# *CALIBRATION OF THE SIMPLE BIOSPHERE MODEL (SiB) FOR AN AMAZONIAN RANCHLAND PASTURE*

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ABSTRACT

General Circulation Models (GCMs) have predicted substantial changes in the regional climate of Amazonia if forest is replaced by pastureland. Nobre et al. (1991) indicates reduced evaporation and precipitation over the Amazon basin mostly as consequence of a severe and longer dry season. This paper calibrates a land surface parameterization used in GCMs and suitable for climate simulations, the Simple Biosphere Model (SiB), for typical ranchland pasture of central Amazonia. Observed data compare well the simulated fluxes, wether the vegetation is stressed or not due to the soil moisture limitation in the 1990 dry season.

## 1. INTRODUCTION

The most recent scientific evaluation of how deforestation in Amazonia will impact regional and global climate (Nobre et al., 1991) indicated substantial changes in evaporation and precipitation over regional scales. While Nobre et al. (1991) have pointed out this fact through numerical experiments assuming either forest or pasture conditions over the Amazonia, some observed micrometeorological data of a ranchland pasture in central Amazonia (Rocha et al., 1992) have supported in part their results. Nobre et al. (1991) have used the Simple Biosphere Model (SiB), Sellers et al. (1986) to represent land-surface processes in describing either forest or degraded pasture in Amazonia. The SiB model is a complex parameterization of momentum, heat and mass transfer between surface and atmosphere, where a set of physiological, physical and morphological describe the bioma or vegetation type in the planetary surface layer. This paper calibrates SiB for the degraded pasture bioma in a attempt to set a suitable set of parameters to simulate the surface fluxes observed at an central Amazon ranchland in the 1990 dry season.

## 2. DATA

The Anglo Brazilian Amazonian Climate Observation Study (ABRACOS) has installed automatic weather stations in Manaus, AM, collecting micrometeorological data in both forest and pasture sites since October, 1990. In addition to this, surface fluxes and plant phisiology data were collected in an intensive mission comprising September to October, 1990 (Fisch et al., 1992; Cabral et al., 1992; Rocha et al., 1992). These data has been used as input parameters and meteorological forcings for the SiB model, which calculates the most important factors of the surface-atmosphere interaction, namely the surface temperature, albedo, and the fluxes of sensible heat and evaporation. The Fazenda Dimona site, Manaus, AM, is a

ranchland pasture of 'Brachiaria decumbens' and 'Brachiaria humidicola' species. Four fine days in October, 1990, were selected due to their contrasting soil moisture availability. The first two ones, 05 and 06, October, 1990, followed an storm of about 45 *mm* on the previous night, leaving the field capacity of soil moisture almost saturated. The other two days, 20 and 21, October, 1990, were preceeded by a dry spell, leaving the soil dried and the vegetation stressed. For further details see Wright et al. (1992).

Modifications in the degraded pasture bioma parameters used in Nobre et al. (1991) were sought to better fit the description of the Fazenda Dimona pasture at that time. Simulations of the SiB model were forced by local meteorological data for the four fine days cited above, which used the modified parameter set, see Table 1:

*Table 1: Parameters of pasture bioma used by the SiB model to simulate the Fazenda Dimona vegetation.*

| *Parameter / Initial value* | *Degraded pasture* | *Fazenda Dimona 05,06/Oct* | *Fazenda Dimona 20,21/Oct* |
|---|---|---|---|
| $z_1$ ; $z_2$ | 0.01 ; 0.60 | 0.05;0.30 | 0.05;0.30 |
| $V_{gs}$ ; $V_c$ | 0.80 ; 0.85 | 0.85;0.55 | 0.80;0.55 |
| $L_{gs}$ ; $L_c$ | 2.15 ; 2.40 | 1.22;0.10 | 1.22;0.10 |
| $N_c$ | 0.750 | 0.875 | 0.600 |
| $\alpha_{PAR}$; $\alpha_{NIR}$ | 0.10 ; 0.20 | 0.075;0.125 | 0.075;0.125 |
| $z_o$ ; $d$ | 0.08 ; 0.26 | 0.07;0.05 | 0.07;0.05 |
| - - $W_1$; $W_2$; $W_3$ | - | 0.85;0.82;0.82 | 0.67;0.78;0.80 |

*Only the modified parameters of degraded pasture bioma are shown: $z_1$,$z_2$ (ground cover and canopy height, m); $V_{gs}$,$V_c$ (cover fraction of ground cover and canopy); $L_{gs}$,$L_c$ (leaf area index of ground cover and canopy); $N_c$ (greeness factor); $\alpha_{PAR}$,$\alpha_{NIR}$ (soil reflectance to PAR and NIR; $z_o$, $d$ (roughness length and zero plane displacement, m); $W_i$ (soil moisture wetness for i=1(surface layer), 2(root layer), 3 (drainage layer).*

## 3. RESULTS

Results of simulation using both degraded pasture bioma and the improved Fazenda Dimona set of parameters are presented, and compared to observed data in situ. The soil reflectance parameters were adjusted to improve the simulated albedo, see Fig. 1. The soil colour type at Fazenda Dimona is darker than the one assumed for the degraded pasture.

The calculated fluxes are compared to three different estimates collected in situ: the eddy correlation method used by the 'Hydra' device; estimates derived from the Bowen ratio method as given by the dedicated Campbell System, and those coming from measurements in the *9,0 m* tower profile colleting data in six levels (see Wright et al., 1992).

For the days of wet soil (Figs. 2 and 4), where evaporation reaches higher values, the improved Fazenda Dimona bioma fits the observed fluxes data better, while degraded pasture seems to underestimate it. Wright et al.

(1992) comments that such high evaporation rates are associated to a large water vapour deficit of the air and high surface temperatures.

For the days of stressed vegetation (Figs. 3 and 5), both biomes give good estimates of the fluxes. The degraded pasture biome fits the observations fairly well for this condition, what seems to be a confirmation of the results given by Nobre et al. (1991), that mostly in the dry season there would actually be a significant contrast between the pasture and forest sites. This happens because the forest mantains an average evaporation of about *3.5 mm/day* even over long periods of fairly dryness. This fact seems to be associated to the role of deep roots extracting water to dephts up to 8 or 9 *m*. On the other hand, the pasture vegetation at Fazenda Dimona has a shallower root system, no deeper than *1 m*, thus not able to mantain such large transpiration rates. For the dry days, Rocha et al. (1992) showed the pastureland evaporation is about *2.2 mm/day*.

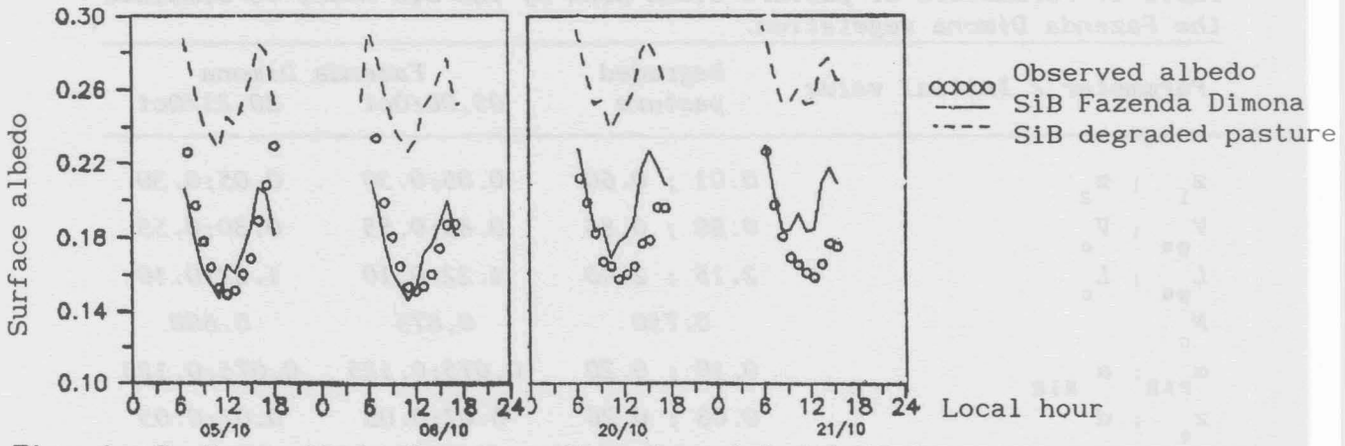


Fig. 1. Surface albedo for four fine days (a) Oct/05,06 and (b) Oct/20,21 as calculated by SiB for degraded pasture (dashed) and Fazenda Dimona (solid) biomes, and observed in situ (point).

## 4. CONCLUSIONS

Simulations using the SiB model forced by surface meteorological data collected in a ranchland pasture, Fazenda Dimona, near Manaus, show that SiB calculated albedo and fluxes of heat compare quite well with in situ measurements of those variables. It is strongly recomended that such parameterizations must take into account periods of data where soil moisture deficit takes place, which can lead to significant changes in the energy partition along the dry season.

## 5. REFERENCES

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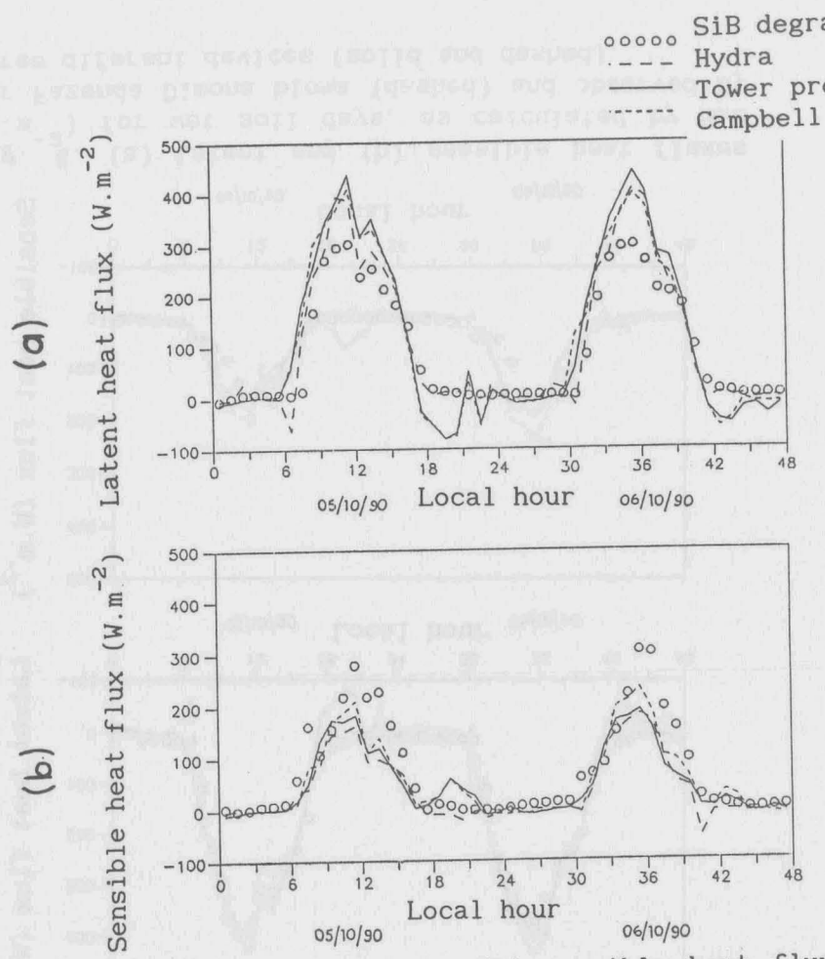


Fig. 2. (a) Latent and (b) sensible heat fluxes ($W.m^{-2}$) for wet soil days, as calculated by SiB for degraded pasture bioma (dashed) and observed by three diferent devices (solid and dashed).

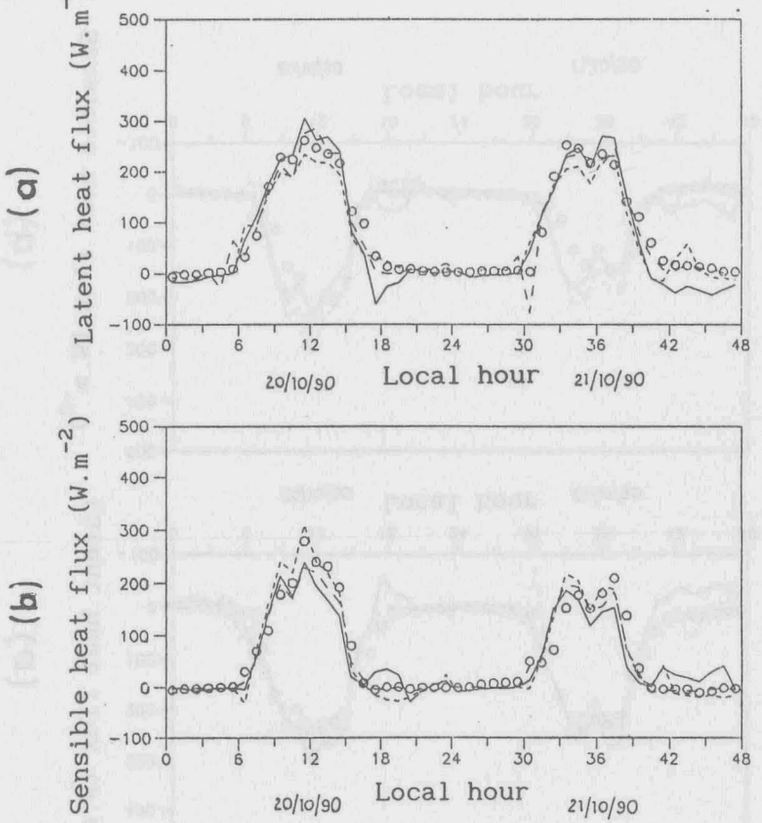


Fig. 3. (a) Latent and (b) sensible heat fluxes ($W.m^{-2}$) for dry soil days, as calculated by SiB for degraded pasture bioma (dashed) and observed by three diferent devices (solid and dashed).

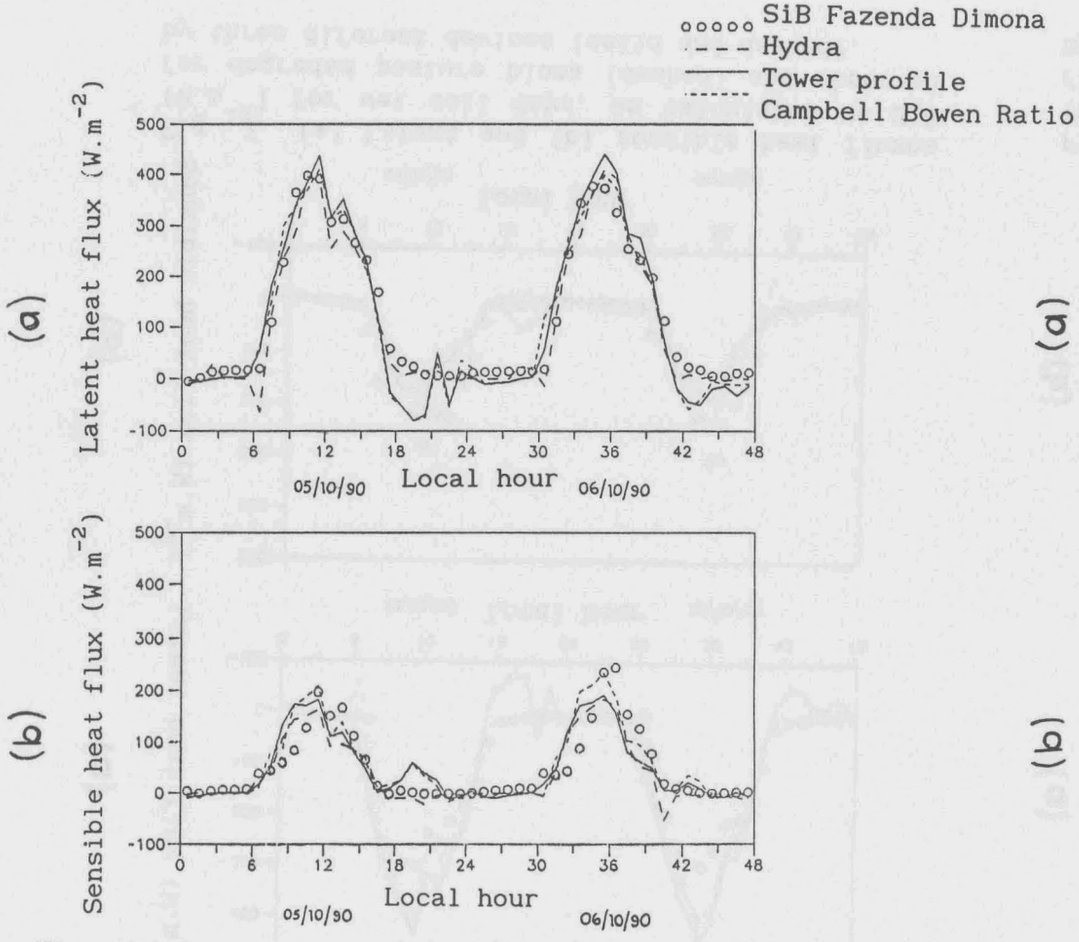


Fig. 4. (a) Latent and (b) sensible heat fluxes ($W.m^{-2}$) for wet soil days, as calculated by SiB for Fazenda Dimona bioma (dashed) and observed by three diferent devices (solid and dashed).

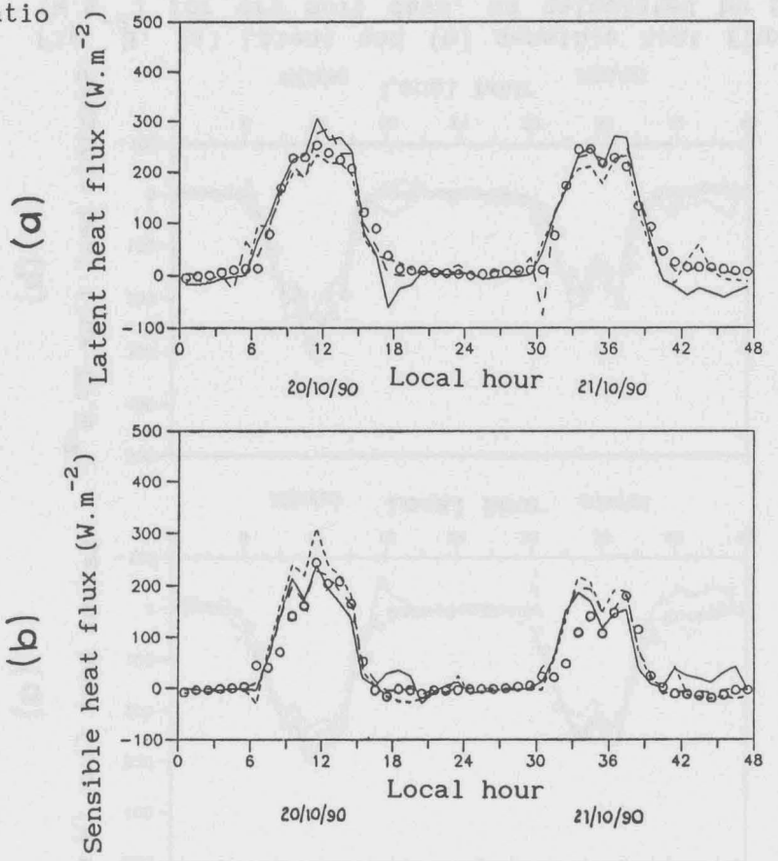


Fig. 5. (a) Latent and (b) sensible heat fluxes ($W.m^{-2}$) for dry soil days, as calculated by SiB for Fazenda Dimona bioma (dashed) and observed by three diferent devices (solid and dashed).