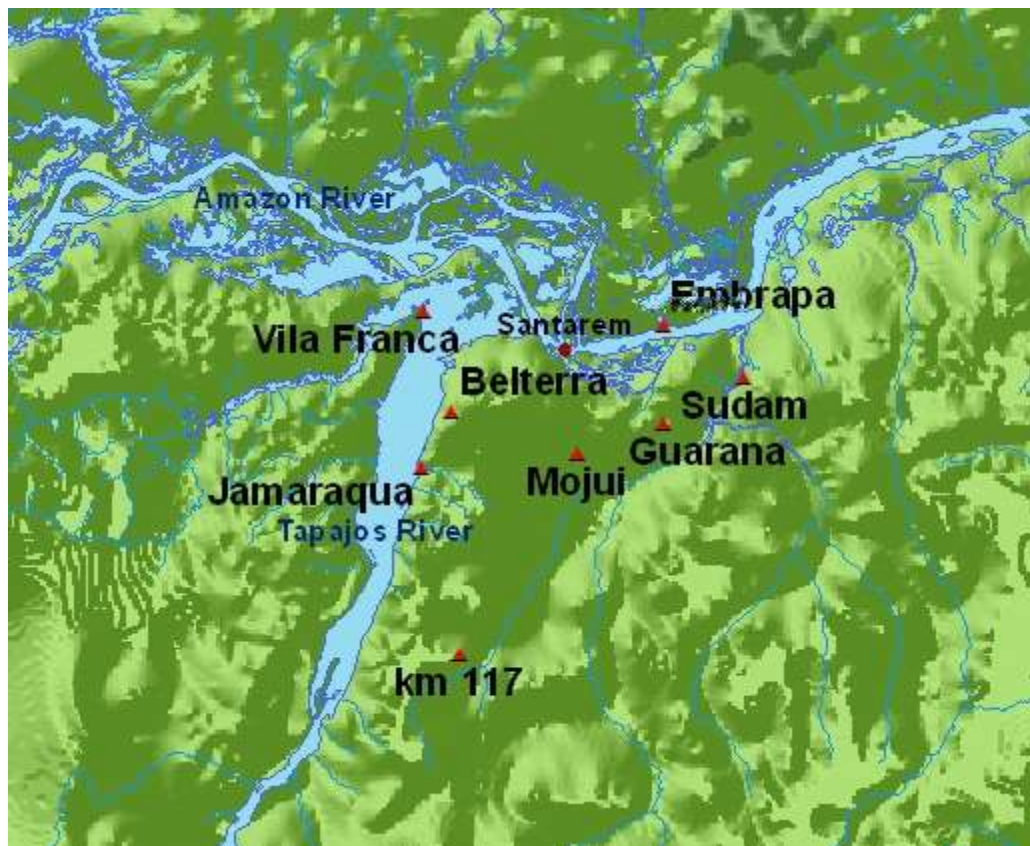


LBA-ECO CD-03 Mesoscale Meteorological Data, Santarem Region, Para, Brazil: 1998-2006

Summary:

A mesoscale network has been set up in the Santarem region of Para, Brazil. This network consists of eight meteorological stations named Belterra, Km 117 (Fazenda Sr. Davi), Mojui, Jaramaqua, Guarana, Embrapa (Cacoal Grande), Vila Franca and Sudam (Curua Una). Belterra and Km 117 stations have been almost continuously collecting data since August, 1998, respectively. Mojui, Jaramaqua, and Guarana have been collecting data since July, 2000. Embrapa, Vila Franca and Sudam stations have been collecting data since 2002.

Data are presented in 52 individual comma-separated ASCII files. Each file contains data from one calendar year for one site; both site and year are identified clearly in the data file name and all files follow the same header information and organizational structure. Measurements include air temperature and pressure, wind speed and direction, relative humidity, downward solar radiation, and at some stations soil temperature and moisture.



Locations of eight meteorological stations in the Santarem region of Para, Brazil.

Data Citation:

Cite this data set as follows:

Fitzjarrald, D.R., R.K. Sakai and O.L.L. de Moraes. 2009. LBA-ECO CD-03 Mesoscale Meteorological Data, Santarem Region, Para, Brazil: 1998-2006. 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/944](https://doi.org/10.3334/ORNLDAAC/944)

Implementation of the LBA Data and Publication Policy by Data Users:

The LBA Data and Publication Policy [http://daac.ornl.gov/LBA/lba_data_policy.html] is in effect for a period of five (5) years from the date of archiving and should be followed by data users who have obtained LBA data sets from the ORNL DAAC. Users who download LBA data in the five years after data have been archived must contact the investigators who collected the data, per provisions 6 and 7 in the Policy.

This data set was archived in September of 2009. Users who download the data between September 2009 and August 2014 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: Physical Climate

Team ID: CD-03 (Fitzjarrald / Moraes)

The investigators were Fitzjarrald, David R.; Moraes, Osvaldo Luiz Leal de; Acevedo, Otavio C; Czikowsky, Matthew J.; Sakai, Ricardo and Tsoyreff, Alexander . You may contact Fitzjarrald, Dr. David R. (fitz@asrc.cestm.albany.edu) and Sakai, Dr. Ricardo K. (sakai@asrc.cestm.albany.edu)

Soil moisture 0.2 m	X	X	X	X	X	X	X	X	X
Km 117									
Met Station	X	X	X	X	X	X	X	X	X
Soil Temp .05m	X	X	X	X	X	X	X	X	X
Soil Temp 1 m	X	X	X	X	X	X	X		
Soil moisture .2 m	X	X	X	X	X	X	X	X	X
Guarana									
Met Station			X	X	X	X	X	X	
Soil Temp .05m			X	X	X	X	X	X	
Soil Temp 1 m			X	X	X	X	X	X	
Soil moisture .2 m			X	X	X	X	X	X	
Mojui									
Met Station			X	X	X	X	X	X	X
Soil Temp 0.05m			X	X	X	X	X	X	X
Soil Temp 1 m			X	X	X	X	X	X	X
Soil moisture 0.2 m			X	X	X	X	X	X	X
Jamaraqua									
Met Station			X	X	X	X	X	X	X
Soil Temp 0.05m			X	X	X	X	X	X	X
Soil Temp 1 m			X	X	X	X	X	X	X
Soil moisture 0.2 m			X	X	X	X	X	X	X
Embrapa									
Met Station					X	X	X	X	X
Soil Temp 0.05m					X	X	X	X	X
Soil Temp 1 m									
Soil moisture 0.2 m					X	X	X	X	X
Sudam									
Met Station					X	X	X	X	
Soil Temp 0.05m					X	X	X	X	
Soil Temp 1 m									
Soil moisture 0.2 m					X	X	X	X	
V. Franca									
Met Station					X	X	X	X	X
Soil Temp 0.05m					X	X	X	X	X
Soil Temp 1 m									
Soil moisture 0.2 m					X	X	X	X	X

*** Meteorological Station measurements reported include: Temperature air, Relative humidity, Solar radiation, Air pressure, Wind speed, Wind direction, and Precipitation.

Data Description:

Heading	Units or Format	Description
Year	(YYYY)	Year
Julian_day	fractional day	Julian day or fractional day (e.g., 1.22917) corresponding to the middle of the averaging period (1 hour) based on GMT. Local time is GMT-4.
Hour	fractional hour	Fractional hour corresponding to the middle of the averaging period (1 hour). Using a 24 hour clock based on GMT.
T_air	degrees C	Air Temperature
RH_air	%	Relative humidity
S_dw	W/m2	Downward solar radiation: 280-2800 nm wavelengths
pressure	millibars	Atmospheric pressure with a 1000 mbar offset: ie a reading of 998 mbars is reported as -2
sd_T_air	degrees C	Standard deviation of the air temperature
sd_RH_air	%	Standard deviation of relative humidity
sd_S_dw	W/m2	Standard deviation of downward solar radiation
sd_press	millibars	Standard deviation of atmospheric pressure
sd_WS	m/s	Standard deviation of the mean wind speed
wind_speed	m/s	Mean horizontal scalar wind speed
vector_WS	m/s	Mean horizontal resultant vector wind speed
WD	degrees	Mean horizontal resultant vector wind direction
sd_WD	degrees	Standard deviation of the wind direction
max_T_air	degrees C	Maximum recorded air temperature
max_RH_air	%	Maximum recorded relative humidity
max_S_dw	W/m2	Maximum recorded downward solar radiation
max_press	millibars	Maximum recorded air pressure
max_WS	m/s	Maximum recorded wind speed
min_T_air	degrees C	Minimum recorded air temperature
min_RH_air	%	Minimum recorded relative humidity
min_S_dw	W/m2	Minimum recorded downward solar radiation
min_press	millibars	Minimum recorded air pressure
min_WS	m/s	Minimum recorded wind speed
precip	mm	Total precipitation for the one hour sampling interval
Tsoil_1	degrees C	Soil temperature 0.05 m depth in degrees C
Tsoil_2	degrees C	Soil temperature 1 m depth in degrees C
soil_moisture	%	Soil moisture at 0.2 m depth: reported as percent on a volume basis
sd_Tsoil_1	degrees C	Standard deviation of soil temperature 0.05 m depth
sd_Tsoil_2	degrees C	Standard deviation of soil temperature 1 m depth
sd_soil_moisture	%	Standard deviation of soil moisture at 0.2 m depth

batt	V	Battery charge
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Example Data Records:

Missing data is represented by -9999. Placeholder missing values are included in a data file even when a parameter was not measured at that site to maintain consistent file format across files from all sites / years.

Data records from file cd03_belterra_1998_hourly_met_data.csv

Year,Julian_day,Hour,T_air,RH_air,S_dw,pressure,sd_T_air,sd_RH_air,sd_S_dw,sd_press,sd_WS,wind_speed, vector_WS,WD,sd_WD,max_T_air,max_RH_air,max_S_dw,max_press,max_WS,min_T_air,min_RH_air, min_S_dw,min_press,min_WS,precip,Tsoil_1,Tsoil_2,soil_moisture,sd_Tsoil_1,sd_Tsoil_2,sd_soil_moisture,batt
1998,233.8125,19.5,32.75,52.81,461.31,-9999,0.32,1.57,162.7,-9999,0.94,2.79, 2.52,99.3,25.01,33.42,56.91,684.68,-9999,6.4,32.04,49.18, 94.03,-9999,0.8,0,-9999,-9999,-9999,-9999,-9999,-9999,-9999
1998,233.85417,20.5,31.85,58.46,249.93,-9999,0.39,2.04,73.5,-9999,0.85,2.29, 2.1,98.8,23.39,32.5,62.65,384.49,-9999,5.6,31.06,54.05, 129.05,-9999,0,0,-9999,-9999,-9999,-9999,-9999,-9999,-9999
...
1998,365.9375,22.5,26.7,79.2,0,-9999,0.43,2.21,0.04,-9999,0.47,1.29, 1.24,125.1,15.48,27.56,82.2,0.65,-9999,2.4,26.22,74.3, -0.65,-9999,0,0,-9999,-9999,-9999,-9999,-9999,-9999,-9999
1998,365.97917,23.5,25.97,82.9,0,-9999,0.17,1.4,0.02,-9999,0.47,1.52, 1.48,130.4,14.12,26.31,85.6,0,-9999,3.2,25.71,80.2, -0.65,-9999,0,0,-9999,-9999,-9999,-9999,-9999,-9999,-9999

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) - Fazenda Sr. David (km 117) (Para Western (Santarem))	-54.924	-54.924	-3.3502	-3.35	World Geodetic System, 1984 (WGS-84)
Para Western (Santarem) - Jaramaqua - Santarem	-55.03639	-55.03639	-2.80639	-2.80639	World Geodetic System, 1984 (WGS-84)

River Site (Para Western (Santarem))					
Para Western (Santarem) - Mojui (Para Western (Santarem))	-54.57917	-54.57917	-2.76667	-2.76667	World Geodetic System, 1984 (WGS-84)
Para Western (Santarem) - Belterra (Para Western (Santarem))	-54.94361	-54.94361	-2.6431	-2.6431	World Geodetic System, 1984 (WGS-84)
Para Western (Santarem) - Guarana (Para Western (Santarem))	-54.32472	-54.32472	-2.67694	-2.67694	World Geodetic System, 1984 (WGS-84)
Para Western (Santarem) - Cacoal Grande (Para Western (Santarem))	-54.32861	-54.32861	-2.38944	-2.38944	World Geodetic System, 1984 (WGS-84)
Para Western (Santarem) - Vila Franca (Para Western (Santarem))	-55.02889	-55.02889	-2.34861	-2.34861	World Geodetic System, 1984 (WGS-84)
Para Western (Santarem) - Curua Una (Para Western (Santarem))	-54.09083	-54.09083	-2.54417	-2.54417	World Geodetic System, 1984 (WGS-84)

Time period:

- The data set covers the period 1998/08/20 to 2006/12/31.
- Temporal Resolution: Hourly

Platform/Sensor/Parameters measured include:

- METEOROLOGICAL STATION / AIR THERMOMETER (VAISALA, HMP45C) / AIR TEMPERATURE
- METEOROLOGICAL STATION / HUMIDITY SENSOR (VAISALA, HMP45C) / HUMIDITY
- METEOROLOGICAL STATION / CUP ANEMOMETER (MET ONE 014A, 034A-L) / WIND SPEED
- METEOROLOGICAL STATION / WIND VANE (MET ONE 024, 034A-L) / WIND DIRECTION
- METEOROLOGICAL STATION / PYRANOMETER (LICOR, LI-200SZ) / SOLAR RADIATION
- METEOROLOGICAL STATION / BAROMETER (VAISALA, PTB 101) / ATMOSPHERIC PRESSURE
- METEOROLOGICAL STATION / RAIN GAGE (CAMPBELL, TE525MM) / PRECIPITATION AMOUNT
- METEOROLOGICAL STATION / THERMISTOR (CAMPBELL, 107) / SOIL TEMPERATURE
- METEOROLOGICAL STATION / TIME DOMAIN REFLECTOMETER (CAMPBELL, CS615) / SOIL MOISTURE/WATER CONTENT

3. Data Application and Derivation:

This CD-03 effort aims to assess how the special mesoclimatic characteristics of the LBA Santarem study area might introduce a bias in standard climatic variables and, potentially, in ecosystem productivity estimates. In the Santarem study areas, for example, the tall flux towers are located in a thin area of forest sandwiched between cleared lands and near to large rivers that are known to influence cloudiness and alter winds in their proximity. The mesoclimate of the region must be understood before results regarding net forest carbon uptake can be generalized.

The need to document radiation, rainfall and temperature anomalies led to the development of a network of eight surface weather stations. Results for the first six years of data indicate that that temperature and precipitation are higher and wind speed is lower during the LBA-ECO years compared to the recent past. The daily averaged wind speed at Santarem correlates well with the observed Belem-Santarem surface pressure difference. From composite data we deduced the river breeze pressure gradient forcing, and identified double diurnal peaks in precipitation and specific humidity. The precipitation peak in the early morning hours is consistent with previous studies of propagating squall line circulations from the Atlantic coast. However, for inland areas away from the rivers, the nocturnal period precipitation contributes less than half of total precipitation. Nocturnal flows following local topographic gradients are seen, including the terral along the Tapajos River south of Jaramaqua identified by Bates (1864).

The most striking mesoclimatic difference is in incident solar radiation and its variation. Owing to over-river clearing provoked by the daytime river breeze, there is 20-30% more incident radiation along the river than inland. The corresponding diminution in the standard deviation of the solar radiation verifies the diminished cloudiness. A large-scale rainfall increase just to the west of Santarem manifests itself locally as a 'tongue' of enhanced rain from along the wide area of open water at the Tapajos-Amazon confluence. The Amazon River breeze circulation affects rainfall more than does the Tapajos breeze, which moves contrary to the predominant wind. East of the riverbank the Tapajos breeze influence on precipitation extends only a few kilometers inland. Rainfall increases to the north of the Amazon, possibly the result uplift over elevated terrain. Dry season rainfall increases by up to 30% going away from the Amazon River, as would be expected given breeze subsidence over the river. This reinforces the idea that stations close to the rivers are biased. These results indicate the data from the standard climatic stations, all located near the river, be used in producing model parameterizations only after allowing for these mesoclimatic biases.

4. Quality Assessment:

There are no known problems with these data.

5. Data Acquisition Materials and Methods:

The met stations consist of a 10 m tower with a Campbell Scientific dataloggers, powered by a solar panel. Data are sampled at 0.5 Hz and a mean, standard deviation and both minimum and maximum values are recorded at hourly intervals for most variables. Precipitation is the cumulative amount for the entire sampling period. The sensors used and installation arrangements at each site are listed below.

Sensor positions (Belterra, Km 117, Mojui, Guarana, Jamaragua):

- Air temperature and relative humidity, (Vaisala, model HMP45C): 2.5 m
- Downward solar radiation, (Licor, model LI200Sz): 8.5 m
- Windspeed and direction, (Met One, model 034A): 10 m
- Pressure,(Vaisala, model PTB101B): 1.9 m(Km 117), 1.7m (Belterra,Mojui, Guarana, Jamaragua)
- Precipitation, (Texas inst., model TE525): 0.5 m
- Soil temperature 1, (Campbell, model 107): 0.05 m
- Soil temperature 2, (Campbell, model 107): 1 m
- Soil moisture, (Campbell, model CS615): 0.2 m

Sensor positions (Embrapa, V. Franca, Sudam):

- Air temperature and relative humidity: 3 m
- Downward solar radiation: 3 m
- Windspeed and direction: 3 m
- Pressure(Vaisala, model PTB101B): 1.7 m
- Precipitation (Texas inst., model TE525): 0.5 m
- Soil temperature 1(Campbell, model 107): 0.05 m
- Soil temperature 2(Campbell, model 107): NA
- Soil moisture (Campbell, model 615): 0.2 m

Collection periods for meteorological and soil measurements varied by site and are listed in the accompanying documentation.

Sensors used include:

- AIR THERMOMETER (VAISALA, HMP45C)
- HUMIDITY SENSOR (VAISALA, HMP45C)
- CUP ANEMOMETER (MET ONE 014A, 034A-L)
- WIND VANE (MET ONE 024, 034A-L)
- PYRANOMETER (LICOR, LI-200SZ)
- BAROMETER (VAISALA, PTB 101)
- RAIN GAGE (CAMPBELL, TE525MM)
- THERMISTOR (CAMPBELL, 107)
- TIME DOMAIN REFLECTOMETER (CAMPBELL, CS615)

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:

Bates, H.W., 1864. A Naturalist on the River Amazons, second edition, reprinted by U. Cal. Press, 1962, 465 pp.

Related Publications

- Fitzjarrald D.R., Sakai, R.K., Moraes, O.M.M., Cosme, R.O., Acevedo, O.C., and Czikowsky, M.J. 2008. Spatial and temporal rainfall variability near the Amazon-Tapajos confluence. Submitted to Journal of Geophysical Research Biogeosciences.