LBA-ECO TG-02 Biogenic VOC Emissions from Brazilian Amazon Forest and Pasture Sites

Summary:

This data set reports concentrations of biogenic volatile organic compounds (BVOCs) collected from tethered balloon-sampling platforms above selected forest and pasture sites in the Brazilian Amazon in March 1998, February 1999, and February 2000.

The air samples were collected from forested sites in Brazil: the Tapajos forest (Para) in the Tapajos/Xingu moist forest; Balbina (Amazonas) in the Uatuma moist forest; and Jaru (Rondonia) in the Purus/Madeira moist forest. Two other sites were also located in Rondonia: at a forest reserve (Rebio Jaru) and a pasture (Fazenda Nossa Senhora Aparecida).

The BVOCs measured included isoprene, alpha and beta pinene, camphene, sabinene, myrcene, limonene, and other monoterpenes. Approximately 24 to 40 soundings, including as many as four VOC samples collected simultaneously at various altitudes, were made at each site. There is one comma-delimited data file with this data set.

Data Citation:

Cite this data set as follows:

Greenberg, J.P. 2012. LBA-ECO TG-02 Biogenic VOC Emissions from Brazilian Amazon Forest and Pasture Sites. 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/ORNLDAAC/1110

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This data set was archived in August of 2012. Users who download the data between August 2012 and July 2017 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 website [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.

Table of Contents:

1. Data Set Overview:

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

Activity: LBA-ECO

LBA Science Component: Trace Gas and Aerosol Fluxes

Team ID: TG-02 (Guenther / Gatti)

The investigators were Artaxo, Paulo Eduardo; Baker, Bradley; Baugh, William Matthew; Brasseur, Guy; Fall, Richard Ray; Gatti, Luciana Vanni; Greenberg, James P.; Guenther, Alex B.; Harley, Peter Campbell; Hills, Alan; Klinger, Lee; Pegoraro, Emiliano; Rinne, Janne; Tavares, Tania Mascarehn; Vasconcellos, Perola de Castro; Bustillos, Oscar Vega and Vierling, Lee Alexander. You may contact Greenberg, James P. (greenber@ucar.edu).

LBA Data Set Inventory ID: TG02_Balloon_VOC

This data set reports concentrations of biogenic volatile organic compounds (BVOCs) collected from tethered balloon-sampling platforms above selected forest and pasture sites in the Brazilian Amazon in March 1998, February 1999, and February 2000.

The air samples were collected from forested sites in Brazil: the Tapajos forest (Para) in the Tapajos/Xingu moist forest; Balbina (Amazonas) in the Uatuma moist forest; and Jaru (Rondonia) in the Purus/Madeira moist forest. Two other sites were also located in Rondonia: at a forest reserve (Rebio Jaru) and a pasture (Fazenda Nossa Senhora Aparecida).

The BVOCs measured included isoprene, alpha and beta pinene, camphene, sabinene, myrcene, limonene, and other monoterpenes. Approximately 24 to 40 soundings, including as many as four VOC samples collected simultaneously at various altitudes, were made at each site.

2. Data Characteristics:

Data are available in one comma separated ASCII file:

TG02_Balloon_BVOC_Summary.csv

Column	Heading	Units/format	Description
1	Site		Sampling site name: the Abracos site is a pasture site all others were forest sites
2	Land_cover		Vegetation cover at the sampling site either forest or pasture
3	Date	YYYYMMDD	Sampling date (YYYYMMDD)
4	Time	HH:MM	Sampling time in local time on a 24 hour clock: time is the start time of a 30 minute sampling period
5	Altitude	m	Sampling height in meters: AMLC (average mixed layer concentration) indicates that sampling height varied significantly during the sampling period (30 min)
6	Location_notes		Additional site location information for the samples from Balbina or none
7	Isoprene	pptv	Isoprene concentration in parts per trillion by volume
8	Alpha_pinene	pptv	alpha-pinene concentration in parts per trillion by volume
9	Camphene	pptv	Camphene concentration in parts per trillion by volume
10	Sabinene	pptv	Sabinene concentration in parts per trillion by volume
11	Beta_pinene	pptv	beta-pinene concentration in parts per trillion by volume
12	Myrcene	pptv	Myrcene concentration in parts per trillion by volume
13	Limonene	pptv	Limonene concentration in parts per trillion by volume
14	other_Monoterpene	pptv	Concentration of monoterpenes not specifically identified in parts per trillion by volume
missing data are indicated by -9999			

Example data records: CD03_Balloon_2001_July.csv.

```
Site,Land_cover,Date,Time,Altitude,Location_notes,
Isoprene,Alpha_pinene,Camphene,Sabinene,Beta_pinene,Myrcene,Limonene,other_Monoterpene
Balbina,Forest,19980319,14:25,400,E. of BALBINA(at AIRPORT),
```

2130,3,-9999,-9999, 1,-9999,1,-9999
Balbina,Forest,19980319,14:25,300,E. of BALBINA(at AIRPORT),
2040,1,-9999,-9999, -9999,-9999,-9999,-9999
Balbina,Forest,19980319,15:15,400,E. of BALBINA(at AIRPORT),
-9999,82,-9999, -9999,5,-9999,5,-9999
...
Abracos,Pasture,19990206,11:40,400,none,
121,20,5,0,2,0,4,7
Abracos,Pasture,19990206,11:40,600,none,
1433,23,1,11,12,1,23,61
Abracos,Pasture,19990206,11:40,950,none,
1149,18,3,1,3,5,9,25
...
Jaru,Forest,19990214,13:30,AMLC,none,
10997,243,22,122,115,28,1768,423
Jaru,Forest,19990214,14:00,AMLC,none
,7725,296,20,146,118,15,1857,277
Jaru,Forest,19990214,14:30,AMLC,none,
9067,295,19,142,118,19,1665,315
...
Tapajos,Forest,20000216,13:10,600,none,
839,93,3,1,14,0,6,2
Tapajos,Forest,20000216,13:10,400,none,
752,92,1,6,19,0,6,5
Tapajos,Forest,20000216,13:10,200,none,
841,73,3,0,6,0,5,0

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

Site (Region)	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude	Geodetic Datum
Amazonas (Manaus) - Balbina (Amazonas (Manaus))	-60.74131	-59.16632	-0.85903	-1.98403	World Geodetic System, 1984 (WGS-84)
Rondonia - Jaru Biological Reserve Tower A (Rondonia)	-61.9309	-61.9309	-10.0832	-10.0832	World Geodetic System, 1984 (WGS-84)
Rondonia - Fazenda Nossa Senhora Aparecida (Rondonia)	-62.2	-62.2	-10.46	-10.46	World Geodetic System, 1984 (WGS-84)
Para Western	-54.9707	-54.9707	-3.017	-3.017	World Geodetic

(Santarem) - km 83 Logged Forest Tower (Para Western (Santarem))					System, 1984 (WGS-84)

Time period

- The data set covers the period 1998/03/22 to 2000/02/16
- Temporal Resolution: variable

Platform/Sensor/Parameters measured include:

- LABORATORY / TETHERED BALLOON / TRACE GASES
- LABORATORY / TETHERED BALLOON / NON-METHANE HYDROCARBONS

3. Data Application and Derivation:

The atmospheric concentrations and emission estimates derived from this study may be used to characterize landscapes at the resolution of regional and global atmospheric chemistry and transport models.

4. Quality Assessment:

Quantitative standards were not prepared for individual terpenes, since many, including alpha-pinene, are unstable and isomerize in some storage cylinders. However, camphene has excellent storage characteristics. For calibration, we have alternatively established relative response factors of other terpenes to camphene. In our method, terpenes are quantified with respect to the abundance of the m/z 93 ion. For individual terpenes, the ratio of the abundance m/z 93 to the total ion abundance is computed using the NIST mass spectrum database. (http://webbook,nist.gov/chemistry/#search). The concentrations of individual terpenes are adjusted to account for differences in this ratio with respect to the ratio calculated for camphene.

The relative response factors (with respective to camphene) determined for a-pinene (the most abundant terpene observed at all sites), b-pinene, sabinene, and limonene were 1.83, 1.46, 1.80, and 0.56, respectively.

Detection limits for the BVOCs were approximately 1 part per trillion by volume (ppt). However, ambient concentrations of isoprene were on the order of 1000 ppt; a-pinene concentrations were typically 100 to 500 ppt. Measurement precision for isoprene at 1000 ppt was approximately 50 ppt; for a-pinene, the precision at 200 ppt was approximately 20 ppt.

5. Data Acquisition Materials and Methods:

Sites

The forest areas studied belong to three distinct eco-regions: the Tapajos forest (Para) in the Tapajos/Xingu moist forest, Balbina (Amazonas) in the Uatuma moist forest, and Jaru (Rondonia) in the Purus/Madeira moist forest (Dinerstein et al., 1995).

The Tapajos forest site is located at km 83 on the BR631 highway south of the city of Santarem in the Tapajos National Forest. The region receives about 2000 mm of annual rain; the monthly rainfall extremes are March (375 mm) and October (50 mm). Tethered balloon measurements were made in Tapajos in late January through mid-February 2000.

Balbina is located approximately 150 km northeast of Manaus. The area has a mean annual precipitation of 2200 mm and average temperature of 27 degrees C. The wettest months are March and April (300 mm per month), and July, August, and September are the driest (100 mm per month). Tethered balloon measurements were made in Balbina in March 1998.

Two other sites were located in Rondonia: a forest reserve (Rebio Jaru) and a pasture (Fazenda Nossa Senhora Aparecida, labelled Abracos in the spreadsheet). The mean annual temperature is about 27 degrees C and varies by less than 4 degrees C between warmest and coldest months. Central Rondonia gets 1800 mm of rainfall annually, with a wet season from October to April and a dry season from May to September. The Rondonia tethered balloon measurements were made in February 1999.

Tethered balloons/Air samplers

Several balloons, 9 to 15 m3 in volume (Blimpworks, Statesville, NC, USA) were used during the different deployments. These were blimp shaped, with rigid steering fins to point balloons into the wind. The static lift of balloons increased with volume and was approximately 3 to 5 kg. A portable winch (AIR model TS-3AW, Vaisala, Boulder, CO, USA) was run from line AC power or from storage (automobile) battery with a DC/AC power inverter.

Air samplers collected VOCs onto solid absorbents (Greenberg et al., 1999a, b). The air sampler consisted of a solid absorbent cartridge (preceded by an ozone trap), a sample pump, flow sensor, and a microcomputer, which monitored flow through the cartridge and maintained the prescribed flow. The samplers also included sensors for pressure, temperature, and relative humidity. The data from all sensors was logged by the microcomputer and downloaded after each sampling period. Packages were designed to attach to the tether line and pivot freely into the wind. Up to four samplers were deployed in individual soundings, usually at 200, 400, 600, and 1000 m above the ground, in order to routinely observe concentrations in and above the mixed layer. The designation of average mixed layer concentration was used in place of a specific height when the altitude of the balloon during sampling varied significantly. This may occur for several reasons: too little static lift of balloon for specific payload, hilly topography at launch site, some atmospheric turbulent regimes, etc. Samples were collected at constant flow rate (200 standard cubic centimeters per minute (sccm)) over a 30 min sampling period, several times longer than the scale of the largest convective eddies in the mixed layer (Lenschow et al., 1980).

Analyses

After balloon sampling, VOC cartridges were sealed and stored at minus 30 degrees C until analysis (except during transport from Brazil to the NCAR Boulder laboratory, when they were at ambient temperatures for approximately 24 h). All BVOC analyses were made at the NCAR Boulder laboratory. Cartridges were desorbed by a custom thermal desorption system directly into a GC MS (HP 5890 GC/5972 Mass Selective Detector, Hewlett- Packard, Palo Alto, CA, USA). Details of the analytical procedures have been described (Greenberg et al., 1999a, b). Isoprene and terpenes were detected by selected ion monitoring and were quantified with respect to a laboratory prepared standard of isoprene

and camphene (approximately 10 ppb each). The mixing ratio of the standard was confirmed by GC FID analysis.

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:

Dinerstein E, Olson DM, Graham DJ et al. 1995. A Conservation Assessment of the Terrestrial Ecoregions of Latin America and the Caribbean. The World Bank, Washington, DC.

Fisch G, Tota J, Machado LAT et al. 2002. The convective boundary layer over pasture and forest in Amazonia. Theoretical and Applied Climatology.

Greenberg JP, Guenther AB, Madronich S et al. 1999a. Biogenic volatile organic compound emissions in central Africa during the Experiment for the Regional Sources and Sinks of Oxidants (EXPRESSO) biomass burning season. Journal of Geophysical Research, 104, 30659 to 30672.

Greenberg JP, Guenther A, Zimmerman P et al. 1999b. Tethered Balloon measurements of biogenic VOCs in the atmospheric boundary layer. Atmospheric Environment, 33, 855 to 867.

Lenschow DH, Wyngaard JC, Pennel WT 1980. Mean-field and second moment budgets in a baroclinic, convective boundary layer. Journal of Atmospheric Science, 37, 1313 to 1326.

Related Publications

- Greenberg, J.P., A.B. Guenther, G. Petron, C. Wiedinmyer, O. Vega, L.V. Gatti, J. Tota, and G. Fisch. (2004) Biogenic VOC emissions from forested Amazonian landscapes. Global Change Biology 10(5):651-662.