sequence (2 minutes at each level). The profile concentration data were used to estimate the change in vertical average concentration between the ground and flux measurement height in order to calculate the column average storage of CO2. The profile IRGA was zeroed between each profile sequence and an absolute calibration at 325, 400, and 475 ppm was made every 6 or 12 hours, as for the eddy CO2 measurements.

A suite of environmental measurements was also made on the tower. Dataloggers (CR-10X, Campbell Scientific, Logan, UT), controlled the overall operation of the system. The data were downloaded via coaxial cable to a computer, housed in a climate controlled hut near the tower.

**Sensors used include:**

- IRGA (INFRARED GAS ANALYZER)

## 6. Data Access:

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

**Data Archive Center:**

**Contact for Data Center Access Information:**

E-mail: [uso@daac.ornl.gov](mailto:uso@daac.ornl.gov)  
Telephone: +1 (865) 241-3952

## 7. References:

Hutyrá, L.R. 2007. Carbon and water exchange in Amazonian rainforests. Ph.D. Thesis, Department of Earth and Planetary Sciences, Harvard University, Cambridge, Massachusetts. With the kind permission of the author, this document is included as a companion file with this data set.

Hutyrá, L. R., J. W. Munger, S. R. Saleska, E. Gottlieb, B. C. Daube, A. L. Dunn, D. F. Amaral, P. B. de Camargo, and S. C. Wofsy. 2007. Seasonal controls on the exchange of carbon and water in an Amazonian rain forest, *J. Geophys. Res.*, 112, G03008, doi:10.1029/2006JG000365.

Saleska, S.R., Miller, S.D., Matross, D.M., Goulden, M.L., Wofsy, S.C., da Rocha, H., de Camargo, P.B., Crill, P., Daube, B.C., de Freitas, H.C., Hutyrá, L., Keller, M., Kirchhoff, V., Menton, M., Munger, J.W., Pyle, E.H., Rice, A.H., and Silva, H. 2003. Carbon fluxes in old-growth Amazonian rainforest: seasonality and disturbance-induced net carbon loss, *Science*, 302, 1554-1557.

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**Related Publications**

- Saleska, S.R., S.D. Miller, D.M. Matross, M.L. Goulden, S.C. Wofsy, H.R. da Rocha, P.B. de Camargo, P. Crill, B.C. Daube, H.C. de Freitas, L. Hutyrá, M. Keller, V. Kirchhoff, M. Menton, J.W. Munger, E.H. Pyle, A.H. Rice, and H. Silva (2003). Carbon in amazon forests: Unexpected seasonal fluxes and disturbance-induced losses. *Science*, Vol. 302, No. 5650, pp. 1554-1557.
- Xiao, X.M., Q.Y. Zhang, S. Saleska, L. Hutyrá, P. De Camargo, S. Wofsy, S. Frohling, S. Boles, M. Keller, and B. Moore. (2005) Satellite-based modeling of gross primary production in a seasonally moist tropical evergreen forest. *Remote Sensing of Environment* 94(1):105-122.
- Hutyrá, L.R., Munger, J.W., Nobre, C.A., Saleska, S.R., Vieira, S.A., Wofsy, S.C., Climatic variability and vegetation vulnerability in Amazonia, *Geophysical Research Letters*, 32, L24712, 2005.
- Huete, A.R., Didan, K., Shimabukuro, Y.E., Ratana, P., Saleska, S., Hutyrá, L.R., Yang, W., Nemani, R.R. and Myneni, R. Amazon rainforests green-up with sunlight in dry season, *Geophysical Research Letters*, 33, L06405, 2006.
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- Hutyrá, L.R., Munger, J.W., Gottlieb, E.W., Daube, B.C., Camargo, P.B., Wofsy, S.C., Controls on energy and carbon exchange in an evergreen tropical rainforest., submitted to *Journal of Geophysical Research, Biogeosciences*.



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