# The Large Scale Biosphere-Atmosphere Experiment in Amazônia, Model Intercomparison Project (LBA-MIP) Protocol

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## 1. Summary

### A. Motivation

The importance of the land-surface dynamics of the Amazon region to the global and regional climates, including water, heat and carbon exchanges between land and atmosphere, has motivated an evaluation of the performance of the land surface models by the LBA community. During the workshop *Integrating eddy flux tower sites, remote sensing, and models to understand Amazonian carbon dynamics*, which was held in Brasilia, Brazil in October 2006 in parallel with the 10$^{th}$ LBA-ECO Science Meeting, a small working group was established to plan an LBA Model Intercomparison Project (LBA-MIP). This working group recognizes that comparing the ecosystem models that simulate terrestrial energy, water and $CO_2$ fluxes with the continuous observations of these quantities over the LBA area will provide understanding on how well the models quantify land surface processes, and draw attention to any deficiencies in the models and give guidance on how they can be improved. As such, LBA-MIP will further the goals of Phase III of LBA, which is focused on synthesis and analysis.

Similar studies have been conducted in the past. The well known Project for Intercomparison of Land-surface Schemes (PILPS; Pitman et al. 1993, Henderson-Sellers et al. 1993, Henderson-Sellers et al. 1995) led to a distinct improvement in the understanding of the exchanges of water and energy between land surface and atmosphere. More recently, model intercomparison projects with specific objectives have focused on particular climatic conditions (e.g. SNOWMIP-2, PILPS-urban, PILPS semi arid and PILPS C-1). LBA now provides a unique data source for extending process-based understanding of the coupled terrestrial carbon, water and energy cycles in the Amazon. The LBA-MIP initiative has the potential to lead to an improved seasonal to decadal representation of land-atmosphere interactions in the tropical climates of global climate simulations.

**B. Objectives**.

**The goal** is to gain comparative understanding of ecosystem models that simulate energy, water and $CO_2$ fluxes over the LBA area. **The task** is to subject all the participating models to the same forcing and experimental protocol, and compare the output. **The protocol** presented below proposes that the model intercomparison to be executed in two major steps. The first step is to run models at eight individual LBA tower sites using the most up-to-date available atmospheric forcing and validation data. The second step is will then be to make gridded simulations with these models using the South American LDAS (SALDAS) atmospheric forcing dataset, which is based on the new CPTEC regional reanalysis and surface observations within the LBA region. Initial results from the first phase are expected to be generated in advance of an LBA-MIP workshop to be held on 24-25 September, 2007, adjacent to the 10$^{th}$ LBA-ECO Science Team meeting in Salvador, Brazil. These results will prepare the ground for more detailed subsequent analysis and simulations suitable for comparison with field data.

## 2. Data protocols

### *2.1 Sites description and driver data availability*

Available sites range across a variety of land classes and soil types as documented in Tables 1A, 1B, 1C, and 1D.

**Table 1A. Eddy covariance tower sites providing driver data for LBA-MIP**

| ID | Short Code | Site Name | Longitude | Latitude | Elev. | Tower Height | Biome Type | IGBP Link |
|---|---|---|---|---|---|---|---|---|
| | | | [deg] | [deg] | [m] | [m] | | |
| 1 | BAN | Bananal_Island | -50.159111 | -09.824417 | 120 | 40 | Forest-Savanna | 4 |
| 2 | K34 | Manaus_KM34 | -60.209297 | -02.609097 | 130 | 50 | Tropical Rainforest | 2 |
| 3 | K67 | Santarem_KM67 | -54.958889 | -02.856667 | 130 | 63 | Moist tropical forest | 2 |
| 4 | K77 | Santarem_KM77 | -54.536520 | -03.011896 | 130 | 18 | Pasture-Agriculture | 12 |
| 5 | K83 | Santarem_KM83 | -54.971435 | -03.018029 | 130 | 64 | Selectively Logged moist forest | 2 |
| 6 | RJA | Reserva_Jaru | -61.930903 | -10.083194 | 191 | 60 | Tropical Dry Forest | 2 |
| 7 | FNS | Fazenda_Nossa_Senhora | -62.357222 | -10.761806 | 306 | 8.5 | Pasture | 12 |
| 8 | PDG | Reserva_Pe-de-Gigante | -47.649889 | -21.619472 | 690 | 21 | Savanna | 9 |

Principle Investigators and data references for these tower sites are as follows. Please see “Important Note on Data-Use policy” at the end of this section:

1. PIs: Borma/Collicchio, UFT, Brazil; Rocha, USP, Brazil; Cabral, EMBRAPA, Brazil (Borma et al., in prep for JGR-Biogeosciences)
2. PIs: Manzi/Nobre/Santos, INPA, Brazil (Araujo et al., 2002)
3. PIs: Wofsy, Harvard University, USA / Saleska UofA USA / Camargo, CENA/USP, Brazil. See Saleska et al. (2003).
4. PIs: Fitzjarrald, SUNY, USA, Moraes, UFSM, Brazil. See Sakai et al. (2004).
5. PIs: Goulden, UC Irvine, USA / Miller SUNY-Albany, USA / Rocha, USP, Brazil. See Rocha et al. (2004).
6. 6-7. PIs: Manzi (INPA), Cardoso (UFR), Brazil. See von Randow (2004); Kruijt et. al (2004).
7. 8. PI: Rocha, USP, Brazil.

### Table 1B.  Site characterization

| ID | Short | Soil Type | USDA texture classes | Vegetation cover fraction | Canopy height [m] |
|---|---|---|---|---|---|
| 1 | BAN | loamy sand | 2 | 0.98 | 16 |
| 2 | K34 | clay latosol | 8 | 0.98 | 35 |
| 3 | K67 | clay latosol | 8 | 0.98 | 35 |
| 4 | K77 | clay latosol | 8 | 0 to 0.8 | 0 to 0.6 |
| 5 | K83 | clay latosol | 8 | 0.98 | 35 |
| 6 | RJA | sandy podsol | 10 | 0.98 | 30 |
| 7 | FNS | sandy podsol | 10 | 0.85 | 0.2 to 0.5 |
| 8 | PDG | silty sand latosol | 2 | 0.80 | 12 |

### Table 1C.  USDA soil texture classes based on the 12 USDA classification

| Soil Number | Name |
|---|---|
| 1 | Sand |
| 2 | Loamy sand |
| 3 | Sandy loam |
| 4 | Silt loam |
| 5 | Silt |
| 6 | Loam |
| 7 | Sandy clay loam |
| 8 | Sandy clay |
| 9 | Clay loam |
| 10 | Silty clay loam |
| 11 | Silty clay |
| 12 | Clay |

### Table 1D. IGBP biome classification

| Number | Class name |
|---|---|
| 0 | Water |
| 1 | Evergreen Needleleaf Forest |
| 2 | Evergreen Broadleaf Forest |
| 3 | Deciduous Needleleaf Forest |
| 4 | Deciduous Broadleaf Forest |
| 5 | Mixed Forests |
| 6 | Closed Shrublands |
| 7 | Open Shrublands |
| 8 | Woody Savannas |
| 9 | Savannas |
| 10 | Grasslands |
| 11 | Permanent Wetlands |
| 12 | Croplands |
| 13 | Urban and Built-Up |
| 14 | Cropland/Natural Vegetation Mosaic |
| 15 | Snow and Ice |
| 16 | Barren or Sparsely Vegetated |

Site-specific driver data will be available in ALMA-compliant NetCDF and ASCII formats via ftp at ftp://ezdods.ethz.ch/pub_read/stockli/lba_mip/driver/. Available data includes:

- general site-specific information (see Table 1, above), in ASCII format only from ftp://ezdods.ethz.ch/pub_read/stockli/lba_mip/vegsoil.lbamip.txt .
- atmospheric forcing data (see Section 2.2, below)
- MODIS-derived vegetation phenological data (LAI, NDVI, EVI and FPAR), available for those models which cannot make a full prognostic simulation of dynamic vegetation (see Section 2.3, below).

**Important Note on Data-Use policy**

In accordance with LBA data sharing policy, this data is freely available to all LBA researchers (http://www.lbaeco.org/lbaeco/data/data_poldoc.htm; see policy #2). Note, in particular, that policy #7 states that:

> *7. Where data are used for modeling or integrating studies, the scientist collecting the data will be credited appropriately, either by co-authorship or by citation. The data collectors should be informed of publication plans well in advance of submission of a paper, given an opportunity to read the manuscript, and be offered co-authorship. In cases where data from other investigators are a minor contribution to a paper, the data should be referenced by a citation. Users of the data will always have to state the source of the data*

Please note that, notwithstanding the availability of this common driver dataset, the LBA data sharing policy still requires any author or presenter of these data to contact and appropriately credit PIs from the individual projects that generated the data used. The necessary contact information is given in the Table 1.

### *2.2 Atmospheric Forcing Datasets*

The forcing data are ALMA-compliant, multi-year driving data are consistently-filled, meteorological observations from selected LBA flux towers, including boundary conditions (site location, biome type, soil type and initial data). The data are for periods between 1999 and 2006, the exact time coverage being determined by site-specific data availability (see table below). Forcing datasets include:

a. air temperature
b. specific humidity
c. module of wind speed
d. downward long wave radiation at the surface
e. surface pressure
f. precipitation
g. shortwave downward radiation at the surface

These atmospheric drivers are provided at one hour time-steps as ALMA-compliant NetCDF files (see http://www.lmd.jussieu.fr/~polcher/ALMA/). Models should use linear interpolation (except for solar radiation, where zenithal angle would be more appropriate) if they are run at shorter than an hourly time step. These data are available from: ftp://ezdods.ethz.ch/pub_read/stockli/lba_mip/

**Table 2. Site-specific Availability of continuously filled driver data**

| | **1999** | **2000** | **2001** | **2002** | **2003** | **2004** | **2005** | **2006** |
|---|---|---|---|---|---|---|---|---|
| **1. BAN** | | | | | | | | |
| **2. K34** | | | | | | | | |
| **3. K67** | | | | | | | | |
| **4. K77** | | | | | | | | |
| **5. K83** | | | | | | | | |
| **6. RJA** | | | | | | | | |
| **7. PDG** | | | | | | | | |
| **8. FNS** | | | | | | | | |

### *2.3 Phenological information*

Models with dynamic vegetation (DVMs) should be run in the model in which they generate their own phenology (e.g., Leaf Area Index, LAI). To facilitate inclusion of those models which cannot simulate dynamic vegetation structure and phenology prognostically, a standard set of monthly mean MODIS-derived phenological information is provided (as in Table 3). It should be recognized that known remote sensing technical and physical uncertainties mean these data may be unreliable. However, to minimized these defects, aggregations of the best quality filtered satellite phenological information were derived for each tower site.

To facilitate comparison between models, and to explore the effect of differences between dynamic vegetation model-derived and MODIS-derived vegetation phenologies, DVM's should be run in two modes if possible: i.e. in prognostic mode (in which leaf phenology is simulated) and in forced mode (in which model phenology is forced by the MODIS-derived phenology).

**Table 3. MODIS-derived monthly LAI***

| ID | Short | | Jan | Feb | Mar | Apr | May | Jun | July | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | BAN | avg | 5.38 | 4.03 | 4.24 | 4.84 | 4.74 | 4.43 | 4.88 | 4.91 | 4.5 | 4.57 | 3.81 | 5.83 |
| | | std | 0.87 | 1.45 | 1.28 | 1.14 | 0.69 | 0.78 | 0.56 | 0.67 | 1 | 0.94 | 1.09 | 1.25 |
| 2 | K34 | avg | 5.21 | 4.66 | 2.89 | 4.26 | 4.62 | 4.34 | 5.25 | 5.76 | 5.59 | 5.6 | 5.96 | 5.5 |
| | | std | 1.19 | 1.08 | 1.12 | 1.28 | 1.11 | 1.04 | 0.59 | 0.7 | 0.49 | 0.64 | 0.38 | 0.57 |
| 3 | K67 | avg | 4.99 | 5.69 | 6.09 | 5.48 | 4.87 | 5.1 | 5.05 | 5.47 | 5.79 | 5.67 | 5.77 | 5.91 |
| | | std | 1.56 | 1.25 | 0.23 | 0 | 1.98 | 1.03 | 1.18 | 0.85 | 0.83 | 0.96 | 0.9 | 0.26 |
| 4 | K77 | avg | 4.48 | 4.55 | 4.63 | 4.7 | 5.44 | 4.89 | 4.8 | 4.93 | 4.96 | 4.9 | 5.69 | 5.62 |
| | | std | 1.48 | 0 | 0 | 0.97 | 1.44 | 0.99 | 1.03 | 0.99 | 0.97 | 1.19 | 0.92 | 1.32 |
| 5 | K83 | avg | 5 | 5.01 | 5.02 | 4.76 | 5.04 | 4.82 | 4.76 | 4.57 | 4.71 | 5.62 | 5.73 | 3.97 |
| | | std | 1.79 | 0 | 1.99 | 2.04 | 2.06 | 1.19 | 0.96 | 0.86 | 0.94 | 0.98 | 0.91 | 1.17 |
| 6 | RJA | avg | 4.77 | 5.16 | 2.94 | 4.98 | 4.63 | 4.76 | 4.99 | 5.02 | 5.16 | 4.97 | 4.88 | 5.45 |
| | | std | 1.55 | 1.37 | 1.57 | 1.06 | 0.96 | 0.77 | 0.72 | 0.78 | 0.79 | 0.77 | 0.77 | 0.69 |
| 7 | PDG | avg | 3.92 | 3.7 | 3.69 | 3.98 | 3.61 | 3.22 | 3.09 | 3.38 | 3.18 | 3.64 | 3.36 | 3.49 |
| | | std | 1.59 | 1.61 | 1.62 | 1.43 | 1.54 | 1.74 | 1.79 | 1.79 | 1.75 | 1.59 | 1.6 | 1.57 |
| 8 | FNS | avg | 4.2 | 5.63 | 5.1 | 3.66 | 5.01 | 4.53 | 3.48 | 3.16 | 1.53 | 3.63 | 4.59 | 4.56 |
| | | std | 1.15 | 0.9 | 1.31 | 1.12 | 0.92 | 1.07 | 1.38 | 1.66 | 1.64 | 1.52 | 1.28 | 1.32 |

** Monthly mean LAI values derived from MODIS 7x7 km retrievals from ORNL, also available at* ftp://ezdods.ethz.ch/pub_read/stockli/lba_mip/modis/mean_monthly/ as *monthly mean, MODIS-derived NDVI, EVI, and FPAR for each site. "NaN" indicates there was not sufficient information to characterize mean LAI. Raw MODIS 7x7 km fields are also provided at* ftp://ezdods.ethz.ch/pub_read/stockli/lba_mip/modis/raw_ascii/

### *2.4 Initialization and spin-up*

Model physics and biophysics should be initialized as follows:

a) Soil moisture in all layers should be set to 0.95 of saturation (porosity);
b) Soil temperature in all layers should be set to the mean of the yearly air temperature; and
c) Because reliable carbon and nitrogen pools observations are not available, soil carbon, living biomass, etc should be spun up according to the best practices for each model, but the spin up procedure used should be documented.

Spin-up for model physics and biogeochemistry should use one of the following procedures:

a) replicate the driving dataset to achieve a 10-15 year simulation run; or
b) replicating the driver dataset until the mean monthly soil moisture does not deviate by more than 0.1% from the previous year.

### *2.5 Model output*

The first phase of the LBA-MIP will focus on model simulations at eight individual towers using the meteorological forcing data from the LBA project. Participating models should be able to provide the defined set of variables in the ALMA-compliant format (please see ALMA website http://www.lmd.jussieu.fr/~polcher/ALMA/convention_3.html for units and details). This will allow compatibility among all the models and simplify comparisons. Output should be provided at 1 hour time-steps in NetCDF for the variables listed below. The values of state variables should be given at the end of each time-step, fluxes should be averaged values over the time-step, and storage change variables should be accumulated over each time-step.

a. Model states and outputs
    i. *Carbon fluxes*: GPP, NPP, Re.
    ii. *Energy balance and hydrology*:: sensible and latent heat flux, net radiation for short and long wave, and runoff
    iii. surface soil temperature and soil temperature by layer,
    iv. soil moisture at the surface and soil moisture by layer
    v. soil carbon (total, and by pools if possible, including separate litter pool)
    vi. input parameters, re-output at the time resolution to simplify analysis
b. Vegetation dynamics (if applicable);
    i. vegetation carbon (total, leaves, roots, woods etc. if possible)
    ii. tree mortality, recruitment, and growth (in carbon flux and as annual rates) (broken down by components if possible: total, leaves, roots, wood)

Table 4 shows the list of ALMA variables that each modeling group should return. If a variable is not delivered, it should be replaced by the value of -999.99 which will represent either an undefined or missing value. Please note the desired sign convention for flux directionality is specified in column five of the table. (Note: because it may vary from model to model, reporting by model preference would complicate the future comparative model analysis.)

Model diagnostic variables should comply with the following radiation energy and water conservation equations. Participants are advised to check against these before submitting their results. This will ensure that diagnostics, units and timings of the submitted results are appropriate for the analysis:

Energy balance (residual at all times should be smaller than 1 $W/m^2$):

$$SWnet + LWnet - Qh - Qle - Qg = DelCanh / dt$$

Water balance (residual at all times should be smaller than $1x10^{-6}$ $kg/m^2/s$):

$$Rainf + Snowf - Evap - Qs - Qsb + Qrec = (DelIntercept + DelSrfStor + DelSoilMoist) / dt$$

For the LBA towers, neither snow nor ice is separately diagnosed because these states are not likely to occur. If this is a problem for closing the energy and water balance above, please add snow states and fluxes to respective water state and flux variables. If the model needs additional diagnostic radiation, heat and water storage terms (e.g. canopy air space water and heat storage) on the right hand side of the above equations, please add those to the diagnostic output and let us know.

**Table 4A. General energy balance components:**

| Variable | Description | Definition | Units | Positive Dir. (Traditional) | Priority |
|---|---|---|---|---|---|
| SWnet | Net shortwave radiation | Incoming solar radiation less the simulated outgoing shortwave radiation, averaged over a grid cell | $W/m^2$ | Downward | Mandatory |
| LWnet | Net long wave radiation | Incident long wave radiation less the simulated outgoing long wave radiation, averaged over a grid cell | $W/m^2$ | Downward | Mandatory |
| Qle | Latent heat flux | Energy of evaporation, averaged over a grid cell | $W/m^2$ | Upward | Mandatory |
| Qh | Sensible heat flux | Sensible energy, averaged over a grid cell | $W/m^2$ | Upward | Mandatory |
| Qg | Ground heat flux | Heat flux into the ground, averaged over a grid cell | $W/m^2$ | Downward | Mandatory |
| DelCanHeat | Change in canopy heat storage | Change in canopy heat storage | $J/m^2$ | Increase | Mandatory |
| DelSurfHeat | Change in surface heat storage | Change in heat storage over the soil layer and the vegetation for which the energy balance is calculated, accumulated over the sampling time interval. | $J/m^2$ | Increase | Recommended |

## Table 4B. General water balance components:

| Variable | Description | Definition | Units | Positive Dir. (Traditional) | Priority |
|---|---|---|---|---|---|
| Rainf | Rainfall rate | Average of the total rainfall over a time step and grid cell. | $kg/m^2/s$ | Downward | Mandatory |
| Evap | Total Evapotranspiration | Sum of all evaporation sources, averaged over a grid cell | $kg/m^2/s$ | Upward | Mandatory |
| Qs | Surface runoff | Runoff from the land surface and/or subsurface stormflow | $kg/m^2/s$ | Out of gridcell | Mandatory |
| Qrec | Recharge | Recharge from river to the flood plain | $kg/m^2/s$ | Into gridcell | Optional |
| Qsb | Subsurface runoff | Gravity drainage and/or slow response lateral flow. Ground water recharge will have the opposite sign. | $kg/m^2/s$ | Out of gridcell | Mandatory |
| DelSoilMoist | Change in soil moisture | Change in the simulated vertically integrated soil water volume, averaged over a grid cell, accumulated over the sampling time interval. | $kg/m^2$ | Increase | Mandatory |
| DelSurfStor | Change in Surface Water Storage | Change in vertically integrated liquid water storage, other than soil, snow or interception (lake, depression and river channel etc.), accumulated over the sampling time interval. | $kg/m^2$ | Increase | Recommended |
| DelIntercept | Change in interception storage | Change in the total liquid water storage in the canopy, accumulated over the sampling time interval. | $kg/m^2$ | Increase | Recommended |

## Table 4C. Surface state variables:

| Variable | Description | Definition | Units | Positive Dir. (Traditional) | Priority |
|---|---|---|---|---|---|
| VegT | Vegetation Canopy Temperature | Vegetation temperature, averaged over all vegetation types | K | - | Mandatory |
| BaresoilT | Temperature of bare soil | Surface bare soil temperature | K | - | Mandatory |
| AvgSurfT | Average surface temperature | Average of all vegetation, bare soil and snow skin temperatures | K | - | Mandatory |
| Albedo | Surface Albedo | Grid cell average albedo for all wavelengths. | - | - | Mandatory |
| SurfStor | Surface Water Storage | Total liquid water storage, other than soil, snow or interception storage (i.e. lakes, river channel or depression storage). | $kg/m^2$ | - | Mandatory |

## Table 4D. Subsurface State Variables

| Variable | Description | Definition | Units | Positive Dir. (Traditional) | Priority |
|---|---|---|---|---|---|
| SoilMoist | Average layer soil moisture | Soil water content in each user-defined soil layer (3D variable). Includes the liquid, vapor and solid phases of water in the soil. | $kg/m^2$ | - | Mandatory |
| SoilTemp | Average layer soil temperature | Average soil temperature in each user-defined soil layer (3D variable) | K | - | Recommended |
| SoilWet | Total Soil Wetness | Vertically integrated soil moisture divided by maximum allowable soil moisture above wilting point. | - | - | Mandatory |

**Table 4E. Evaporation components:**

| Variable | Description | Definition | Units | Positive Dir. (Traditional) | Priority |
|---|---|---|---|---|---|
| ECanop | Interception evaporation | Evaporation from canopy interception, averaged over all vegetation types within a grid cell. | $kg/m^2/s$ | Upward | Recommended |
| TVeg | Vegetation transpiration | Transpiration from canopy, averaged over all vegetation types within a grid cell. | $kg/m^2/s$ | Upward | Mandatory |
| ESoil | Bare soil evaporation | Evaporation from bare soil. | $kg/m^2/s$ | Upward | Mandatory |
| EWater | Open water evaporation | Evaporation from surface water storage. | $kg/m^2/s$ | Upward | Recommended |
| RootMoist | Root zone soil moisture | Total simulated soil moisture available for evapotranspiration. | $kg/m^2/s$ | - | Mandatory |
| CanopInt | Total canopy water storage | Total canopy interception, averaged over all vegetation types within a grid cell. | $kg/m^2/s$ | - | Recommended |

**Table 4F. Carbon Budget:**

| Variable | Description | Definition | Units | Positive Dir. (Traditional) | Priority |
|---|---|---|---|---|---|
| GPP | Gross Primary Production | Net assimilation of carbon by the vegetation | $Kg/m^2/s^2$ | Downward | Mandatory |
| NPP | Net Primary Production | Carbon assimilation by photosynthesis | $Kg/m^2/s^2$ | Downward | Mandatory |
| NEE | Net Ecosystem Exchange | Sum of all carbon fluxes exchanged between the surface and the atmosphere | $Kg/m^2/s^2$ | Upward | Mandatory |
| AutoResp | Autotrophic Respiration | Autotrophic respiration includes maintenance respiration and growth respiration | $Kg/m^2/s^2$ | Upward | Recommended |
| HeteroResp | Heterotrophic Respiration | Total flux from decomposition of organic matter | $Kg/m^2/s^2$ | Upward | Recommended |
| TotSoilCarb | Total Soil Carbon | Total soil and litter carbon content integrated over the entire soil profile | $Kg/m^2$ | - | Recommended |
| TotLivBiom | Total Living Biomass | Total carbon content of the living biomass | $Kg/m^2$ | - | Recommended |

## 3. Intercomparison Methods and Analysis

The models compared will be divided in two categories, i.e. models that simulate carbon (C) and models that do not simulate carbon (NC). Models that simulate carbon may also participate in the simulations for group NC with their carbon component disabled. Models which simulate carbon will further be divided into fully dynamic vegetation models (which prognostically simulate vegetation phenology) and those which require phenological driving data.

The evaluation will include comparison at the different sites between the model output and measured fluxes and state variables, namely:

a. Latent heat flux
b. Sensible heat flux
c. Ground heat flux
d. Carbon flux (NEE – Net Ecosystem Exchange)
e. Soil moisture
f. Soil temperature
g. Net short wave radiation
h. Net long wave radiation

The proposed evaluation will also be performed at different time-scales:

a. Daily mean
b. Monthly mean
c. Annual mean
d. Seasonal (dry and wet seasons analyzed separately)
e. Hourly
f. Diurnal cycle (amplitude and phase)
g. Daytime and nighttime carbon

### *Sensitivity analysis*

A minimal standard set of sensitivity analyses are recommended for all model participants, with focus on sensitivity to precipitation and to vegetation phenology: In the case of *precipitation*, medium (best estimate) and low/high precipitation drivers will be provided for each site. In the case of p*henology,* in addition to runs in which MODIS phenology is used, a sensitivity run is recommended in which models use their own default phenology prescription (i.e. model-calculated or from lookup tables). The following relevant driving data are available:

- Vegetation and Soil Characteristics
- ALMA NetCDF forcing data
- ASCII forcing data
- Plots of driver variables
- MODIS 7x7 km NDVI/EVI/FPAR/LAI fields
- Monthly mean NDVI/EVI/FPAR/LAI fields

## 4. Files and datasets name conventions

The file naming will follow the PILPS convention:

[modelname].[simulationcode].[sitename].lbamip.nc

where:

- [modelname] is the name of the model used;
- [simulationcode] is the convention used to identify the experiment: “c” or “nc” for carbon or non carbon, respectively, followed by the experiment number;
- [sitename] is the name of the site, for example, “ban” or “fns” or “k83” or “k77” or etc.

For example, the file “sib.nc1.k83.lbamip.nc” includes all the output for the first experiment using the sib model, without carbon at the K83 site. Files with additional information such as set of parameters used at a specific experiment or initial states should follow similar convention, respectively, e.g.:

[modelname].[simulationcode].[sitename].lbamip.par
[modelname].[simulationcode].[sitename].lbamip.ini

## 5. Participant Models Registration

A list of participating modeling groups is being maintained and the latest available version is given below. Groups that have not yet registered their model should provide the following information:

a. A short model description including model structure
b. A description of land surface that can be represented (topography? Land cover (plant functional types? Or biomes?, rooting depth, soil texture etc.) Although some parameters will be provided (i.e. vegetation cover, LAI, height of canopy, etc.) for LBA-MIP, the default set of parameters for the given soil and vegetation types for each site should be reported.
c. A description of the external forcing required (not calculated by the model) such as time variant and time invariant parameters, atmospheric forcing, etc.
d. Description of the “default” parameters used based on the different towers characteristics and, if any calibration is used, description of the calibration procedure and parameters affected

## 6. LBA- MIP Timeframe and Deadlines (proposed)

| | |
|---|---|
| **Jun 8th, 2007:** | Driver datasets at individual tower sites made available (downloadable at ftp://ezdods.ethz.ch/pub_read/stockli/lba_mip/) |
| **June 8th, – July 10th:** | Simulation runs conducted |
| **July 15th:** | target for preliminary model outputs made available by participants |
| **July 15th – Sept 10th:** | Analysis/intercomparison of model outputs |
| **Sept 24th and 25th:** | Workshop meeting to present/discuss the LBA/MIP preliminary results – Hotel Fiesta, Salvador, Brazil (just prior to the LBA-ECO 11th Science Team Meeting) |
| **Oct-Nov, 2007:** | Write LBA-MIP results/paper(s) |