LBA-ECO LC-31 Simple Tropical Ecosystem Model

Summary:

This model product provides the Fortran source code and input data for the Simple Tropical Ecosystem Model (SITE). SITE is a simplified point model of vegetation dynamics that uses an integration interval of one hour to estimate the fluxes of CO2, water, and energy. Model forcing data are hourly meteorological parameters. SITE is a simplified model of vegetation dynamics for tropical ecosystems developed by Santos and Costa (2004).

Model input data measurements of temperature, wind velocity, precipitation, latent heat, sensible heat, downward incident solar flux, and downward incident infrared flux were collected at the km 67 Tapajos National Forest site, Para, Brazil, from 2002 to 2003.

SITE is structured with a canopy layer and two soil layers, and incorporates the following processes:

- infrared radiation balance in the canopy and balance of solar radiation
- aerodynamic processes
- plant physiology
- transpiration
- balance of water intercepted by the canopy
- transport of mass and energy fluxes
- soil heat flux and soil moisture
- carbon balance

There are five files provided with this data set: the Fortran source code (version 1.1-0d), one file for the main program that declares variables and input parameters, one file that initializes vegetation parameters, one file used to compile the SITE model, and the km 67 site input data file in comma-delimited (.csv) format. The four SITE files are provided in the compressed file SITE_Model.zip.

One companion file is also provided that describes the collection and processing of the meteorological and flux measurements at the km 67 Tapajos National Forest site and the use of the data to calibrate SITE.

Data Citation:

Cite this data set as follows:

Santos, S.N.M., and M.H. Costa. 2013. LBA-ECO LC31 Simple Tropical Ecosystem Model. Model product. Available on-line [http://daac.ornl.gov] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, USA DOI: 10.3334/ORNLDAAC/1173

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data have been archived must contact the investigators who collected the data, per provisions 6 and 7 in the Policy.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 July 2013. Users who download the data between July 2013 and June 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: Land Use and Land Cover

Team ID: LC-31 (Foley / Costa)

The investigators were Costa, Marcos; Foley, Jonathan A.; Coe, Michael T; Gibbs, Holly; Howard, Erica Akiko; Leite, Christiane Cavalcante; Lima, Francisca Zenaide de; Senna, Monica Carneiro Alves; Zaks, David and Santos, Silvio N Monteiro. You may contact Santos, Silvio N Monteiro (snmonteiro@vicosa.ufv.br).

LBA Data Set Inventory ID: LC31_SITE

Thismodel product provides the Fortran source code and input data for the Simple Tropical Ecosystem Model (SITE). SITE is a simplified point model of vegetation dynamics that uses an integration interval of one hour to estimate the fluxes of CO2, water, and energy. Model forcing data are hourly meteorological parameters. SITE is a simplified model of vegetation dynamics for tropical ecosystems developed by Santos and Costa (2004).

Model input data measurements of temperature, wind velocity, precipitation, latent heat, sensible heat, downward incident solar flux, and downward incident infrared flux were collected at the km 67 Tapajos National Forest site, Para, Brazil, from 2002 to 2003.

SITE is structured with a canopy layer and two soil layers, and incorporates the following processes:

- infrared radiation balance in the canopy and balance of solar radiation
- aerodynamic processes
- plant physiology
- transpiration
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- carbon balance

2. Data Characteristics:

There are five files provided with this data set: the Fortransource code, one file for the main program that declares variables and input parameters, one file that initializes vegetation parameters, one file used to compile the SITE model, and the km 67 site input data file in comma-delimited (.csv) format.

The four SITE files are provided in the compressed file **SITE_Model.zip:**

File 1. **site.f** - Main source code written in Fortran compiled using Fortran 77.

File 2. **initsite.h** - This is an include file for the main program file which declares variables and input parameters.

File 3. **makefile** - File used to compile SITE.

File 4. **vegetation_02.h** - Include file for the main program file that initializes vegetation parameters.

Input data file:

KM67_input.csv - Model input data (hourly data for 365 days) from the km 67 site for 2002 to 2003. All measurements were taken above the canopy at 65 m height.

Column	Heading	Units/format	Description
1	year	yyyy	Year data were collected (yyyy)
2	date	ddd	Julian day data were collected. Day 1=January 1, 2002 or 2003
3	time	hour	Time data were collected, from hour 1 through hour 24 (1-24)
4	ta	K	Temperature in degrees Kelvin (K)
5	qa	kg H2O/kg air	Specific humidity of air (kg H2O/kg air)
6	us	m/s	Horizontal velocity of the wind in m/s
7	fsa	W/m2	Downward incident solar flux in W/m2
8	firatm	W/m2	Downward incident infrared flux in W/m2
9	prp	mm/hr	Precipitation rate in mm/hr

Example data records:

```
year,date,time,ta,qa,ua,fsa,firatm,prp
2002,170,1,299.74,0.0143,2.39,0,427.88,0
2002,170,2,298.66,0.015,2.66,0,420.72,0
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2002,170,3,298.15,0.0159,2.38,0,416.47,0,
...
2003,7,1,300.33,0.0166,3.1,0,420.38,0
2003,7,2,300.27,0.0166,3.27,0,421.9,0
2003,7,3,299.8,0.0168,3.36,0,418.67,0
...
2003,240,22,298.77,0.0163,1.29,12.52,411.83,0
2003,240,23,299.08,0.0156,0.96,0,415.96,0
2003,240,24,299.7,0.0154,1.91,0,419.07,0
```

Companion File:

The companion file, **Calibration_of_the_SITE_model_km67_Tapajos_site.pdf**, describes the collection and processing of the meteorological and flux measurements provided as input data.

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 67 Primary Forest Tower Site (Para Western (Santarem))	-55.036389	-54.95900	-2.85500	-2.85500	World Geodetic System, 1984 (WGS-84)

Time period:

- The data set covers the period 2002/06/19 to 2003/08/28 (dates for input data collections).
- Temporal Resolution: hourly (24 measurements/day)

Platform/Sensor/Parameters measured include:

- COMPUTER MODEL / MODEL ANALYSIS / ECOSYSTEM FUNCTIONS
- COMPUTER MODEL / MODEL ANALYSIS / FORESTS

3. Data Application and Derivation:

SITE is based on previously developed models, mainly LSX (Pollard and Thompson, 1995), LSM (Bonan, 1996), IBIS (Foley et al., 1996), and SiB2 (Sellers et al., 1996).

4. Quality Assessment:

SITE is a dynamic point model that uses an integration time step (dt) of 1 hour, representing a point of land totally covered by an evergreen broadleaf forest. Small modifications may be necessary for the representation of other tropical ecosystems.

SITE has been evaluated using different input data in Sanches et al. (2011). SITE was originally developed to study the response of tropical ecosystems to varying environmental conditions. This study evaluated the applicability of SITE to simulation of energy fluxes in a tropical semi-deciduous forest of the southern Amazon Basin. The model was simulated with data representing the wet and dry seasons,

and was calibrated according to each season. The output data of the calibrated model (net radiation (Rn), latent heat flux (LE) and sensible heat flux (H)) were compared with data observed in the field for validation. Considering changes in parameter calibration for a time step simulation of 30 min, the magnitude of variation in temporal flux was satisfactory when compared to observation field data. There was a tendency to underestimate and overestimate LE and H, respectively. Of all the calibration parameters, the soil moisture parameter presented the highest variation over the seasons, thus influencing model performance.

5. Data Acquisition Materials and Methods:

SITE is a simplified point model of vegetation dynamics thath uses an integration interval (dt) of one hour to estimate the fluxes of CO2, water, and energy, and is forced with hourly weather observed data (air temperature, radiation balance, precipitation, humidity, and wind speed).

SITE is structured with a canopy layer and two soil layers, and incorporates the following processes:

- infrared radiation balance in the canopy and balance of solar radiation
- aerodynamic processes
- plant physiology
- transpiration
- balance of water intercepted by the canopy
- transport of mass and energy fluxes
- soil heat flux and soil moisture
- carbon balance

The input data used in SITE were collected in the area of the km 67 Tapajos National Forest site, Para, Brazil, from 2002 to 2003. Input data measurements collected include temperature, wind velocity, precipitation, latent heat, sensible heat, downward incident solar flux, and downward incident infrared flux.

The companion file describes the collection and processing of the meteorological and flux measurements provided as input data.

7. References:

Bonan, G.B., 1996. A land surface model (LSM version 1.0) for ecological, hydrological, and atmospheric studies: technical description and user's guide.

Foley, J.A., Prentice, I.C., Ramankutty, N., Levis, S., Pollard, D., Sitch, S., Haxeltine, A., 1996. An integrated biosphere model of land surface processes. Global Biogeochem. Cycles 10, 603-628.

Pollard, D., Thompson, S.L., 1995. The effect of doubling stomatal resistance in a global climate model. Global Planet. Change 10, 129-161.

Sanches, L., N. L. Reis de Andrade, M. H. Costa, M. de Carvalho Alves, and D. Gaio. 2011. Performance evaluation of the SITEA (R) model to estimate energy flux in a tropical semi-deciduous forest of the southern Amazon Basin. Int J Biometeorol (2011) 55:303–312.

Santos S.N.M., and Costa, M.H. 2004. A simple tropical ecosystem model of carbon,water and energy fluxes. Ecological Modelling 176: 291-312.

Sellers, P.J., Mintz, Y., Sud, Y., Dalcher, A., 1986. A simple biosphere model (SiB) for use within general circulation models. J. Atm. Sci. 43, 505-531.