

LBA-ECO CD-03 Nocturnal Meteorological Data, Forest and Pasture Sites, Para, Brazil

Summary:

This data set contains measurements of nocturnal meteorological profiles collected from tethered balloon platforms during July 2001, October 2001, and November 2003. Measurements were made near the pasture/agricultural tower site at km 77 on BR-163 just south of the city of Santarem, and near the Tapajos National Forest, km 83 tower site, Santarem, Para, Brazil. Measurements collected include air temperature, wind speed and direction, and specific humidity. The 2003 measurements also included CO₂ concentrations. Sites were near enough to allow comparison between sounding profiles and tower data. There are three comma-delimited ASCII files with this data set.

Profiles were obtained from sunset until the first hours after sunrise. Each sounding provided information on temperature, humidity, horizontal wind magnitude and direction as the balloon went up and down. Typical soundings went up to 300 to 400 m. During most of the night, soundings were performed hourly. The balloon rose at a rate of 0.5 m per second in the first 100 m, and 2 m per second above 100 m. The time between successive samplings was 10 seconds. Intensive periods of shallow, successive soundings were performed starting at dawn, to catch the early development of the convective boundary layer (CBL). These early morning soundings went up only to the capping inversion.

Data Citation:

Cite this data set as follows:

Acevedo, O.C., D.R. Fitzjarrald, R.K. Sakai, O.L.L. Moraes and R. da Silva. 2012. LBA-ECO CD-03 Nocturnal Meteorological Data, Forest and Pasture Sites, Para, Brazil. Data set. Available on-line [<http://daac.ornl.gov>] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, U.S.A. <http://dx.doi.org/10.3334/ORNLDAAAC/1108>

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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: Physical Climate

Team ID: CD-03 (Fitzjarrald / Moraes)

The investigators were Fitzjarrald, David Roy; Acevedo, Otavio C; Anabor, Vagner; Brait, Eleazar; Czikowsky, Matthew John; Da Silva, Rodrigo; Martins, Cintya de Azambuja; Parker, Geoffrey ; Sakai, Ricardo; Sampaio, Irene Cibelle Goncalves; Silva, Julio Tota da; Siqueira, Adriano Costa; Staebler, Ralf Manfred; Tsoyref, Alexander E. and Zimmermann, Hans Rogerio. You may contact Acevedo, Dr. Otavio. (acevedo@pesquisador.cnpq.br).

LBA Data Set Inventory ID: CD03_Tethered_Balloon

This data set contains measurements of nocturnal meteorological profiles collected from tethered balloon platforms during July 2001, October 2001, and November 2003. Measurements were made near the pasture/agricultural tower site at km 77 on BR-163 just south of the city of Santarem, and near the Tapajos National Forest, km 83 tower site, Santarem, Para, Brazil. Measurements collected include air temperature, wind speed and direction, and specific humidity. The 2003 measurements also included CO2 concentrations. Sites were near enough to allow comparison between sounding profiles and tower data.

Related data sets:

- Fitzjarrald, D.R. and R.K. Sakai. 2010. LBA-ECO CD-03 Flux-Meteorological Data, km 77 Pasture Site, Para, Brazil: 2000-2005. 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/962](https://doi.org/10.3334/ORNLDAAC/962)
- Miller, S., M.L. Goulden, and H.R. da Rocha. 2009. LBA-ECO CD-04 Meteorological and Flux Data, km 83 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/946](https://doi.org/10.3334/ORNLDAAC/946)

2. Data Characteristics:

Data are provided in three comma-delimited ASCII files.

File # 1: [CD03_Balloon_2001_July.csv](#)

File # 2: [CD03_Balloon_2001_Oct.csv](#)

The file contents are the same for both 2001 files and the sampling site was only the pasture/agriculture site. There are no CO2 measurements for 2001 files. Example data records from each of the 2001 files are provided following the table below.

Column	Heading	Units/format	Description
1	Site		Sampling location: agriculture-500 meters from the km 77 tower south of Santarem
2	Year	yyyy	Year of the sampling campaign
3	Month	mm	Month of the year in which the sampling was done
4	Day	dd	Day of the month in which the sampling was done
5	Time	HH:MM	Time at the start of the ascent in local time on a 24 hour clock. Local time is GMT -5
6	Height	m	Sampling height in meters above the ground
7	T_air	degrees C	Air temperature in degrees Celsius
8	Humidity	g/kg	Specific humidity in grams per kilogram
9	Windspeed	m/s	Wind speed in meters per second
10	Wind_dir	degrees	Wind direction in degrees from north
Missing data values are represented as -9999			

Example data records: CD03_Balloon_2001_July.csv.

Site,Year,Month,Day,Time,Height,T_air,Humidity,Windspeed,Wind_dir
Agriculture,2001,7,26,0:33,0,21.16,15.60558,-0.2,316
Agriculture,2001,7,26,0:33,1,2,21.24,15.60442,-0.2,324
Agriculture,2001,7,26,0:33,3,6,21.46,15.70767,-0.2,320

Example data records: CD03_Balloon_2001_Oct.csv

Site,Year,Month,Day,Time,Height,T_air,Humidity,Windspeed,Wind_dir
Agriculture,2001,10,3,21:51,0,21.81,16.25193,-0.2,355
Agriculture,2001,10,3,21:51,0,21.83,16.27219,-0.1,350
Agriculture,2001,10,3,21:51,2,4,21.85,16.27597,-0.2,351
...
Agriculture,2001,10,8,18:57,447,26.1,15.98569,5.9,100
Agriculture,2001,10,8,18:57,449.4,26.09,15.97601,5.8,100
Agriculture,2001,10,8,18:57,452.4,26.05,15.93738,5.8,100
...
Agriculture,2001,10,11,7:04,144,23.59,16.89559,4.8,94
Agriculture,2001,10,11,7:04,148.8,23.58,16.92194,4.6,95
Agriculture,2001,10,11,7:04,150,23.52,16.84124,4.7,112

File # 3: CD03_Balloon_2003_Nov.csv

This file includes data on atmospheric CO2 concentrations. Sampling sites included the agriculture site and the forest site.

Column	Heading	Units/format	Description
1	Site		Sampling location: Pasture/agriculture was 500 meters from the km 77 tower; Forest was 5 km from the km 83 towers all south of Santarem
2	Year	yyyy	Year of the sampling campaign
3	Month	mm	Month of the year in which the sampling was done
4	Day	dd	Day of the month in which the sampling was done
5	Time	HH:MM	Time at the start of the ascent in local time on a 24 hour clock. Local time is GMT -5
6	Height	m	Sampling height in meters above the ground
7	T_air	degrees C	Air temperature in degrees Celsius

8	Humidity	g/kg	Specific humidity in grams per kilogram
8	CO2	ppm	Atmospheric CO2 concentration in parts per million
9	Windspeed	m/s	Wind speed in meters per second
10	Wind_dir	degrees	Wind direction in degrees from north
Missing data are represented as -9999			

Example data records : CD03_Balloon_2003_Nov.csv

```
Site,Year,Month,Day,Time,Height,T_air,Humidity,CO2,Windspeed,Wind_dir
Agriculture,2003,11,11,23:11,0,-9999,-9999,-9999,0,228
Agriculture,2003,11,11,23:11,5,24.07,18.88,442.56,0,213
Agriculture,2003,11,11,23:11,10,24.27,19,438.28,0,193.44
...
Agriculture,2003,11,18,22:46,255,30.2,16.81,349.42,5,100
Agriculture,2003,11,18,22:46,260,30.37,16.65,349.27,5.1,102
Forest,2003,11,23,19:11,0,-9999,-9999,-9999,0,334
...
Forest,2003,11,26,2:36,145,26.61,16.47,370.36,5.22,90
Forest,2003,11,26,2:36,150,26.73,16.41,369.81,5.3,87
Forest,2003,11,26,2:36,155,26.84,16.4,370.19,5.71,86
```

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

Site (Region)	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude	Geodetic Datum
Para Western (Santarem) - km 77 Pasture Tower Site (Para Western (Santarem))	-54.88850	-54.88850	-3.02020	-3.02020	World Geodetic System, 1984 (WGS-84)
Para Western (Santarem) - km 83 Logged Forest Tower Site (Para Western (Santarem))	-54.97070	-54.97070	-3.01700	-3.01700	World Geodetic System, 1984 (WGS-84)

Time period

- The data set covers the period 2001/07/26 - 2003/11/26
- Temporal Resolution: variable

Platform/Sensor/Parameters measured include:

- TETHERED BALLOON / THERMISTOR / AIR TEMPERATURE
- TETHERED BALLOON / HUMIDITY SENSOR / RELATIVE HUMIDITY

- TETHERED BALLOON / PRESSURE SENSOR / ATMOSPHERIC PRESSURE
- TETHERED BALLOON / WIND SENSOR / WIND SPEED/ WIND DIRECTION
- TETHERED BALLOON / IRGA (INFRARED GAS ANALYZER) / CARBON DIOXIDE

3. Data Application and Derivation:

These data were used to improve our estimations of ecosystem carbon budgets on calm nights when there is insufficient turbulence for eddy flux calculations. In tropical forest systems calm conditions at night are frequent and result in significant uncertainty in carbon budgets developed based on eddy flux approaches. These measurements allow an accurate determination of the nocturnal boundary layer thickness and trace the changes in the same over the course of the night.

4. Quality Assessment:

The manufacturer specifies precision of the DX6100 gas analyzer to be 1 ppm CO₂. To estimate accuracy, this sensor was compared with a model LI-7000 gas analyzer (Li-Cor, Inc., USA) both in the laboratory and in the field and with a LI-820 gas analyzer during profiling. Even though both temperature and pressure could potentially influence the measurements from the IRGA, our tests indicated that only temperature compensation needed to be applied here to the DX6100 signal. We found that the temperature influence on the CO₂ concentration data may be significant, a consequence of the small dimensions of the optical chamber and the fact that the small aluminum instrument body is in direct contact with the chamber that provides the readings. The corrections for the temperature were done by comparing the DX6100 signal to the outputs provided by a Licor LI-7000 IRGA.

5. Data Acquisition Materials and Methods:

Sites

Measurements were made near the pasture/agricultural tower site at km 77 on BR-163 just south of the city of Santarem, and the near the Tapajos National Forest, km 83 tower site, Santarem, Para, Brazil.

- The pasture/agricultural (deforested) site consists of a 500-ha area that was converted from forest into pasture in 1992. It is surrounded by primary and secondary forest, 25 km east of the Tapajos River. Topography, soil properties and vegetation are described by Sakai et al. (2004). Originally used as pasture for cattle ranching, the pasture was burned in November 2001 and the land was tilled and prepared for the planting of first rice and later soybeans.
- The measurements on the forested site were made in a 50 m by 80 m clearing surrounded by secondary forest with an approximately 35-m high canopy. These measurements were made 5 km from the LBA-ECO km 83 flux towers, where sensors on two towers have monitored the surface flux evolution in an area subject to selective logging (Miller et al., 2004).

Campaigns

Intensive tethered balloon campaigns were performed in 2001 during July and October, and in November, 2003.

2001 Campaigns:

- **2001/07/26 - 2001/07/30:** The site was in pasture. The weather during the first campaign (July) included the passage of a squall line on the night of 24 July 2001. Normally steady easterly winds were weaker than normal, owing to penetration of a cold air mass into the western Amazon basin (Silva Dias et al., 2003). Northerly winds were observed before the passage of the system, and in the following nights the usual pattern of easterlies dominated.

- **2001/10/03 - 2001/10/11:** During the second 2001 campaign no major synoptic events happened, and a consistent pattern was observed from night to night.
- **Sampling Design:** Profiles were obtained from sunset until the first hours after sunrise. The tethered balloon soundings were done in the field 500 m from the pasture tower, near enough to allow comparison between sounding profiles and tower data. Each sounding provided information on temperature, humidity, horizontal wind magnitude and direction as the balloon went up and down. Typical soundings went up to 300 to 400 m. During most of the night, soundings were performed hourly. The balloon rose at a rate of 0.5 m per second in the first 100 m, and 2 m per second above 100 m. The time between successive samplings was 10 s. Intensive periods of shallow, successive soundings were performed starting at dawn, to catch the early development of the convective boundary layer (CBL). These early morning soundings went up only to the capping inversion.

2003 Campaign:

- **2003/11/11 - 2003/11/26:** Measurements were made at the agriculture and forested site. The agricultural land was tilled during the week of the observations and there was no vegetation above the surface. CO₂ measurements were also made.
- **Sampling Design:** Profiles were obtained from sunset until the first hours after sunrise. During the night, the soundings were taken every hour, going either to 300 m altitude, or to the level at which the wind speed reached 12 m per second. The balloon ascended at 1 m per second.

Methods

Pressure, temperature and humidity were determined by the PTH module, developed at the Atmospheric Sciences Research Center (ASRC) by J. Berndt. The pressure observation is used for the determination of the sounding height. The pressure sensor is a model OMEGA PX72030AV (Omega Engineering, Inc., USA) (Acevedo et al., 2004).

Relative humidity was determined by a sensor HIH3605 (Honeywell, Inc., USA) and for the temperature observations a thermoresistor SI44006 (YSI, Inc., USA) was used. The temperature and humidity measured by the PTH module were calibrated against values measured independently provided by a Humitter 50Y/50U. The calibrations for these sensors are described in detail by da Silva (2006).

CO₂ gas concentration was measured during 2003 by a differential, nondispersive infrared gas analyzer (DX6100, RMT, Ltd., Moscow, Russia) that works on detection of the selective absorption of infrared radiation by the gas molecules. The sampling cell volume is 4.7 ml, the pump flow rate used was 1 liter per minute and the highest sampling frequency is 1 Hz (Acevedo et al., 2008).

The data were stored during sounding by a Tattletale 5F-LCD data logger (Onset Computer Corporation, USA). The sounding signal is transmitted by a radio system consisting of a transmitter AM-TXHP-433 and a receiver AM-HRR6-433 (ABACOM Technologies, USA), which is connected to a computer, at the ground. It allows the real time monitoring of the observations and provides a backup to the data stored in the data logger. Data were also recorded on board the sonde as a backup.

The combined sensors were fitted into a sonde that was installed below a tethered balloon, model Blimp 130 (BlimpWorks, USA). The balloon can operate up to 1000-m height. A Tethersonde (AIR, Inc., USA) provided wind speed and direction observations and an alternate set of temperature, humidity and pressure measurements. These data were recorded by a ground receiver.

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

Telephone: +1 (865) 241-3952

7. References:

Acevedo, O.C., O.L.L. Moraes, R. Da Silva, D.R. Fitzjarrald, R.K. Sakai, R.M. Staebler, and M.J. Czikowsky. 2004. Inferring nocturnal surface fluxes from vertical profiles of scalars in an Amazon pasture. *Global Change Biology* 10(5):886-894.

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