LBA-ECO TG-05 NPP, Carbon Pool, Soil Characteristics, Soil Gas Flux Maps of Brazil

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Revision date: November 26, 2013

Summary:

This data set provides maps produced from model output data from the National Aeronautics and Space Administration–Carnegie Ames Stanford Approach (NASA-CASA) model and other modeling approaches. The maps include estimated annual Net Primary Production (ANPP), leaf (live) biomass carbon, wood (live) biomass carbon, fine root (live) biomass carbon, metabolic leaf litter (dead) carbon, structural leaf litter (dead) carbon, woody detritus (dead) carbon, and slow soil carbon, gridded at half-degree spatial resolution for the years 1982-1998, and 2001 (NPP data) for Brazil. Maps are provided at one-degree resolution for monthly soil emissions and soil uptake of N2O, NO, CO, and CH4. In addition, there are maps in 8-km resolution for soil texture, soil carbon, soil pH, soil maximum plant available water (paw), and net primary productivity (NPP).

The input data for the maps were from various sources (see section 5 for more details):

- Carbon storage and NPP data (model output) were from the National Aeronautics and Space Administration–Carnegie Ames Stanford Approach (NASA-CASA) model.
- NO and N2O data were from an expanded version of the Carnegie-Ames-Stanford (CASA) Biosphere model.
- CH4 data were estimated by applying a modified version of Fick's first law based on theoretical computations for diffusivity in aggregated media, together with a soil water balance model run on a one-degree global grid.
- CO data were estimated from:
    - A modified version of Fick's first law for CO uptake by soils and to estimate the production of CO from decaying soils.
    - Soil CO emissions using as the source, substrate carbon stage estimates for surface soils worldwide from the CASA Biosphere model.
- Soil maps were created by interpolation of soil profile data available for more than 1,000 Amazon soil pits asssembled during the RADAMBRASIL campaign. The procedure was also used to produce soil attribute maps for texture class, carbon content, and pH.

There are three files with this data set in tar.gz format. The files are in half-degree, one-degree, and 8-km resolution. When expanded, the half degree and one degree files contain 83 map files in GeoTIFF (.tif) format. The third file (8-km resolution) contains the soil and productivity maps. When expanded, this file contains 22 files in GeoTIFF (.tif) format.

Data Citation:

Cite this data set as follows:

Potter, C.S. 2013. LBA-ECO TG-05 NPP, Carbon Pool, Soil Characteristics, Soil Gas Flux Maps of Brazil. Data set. Available on-line (http://daac.ornl.gov) from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, USA. http://dx.doi.org/10.3334/ORNLDAAC/1199

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This data set was archived in November 2013. Users who download the data between November 2013 and October 2018 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.

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 Gases

Team ID: TG-05 (Potter / Carvalho / Oliveira)

The investigators were Potter, Christopher S.; Carvalho, Claudio Jose Reis de; Oliveira Jr., Raimundo Cosme de; Alexander, Susan; Genovese, Vanessa Brooks; Klooster, Steven A.; Kramer, Marc Gerald; Maria, Renato Maria Siqueira and Pereira, Wanderley de Oliveira. You may contact Potter, Christopher S. (cpotter@gaia.arc.nasa.gov).

LBA Data Set Inventory ID: TG05_CASA

This data set provides maps produced from model output data from the National Aeronautics and Space Administration–Carnegie Ames Stanford Approach (NASA-CASA) model and other modeling approaches. The maps include estimated annual Net Primary Production (ANPP), leaf (live) biomass carbon, wood (live) biomass carbon, fine root (live) biomass carbon, metabolic leaf litter (dead) carbon, structural leaf litter (dead) carbon, woody detritus (dead) carbon, and slow soil carbon, gridded at half-degree spatial resolution for the years 1982-1998, and 2001 (NPP data) for Brazil. Maps are provided at one-degree resolution for monthly soil emissions and soil uptake of N2O, NO, CO, and CH4. In addition, there are maps in 8-km resolution for soil texture, soil carbon, soil pH, soil maximum plant available water (paw), and net primary productivity (NPP).

2. Data Characteristics:

There are three files with this data set in tar.gz format. The files are in half-degree, one-degree, and 8-km resolution. When expanded, the half degree and one degree files contain 83 map files in GeoTIFF (.tif) format. The third file (8-km resolution) contains the soil and productivity maps. When expanded, this file contains 22 files in GeoTIFF (.tif) format.

Half-degree and one-degree resolution maps:

File 1: half_degree.tar.gz: There are 26 files in half-degree spatial resolution which includes 19 NPP data files and seven additional files of C storage data from different biomass sources. The NPP data files and the units are in g C/m2/y. Units for the other variables are in g C/m2.

Table 1. Half-degree variables and file names.

Variable	File Name
Net Primary Productivity (NPP)	There are 19 NPP data files named **NPPa_AN xx.YY.v11.0514.d1ref.tif.** where xx=00-17 and 20, YY=2-digit year 82-98 and a file for 2001(YYYY). Example file name: **NPPa_AN01.82.v11.0514.d1ref.tif**
Leaf (live) biomass carbon	LEAF_BMASS_11.98.v11.0514.d1ref.tif
Wood (live) biomass carbon	WOOD_BMASS_11.98.v11.0514.d1ref.tif
Fine root (live) biomass carbon	ROOT_BMASS_11.98.v11.0514.d1ref.tif
Metabolic leaf litter (dead) carbon	M_LIT_C_11.98.v11.0514.d1ref.tif
Structural leaf litter (dead) carbon	S_LIT_C_11.98.v11.0514.d1ref.tif
Woody detritus (dead) carbon	WOOD_DET_C_11.98.v11.0514.d1ref.tif
Slow soil carbon	SLOW_C_11.98.v11.0514.d1ref.tif

File 2: one_degree.tar.gz: There are 57 files in one-degree spatial resolution. The data are for monthly soil emissions and uptake of N2O, NO, CH4, and CO.

Table 2. One-degree variables and file names.

Variable	File Name	Units
Monthly N2O emissions	**N2O_X.boutv611202.d1.tif** where X stands for the month, Jan-Dec. (i.e. 0 = January-Dec=11).	10^5*g N2O-N m-2 mo-1 Note: Values should be multiplied by two to generate estimates reported by Potter et al. (1996).
Monthly NO soil emission	**NO_X.boutv611202.d1.tif** where X stands for the month, Jan-Dec. (i.e. 0 = January-Dec=11).	10^5*g NO-N m-2 mo-1 Note: Values should be multiplied by two to generate estimates reported by Potter et al. (1996).
Monthly CH4 soil uptake	**J_CH4mg.100.CO2.XXX.tif** where X stands for the month, Jan-Dec.	10^2*mg CH4 m-2 mo-1
Monthly CO soil emission	**E_COmg.100.XXX.tif** where X stands for the month, Jan-Dec.	10^2*mg CO m-2 mo-1
Monthly CO soil uptake	**J_COmg.100.CO2.XXX.tif** where X stands for the month, Jan-Dec.	10^2*mg CO m-2 mo-1

Image Projection Information:

Coordinate system: WGS 1984
Angular Unit: Degree
Prime Meridian: Greenwich
Datum: D_WGS_1984
Spheroid: WGS_1984
Semimajor Axis: 6378137.0
Semiminor Axis: 6356752.3
Inverse Flattening: 298.3

File 3: Maps_8km.tar.gz: The 22 soil and productivity maps are gridded, 8-km resolution maps of Brazil for soil texture, soil maximum plant available water (paw), soil carbon, NEP, soil pH, and net primary productivity (NPP), leaf biomass, and wood biomass. Variables are indicated in the file names.

8-km variables and file names

Soil texture: There are three files for soil texture from different depths**.**

File names: TG05_CASA_8km/data/am_gztex_x.tif

where x =1, 2, or 3.

1= soil texture class for 0 to 0.2 m depth,

2= soil texture class for 0.2 to 1.0 m depth, or

3=soil texture class for 1.0 to 11.0 m depth

Maximum plant available water (soil paw is maximum plant available water): There are three files for soil paw from different depths (units= 100*mm).

File names: **TG05_CASA_8km/data/paw100_x.tif**

where x =1, 2, or 3.

1= soil paw for 0 to 0.2 m depth,

2= soil paw for 0.2 to 1.0 m depth, or

3=soil paw for 1.0 to 11.0 m depth

Soil carbon (100*mm soil carbon per cm): There are two files for soil carbon from different depths (units=100*kg C/m2).

File names: **TG05_CASA_8km/data/pcarbonX.tif**

where x =1 or 2.

1= soil carbon for 0 to 0.2 m depth,

2= soil paw for 0.2 to 1.0 m depth

NEP: There are 10 files for NEP named as follows (units=100*g C/m2/y):

TG05_CASA_8km/data/NEP_AN0XX.YY.v11.0217.d1ref.tif

where **XX**=**year number**=01-09 and **Y**=**year**= 82-89. **v11** is the model version number.

There is also one file for average NEP named **TG05_CASA_8km/data/NEP_AN00.ave.v11.0217.d1ref.tif**

Soil pH (pH units*100, soil pH for 0 to 0.2 m depth)**:** There is one file**, TG05_CASA_8km/data/ph_soil1.tif**

NPP: There is one file, **TG05_CASA_8km/data/npp.ann.tif** (units=g C/m2/y)

Leaf biomass: There is one file for aboveground leaf biomass for 1990 (units are g C/m2),
TG05_CASA_8km/data/LEAF_BMASS_11.90.v11.0217.d1ref.tif

Wood biomass: There is one file for aboveground leaf biomass for 1990 (units are g C/m2),
TG05_CASA_8km/data/WOOD_BMASS_11.90.v11.0217.d1ref.tif

Image Projection Information:

- Coordinate system: WGS 1984
- Datum: D_WGS_1984
- Spheroid: WGS_1984
- Prime Meridian: Greenwich
- Semimajor axis: 6378137.0
- Semiminor axis: 6356752.3
- Inverse Flattening: 298.3
- Angular Unit: Degree

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

Site (Region)	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
Brazil	-80	-34.035	6.02	-34

Time period:

- The data set covers the period 1982/01/01 to 2001/12/31
- Temporal Resolution: Annual and monthly

Platform/Sensor/Parameters measured include:

- COMPUTER MODEL / MODEL ANALYSIS / EMISSIONS
- COMPUTER MODEL / MODEL ANALYSIS / PRIMARY PRODUCTION
- COMPUTER MODEL / MODEL ANALYSIS / CARBON
- COMPUTER MODEL / MODEL ANALYSIS / BIOMASS
- COMPUTER MODEL / MODEL ANALYSIS / CARBON MONOXIDE
- SOIL SURVEY / MODEL ANALYSIS / ALKALINITY
- SOIL SURVEY / MODEL ANALYSIS / SOIL CHEMISTRY
- SOIL SURVEY / MODEL ANALYSIS / SOIL MOISTURE
- SOIL SURVEY / MODEL ANALYSIS / SOIL POROSITY
- SOIL SURVEY / MODEL ANALYSIS / SOIL TEXTURE

3. Data Application and Derivation:

Not available.

4. Quality Assessment:

Interannual NPP fluxes from the CASA model have been reported (Behrenfeld et al., 2001) and checked for accuracy by comparison to multiyear estimates of NPP from field stations and tree rings (Malmstrom et al., 1997).

The NASA-CASA model has been validated against field-based measurements of NEP fluxes and carbon pool sizes at multiple boreal forest sites in North America (Potter et al., 2001c; Amthor et al., 2001) and against atmospheric inverse model estimates of global NEP (Potter et al., 2003).

5. Data Acquisition Materials and Methods:

The maps were produced from model output data from the National Aeronautics and Space Administration–Carnegie Ames Stanford Approach (NASA-

CASA) model and other modeling approaches.

Half-degree and one-degree resolution maps

NPP and C storage data

The National Aeronautics and Space Administration–Carnegie Ames Stanford Approach (NASA–CASA) model was used to estimate monthly patterns in plant carbon fixation, plant biomass, nutrient allocation, litter fall, soil nutrient mineralization, and carbon emissions from soils worldwide. Direct input of satellite sensor ‘‘greenness’’ data from the Advanced Very High Resolution Radiometer (AVHRR) sensor into the NASA–CASA model were used to estimate spatial variability in monthly NPP, biomass accumulation, and litter fall inputs to soil carbon pools at half-degree resolution (Potter et. al, 1999, 2003).

NO and N2O data

N2O and NO soil emissions were estimated using an expanded version of the Carnegie-Ames-Stanford (CASA) Biosphere model, a coupled ecosystem production and soil carbon-nitrogen model at one-degree resolution. Details on the CASA-Biosphere model are outlined by Potter et. al (1993). Monthly production of NO and N2O were based on predicted rates of gross N mineralization together with an index of transient water-filled pore space in soils (Potter et al, 1996).

CH4 data

CH4 uptake by soils were estimated by applying a modified version of Fick’s first law based on theoretical computations for diffusivity in aggregated media, together with a soil water balance model run on a one-degree global grid. Uptake rates were assumed to be zero in very dry desert soils that are mostly devoid of microbial activity, in frozen soils, and in wetlands that are usually CH4 sources. Gridded data sets for soil texture and inundation mean monthly surface temperature, and mean monthly precipitation were combined to produce reference flux estimates of soil CH4 uptake. (Potter et al, 1996b).

CO data

A modified version of Fick’s first law was also used to estimate CO uptake by soils worldwide. Gross uptake rates were assumed to be negligible in very dry desert soils, in frozen soils and in wetlands. This process was also used to estimate the production of CO from decaying soils organic matter as a process of chemical oxidation. Gridded data sets for soil texture and inundation, mean monthly surface temperature and mean monthly precipitation were combined to produce a reference flux range for soil CO uptake. Additional global maps at one-degree resolution, corresponding to soil microbial activity (CR emission), wetland coverage, and agricultural land use were used to adjust reference uptake fluxes for hypothesized biogeochemical and human impacts on the worldwide soil sink for atmospheric CO. Soil CO emissions were also estimated using as the source substrate carbon stage estimates for surface soils worldwide from the CASA Biosphere model (Potter et al., 1993, 1996c).

Soil and productivity maps, 8-km resolution:

Driver Data

The model drivers were regional data sets at 8-km resolution from a geographical information system (GIS) and land surface parameter files. A complete set of raster GIS coverages were used to serve as inputs including soil texture, land cover type and satellite vegetation index for Brazil. All raster maps were gridded in an equal projection. Refer to Potter et al, 1998, for more details regarding the data sources.

Creation of Soils Maps

Soil maps were created by interpolation of soil profile data available for more than 1,000 Amazon soil pits asssembled during the RADAMBRASIL campaign. The profile measeurements of particle size fractions (sand:silt:clay) in combination with the soil maps were used to define 19 generalized soil groups cross-referenced to the pit profile entries. The regional soil maps were used as the basis to interpolate pit profile attributes within soil groups using the nearest-neighbor similarity of profile soil classification to the matching soil group. The Brazilian soil map used in these interpolations is the most generalized classification level of Brazilian soil types (19 classes) (Potter et al., 1998).

The procedure was used to produce soil attribute maps for texture class, carbon content, and pH. Using the soil attribute value from each pit profile, country-wide maps were created at a 8-km x 8-km cell size, using a modified nearest-neighbor spatial fill routine (Potter et al., 1998).

Soil Texture Classes

Soil texture classes were assigned on the basis of estimated clay content (FAO 1971) and the Brazilian soil class map. Seven soil texture classes were determined from percent clay content (for definitions, see Table 1 in Potter et al., 1998): 1 = organic, 2 = coarse, 3 = coarse/medium, 4 = medium, 5= medium/fine, 6 = fine, 7 = lithosol.

Soil paw

On a 'per unit depth' basis, paw = FC(-10 kPa) - WP(-1500 kPa). FC (field capacity) and WP (wilting point) were computed from the equations generated for Amazon soils by Tomasella and Hodnett (1998). By computing the third layer for a nominal 10 meters depth, one can truncate or expand paw100_3 to whatever total rooting depth is required.

NEP, NPP, and Biomass

NEP, NPP, and Biomass data were determined from the NASA-CASA model.

6. Data Access:

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

Data Archive Center:

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

7. References:

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Related Publications

- Potter, C., S. Klooster, M. Steinbach, P.N. Tan, V. Kumar, S. Shekhar, and C.R. de Carvalho. 2004. Understanding global teleconnections of climate to regional model estimates of Amazon ecosystem carbon fluxes. Global Change Biology 10(5):693-703.
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