EOP Reference Site Data Set Metadata Information

LBA Santarem Site (October 01, 2002 to March 31, 2003 - EOP3, part A)

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Abstract

This document includes the Metadata and information the user should be aware of when using any of the LBA reference site data from the CEOP Central Data Archive (CDA) submitted for the measurement period October 01, 2002 to March 31, 2003. It includes a description of the measurement site, the instrumentation, the data collection and quality control procedures and some remarks pointing at peculiarities of specific data.

1. Data Set Overview

1.1 Site and Time Period

This description refers to the data from the LBA Santarem site for the period October 01, 2002 – 0000 UTC to March 31, 2003 – 2330 UTC.

1.2 Site Coordinates

All meteorological ~, radiation ~, soil ~, tower ~ and flux measurements have been performed at the LBA Santarem KM 83 Site. The coordinates for the KM 83 Santarem sites are:

DMS:	3° 1' 11" S	54° 58' 12 " W	
DD:	-3.02° S	-54.97° S	
UTM:	9665986.0	725623.7	21M

1.3 Site Operator

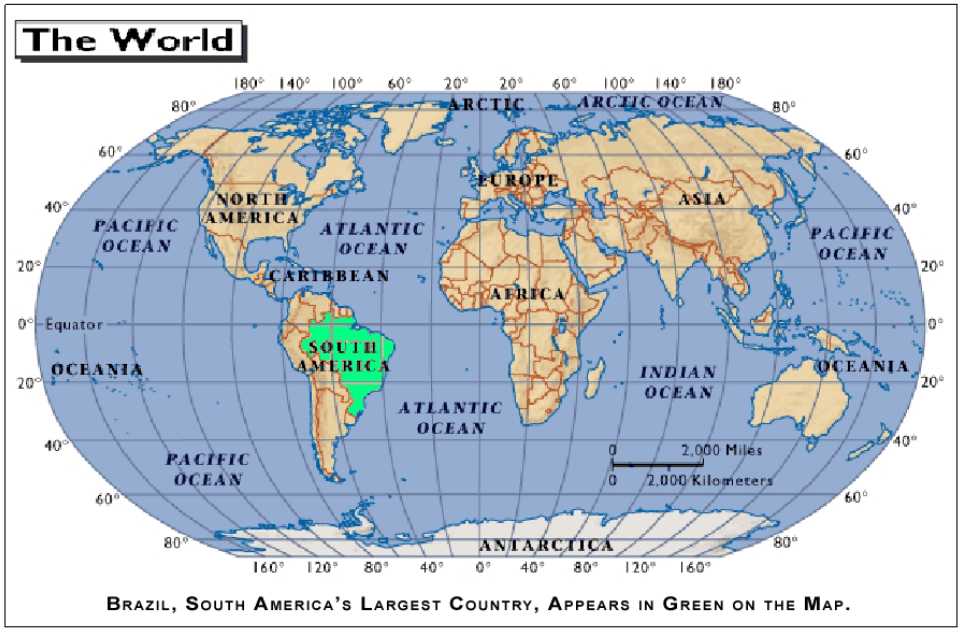
The LBA Santarem km 83 site is part of the LBA Project, managed by the Brazilian Institute for Amazon Research (INPA) which is subordinated to Brazilian Ministry of Science and Technology (MCT).

1.4 General Site Description

Landscape

Santarém is located in Western Pará, a port city of 250,000 people at the confluence of the Tapajós and Amazon Rivers. Many of the LBA-ECO intensive study sites are in or near the Tapajós National Forest (Flona Tapajós), which contains nearly 600,000 ha of protected old growth evergreen forest and is located 50 km south of Santarém. This national forest is bordered on the west by the Tapajós River and on the east by the highway BR 163, which intersects the Transamazon Highway about 180 km to the south of Santarém. The region receives about 2 m of rain each year with a seasonal pattern typical of much of eastern and southern Amazonia. The monthly rainfall extremes are March (375 mm) and October (50 mm; SUDAM, 1984). The Flona Tapajós has a variety of landforms and soils, which provide notable ecological contrasts for research. The Santarem site surface type is "Para Forest".

Figure 1 Map of Brazil in the World



BRAZIL, SOUTH AMERICA'S LARGEST COUNTRY, APPEARS IN GREEN ON THE MAP.

Figure 2 Map of Brazil in South America

Figure 3 Map of Pará State Seen From the Space

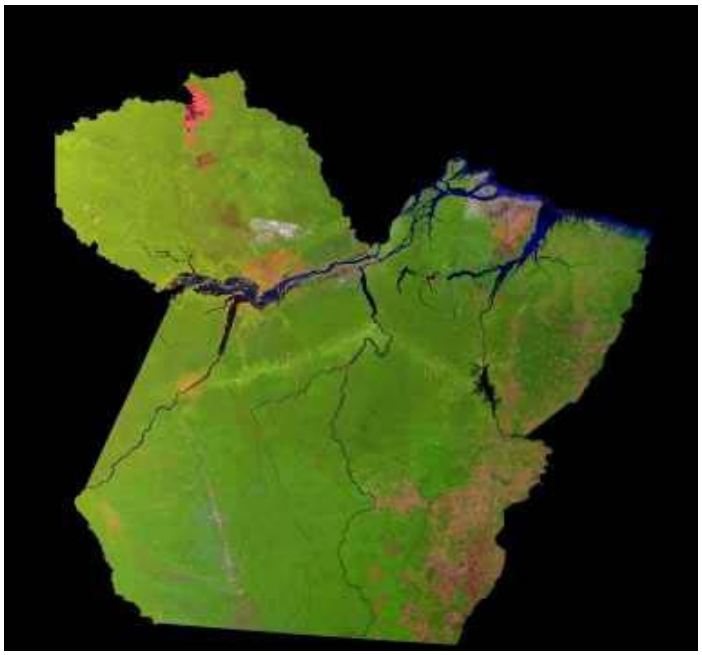


Figure 4 Map of the Pará Western (Santarém)

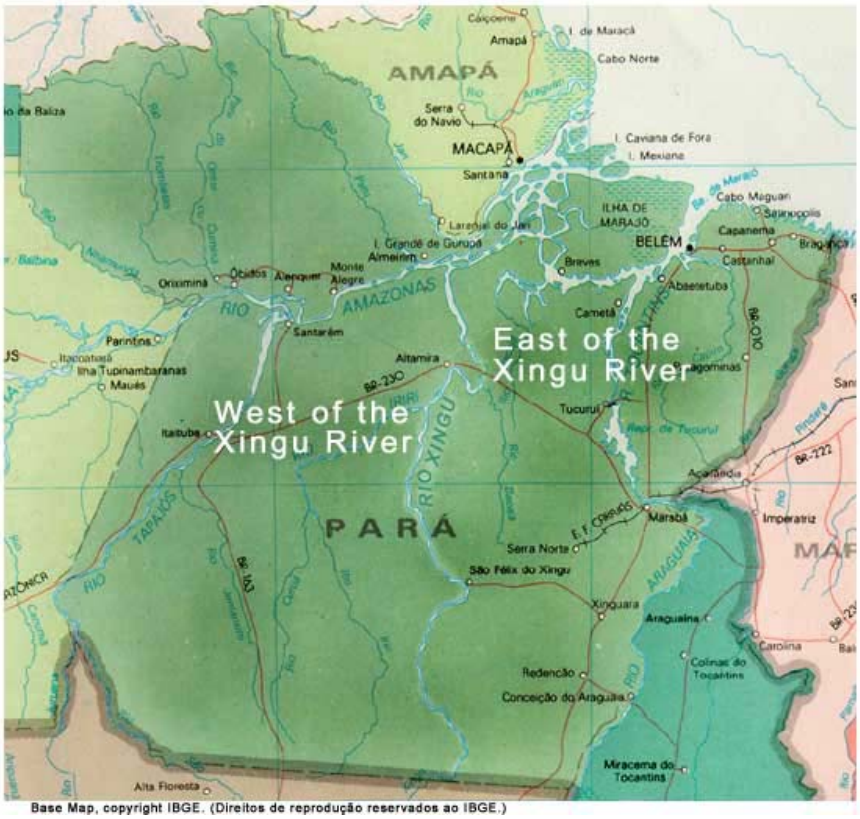


Figure 5 Location of LBA km 83 Logged Forest Tower Site

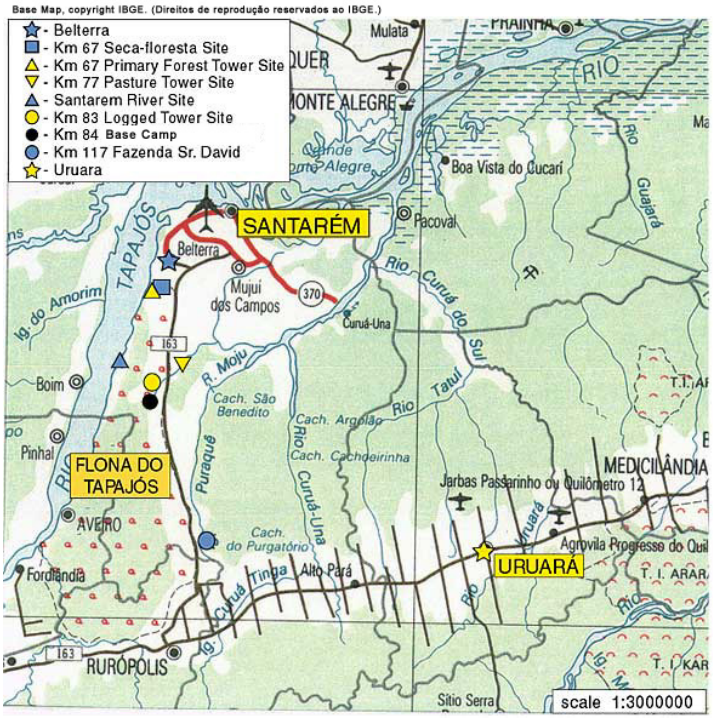


Figure 6 km 83 Santarem Forest Tower Site

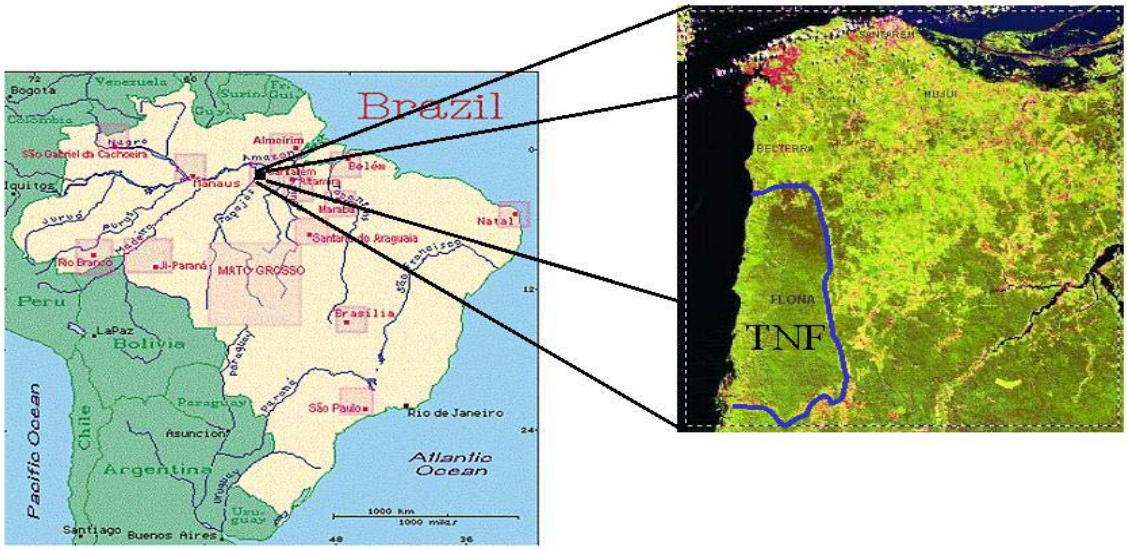


Figure 7 Entrance to km 83 Santarem Forest Tower Site

Figure 8 Santarem Flux Tower

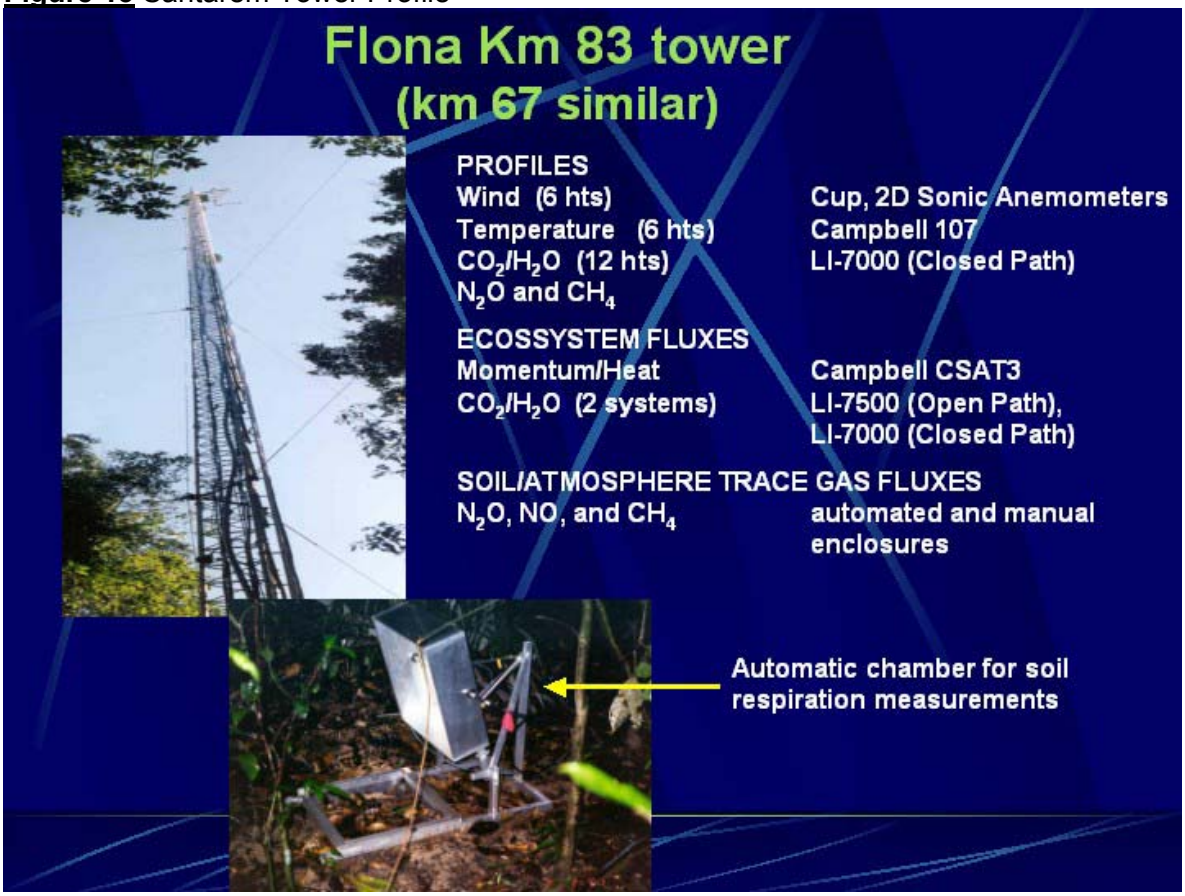
Figure 9 Santarem Site equipment house

Figure 10 Inside Santarem Site equipment house

Figure 11 Santarem Site scaffold tower above tree canopy

Figure 12 Santarem Site scaffold tower and Flux Tower in the background

Figure 13 Santarem Tower Profile



Soil

The landscape of the Tapajos National Forest can be divided into 3 units. The western portion of the forest that borders on the Tapajós River is characterized by a belt of dissected westward draining terrain called *flanco* that varies in width from 50 to 30 km. In the northern portion of the Tapajos National Forest, the *flanco* borders on an eastward draining plateau (*planalto).*(Parrotta et al. 1995). Toward the south of the forest (approximately south of the intersection of the Rio Moju with the BR-163 at km 135) the plateau becomes increasingly dissected. In order to remain close to Santarém and to select sites with relatively flat topography for eddy flux measurements we concentrated our site selection activities in the region of the plateau. The Tapajos National Forest is located in the Amazon River Valley, a low sedimentary area dominated by Tertiary and Quaternary sediments located between the pre-Cambrian shield regions of Central Brazil and the Guyanas. The plateau portion of the Tapajos National Forest is underlain by the "Belterra clay" described in detail by Sombroek (1966) who identified this surface in Belterra. The soils formed on this surface are common throughout the eastern Amazon are primarily classified according to the Brazilian system as *Latossolo amarelo distrófico* which correspond generally to Oxisols in the USDA classification. These soils are acidic, have a low base saturation and cation exchange capacity and have a high clay content. While clay soils predominate in the plateau area of the Tapajos National Forest, we have also found sandy soils particularly in the forest near km 83 in the area of the logging project.

Climate
The Tapajos National Forest is an area of forested vegetation wedged between a managed mosaic of forests, pastures, agricultural fields and secondary succession to the east and the expansive Tapajos River to the west. With predominant easterlies during much of the year, one can expect a less turbulent but still convective boundary layer to grow from the forested edge to the west, as the air passes from the hot, smoother flow over the pastures, to the rough, relatively cooler near surface air over the TNF. Carbon uptake as measured at towers in the TNF may present a biased view of the regional situation because of variations in cloudiness. At least during the dry season, presence of clouds is strongly determined by the strength of the easterlies and by proximity to the river.
Conditions further inland can be somewhat different than over the TNF. Judging from a reduced tendency for afternoon wind shifts at Belterra, we infer that the direct importance of the river breeze circulation has already been seen to wane with the onset of the rainy season. However, results from ABLE-2 indicate that a convergence zone can be set up inland, even when the wind direction does not shift in the afternoon. During the site visit to the km 67 site, the wind shifted to westerly in the late afternoon, and the IBAMA guards verified that this was common.

1.5 Site References

http://lba.cptec.inpe.br/lba/eng/research/santarem_report/santarem_report.pdf
http://www.cnpm.embrapa.br/projects/cdbrasil_us/

2. Instrumentation Description

2.1 Towers at km 83 Logged Forest Tower Site

This data set was formed by extracting the top of the hour observations from the 30 minute native format data. The data were provided in GMT time. The U and V wind components were computed from wind speed and direction. The dew point was computed from the temperature and relative humidity (Bolton, 1980). Specific Humidity values were computed from the calculated dew point and station pressure using formulas from Wexler and Wildhack (1963).
The equations used to derive the dew point and relative humidity
> need to be provided in the documentation

The precipitation data set was formed by summing the previous bottom of the hour and current top of the hour 30 minute values. The Incoming PAR, Outgoing PAR, Incoming Shortwave, Outgoing Shortwave, and the Net Radiation values were measured at the 21m level. The Latent Heat Flux reported in this data set were measured with the Licor IRGA.

3. Data Collection and Processing

3.1 Data Collection

The study area is located in the Tapajos National Forest (FNT) in the State of Pará, a conservation Unit with 6×105 ha of area of tropical humid forest, with canopy vegetation averaging 40 meters high, approximately 70 km south of Santarém. The instrumental platform was installed in June 2000, approximately 2 km the West of km83 entrance for the Cuiabá-Santarém Highway and about 14 km the east of the eastern edge of the Tapajos River Composed by a micrometeorological tower 67m Height (Rohn type 55G - Peoria IL with triangular base, 46 cm of transversal section and energy consumption of 1000W/120V/60Hz), beyond instruments installed in the ground and tripods of 2m height inside the forest. The system energy is supplied by a diesel generator located at 800m to the south of the tower. The soils formed on this surface are common throughout eastern Amazon and are primarily classified according to the Brazilian system as *Latossolo amarelo distrófico.* In September 2001 it was presented a demonstration of Selective Logging, carried out by CEMEX under IBAMA supervision, with support from the American Forest Service (USFS) and Tropical Forest Foundation (FFT).

Data collection is achieved by a system composed of five data loggers (Campbell Scientific CR10x or CR23x), connected to a central microcomputer (Dell Computer), running computer software PC208W (Campbell data-logger support software - version 3.1) which is in charge of storing data in archives of type *"slow files",* containing average values of 30 minutes, and *"fast files",* containing measured values at frequencies of 4.0, 1.0, 0.5, or 0.1 *Hz*. The dates-loggers" had been originally named as:

- Air Temperature and zonal components, southern and vertical from the wind, proceeding from a sonic anemometer (Campbell CSAT3 3-D) at 4 Hz; water vapor and CO_2 concentrations, coming from an Open-Path Infrared Gas Analyzer (IRGA LICOR LI7500) at 4 Hz.
    1. Radiation Balance proceeding from balance-radiometer (Campbell Q-7.1); spectral irradiances of short wave incident and reflected, proceeding from the Thermopile Pyranometer (Kipp & Zonen CM6B); spectral irradiances of incident and emitted long wave, proceeding from the Pyrgeometer (Kipp & Zonen CG2); photosynthetically active radiation (PAR), incident and reflected, proceeding from photosynthetically active radiation (PAR) PYRANOMETER (LICOR LI190); and precipitation proceeding from Tipping Bucket Rain Gage (Texas Electronics TE525)
- "Profile" (CR10x), responsible for the acquisition, at 1.0 *Hz frequency*, of measures taken through the tower (profile), that includes: air temperature at 64, 40, 30, 20, 10 and 2 meters of altitude, proceeding from ventilated temperature probes (Met One 076B or Campbell 107); horizontal wind speed taken at 64, 50 and 40 *meters* of altitude, proceeding from cup anemometers (Met One 014)
- "Eddy" (CR23x), in charge of acquiring, at 4.0 Hz frequency, water vapor and CO_2 concentrations, coming from two Closed Loop Infrared Gas Analyzers (IRGA) LICOR LI7000, at the top and throughout the tower at levels of 64, 50, 40, 35, 20, 10.7, 6.0, 3.0, 1.4, 0.7, 0.35 and 0.1 meters.
- "Forest" (CR10x), in charge of acquiring, at 0.1 Hz frequency, measures inside the dossal and underground. The variables collected are:
    - Air temperature at 1.0 and 2.0 meters high collected using ventilated temperature probes (Campbell 107).
    - Surface precipitation using 5 Tipping Bucket Rain Gage Pluviometers (Texas Electronics TE525) distributed in the forest.
    - Soil heat flux at 10 centimeter depth using 5 sensor radiation and energy balance heat flux sensors (REBS HFT3.1).
    - Soil temperature at depths of 2, 5, 10, 20, 50, 150 and 200 centimeters using thermo sensors (Omega Engineering)
    - Soil humidity at depths of 5, 10, 20, 40, 60, 80, 100, 120, 140, 160, 180, 200, 225, and 250 centimeters using water content reflectometer (Campbell CS615)

4. Quality Control Procedures

5. Gap filling Procedures

Data processing/gap filling: the procedure is described in Miller et al (2004) Ecological Applications and Saleska et al (2003) Science articles. With all missing data periods, we encourage people to develop their own gap filling strategy.

6. Data Remarks

This section gives specific additional information on different parameters the user should be aware of when using the data:
Specific humidity and pressure are needed to derive the moisture parameters Td (dew point temperature) and RH (relative humidity); if one of them is missing, then the derived parameters are also flagged this way ('M', for missing); if one of them is estimated (or dubious), then the derived parameters are also flagged 'I', for estimated (or 'D', for dubious).

The moisture parameters were derived using the equations suggested in the CEOP web page. In the absence of measured pressure values an estimated value was used in the derivations: for the EOP3 part 1 data set the pressure mean value from October 1 to December 30 (when pressure was available) was used in the derivations for December 31 to March 31 (there was no measured pressure values for this period); for the EOP3 part 2 data set the site contacts suggested a 1000mb mean value for the pressure in the period.

Disclaimer

The data from the Santarem LBA Site have undergone the QA/AC procedure described in section 4 before being transferred to the CEOP Central Data Archive (CDA). The data supplier, however, cannot guarantee the absence of any errors and can not take over any responsibility for the results coming out of the use of the data. Data users who should discover problems, inconsistencies or any questionable effects when using the Santarem data are kindly invited to contact the Santarem site and/or data managers.

7. Reference Requirements

Use of the Santarem reference site data should be made according to the CEOP policy rules outlined in the CEOP Reference Site Data Release Guidelines. The Santarem data is freely available and we encourage others to use it. Kindly keep inform the originators of the data of how you are using their data and of any publication plans. Please acknowledge the data source as a citation or in the acknowledgments if the data have not yet been published. If the data originators feel that they should be offered participation as authors, they will let you know and we assume that an agreement on such matters will be reached prior to publishing the data. If your work directly competes with analyses under-way by the data originators, we may ask that they have the opportunity to submit a manuscript before you submit one that uses unpublished data. In order to maintain our measurement program we periodically need to demonstrate progress to our sponsoring agencies. In addition to informing us of your plans, we kindly request that you help us by providing preprints and updates on publication status.

The data source should be referred to as: The Large Scale Biosphere-Atmosphere Experiment in Amazon (LBA).